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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

HEADQUARTERS

SCIENCE MISSION DIRECTORATE

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES – 2015 (ROSES-2015)

NASA RESEARCH ANNOUNCEMENT (NRA)

SOLICITING BASIC AND APPLIED RESEARCH PROPOSALS

NNH15ZDA001N

CATALOG OF FEDERAL DOMESTIC ASSISTANCE (CFDA) NUMBER: 43.001

ISSUED: FEBRUARY 13, 2015

FULL (STEP-2) PROPOSALS DUE
STARTING NO EARLIER THAN MAY 1, 2015
THROUGH NO LATER THAN APRIL 30, 2016

NOTICE: On October 2, 2015 Table 1 of the ROSES-2015 Summary of Solicitation has been corrected to indicate that the Facilities and Equipment section may be as long as needed, consistent with the 2015 guidebook for proposers.

On May 12, 2015 the ROSES-2015 Summary of Solicitation has been modified in a few places to: 1) remove the requirement for dollar values for current and pending funding, and 2) clarify the rules about the location of some components of the proposal (see Table 1). In addition, new program elements previously added to ROSES via amendments now appear in the list of appendices. New text is in bold, deleted text is struck through.

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES (ROSES)–2015

EXECUTIVE SUMMARY

This National Aeronautics and Space Administration (NASA) Research Announcement (NRA), entitled Research Opportunities in Space and Earth Sciences (ROSES)–2015, solicits basic and applied research in support of NASA's Science Mission Directorate (SMD). ROSES is an omnibus with many individual program elements, each with its own due dates and topics and all together these cover all aspects of basic and applied supporting research and technology in space and Earth sciences, including, but not limited to: theory, modeling, and analysis of SMD science data; aircraft, scientific balloon, sounding rocket, International Space Station (ISS), CubeSat and suborbital reusable launch vehicle investigations; development of experiment techniques suitable for future SMD space missions; development of concepts for future SMD space missions; development of advanced technologies relevant to SMD missions; development of techniques for and the laboratory analysis of both extraterrestrial samples returned by spacecraft, as well as terrestrial samples that support or otherwise help verify observations from SMD Earth system science missions; determination of atomic and composition parameters needed to analyze space data, as well as returned samples from the Earth or space; Earth surface observations and field campaigns that support SMD science missions; development of integrated Earth system models; development of systems for applying Earth science research data to societal needs; and development of applied information systems applicable to SMD objectives and data.

Awards range from under $100K per year for focused, limited efforts (e.g., data analysis) to more than $1M per year for extensive activities (e.g., development of science experiment hardware). The funds available for awards in each program element offered in this NRA range from less than one to several million dollars, which allow selection from a few to as many as several dozen proposals, depending on the program objectives and the submission of proposals of merit. Awards will be made as grants, cooperative agreements, contracts, and inter- or intraagency transfers, depending on the nature of the work proposed, the proposing organization, and/or program requirements. The typical period of performance for an award is three years, but some programs may allow up to five years and others specify shorter periods. Organizations of every type, domestic and foreign, Government and private, for profit and not-for-profit, may submit proposals without restriction on teaming arrangements. Note that it is NASA policy that all investigations involving non-U.S. organizations will be conducted on the basis of no exchange of funds. Unless otherwise stated the rules in the Guidebook for Proposers Responding to a NASA Research Announcement (hereafter referred to as the *NASA Guidebook for Proposers*) are the default, but ROSES takes precedent where there are differences. Any changes or modifications to any the guidelines in this Summary of Solicitation will be specified in the descriptions of the relevant program elements in the Appendices of this solicitation.

Details of the solicited program elements are given in the Appendices of this NRA. Proposal due dates are given in Tables 2 and 3 of this NRA, which will be posted at http://nspires.nasaprs.com/ and for which links are provided below. Interested proposers should monitor http://nspires.nasaprs.com/ or subscribe to the SMD electronic notification system there for additional new program elements or amendments to this NRA through February 2016, at which time release of a subsequent ROSES NRA is planned. A web archive (and RSS feed) for amendments, clarifications, and corrections to ROSES-2015 can be found at: http://nasascience.nasa.gov/researchers/sara/grant-solicitations/roses-2015/. This NRA will be available upon its release at http://solicitation.nasaprs.com/ROSES2015.

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES (ROSES)–2015

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RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES (ROSES)–2015

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Note: Any amendments to the Table of Contents for Appendices A through E will be indicated as red in Table 2 and Table 3 of this NRA, which are posted and updated as separate html documents on the web. These can be reached either by following the hypertext links above embedded in the electronic version of this document, at http://solicitation.nasaprs.com/ROSES2015table2 and http://solicitation.nasaprs.com/ROSES2015table3, respectively, or by going to http://solicitation.nasaprs.com/ROSES2015 and following links there. Potential proposers may receive notification of amendments to ROSES-2015 by signing up for the SMD NSPIRES mailing list and/or by signing up for the ROSES-2015 RSS feed at https://admin.science.nasa.gov/researchers/sara/grant-solicitations/roses-2015/

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES (ROSES)–2015

SUMMARY OF SOLICITATION

I. FUNDING OPPORTUNITY DESCRIPTION

(a) Strategic Objectives of NASA's Research Program

The National Aeronautics and Space Administration (NASA) is chartered in the National Aeronautics and Space Act [51 U.S.C. § 20101 et seq.] with, among other objectives, the expansion of human knowledge of the Earth and of phenomena in the atmosphere and space. Working from this Congressional authorization, U.S. National Space Policy directs NASA to execute a sustained and affordable human and robotic space exploration program and develop, acquire, and use civil space systems to advance fundamental scientific knowledge of our Earth system, solar system, and the universe. This direction allows the science objectives of the NASA Science Mission Directorate (SMD) to be clearly defined as the orderly pursuit of the Agency's strategic direction.

The *2014 NASA Strategic Plan* identifies the following strategic objectives as those to be pursued by SMD:

- Understand the Sun and its interactions with Earth and the solar system, including space weather;
- Ascertain the content, origin, and evolution of the solar system and the potential for life elsewhere;
- Discover how the universe works, explore how it began and evolved, and search for life on planets around other stars; and,
- Advance knowledge of Earth as a system to meet the challenges of environmental change and to improve life on our planet.

Further insight into the NASA's Goals and the NASA strategic objectives, questions, and goals for science are given in the documents at http://science.nasa.gov/about-us/science-strategy/. Each program element in this NASA Research Announcement (NRA) is explicitly relevant to these NASA strategic objectives, and the *NASA Science Plan*. Each proposer to this NRA demonstrates relevance of the proposed research to NASA's strategic objectives for science by demonstrating relevance to the programmatic goals and objectives of the appropriate program element (further instructions concerning relevance and the other evaluation criteria are provided in Section VI (a) below).

(b) Research Programs of NASA's Science Mission Directorate

The NASA Science Mission Directorate (SMD) pursues NASA's strategic objectives using a wide variety of space flight programs that enable the execution of both remote sensing and *in situ* investigations. These investigations are carried out through flight of space missions in Earth orbit, as well as to or even beyond objects in the solar system, and also through ground-based research activities that directly support these space missions. This ROSES NASA Research Announcement (NRA) solicits proposals for investigations using suborbital-class platforms (including aircraft, balloons, sounding rockets, CubeSats, commercial suborbital reusable launch vehicles, and small International Space Station (ISS) payloads), and all kinds of ground-based

supporting research and technology (SR&T) investigations that seek to understand naturally occurring space and Earth phenomena, human-induced changes in the Earth system, and Earth and space science-related technologies and to support the national goals for further robotic and human exploration of space.

Proposals in response to this NRA should be submitted to the most relevant science program elements described in Appendices A, B, C, D, and E (see also the *Table of Contents* that prefaces this NRA). Table 2 lists these program elements in the order of their calendar deadlines for the submission of proposals, while Table 3 lists them in the order in which they appear in the appendices of this NRA. Questions about each specific program element should be directed to the Program Officer(s) identified in the *Summary of Key Information* section that concludes each program element description.

In order to pursue NASA's strategic objectives, SMD research activities are organized into four Research Programs:

- The *Earth Science Research Program* sponsors research to explore interactions among the major components of the Earth system — continents, oceans, atmosphere, ice, and life — to distinguish natural from human-induced causes of change and to understand and predict the consequences of change.
- The *Heliophysics Research Program* sponsors research to understand the Sun as a magnetic variable star and its effects on the Earth and other planets and the dynamics of structures in the solar system.
- The *Planetary Science Research Program* sponsors research to explore the solar system to study its origins and evolution, including the origins of life within it.
- The *Astrophysics Research Program* sponsors research to explore the universe beyond, from the search for planets and life in other solar systems to the origin, evolution, structure, and destiny of the universe itself.

The program elements in Appendices A, B, C, and D describe program elements of these four science research programs, respectively, while Appendix E describes cross-division program elements relevant to two or more of these science research programs. Each of these appendices is prefaced with an *Overview* section that provides an introduction to the research program content that all interested applicants to this NRA are encouraged to read.

The program elements described in these appendices also provide any clarifications or modifications to the general guidelines contained in this *Summary of Solicitation*.

(c) Significant Changes from Recent ROSES

Proposers should be aware of the following significant changes in this NRA from last year:

- Table 1 has changed from being a repetition of the goals and objectives in the science plan (which is now merely referenced, but not included) to a checklist for proposers. It is to be hoped that this checklist will be a useful reminder and diminish the frequency of noncompliant proposals.
- To allow offerors to more accurately represent the work effort planned, the *Guidebook for Proposers* has moved the table of personnel and work effort out of the budget section and noted that any time commitment included that is not funded by NASA is not

considered cost sharing, as defined in 2 CFR § 215.23. This table of work effort, which is not in either the page limited technical/scientific section nor in the budget, is merely a reporting of all of the planned work commitment, funded by NASA or not. This is distinct from the page limited technical/scientific proposal, which should describe what work each team member will be doing. **See Table 1 [Clarified May 12, 2015].**

- What was Section IV(e) "Proposal Requirements for Relevance" in prior ROSES has been deleted and what was there that was not redundant has been moved to an expanded and clarified Section VI. "Proposal Review Information".
- What was Section II(b) "Successor Proposals and Resubmissions" in prior ROSES has been moved to I(g), clarified, and renamed "Successor, Resubmitted, Multiple and Duplicate Proposals". This section includes restrictions on submissions.
- Section II (c) is now devoted to Increasing Access to the Results of Federally Funded Research. All new research awards from NASA will come with requirements about archiving manuscript versions of peer-reviewed publications and most research proposals to NASA require data management plans or a statement as to why one is not needed.
- Program Element E.4, the call for Opportunities in Education and Public Outreach, is not being offered this year.
- Section V, Suborbital-Class Investigations, has been reorganized to remove redundancy.
- As always, many of the individual program elements have changed. More information will appear in the overviews (i.e., A.1, B.1, C.1, etc.) and proposers should read the individual program elements carefully.

Proposers should be aware of the following features of note in this NRA, most of which are changes made in recent years:

- The Planetary Science Division Research Program was restructured in 2014 and the ROSES-2014 structure has been maintained into ROSES-2015, as can be seen in the Table of Contents for Appendix C. Most of the program elements in Appendix C will continue to use a two-Step submission process that requires submission of Step-1 mandatory proposal by the institution. See Section IV(b)vii of this *Summary of Solicitation*, Section 2 of Appendix C.1, and the individual program elements for details.
- The Cross Division Program supported by the Astrophysics and Planetary Science Divisions, formerly known as "Origins of Solar Systems," has been changed to the Exoplanets Research Program. See Appendix E.3 for details
- The Heliophysics Research Program was restructured in 2013 and that structure has been maintained into ROSES-2015, as can be seen in the Table of Contents for Appendix B. All of the program elements in Appendix B will continue to use a two Step submission process. Heliophysics Supporting Research (H-SR, B.2) and Heliophysics Guest Investigators (H-GI, B.4) continue to require submission of Step-1 proposals that are up to three pages in length and will be reviewed. See Appendix B.1 for more information.
- In accordance with Public Law 113-76, Division B, Title V, Section 532, NASA cannot support bilateral participation, collaboration, or coordination with China or any Chinese-

owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement. See Section III (c) on restrictions involving China.

- NASA civil servant salaries must not be included in either the NSPIRES cover page (web-based form) budgets nor the budget justification within the proposal. This applies to proposals submitted by NASA Centers, as well as to proposals submitted by non-NASA organizations that include NASA civil servants serving as funded co-investigators. However, the Full Time Equivalents (FTEs) being requested for NASA civil servant investigators must be included and justified in the budget justification within the proposal. NASA will budget and account for civil servant salaries within ROSES proposals through a separate internal agency process. The latest NASA internal policy on this subject, including instructions on what to include in budgets for ROSES proposals, may be found at the SARA website at http://science.nasa.gov/researchers/sara/how-to-guide/nspires-CSlabor/.
- Unsolicited proposals for topical workshops, symposia, conferences, and other scientific/technical meetings will not be accepted. Proposals for such events should be submitted to the few program elements that include it or in response to the Topical Workshops, Symposia, and Conferences program element found in Appendix E.2.
- Some research programs specify that they will not award contracts, as it is not appropriate for the nature of the work. See, for example, Program elements A.15, A.26, A.39, B.2, and B.4. If not explicitly excluded, a contract is a possible award type, if appropriate to the work proposed. See Section II (a).
- Note in Section VII (c) that NASA funded projects that receive assistance from the U.S. Antarctic Program (USAP) should explicitly acknowledge USAP.

Proposers may also refer to the ROSES FAQ at http://science.nasa.gov/researchers/sara/faqs/. In addition to the listed significant changes, this NRA and the *NASA Guidebook for Proposers Responding to a NASA Research Announcement or Cooperative Agreements Notice* (hereafter referred to as the *NASA Guidebook for Proposers*) incorporate a large number of additional changes, including both policy changes and changes to proposal submission requirements. Many sections of both documents have been clarified since last year. All proposers are urged to carefully read this NRA and the latest edition of the *NASA Guidebook for Proposers*, since all proposals must comply with their requirements, constraints, and guidelines.

(d) NASA-Provided High-End Computing (HEC) Resources

SMD provides a specialized computational infrastructure to support its research community, managed on its behalf by NASA's High-End Computing (HEC) program (see the HEC website at http://www.hec.nasa.gov/). Two major computing facilities are offered, namely, the NASA Center for Climate Simulation (NCCS) at the Goddard Space Flight Center (GSFC), and the NASA Advanced Supercomputing (NAS) facility at the Ames Research Center (ARC).

The HEC program facilities maintain a range of capacity and capability computing systems with significant data storage resources. These offerings are summarized at http://www.hec.nasa.gov/about/overview.html. Augmentation and refreshment of these central systems occur on a periodic basis. The HEC program also provides assistance in code porting, performance tuning, scientific data visualization, and data transfer.

Any need for computing time and other HEC program resources for the proposed research must be explicitly described. The proposal should include identification of the computing system and location, rationale, and justification of the need; how it supports the investigation; when during the proposed period the resources will be required; and an estimate of processor hours and storage capacity needed. An aggregated computing time per year (i.e., number of runs, multiplied by the number of processors per run, multiplied by the number of hours per run) should also be included.

The box provided on the *Cover Page* for proposals submitted in response to this NRA should also be "checked" to indicate that a request for computing resources is included in the proposal. As they review the intrinsic merit of the proposed investigation, science peer review panels will be asked to consider the realism and reasonableness of the computing time request and whether it is an appropriate utilization of a highly constrained resource.

To receive an allocation of HEC resources, proposed investigations selected for funding must make annual requests. The HEC website provides the mechanism for Principal Investigators (PIs) to formally request computing time allocations as identified in their funded proposals. Visit http://www.hec.nasa.gov/request/request.html for process details. The full requested levels cannot be guaranteed, but SMD will make every attempt to satisfy the needs in the context of the overall set of requirements, resource constraints, and science priorities.

Computing time awards are for one year and are nontransferable. PIs may make requests of any size at any time during the year, but large requests will only be considered for May 1 and November 1 awards (request deadlines are March 20 and September 20). Small requests may be awarded throughout the year. See http://www.hec.nasa.gov/request/science_call.html for the definitions of large and small requests.

To expedite initiation of new projects where PI and/or users are foreign nationals (whose accounts will require additional documentation and longer processing), the HEC program will consider providing a minimal allocation to such projects which have been notified of pending funding soon after the PI submits an allocation request in e-Books (accessed through the HEC website). PIs should identify this foreign national status in their request abstract.

For further information about NASA provided High-End Computing resources contact:

Tsengdar J. Lee
Earth Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
E-mail: Tsengdar.J.Lee@nasa.gov
Telephone: 202-358-0860

(e) Opportunities for Education and Public Outreach

SMD strives to foster broad involvement of the Earth and Space science communities in Education and Public Outreach (E/PO). Some individual program elements within ROSES (See Appendix C) may include some E/PO associated with the proposed research activities, but in general they do not. In the past SMD solicited E/PO, via E.4 Education and Public Outreach for Earth and Space Sciences, but we do not anticipate offering that call this year. Instead, SMD has released a Science Education Cooperative Agreement Notice that will cover this work.

Questions and/or comments and suggestions about the SMD E/PO program may be directed to:

Kristen Erickson
Deputy Assistant Administrator for Communications Planning
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-0039
E-mail: kristen.erickson@nasa.gov

(f) Availability of Funds for Awards

Prospective proposers to this NRA are advised that funds are not in general available for awards for all of its solicited program elements at the time of its release. The Government's obligation to make awards is contingent upon the availability of sufficient appropriated funds from which payment can be made and the receipt of proposals that NASA determines are acceptable for award under this NRA.

(g) Successor, Resubmitted, Multiple and Duplicate Proposals

PIs holding previous awards selected through any of the programs offered through earlier NRAs are welcome to submit "successor" proposals that seek to continue a previously funded line of research. However, as described in the *NASA Guidebook for Proposers* (Section 1.5 Successor Proposals) such successor proposals will be considered with neither advantage nor disadvantage along with new proposals that are submitted for that same program.

Generally, proposers are welcome to resubmit proposals (or tasks) that were not funded under a prior solicitation. Such submissions will be peer reviewed and considered with neither advantage nor disadvantage along with new proposals that are received by NASA. However, some Appendices and program elements in ROSES may limit submissions in a couple of ways.

The first limitation on submission prevents "multiple" proposals to a given program element. Some program elements in Appendix B (Heliophysics) will not allow a particular individual to be the PI on more than one proposal to those program elements. The first proposal identifying a particular PI will be evaluated but any subsequent proposal to the same program element that identifies the same PI will not be evaluated or considered.

The second limitation bars submission of "duplicate" proposals. Planetary Science will not accept duplicate (the same or essentially the same) proposals submitted to any of its program elements (Appendix C, or its part of E.3 the Exoplanets Research Program). The first time a Step-2 proposal is submitted via Appendix C it will be evaluated, but subsequently the same or essentially the same proposal submitted to Planetary Science (via Appendix C or E.3) will not be evaluated or considered. See C.1 for more information.

In either case the order of receipt of the proposals will be determined by the time stamp generated automatically by the proposal submission system. Please carefully read the program elements and propose to Heliophysics and Planetary Science with this in mind.

(h) NASA Safety Policy

Safety is the freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. NASA's safety

priority is to protect the public, astronauts and pilots, the NASA workforce (including employees working under NASA award instruments), and high-value equipment and property.

II. AWARD INFORMATION

(a) Funding and Award Policies

NASA may support an award as outlined in the proposal budget, or may offer to fund only selected tasks, or all tasks for a shorter duration (e.g., a one year pilot study), or a combination. Awards may depend on acceptable revised versions of budgets, statements of work, data management plans, or other elements of proposals described in ROSES or in the *NASA Guidebook for Proposers*.

The amount of funds expected to be available for new awards for proposals submitted in response to this NRA is given in the Summary Table of Key Information at the end of each program element in the appendices. An estimate of the number of awards to be made for each program element is also given in this table, contingent on adequate budget and presuming the submission of sufficient highly rated proposals.

In all cases, NASA's goal is to initiate new awards as rapidly as possible after the selection of proposals is announced for each program element. However, the workload experienced by NASA, the availability of appropriated funds, and any necessary postselection negotiations with the proposing organization(s) needed for the award(s) in question can all cause delays. Regarding this last item, every proposer is especially encouraged to submit full and detailed explanations of the requested budget (see Section 2.3.10 of the *NASA Guidebook for Proposers*) to help expedite the processing of the award, should their proposal be selected.

Awards made through this NRA will be in the form of grants, cooperative agreements, contracts, and intra- or interagency transfers, depending on the nature of the proposed work, submitting organization, and/or the specific requirements for awards given in each program element description in the appendices. The type of award to be offered to selected proposers will generally follow the policies in Section D.1 of the *NASA Guidebook for Proposers*, although in a few cases, the types of awards may be restricted (e.g., no contracts), as specified in the program element description. Another difference with the *NASA Guidebook for Proposers* is that the budget narrative need not state the type of award instrument that is anticipated. A NASA awards officer will determine the appropriate award instrument for the selections resulting from this solicitation. Grants and cooperative agreements will be subject to the provisions of the *Grants Handbook*[1] and Appendix D of the *NASA Guidebook for Proposers*. In the case of any conflict, the *Grants Handbook* takes precedence. Contract awards will be subject to the provisions of the Federal Acquisition Regulations (FAR) and the NASA FAR Supplement (see http://prod.nais.nasa.gov/cgi-bin/nais/nasa_ref.cgi).

(b) Award Period of Performance

The maximum period of performance (duration) for new awards for proposals submitted in response to this NRA is given in the *Summary of Key Information* that concludes each program element description in the appendices. The usual maximum period of performance ranges from

[1] The *NASA Grants and Cooperative Agreement Handbook* (hereafter referred to as the *Grants Handbook*) is at http://prod.nais.nasa.gov/pub/pub_library/grcover.htm.

one year for activities of limited scope to five years for extensive, comprehensive studies. Award durations may be longer in special cases, such as teams of long duration space missions. Any proposed period of performance must be justified in the proposal. The appropriateness of

the proposed period of performance will be evaluated by peer review. NASA may offer to support an award of shorter duration than was proposed.

(c) Increasing Access to the Results of Federally Funded Research

In keeping with the NASA Plan for increasing access to results of Federally funded research, new terms and conditions about making manuscripts and data publically accessible may be attached to awards that derive from ROSES. Almost all proposals to ROSES will be required to provide a data management plan (DMP) or an explanation of why one is not necessary given the nature of the work proposed. In most cases the data management plan will be collected on the NSPIRES web cover pages and limited to 8000 characters. The kind of proposal that requires a data management plan is described in the NASA Plan for increasing access to results of Federally funded research and in the SARA FAQs for ROSES. The appendices and individual program elements of ROSES may specify preferred archives and may require more than is outlined here for all proposers or just those that generate certain kinds of data. Please read the individual program elements carefully. Proposers that include a plan to archive data should allocate suitable time for this task. Unless otherwise stated this requirement supersedes the data sharing plan mentioned in the *NASA Guidebook for Proposers*.

(d) Rephasing of Award Budgets

Occasionally the schedule for delivery of funds for SMD awards will be changed, either at the request of the PI or NASA, and this is referred to as rephasing of awards.

In keeping with the NASA's family friendly stance, SMD will accommodate all reasonable requests from the PI or Authorized Organization Representative (AOR) to rephase ROSES awards (e.g., for family or medical leave) as long as it does not compromise previously agreed upon project goals, timelines, or deliverables associated with a NASA requirement described in the contract (grants are not used for NASA requirements). This is consistent with NASA's adherence to Federal Demonstration Partnership (FDP) terms that allow grantee initiated first time no-cost extensions of up to 12 months. See https://www.nssc.nasa.gov/nocostextension for more information.

To facilitate the reduction of funds from one fiscal year remaining unspent in the next fiscal year (uncosted carryover), SMD program officers engage in active grant management after appropriate communication with the grantees. Program Officers assess the uncosted carryover in the awards in their portfolios. While some uncosted carryover is necessary, those awards that are both (a) carrying a year (or more) of funding and (b) carrying a total carryover of $100K or more will be considered for rephasing. Program Officers take into account the history of funding and costing on a grant-by-grant basis.

In those cases where funds for a year or more are being carried over, the standard procedure would be to propose rephasing the funds to slip out by a year. The total funds disbursed would not change, only the fiscal year (FY) in which they arrive. Program Officers will inform the PI of their intentions regarding fund disbursement/rephasing and give the PI an opportunity to respond.

SMD policy is that work on continuing awards should never have to stop because of a delay in delivery of promised funds. If an award is rephased, NASA will make every reasonable effort to deliver the next fiscal year funding in a timely manner. Honoring commitments and ensuring the continuation of existing projects is a high priority of SMD.

III. ELIGIBILITY INFORMATION

(a) Eligibility of Applicants

Prospective investigators from any category of organizations or institutions, U.S or non-U.S., are welcome to respond to this solicitation. Specific categories of organizations and institutions that are welcome to respond include, but are not limited to, educational, industrial, and not-for-profit organizations, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), NASA Centers, the Jet Propulsion Laboratory (JPL), and other Government agencies. Historically Black Colleges and Universities (HBCUs), Other Minority Universities (OMUs), small disadvantaged businesses (SDBs), veteran-owned small businesses, service disabled veteran-owned small businesses, HUBZone small businesses, and women-owned small businesses (WOSBs) are encouraged to apply.

Participation by non-U.S. organizations in this program is welcome, but subject to NASA's policy of no exchange of funds, in which each government supports its own national participants and associated costs (further information on foreign participation is provided in Section 1.6 of the *NASA Guidebook for Proposers*). NASA does not normally fund foreign research proposals or foreign research efforts that are part of U.S. research proposals. Rather, cooperative research efforts are implemented via international agreements between NASA and the sponsoring foreign agency or funding/sponsoring institution under which the parties agree to each bear the cost of discharging their respective responsibilities. NASA funding may not be used for subcontracted foreign research efforts, including travel. The direct purchase of supplies and/or services, which do not constitute research, from non-U.S. sources by U.S. award recipients is permitted.

(b) Number of Proposals and Teaming Arrangements

There is no restriction on the number of proposals that an organization may submit to this solicitation or on the teaming arrangements for any one proposal, including teaming with employees of NASA's Centers and the Jet Propulsion Laboratory. However, each proposal must be a separate, stand-alone, complete document for evaluation purposes.

(c) Restrictions Involving China

Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement.

In accordance with Public Law 113-76, Division B, Title V, Section 532, NASA is prohibited from funding any NASA contract, grant, or cooperative agreement action (including new awards and continuing awards) that involves the bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement.

Proposals involving bilateral participation, collaboration, or coordination in any way with China or any Chinese-owned company, whether funded or performed under a no-exchange-of-funds arrangement, may be ineligible for award.

For more information please see the ROSES FAQ on the SARA web page at http://science.nasa.gov/researchers/sara/faqs/prc-faq-roses/

Grant Information Circular 12-01A instructs NASA, when issuing new NASA Research Announcements such as ROSES, to add the following paragraph to the current proposal requirements set forth at 14 CFR § 1260.10 (c)(1) so that proposers, by submission of their proposal, represent that they are not China or a Chinese-owned company, and that they will not participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level or at any subrecipient level, whether the bilateral involvement is funded or performed under a no-exchange-of-funds arrangement.

> An Assurance of Compliance with Public Law 113-76, Division B, Title V, Section 532; and future-year appropriations herein after referred to as "the Acts" whereas:
>
> (1) NASA is restricted from using funds appropriated in the Acts to enter into or fund any grant or cooperative agreement of any kind to participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level and at all subrecipient levels, whether the bilateral involvement is funded or performed under a no-exchange-of-funds arrangement.
>
> (2) Definition: "China or Chinese-owned Company" means the People's Republic of China, any company owned by the People's Republic of China, or any company incorporated under the laws of the People's Republic of China.
>
> (3) The restrictions in the Acts do not apply to commercial items of supply needed to perform a grant or cooperative agreement.
>
> (4) By submission of its proposal, the proposer represents that the proposer is not China or a Chinese-owned company, and that the proposer will not participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level or at any subrecipient level, whether the bilateral involvement is funded or performed under a no-exchange-of-funds arrangement.

(d) Cost Sharing or Matching

If an institution of higher education or other not-for-profit organization wants to receive a grant or cooperative agreement, cost sharing is not required, although NASA can accept cost sharing if it is voluntarily offered (see the *Grants Handbook*, Section B, §1260.123, "Cost Sharing or Matching"). If a commercial organization wants to receive a grant or cooperative agreement, cost sharing is required unless the commercial organization can demonstrate that it does not expect to receive substantial compensating benefits for performance of the work. If this demonstration is made, cost sharing is not required, but may be offered voluntarily (see also the *Grants Handbook*, Section D, §1274.204, "Costs and Payments"). See also Section VI(a) "Evaluation Criteria" below.

Each proposal must include a summary table with names and planned work commitment of all personnel necessary to perform the proposed effort, regardless of whether that work effort requires funding or not. In the past, some proposers at universities were not able indicate the time that they were planning to devote to the effort that was not paid for by NASA. The Summary of Proposal Personnel and Work Effort is no longer located in the budget section and the *NASA Guidebook for Proposers* notes that any planned work commitment not funded by NASA listed there is not considered cost sharing as defined in 2 CFR § 215.23. This should now allow all proposers to more accurately reflect the actual time they will devote, whether or not it is paid for

by NASA. As always, level of effort estimates for unfunded team members are not intended to represent voluntary committed cost sharing. Collaborators should be listed on the table, but their level of effort may be simply given as "de minimis."

IV. Proposal and Submission Information

(a) Proposal Instructions and Requirements

All information needed to apply to this solicitation is contained in this ROSES NRA and in the companion document, the *NASA Guidebook for Proposers*, located at http://www.hq.nasa.gov/office/procurement/nraguidebook. By reference, the latest edition of the *NASA Guidebook for Proposers* is incorporated into this NRA. We also include 48 CFR 1852.235-72 by reference and it appears in Appendix B the *NASA Guidebook for Proposers*. Proposers are responsible for understanding and complying with its procedures for the successful, timely preparation and submission of their proposals. Proposals that do not conform to its standards may be declared noncompliant and rejected without review.

Questions regarding this NRA or its program elements should be directed to the cognizant Program Officer identified in the Summary Table of Key Information at the end of each program element or on the list of program officers on the SARA web page. Any clarifications or questions and answers that are published will be posted on the relevant program element's index page in NSPIRES.

The introductory material, as well as the appendices, of the *NASA Guidebook for Proposers* provide additional information about the entire NRA process, including NASA policies for the solicitation of proposals, guidelines for writing complete and effective proposals, and NASA's general policies and procedures for the review and selection of proposals and for issuing and managing the awards to the institutions that submitted selected proposals. A group of Frequently Asked Questions (FAQs) provides additional miscellaneous information about a variety of the NASA proposal and award processes, policies, and procedures.

Comments and suggestions of any nature about the *NASA Guidebook for Proposers* are encouraged and welcome and may be directed at any time to the point of contact identified in Section VIII below.

(b) Content and Form of the Proposal Submission

(i) Electronic Proposal Submission

All proposals submitted in response to this ROSES NRA must be submitted in a fully electronic form. No hard copy of the proposal is required or permitted. Electronic proposals must be submitted by one of the officials at the PI's organization who is authorized to make such a submission; electronic submission by the authorized organization representative (AOR) serves for the proposal as the required original signature by an authorized official of the proposing organization.

Proposers may opt to submit proposals in response to this ROSES NRA via either of two different electronic proposal submission systems: either via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) (http://nspires.nasaprs.com; see Section IV(b)(iv) below) or via Grants.gov (http://www.grants.gov; see Section IV(b)(v) below).

Note carefully the following requirements for submission of an electronic proposal, regardless of the intent to submit via NSPIRES or Grants.gov.

- Every organization that intends to submit a proposal to NASA in response to this NRA, including educational institutions, industry, not-for-profit institutions, the Jet Propulsion Laboratory, NASA Centers, and other U.S. Government agencies, must be registered in NSPIRES. This applies equally for proposals submitted via Grants.gov, as well as for proposals submitted via NSPIRES. Every organization that intends to submit a proposal through Grants.gov must also be registered in Grants.gov, as well as in NSPIRES. Registration for either proposal data system must be performed by an organization's electronic business point-of-contact (EBPOC) in the System for Award Management (http://www.sam.gov).
- Any organization requesting NASA funds through the proposed investigation must be listed on the Proposal Cover Page. NASA will not fund organizations that do not appear on the Proposal Cover Page.
- Each individual team member (e.g., PI, Co-Investigators, etc.), including all personnel named on the proposal's electronic cover page, must be individually registered in NSPIRES. This applies equally for proposals submitted via Grants.gov, as well as for proposals submitted via NSPIRES.
- Unless specifically allowed by an individual program element appendix, multiple PIs (as described in Section 1.4.2 of the *NASA Guidebook for Proposers*) are not permitted. The use of other categories of participation described in Section 1.4.2 of the *NASA Guidebook for Proposers*, including Science PI, Institutional PI, and Co-PI (from a non-U.S. organization under specific circumstances), remain permitted.
- Each individual team member (e.g., PI, co-investigators, etc.), including all personnel named on the proposal's electronic cover page, must confirm their participation on that proposal (indicating team member role) and specify an organizational affiliation. For proposals submitted via NSPIRES, this confirmation is via NSPIRES (see Section IV(b)(iv), below). For proposals submitted via Grants.gov, this confirmation is via "Letters of Commitment" included within the proposal. The organizational affiliation specified on the cover page must be the organization through which the team member would work and receive funding while participating in the proposed investigation. If the individual has multiple affiliations, then this organization may be different from the individual's primary employer or preferred mailing address. Team members are asked to ensure that their contact information in NSPIRES is up-to-date. Changes can be made using the "Account Management" link on the "NSPIRES Options" page.

Generically, an electronic proposal consists of electronic forms and one or more attachments. The electronic forms contain data that will appear on a proposal's cover pages and will be stored with the proposal in the NSPIRES database. A proposal submitted in response to this NRA must have only a single attachment. The single attachment contains all sections of the proposal, including the Science/Technical/Management section, the budget narrative, and all required and allowed appendices; see Section IV(b)(ii) below for further requirements.

Submission of proposals via either NSPIRES or Grants.gov is a two-part process. When the PI has completed entry of the data requested in the required electronic forms and attachment of the

allowed PDF attachments, including the science/technical/management section, an official at the PI's organization who is authorized to make such a submission, referred to as the Authorized Organizational Representative (AOR), must submit the electronic proposal (forms plus attachments). Coordination between the PI and his/her AOR on the final editing and submission of the proposal materials is facilitated through their respective accounts in NSPIRES and/or Grants.gov.

(ii) Proposal Format and Contents

All proposals submitted in response to this NRA must include any specified required electronic forms available through either of two proposal submission systems, NSPIRES or Grants.gov. Submission via NSPIRES requires responding to questions on the NSPIRES submission page.

The Science/Technical/Management section and other required sections of the proposal must be submitted as a single, searchable, unlocked PDF file that is attached to the electronic submission using one of the proposal submission systems. Proposers must comply with all format requirements specified in this NRA and in the *NASA Guidebook for Proposers* (e.g., Section 2.3 of the *NASA Guidebook for Proposers*). Only appendices that are specifically requested in either this NRA or in the *NASA Guidebook for Proposers* will be permitted; proposals containing unsolicited appendices may be declared noncompliant. Section 2 of the *NASA Guidebook for Proposers* provides detailed discussions of the content and organization of proposals suitable for all program elements in this NRA, as well as the default page limits of a proposal's constituent parts.

Note that some of the program element descriptions in Appendices A through E of this NRA may specify different page limits for the main body of the proposal; if so, these page limits will be prominently given in the Summary of Key Information subsection that concludes each program element description. In the event the information in this NRA is different from or contradictory to the information in the *NASA Guidebook for Proposers*, the information in this NRA takes precedence.

Proposals submitted in response to ROSES are permitted 15 characters per inch, typical of font Times New Roman 12. This requirement applies to body text and figure captions, but it does not apply to text within figures and tables, which may be smaller, but must still be judged by the reviewers to be readable. Do not place expository text in tables or figures in order to gain space.

Important note on creating PDF files for upload: It is essential that all PDF files generated and submitted meet NASA requirements. This will ensure that the submitted files can be ingested by NSPIRES regardless of whether the proposal is submitted via NSPIRES or Grants.gov. At a minimum, it is the responsibility of the proposer to: (1) ensure that all PDF files are unlocked and that edit permission is enabled – this is necessary to allow NSPIRES to concatenate submitted files into a single PDF document; and (2) ensure that all fonts are embedded in the PDF file and that only Type 1 or TrueType fonts are used. In addition, any proposer who creates files using TeX or LaTeX is required to first create a DVI file and then convert the DVI file to Postscript and then to PDF. See http://nspires.nasaprs.com/tutorials/PDF_Guidelines.pdf for more information on creating PDF documents that are compliant with NSPIRES. PDF files that do not meet NASA requirements cannot be ingested by the NSPIRES system; such files may be declared noncompliant and not submitted to peer review for evaluation.

There is a 10 MB size limit for proposals (Section 2.3(c) of the *NASA Guidebook for Proposers*). Large file sizes can impact the time it takes for NASA and peer reviewers to download and access the proposal. In order to increase the ease in reviewing the proposal, the proposer should crop and compress any embedded photos and graphic files to an appropriate size and resolution.

(iii) ROSES Budget Format including Special Requirements for NASA Civil Servants and JPL Proposals

In the evaluation of proposals submitted under ROSES, SMD will be showing the budget data included in proposals to peer reviewers. The budget justification and detailed budget(s) at the end of the proposal document should include all relevant facts except salaries for NASA civil servants. Proposals submitted in response to this ROSES NRA should follow the directions for the budget section of the proposal given in Section 2.3.10 of the *NASA Guidebook for Proposers*. There are no additional requirements for ROSES proposals from non-NASA proposers.

NASA civil servant salaries must not be included in either the NSPIRES cover page (web-based form) budgets nor the budget justification within the proposal. This applies to proposals submitted by NASA Centers, as well as to proposals submitted by non-NASA organizations that include NASA civil servants serving as funded co-investigators. However, all FTEs being requested, including those for NASA civil servant investigators, must be included and justified in the budget justification within the proposal. NASA will budget and account for civil servant salaries within ROSES proposals through a separate internal agency process. The latest NASA internal policy on this subject, including instructions on what to include in budgets for ROSES proposals, may be found at the SARA website at http://science.nasa.gov/researchers/sara/how-to-guide/nspires-CSlabor/.

Since NASA funding sent to NASA Centers must be obligated in the same fiscal year (FY) in which they are received, proposals submitted by NASA Centers (but not including JPL) should begin the budget section of the proposal with a breakdown of funding by NASA Center and by fiscal year, assuming the start date given in the Summary of Key Information table at the end of the program element (the default is six months after proposal submission). Thus, a ROSES-2015 proposal for a two-year award that starts in mid FY 2016 could phase the funds for a half year of funding in FY 2016, a full year in FY 2017, and a half a year in FY 2018. NASA civil servant salaries are not included in the proposal; total budgets with those must be uploaded separately.

Proposers from JPL should not include the JPL award fee in the total requested amount, nor should the budgets of JPL Co-Investigators on proposals from other institutions include the JPL award fee in their total requested amount. The total requested amount is that which appears on the NSPIRES online (cover page) budget form or the Grants.gov standard budget form. JPL award fees are paid for and accounted for by a different mechanism than the mechanism used to fund research investigations.

(iv) Submission of Proposals via NSPIRES, the NASA Proposal Data System

Proposals may be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES). The only exceptions are occasional joint calls with the National Science Foundation (NSF) that use FastLane and the Swift and Fermi Guest Investigator and NuSTAR Guest Observer programs in Astrophysics (Program Elements D.5 Swift Guest Investigator – Cycle 12, D.6 Fermi Guest Investigator – Cycle 9, and D.10 NuSTAR Guest Observer – Cycle 2), see those program

elements for details. In order to submit a proposal via NSPIRES, this NRA requires that the proposer register key data concerning the intended submission with NSPIRES at http://nspires.nasaprs.com. Potential applicants are urged to access this site well in advance of the Notice of Intent (NOI) and proposal due dates of interest to familiarize themselves with its structure and enter the requested identifier information.

It is especially important to note that every individual named on the proposal's electronic Cover Page form (see below) as a proposing team member in any role, including co-investigators and collaborators, must be individually registered in NSPIRES and that such individuals must perform this registration themselves; no one may register a second party, even the PI of a proposal in which that person is committed to participate. It is also important to note that every named individual must be identified with the organization through which they are participating in the proposal, regardless of their place of permanent employment or preferred mailing address. This data site is secure and all information entered is strictly for NASA's use only.

Every individual identified on the NSPIRES proposal cover page as a team member must indicate their commitment to the proposed investigation through NSPIRES prior to proposal cover page submission. Team members must additionally confirm the organization through which they are participating on this proposal. A team member will receive an E-mail from NSPIRES indicating that he/she has been added to the proposal and should log in to NSPIRES.

- Once logged in, the team member should follow the link in the "Reminders and Notifications" section of his NSPIRES homepage, titled "Need <role> confirmation for proposal <title> for Solicitation <<solicitation number>>." On the "Team Member Participation Confirmation" page, the proposal team member should read language about the Organizational Relationship, then click the "Continue" button.
- If the contact information then displayed on the "Team Member Profile" screen is out of date, the proposal team member should update this information later using the "Account Mgmt" link in the NSPIRES navigation bar across the top. Prior to making that update, however, the team member should follow the on-screen prompts to identify the organization through which he/she is participating on this proposal. Click the "Link Relationship" button to the right side of the "Organizational Relationship" banner. Select the organization from the "Link Proposal to an Association" part of the page. If the correct organization is not displayed here, try using the "Add Association" button to add the organization to this list. Then click the "Save" button at the bottom of the page. If the team member cannot find the organization when searching in the "Add Association" area (i.e., the organization is not registered), type in the formal name in the space provided (or select "Self," if appropriate). Once the organization is selected and the "Save" button is clicked, there is a confirmation page that allows the team member to edit that relationship if it was chosen incorrectly. Click "Continue".
- Note that the organization through which the proposal team member is participating in the proposal might not be the proposal team member's primary employer or primary mailing address. If the address information is accurate (or once it has been edited to be accurate), the proposal team member may log out of NSPIRES.
- NSPIRES will send an E-mail to both the team member and the PI confirming that the commitment was made and the organization was identified. The PI may additionally monitor the status of proposal team member commitments by examining the "Relationship Confirmed" column on the Team Member page of the NSPIRES proposal cover page record.

Note that the proposal cannot be submitted until all identified team members have confirmed their participating organizations.

All proposals submitted via NSPIRES in response to this NRA must include a required electronic Cover Page form that is accessed at http://nspires.nasaprs.com/. This form is comprised of several distinct sections: a Cover Page that contains the identifier information for the proposing institution and personnel; a Proposal Summary that provides an overview of the proposed investigation that is suitable for release through a publicly accessible archive should the proposal be selected; Business Data that provides the proposed start and end dates, as well as other proposal characteristics; a Budget form that contains a budget summary of the proposed research effort; Program Specific Data that includes required questions specific to ROSES and that particular program element; and Proposal Team that provides the co-investigators and other participants in the proposal. This Cover Page form is available for access and submission starting about 90 days in advance of the proposal due dates given in Tables 2 and 3 of this NRA and remains open until the proposal due date for each program element. Unless specified in the program element description itself, no other forms are required for proposal submission via NSPIRES. See the *NASA Guidebook for Proposers*, Sections 2 and 3, for further details.

Although NSPIRES has the ability to accept many, separate proposal documents, the required elements of any proposal submitted in response to this NRA must be submitted as a single, searchable, unlocked PDF document that contains the complete proposal, including the Science/Technical/Management section and budget justification, assembled in the order provided in the *NASA Guidebook for Proposers* (see Section 2.3) and uploaded as a single attachment using the tools in NSPIRES. The proposer is responsible for assembling the complete proposal document for peer review. All required and permitted appendices must be included in the PDF file and should not be uploaded as separate attachments, unless specified otherwise in the program element description in the appendices to this NRA. Including any part of the proposal twice creates an additional burden on the peer reviewers. Documents such as team member biographical sketches, letters of commitment, and current and pending support should not be uploaded to NSPIRES as separate files.

NSPIRES generates error and warning messages as part of the element check concerning possibly missing data. An error (designated by a red X) will preclude proposal submission to NASA by the AOR. A warning (indicated by a ! on a yellow field) is an indication that data may be missing; a warning can be ignored after verifying that the material is included in the single attachment containing the complete proposal. Any actions taken because of warnings are at the PI's discretion.

In addition, it is unnecessary to download the Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the reviewers.

Proposers are encouraged to begin their submission process early. Tutorials and other NSPIRES help topics may be accessed through the NSPIRES online help site at http://nspires.nasaprs.com/external/help.do. For any questions that cannot be resolved with the available online help menus, requests for assistance may be directed by E-mail to nspires-help@nasaprs.com or by telephone to (202) 479-9376, Monday through Friday, 8:00 a.m. – 6:00 p.m. Eastern Time.

(v) Submission of Proposals via Grants.gov

Grants.gov may be used in place of NSPIRES to submit proposals in response to this ROSES NRA. Grants.gov requires that the PI download an application package from Grants.gov. Identifying the appropriate application package requires the funding opportunity number for that program element; the funding opportunity number may be found in the Summary of Key Information subsection that concludes each program element description in the appendices of this NRA. Proposals submitted via Grants.gov must be submitted by the AOR.

Submitting a proposal via Grants.gov requires the following steps:

- Grant researchers (PIs) do not need to register with Grants.gov. However, every individual named in the proposal as a proposing team member in any role, including PI, Co-Investigators, and collaborators, must be registered in NSPIRES (http://nspires.nasaprs.com) and such individuals must perform this registration themselves; no one may register a second party, even the PI of a proposal in which that person is committed to participate. This data site is secure and all information entered is strictly for NASA's use only.
- Follow Grants.gov instructions provided at the website to download any software tools or applications required to submit via Grants.gov.
- Download the application package from Grants.gov by selecting "Download grant application packages" under "Apply for Grants" at http://www.grants.gov. Each program element described in an appendix of ROSES requires a different application package and has a different Funding Opportunity Number; the Funding Opportunity Number may be found in the Summary of Key Information at the end of the program element description in each appendix of ROSES. Enter the appropriate Funding Opportunity Number to retrieve the desired application package. All NASA application packages may be found by searching on CFDA Number 43.001.
- Note that you must download the "application instruction" document, in addition to the "application package" as this contains the mandatory data management plan as well as important questions about, for example, China and ITAR..
- Complete the required Grants.gov forms, including the Standard Form 424 Application for Federal Assistance, research and research-related (R&R) Other Project Information, R&R Senior/Key Person Profile, and R&R Budget. Every named individual must be identified with the organization through which they are participating in the proposal, regardless of their place of permanent employment or preferred mailing address.
- Complete the required NASA specific forms including NASA Other Project Information, NASA PI and Authorized Representative Supplemental Data Sheet, and NASA Senior/Key Person Supplemental Data Sheet (this form is only required if there are Senior/Key Persons other than the PI).
- Complete any NASA program-specific form that is required for the specific program element. This form, which is usually required for all ROSES program element submissions, is included as a PDF form within the proposal instruction package downloaded from Grants.gov. The form, once completed, is attached to the NASA Other Project Information form.

- Create a proposal in PDF, including the Science/Technical/Management section and all other required proposal sections (see Section 2 of the *NASA Guidebook for Proposers*). Attach sections as separate PDF documents as prompted by Grants.gov.
- Because Grants.gov does not support the electronic commitment of team members, statements of commitment from all team members must be provided as letters attached to the proposal application at the place(s) specified by Grants.gov. This statement must include confirmation of both the team member role in the proposed effort (e.g., Co-Investigator, collaborator) and the identification of the organization through which the team member will be participating.

  Here is an example of a statement of commitment: "I acknowledge that I am identified by name as <<role>> to the investigation, entitled <<name of proposal>>, that is submitted by <<name of Principal Investigator>> to the NASA Research Announcement <<alpha-numeric identifier>>, and that I intend to carry out all responsibilities identified for me in this proposal. I understand that the extent and justification of my participation as stated in this proposal will be considered during peer review in determining in part the merits of this proposal. I have read the entire proposal, including the management plan and budget, and I agree that the proposal correctly describes my commitment to the proposed investigation. For the purposes of conducting work for this investigation, my participating organization is <<insert name of organization>>."
- Submit the proposal via the Authorized Organization Representative (AOR); the PI may not submit the application to Grants.gov unless he/she is an AOR.

Potential applicants are urged to access Grants.gov site well in advance of the proposal due date(s) of interest to familiarize themselves with its structure and download the appropriate application packages and tools.

Additional instructions for formatting and submitting proposals via Grants.gov may be found in Sections 2 and 3 of the *NASA Guidebook for Proposers*. Instructions for the use of Grants.gov may be found in the Grants.gov Applicant User Guide at http://www.grants.gov/web/grants/applicants/applicant-resources.html. Instructions for NASA-specific forms and NASA program-specific forms may be found in the application. For any questions that cannot be resolved with the available online help menus and documentation, requests for assistance may be directed by E-mail to support@grants.gov or by telephone to (800) 518-4726, Monday through Friday, 7:00 a.m. – 9:00 p.m. Eastern Time.

(vi) Notice of Intent to Propose

For most of the program elements in Earth Science (Appendix A) and Astrophysics (Appendix D), a brief Notice of Intent (NOI) to propose is encouraged, but not required, for the submission of proposals to this solicitation. The information contained in an NOI is used to help expedite the proposal review activities and, therefore, is of considerable value to both NASA and the proposer. To be of maximum value, NOIs should be submitted by the PI to NSPIRES (located at http://nspires.nasaprs.com) by the dates given in Tables 2 or 3 of this NRA. Note that NOIs may be submitted within NSPIRES directly by the PI; no action by an organization's AOR is required to submit an NOI.

Grants.gov does not provide NOI capability; therefore, NOIs should be submitted via NSPIRES whether or not the proposal will be submitted via NSPIRES or Grants.gov. Interested proposers

must register with NSPIRES before it can be accessed for use. NSPIRES is open for the submission of NOIs for typically 30 days, starting about 90 days in advance of the due date for the proposals themselves. Since NOIs submitted after these deadlines may still be useful to NASA, late NOIs may be submitted by E-mail to the main point of contact given in the Summary Table of Key Information at the end of the individual program element.

(vii) The Two-Step Proposal Process

Some ROSES program elements require that proposals be submitted using a two-step process in which the NOI is replaced by a required Step-1 proposal. This Step-1 proposal is an abbreviated presentation of the intended research and, as a proposal, it must be submitted by the Step-1 due date given in Tables 2 and 3 of this NRA by the organization Authorized Organizational Representative (AOR). The Step-1 proposal is a prerequisite for submission of a full Step-2 proposal, but it does not obligate the offerors to submit a Step-2 (full) proposal later.

For some program elements, the purpose of the Step-1 proposal is simply to avoid conflicts in the assembly of the review panel and no response will be provided to proposers. For other program elements, the Step-1 proposal may be evaluated to determine if the anticipated research project exhibits sufficient programmatic relevance and responsiveness to the program element to permit or encourage submission of a full Step-2 proposal. The two-step process can be structured in two ways: 1) so that a Step-2 proposal may be submitted even if the preceding Step-1 was discouraged or 2) so that a Step-2 proposal cannot be submitted if it was not invited after the evaluation of the preceding Step-1. In any case those who submitted Step-1 proposals will be informed no later than four weeks prior to the Step-2 due date whether they are, or are not, encouraged or invited to submit a full Step-2 proposal.

The required Step-1 proposal is sometimes just the contents of the 4000 character limited Proposal Summary field in the cover pages but often also requires a PDF document upload. The required contents for the Step-1 proposal will be specified in the program element description. In some cases, the investigation team is not considered binding for Step-1 (i.e., it can be adjusted between the Step-1 and Step-2 proposal), but in other cases, the Step-1 team is binding. Also, some program elements limit the number of Step-2 proposals on which an individual may be PI. Please read the program element carefully. Budget data will not be requested as part of the Step-1 proposal. Unlike a Notice of Intent, which may be submitted by an individual, the Step-1 proposal must be submitted by an Authorized Organizational Representative of the proposing organization. Step-2 proposals are to be submitted in full compliance with the *NASA Guidebook for Proposers* discussed in Section IV(a) above. Proposers are encouraged to read the instructions document on Submitting Step-1 proposals that appears under "Other Documents" on the NSPIRES web page of any program element that requires a Step-1 proposal.

At the time of release of this ROSES-2015 NRA, the following program elements solicit proposals using a two-step process: All of Appendix B, i.e., all program elements within Heliophysics, and most in Planetary Science, i.e., most program elements in Appendix C (exceptions include Planetary Protection and the Early Career Fellowship program), the K2 Guest Observer calls in Appendix D, and E.3, the Cross-Division Exoplanets Research Program.

(viii) The Two-Phase Proposal Process

On occasion, NASA will solicit proposals using a two-phase proposal process for which Phase-1 is a request for an observation to be performed by a NASA space observatory as part of a NASA

guest investigator/guest observer program element. Phase-2 is a proposal for funding. An NOI may or may not be requested, and the Phase-1 observing request must be submitted to the observatory web page by the proposal due date in Tables 2 and 3 of this NRA.

At the time of release, of this ROSES-2015 NRA contains three guest investigator/guest observer program elements using the two-phase proposal process: Swift Guest Investigator (D.5), Fermi Guest Investigator (D.6), and NuSTAR Guest Observer (D.10).

Phase-1 observing requests for these programs cannot be submitted via either NSPIRES or Grants.gov. They must be submitted via the URL given in the Summary Table of Key Information given at the end of program element description. The Phase-2 proposal for funding must be submitted via NSPIRES by a proposal due date that will be announced when NASA announces the disposition of the Phase-1 observing requests. The process and requirements for the submission of Phase-1 observing requests and Phase-2 proposals may differ for each program element; proposers should read carefully the relevant program element Appendix to this ROSES NRA.

(c) Proposal Submission Due Dates and Deadlines

For each program element in Appendices A through E of this NRA, the electronic proposal must be submitted in its entirety by an Authorized Organizational Representative (AOR) no later than the proposal deadline on the appropriate proposal due date given in Tables 2 or 3 of this NRA. Unless stated otherwise in the relevant appendix to this NRA, the proposal deadline is 11:59 p.m. Eastern Time. Unless otherwise specified, all proposals must be submitted electronically using either NSPIRES or Grants.gov (see Sections IV(b)(i–iii) above).

Proposals submitted after than the proposal due date and deadline will be considered "late." Proposals that are late will be handled in accordance with NASA's policy as given in Section (g) of Appendix B of the *NASA Guidebook for Proposers* (see also its Sections 3.2 and F.23). Proposals received after the due date may be rejected without review. If a late proposal is rejected, it is entirely at the discretion of the proposer whether or not to resubmit it in response to a subsequent appropriate solicitation. It is not possible to submit a late proposal electronically via NSPIRES unless the electronic *Cover Page* was initially created prior to the proposal due date.

(d) Proposal Funding Restrictions and Exceptions to the Guidebook

In addition to the funding restrictions and requirements given in the *NASA Guidebook for Proposers* and the *NASA Grants Handbook*, the following restrictions are applicable to this ROSES NRA.

- The estimated funding and number of proposals anticipated to be funded, as shown in the Summary of Key Information at the end of each program element, are subject to the availability of appropriated funds, as well as the submission of a sufficient number of proposals of adequate merit.
- Other than the special cases discussed in Section 2.3.10(c)(ii) of the *NASA Guidebook for Proposers*, and unless specifically noted otherwise in the specific ROSES Appendix and or program element, the proposing PI organization must subcontract the funding of all proposed Co-Is who reside at other non-Government organizations, even though this may result in a higher proposal cost because of subcontracting fees. Potential exceptions to this rule include, but are not limited to, the awards that stem from the Suborbital-Class Platforms (see

Section V). Other rare exceptions will be considered on a case by case basis when requested in the proposal and found to be in the interest of the Government and consistent with appropriate law, regulation, policy, and practice.

- Unless otherwise noted in the solicitation, SMD will send funds directly to Co-Is at NASA centers and other Government laboratories, including JPL. Thus, if a proposal submitted by a university has a Government Co-I, the funds will not pass through the university, so the university (or other institution that receives a grant) should not include overhead or any other pass through charges on those funds. Funds for Co-Is who do not work for the Government would pass through the university and those charges may be applied. Regardless of whether a Co-I will be funded through a subaward via the proposing institution or funded directly by NASA, the budget for the proposal must include all funding requested from NASA for the proposed investigation, except salaries for NASA civil servants, see Section IV(b)(iii). This must be reflected in the budget totals that appear in the proposal and its budget forms. Any funds for Co-Is at NASA centers and other Government laboratories (except salaries for NASA civil servants) should be included in the proposal's Budget Narrative and should be listed as "Other Applicable Costs" in the required Budget Details, as well as entered in the "Other" line(s) on the NSPIRES or Grants.gov budget entry form in the "Other Direct Costs" section. This funding must be included in the total cost of the proposed work. No indirect burden from the PI's organization should be applied to this amount. (see Section 2.3.10(c)(ii) of the *NASA Guidebook for Proposers*).
- The construction of facilities is not an allowed activity for any of the program elements solicited in this NRA unless specifically stated. For further information on what costs are permissible, refer to the cost principles cited in the *NASA Grants Handbook*, Section B, §1260.127, "Allowable Costs."
- Travel, including foreign travel, is allowed as may be necessary for the meaningful completion of the proposed investigation, as well as for publicizing its results at appropriate professional meetings. Proposers from NASA Centers should consult the latest NASA policy document regarding restrictions on travel funding. Note that selection of a proposal and approval of a proposed budget that includes travel for civil servants does not guarantee that a NASA Center has sufficient travel authority to approve the proposed travel under NASA's reduced travel budget.
- In general, proposals for sponsorship of topical conferences, workshops, consortia, or symposia meeting certain criteria are solicited through the ROSES program element Topical Workshops, Symposia, and Conferences (Appendix E.2).
- Regardless of whether a conference is sponsored by NASA, individual conference travel by grantees is permitted and proposers from universities may include a budget for travel to conferences and workshops. Proposers from NASA Centers should consult their Center implementing policy on the latest NASA guidance on conference spending and reporting requirements. Note that selection of a proposal and approval of a proposed budget that includes travel for civil servant does not guarantee that a NASA Center has sufficient travel authority under NASA's reduced travel budget to approve the proposed travel.
- Profit for commercial organizations is not allowable under grant or cooperative agreement awards, but is allowable under contract awards.

- NASA funding may not be used for subcontracted foreign research efforts. U.S. research award recipients may directly purchase supplies and/or services from non-U.S. sources that do not constitute research, but award funds may not be used to fund research carried out by non-U.S. organizations. However, a foreign national may receive remuneration through a NASA award for the conduct of research while employed either full- or part-time by a U.S. organization (see Section 1.6 of the *NASA Guidebook for Proposers*; see also Appendix B, part (c)(8)(iv)). Special restrictions apply to collaboration with China, see Section III(c).
- Travel by a participant in the research investigation, whether for the purpose of conducting the research, for collaboration, or for attending a conference, is considered to be a research expense. NASA conducts its collaborations with foreign institutions on a no-exchange-of-funds basis. NASA funding may not be used for research efforts by foreign organizations at any level. Therefore, NASA funding may not be used for travel expenses by any team member who is not participating as a member of a U.S. organization (see Section 1.6 of the *NASA Guidebook for Proposers*; see also Appendix B, part (c)(8)(iv)).
- As noted in the *NASA Guidebook for Proposers*, costs of preparing, publishing, and disseminating the results of NASA funded research (e.g., page charges, open access fees, etc.) may be included in research proposals and are allowable charges against the grant, as long as the charges are levied impartially on all research papers published by the journal.
- The instructions in the following paragraph clarify and supersede the *NASA Guidebook for Proposers*, Section 2.3.10(c)(iv).

  Regardless of whether functioning as a team lead or as a team member, personnel from NASA Centers must propose budgets consistent with the current accounting implementation for the requested year of performance. Proposal budgets from NASA Centers must include all costs that will be paid out of the resulting award, with the exception of salaries for NASA civil servants (see Section IV(b)(iii)). Costs that will not be paid out of the resulting award, but are paid from a separate NASA budget (e.g., center management and overhead; CM&O) and are not based on the success of this specific proposal, should not be included in the proposal budget. For example, CM&O should not be included in the proposal budget while other direct charges (including procurements and contractor labor) to the proposed research task should be included. Although NASA civil servant salaries are budgeted within NASA program budgets (such as the research budgets which fund ROSES investigations) and are paid out of the resulting award, these costs should not be included in proposal budgets (see Section IV(b)(iii)). NASA will budget and account for civil servant salaries within ROSES proposals through a separate internal agency process. The latest NASA internal policy on this subject, including instructions to NASA Centers on formulating budgets for ROSES proposals, may be found at the SARA website at http://science.nasa.gov/researchers/sara/how-to-guide/nspires-CSlabor/.
- Non-NASA U.S. Government organizations should propose based on full-cost accounting, unless no such standards are in effect; in that case such proposers should follow the Managerial Cost Accounting Standards for the Federal Government as recommended by the Federal Accounting Standards Advisory Board (for further information, see http://www.hq.nasa.gov/fullcost). Proposal budgets must include all costs that will be paid out of the resulting award.

V. SUBORBITAL-CLASS INVESTIGATIONS

(a) Overview of Suborbital-Class Platforms

In each SMD Research Program (Earth Science, Heliophysics, Planetary Science, Astrophysics), flight investigations that require access to space or near-space are solicited. Flight investigations solicited through ROSES generally have modest costs and reduced mission assurance requirements appropriate for the research program, and these investigations are referred to as suborbital-class investigations. Platforms for suborbital-class investigations include aircraft, balloons, sounding rockets, suborbital reusable launch vehicles, CubeSats, and small International Space Station (ISS) payloads. General requirements for proposals to use any of these platforms, with the exception of aircraft, are discussed in this section of ROSES. Requirements for proposals using aircraft are discussed within the description of the Earth Science Research Program found in Appendix A.

Generally speaking, proposals for investigations that are carried out through development, launch, and operation of a short duration orbital experiment, such as one on a CubeSat or ISS-based project, are permitted in any ROSES program element that solicits investigations for use on suborbital-class platforms. In this sense, a CubeSat or an ISS-based investigation is a "suborbital class" investigation, even though it will be placed into orbit. A CubeSat or ISS-based "suborbital class" investigations are subject to the same cost constraints to which traditional suborbital investigations are subject. Proposals for life and microgravity science investigations are not solicited through ROSES. Life and microgravity science investigations are solicited by the Human Exploration and Operations Mission Directorate. For further information contact David Tomko, Human Research Program and Fundamental Space Biology, NASA Headquarters, Washington, DC 20546; Tel.: 202-358-2211; E-mail: dtomko@nasa.gov.

(b) Points of Contact for Suborbital-Class Platforms

NASA provides different avenues for procurement of suborbital launch vehicle services, including: sounding rockets provided by the NASA Sounding Rockets Program Office (SRPO) at the NASA Goddard Space Flight Center/Wallops Flight Facility (NASA/GSFC/WFF), balloons provided by the NASA Balloon Program Office (BPO) at the NASA/GSFC/WFC, and suborbital reusable launch vehicle (sRLV) services provided by the NASA Space Technology Mission Directorate's (STMD) Flight Opportunities Program (FOP). SMD also solicits investigations as CubeSats and as small International Space Station payloads. Regardless of which launch vehicle service is anticipated, all prospective PIs are required to demonstrate the capacity, availability, and commitment of the suborbital-class platform to support their investigation. PIs are strongly urged to discuss prospective investigations with NASA program personnel (see below) prior to submitting their proposal to ensure that probable operational costs are properly anticipated.

(i) NASA-provided Sounding Rocket Services

Information on the capabilities of current available sounding rocket vehicles is available at http://sites.wff.nasa.gov/code810/vehicles.html. Proposers are encouraged to consider these capabilities in designing their investigations, but the Sounding Rockets Program Office (SRPO) has the final authority in the choice of which vehicle is to be used.

The nominal U.S. launch sites for sounding rockets are White Sands Missile Range (WSMR) in New Mexico, Wallops Island in Virginia, Poker Flat Rocket Range (PFRR) in Alaska, and

Reagan Test Site (RTS) in the Kwajalein Atoll. The SRPO also conducts launches from the established non-U.S. launch sites at Andoya, Norway; Kiruna, Sweden (Esrange); or Woomera, Australia; subject to science community requirements and the availability of SRPO operations funding to conduct the campaign.

Investigators proposing payloads to be flown on sounding rockets should answer the program-specific questions on the NSPIRES proposal cover pages. This information is needed by the SRPO to generate a rough order of magnitude cost estimate for the operational requirements associated with a proposed investigation and is used for planning purposes. The required information includes the envisioned vehicle type, payload mass, trajectory requirements, launch site, telemetry requirements, attitude control, or pointing requirements, and any plans for payload recovery and reuse.

Investigators proposing sounding rocket payloads should contact the SRPO to obtain technical information related to SRPO launch vehicle capabilities, services, and the latest planned campaign schedules. Questions concerning sounding rockets may be addressed to:

Philip Eberspeaker
Sounding Rockets Program Office
Code 810
GSFC/Wallops Flight Facility
National Aeronautics and Space Administration
Wallops Island, VA 23337
Telephone: (757) 824-2202
E-mail:Philip.J.Eberspeaker@nasa.gov

(ii) NASA-provided Balloon Services

Information on the capabilities of current available balloon vehicles is available at http://sites.wff.nasa.gov/code820/ and at http://www.csbf.nasa.gov/balloons.html. Proposers are encouraged to consider these capabilities in designing their investigations, but the Balloon Program Office (BPO) has the final authority in the choice of which vehicles to be used.

The nominal U.S. launch sites for Balloons are Fort Sumner, New Mexico, and at the Columbia Scientific Balloon Facility in Palestine, Texas. The BPO also conducts launches from established non-U.S. launch sites at McMurdo, Antarctica; Alice Springs, Australia; or Kiruna, Sweden (Esrange); subject to science community requirements and the availability of BPO operations funding to conduct the campaign.

Proposers needing investigation unique engineering, flight support systems, and/or technical support services from NASA, such as the Wallops Arc-Second Pointing System (WASP), should contact the BPO directly for an estimate of the Government Furnished Equipment (GFE) cost of the desired support.

Investigators proposing balloon payloads should contact the BPO to obtain technical information related to BPO balloon capabilities, services, and the latest planned campaign schedules. Questions concerning balloons may be addressed to:

Debora Fairbrother
Balloon Program Office
Code 820
GSFC/Wallops Flight Facility
National Aeronautics and Space Administration
Wallops Island, VA 23337
Telephone: (757) 824-1717
E-mail: debora.a.fairbrother@nasa.gov

(iii) Suborbital Reusable Launch Vehicles

Suborbital Reusable Launch Vehicles (sRLV) offer newly developed commercial capabilities for the conduct of NASA scientific research, education, and technology advancement. The NASA STMD's Flight Opportunities Program (FOP) has issued commercial contracts to several sRLV flight service providers. Information on sRLV vehicles, including general vehicle capabilities and contact information for some vendors, is available at http://flightopportunities.nasa.gov/platforms. Until NASA establishes a policy to sponsor spaceflight participants onboard sRLVs, the FOP will not sponsor participants to fly on commercial balloon or suborbital reusable launch vehicles. The payloads to be flown on sRLV flights must either be automated or remotely operated. The remote operation capability should be confirmed with the flight operator.

Proposals for investigations using sRLVs as platforms must be for complete investigations, and must describe a complete suborbital science investigation, including payload construction, vehicle integration, launch and flight operations, data analysis, and publication of results. Proposers interested in using sRLVs as platforms to conduct an Earth or space science investigation must identify a vehicle that can provide the technical capabilities required to conduct the proposed investigation.

Proposals for investigations using sRLVs as platforms must specify the technical requirements that their investigation places on the vehicle. The proposal must include a Letter of Endorsement from a commercial vendor that (i) describes how that vendor's vehicle will meet the investigation requirements and provides technical information on how the vehicle will meet the investigation requirements, (ii) states that the vehicle will be available for use at the time proposed for flight and provides information showing a plan for getting from the current vehicle status to flight status, and (iii) provides a quoted cost for the flight and all other services that are required from the vehicle vendor to enable and conduct the proposed investigation.

Proposals for investigations using sRLVs as platforms must provide a description of the instrument; its current status; a clear assessment of what it will take to develop, modify, and integrate the instrument onto the sRLV; and include a plan to provide calibrated, research grade data.

The cost to SMD for the flight and all other services provided by the sRLV vendor must be clearly stated in the proposal but not in the proposed investigation budget. All other costs for conducting the investigation must be included in the PI's proposed investigation budget. Upon final selection for flight, the flight and all other services provided by the sRLV vendor will be procured directly by the FOP and will not be funded through the PI's award.

SMD will conduct a sRLV continuing investigation review (CIR) for all sRLV-based projects. The CIR will take place following maturity of the sRLV-based project to the equivalent of a Phase A concept study report or a systems requirement review. The CIR will include payload description, flight performance assessment, proposed payload configuration and interfaces, mission success criteria, requirements matrix, operational requirements, launch vehicle, and project schedule. Once the sRLV-based project reaches that level of design maturity, the CIR will be held at NASA Headquarters. The SMD Associate Administrator (or designee) is the decision authority for approval to proceed beyond the CIR. It is expected that sRLV-based projects will spend no more than approximately $100K prior to CIR approval. A proposal for a sRLV-based project must describe the proposed schedule for CIR and the proposed funding required to reach CIR.

Proposals for sRLV-based investigations must be submitted to the appropriate ROSES program element, depending on the science addressed by the proposed investigation. The proposed sRLV-based investigation must meet the constraints of the program element to which it is being proposed. This explicitly includes any constraints on the areas of science that are solicited, on the available funding, and on the requirement for a complete science investigation.

All proposals will be evaluated with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*. In addition to the factors specified in the *Guidebook*, the intrinsic merit of a proposal shall include the following additional factors:

- The extent that the proposed sRLV offers an advantage (e.g., scientific, technical, or cost) over other suborbital-class platforms (including sounding rockets, balloons, and aircraft);
- The likelihood that the proposed vehicle will be available at the proposed time for flight and that it will be capable of providing the required technical capabilities;
- The feasibility of the proposed technical investigation, including the concept for conduct of the experiment during the suborbital flight and the plans for calibrating and analyzing the data obtained to accomplish the proposed science objectives; and
- The quality of the plans for completing the preliminary design prior to the investigation confirmation review;

In addition to the factors specified in the *Guidebook*, the cost realism and reasonableness of a proposal shall include:

- The affordability to SMD of the proposed vehicle vendor cost for the flight and other required services.

Note that the Flight Opportunities Program is available to assist the PI with this process. Investigators proposing sRLV payloads are strongly urged to discuss prospective investigations with operations personnel in the Flight Opportunities Program and/or a potential vendor to ensure that probable integration, safety and mission assurance, and operational costs are properly anticipated.

Questions concerning potential sRLV investigations may be addressed to:

LK Kubendran
Flight Opportunities Program
Space Technology Mission Directorate
NASA Headquarters
Washington, DC 20546
Telephone: (202) 358-2528
E-mail: lk@nasa.gov

(iv) Research Investigations utilizing the International Space Station

NASA has determined that there may be payload opportunities for small, suborbital-class space and Earth science research investigations, including both science and technology development, that utilize the International Space Station (ISS). Available external attach points include both zenith and nadir pointing locations and internal attach points, including nadir pointing locations. NASA has available annual external launch opportunities after 2015 on the Japanese HTV launch vehicle and the SpaceX vehicle. NASA also has regular opportunities on a suite of vehicles to launch pressurized cargo for use in the Window Observational Research Facility (WORF). Information on the opportunities and constraints for ISS attached payloads may be found at http://www.nasa.gov/mission_pages/station/research/research_information.html.

Proposals seeking use of the ISS must take advantage of the Station's unique capabilities. In order to be compliant, a proposal must include a clear and convincing scientific and/or technical argument that use of the ISS is required to produce the needed results in ways that could not be accomplished through the use of other platforms. Investigations that make use of the ISS may be proposed for periods of performance of up to five years.

Proposers interested in using the ISS to conduct an Earth or space science investigation must identify a specific accommodation location that can provide the technical capabilities required to conduct the proposed investigation. The proposal must include a letter of feasibility from the NASA Space Station Payload Office. This letter of feasibility must contain: (1) a preliminary assessment of the feasibility for proposed provisions for access to and accommodation at the Space Station, (2) identification of any significant challenges or conditional provisions for access and accommodation, and (3) a description of the level of technical interchange or negotiation required to mature the proposed provisions for access and accommodation. Transportation and accommodation will be provided by NASA at no cost to the proposed research investigation, and costs for transportation to and accommodation on the ISS should not be included in the proposed budget. However, the PI's cost for all accommodation, safety, and other reviews that are conducted and supported by the PI must be included in the PI's proposed investigation budget.

In addition to proposal requirements specified in the appropriate ROSES program element, proposals for investigations utilizing the ISS must provide a description of the instrument; its current status; a clear assessment of what it will take to develop, modify, and integrate the instrument onto the ISS; and include a plan to provide calibrated, research grade data in SI traceable units. Proposals must be for complete investigations that include payload construction, ISS integration, launch and flight operations, data analysis, and publication of results.

The ISS Customer Integration Office will provide integration services, launch services, on-orbit operations and services, as well as safety and mission assurance reviews for all ISS investigations.

Proposals must be submitted to the appropriate ROSES program element depending upon the science addressed by the proposed investigation. The proposed investigation must meet the constraints of the program element to which it is being proposed. This explicitly includes any constraints on the areas of science that are solicited, on the available funding, and on the requirement for a complete science investigation.

Investigations proposed for the ISS will be approved for the first year only. During the first year, in addition to beginning the proposed investigation, a detailed transportation and accommodation study will be undertaken with the ISS Customer Integration Office. Approval for continued funding beyond the first year will be contingent on the ISS Program making a firm commitment for transportation and accommodation on the ISS that is compatible with the requirements of the proposed investigation.

All proposals will be evaluated with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*. In addition to the factors specified in the *Guidebook*, the intrinsic merit of a proposal shall include the following additional factors:

- The extent that the advantages (e.g., scientific, technical, or cost) of the International Space Station's capabilities and location will be utilized; and
- The feasibility of the proposed technical investigation, including the concept for conduct of the experiment during the flight and the plans for calibrating and analyzing the data obtained to accomplish the proposed science objectives.

External accommodations for payloads include Express Logistics Carriers (ELCs) mounted to the ISS truss structure, the Japanese Experiment Module-Exposed Facility (JEM-EF), and the Columbus Orbiting Facility-Exposed Facility (COF-EF). Internal accommodations are also available in the pressurized environment via the Window Observational Research Facility (WORF). More detailed information can be found at http://www.nasa.gov/pdf/462947main_2010_June_Jones_ISS%20Accomodations1.2a.pdf.

Attached payloads must be certified for transportation and use in a human tended vehicle. External payloads would be required to complete PDR approximately 36 months before launch, CDR approximately 24 months before launch, and be delivered for certification and integration approximately nine months before launch. Pressurized cargo for the WORF would be required to complete PDR approximately 12 months before launch, CDR approximately nine months before launch, and be delivered for certification and integration approximately four months before launch.

Investigators proposing ISS payloads are strongly urged to discuss International Space Station payload constraints, launch opportunities, and other technical matters with the ISS Research Integration Office.

For further information, please contact:

Sharon C Conover
ISS Research Integration Office/OZ

Johnson Space Center
National Aeronautics and Space Administration
Houston, TX 77058
Telephone: 281.244.8518
E-mail: sharon.c.conover@nasa.gov

(v) Use of Short Duration Orbital Platforms, including CubeSats

Short duration orbital platforms, such as CubeSats (built in increments of 10 centimeter cubes), have historically been used as teaching tools and technology demonstrations, and now may offer newly developed capabilities for the conduct of NASA scientific research and technology advancement. CubeSats can be built as a single unit (1U), weighing less than 1.33 kg, or combined in units of two, three or six.

CubeSats: Proposals for science investigations utilizing short duration orbital platforms, such as CubeSats, must be for complete investigations, and must describe a complete science investigation, including CubeSat construction, payload integration and test, launch vehicle integration, communications, mission operations, data analysis, and publication of results.

Launch: Launch services will be provided under the NASA/HEOMD CubeSat Launch Initiative (CSLI) at no cost to the investigation. The CubeSat Launch Initiative (CSLI) program regularly provides launch opportunities for small satellites to fly as secondary (auxiliary) payloads on rockets planned for upcoming U.S. Government missions. Under the CSLI process, an Agency-wide selection recommendation committee considers candidate CubeSats for selection from among those proposed from organizations both internal and external to NASA. At an appropriate time following selection, SMD will provide direction for being considered for manifest on a launch vehicle going to an appropriate orbit.

CubeSats are typically launched as secondary payloads to low-Earth orbit or from the International Space Station, but submissions to ROSES-2015 may also propose to launch on Exploration Mission 1 (EM-1) to achieve Earth-escape. Further, additional commercial opportunities to leave Earth orbit as a secondary payload may arise on future mission launches. Information on the EM-1 stand-alone CubeSat opportunity, can be found by contacting the CubeSat points of contact listed below.

For more information about the CSLI, including previously-selected respondents, see

http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html.

As a result of their secondary status, CubeSats are placed into orbits that are dictated by the primary. Therefore, in any given year a finite number of specific orbits (e.g., inclinations and altitudes) will be available for CubeSats, and the types of orbits available will vary from year to year. Thus, CubeSat-based missions requiring very specific orbital parameters may be at a disadvantage for securing a timely launch. Proposals should clearly indicate both the required and the acceptable range of orbital parameters needed to meet mission objectives.

NASA's CubeSats are deployed from a Poly-Picosatellite Orbital Deployer, or P-POD. CubeSats must be compliant with the NASA/KSC Launch Services Program (LSP) Program Level Poly-Picosatellite Orbital Deployer (PPOD) and CubeSat Requirements Document and the Compliance and Reference Documents referenced therein. That document may be found at:

http://www.nasa.gov/pdf/627972main_LSP-REQ-317_01A.pdf

Investigators proposing CubeSats in response to this solicitation are expected to comply with the requirements of NASA Procedural Requirement (NPR) 7120.8, NASA Research and Technology Program and Project Management Requirements, and should appropriately tailor these requirements, depending on the project size, complexity, and scope.

Proposals for CubeSat investigations should note the following:

- The proposed CubeSat investigation must meet the constraints of the program element to which it is being proposed. This explicitly includes any constraints on the areas of science that are solicited, on the available funding, and on the requirement for a complete science investigation.
- Proposals will be evaluated with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*. In addition to the factors specified in the *Guidebook*, the proposal will be evaluated against any additional factors called out in the program element to which it is being proposed.
- Proposals for investigations using CubeSats must satisfy the constraints for a standard CubeSat (one "Cube" or "1U" defined above) and the NASA CubeSat deployer.
- Proposals must specify any constraints placed on the required orbit and orbital lifetime. The likely availability of NASA launches satisfying any constraints in the time period contemplated will be a consideration for the ROSES evaluation. The less stringent the orbital constraints, the more probable it will be that NASA can manifest the CubeSat investigation for launch.
- Proposals must demonstrate knowledge of the requirements for limiting orbital debris and must address how the mission will meet the requirements of NPR8715.6 NASA Procedural Requirement for Limiting Orbital Debris.
- Proposals must address the approach to downlink and uplink communications licensing, frequency band selection, and frequency coordination for operations between space and ground within the RF spectrum.
- All costs for preparing and delivering the CubeSat for launch must be included in the proposal. No launch service charges should be included in the proposal cost request.
- Proposals for short duration orbital experiments other than CubeSats must include provisions for access to space as part of the proposal.

Investigators proposing CubeSats are strongly urged to discuss prospective investigations with personnel listed below regarding constraints, launch opportunities, and other technical matters.

For further information on SMD CubeSats, please contact:

David L Pierce,
Senior Program Executive for Suborbital Research,
Phone: 202-358-3808,
E-mail: david.l.pierce@nasa.gov

For further information on CSLI, please contact:

Anne E Sweet,
Launch Services Program Executive,
Phone: 202-358-3784,
E-mail: anne.sweet-1@nasa.gov

or

Jason C Crusan,
Director, Advanced Exploration Systems,
Phone: 202-358-0635,
E-mail: jason.c.crusan@nasa.gov

(c) General Guidelines for Suborbital-Class Investigation Proposals

ROSES supports science investigations and/or technology development utilizing payloads flown on suborbital-class platforms, as defined in Section I(b), or as flights of opportunity. Suborbital-class payloads may be recovered, refurbished, and reflown, in order to complete an investigation. A discussion of the plans for management and for reduction and analysis of the data must be given in the proposal. Although most awards are for three or four years' duration, a five-year proposal may be accepted to develop a completely new, highly meritorious investigation through its first flight.

Budgets are expected to cover complete investigations, including payload development and construction, instrument calibration, launch, and data analysis. The number of investigations that can be supported is limited and heavily dependent on the funds available to the relevant research program. Note that NASA does not carry reserves to accommodate any cost overrun incurred by a particular investigation, including the damage and/or loss of the payload owing to a suborbital-class platform system failure. Therefore, failure to achieve the proposed goals within the proposed time and budget could require either descoping the initially proposed investigation, delaying it, canceling a particular launch date opportunity, or canceling the investigation altogether. Unlike most other ROSES investigations where the proposing PI organization must subcontract funding to non-Government investigators, suborbital-class investigations will sometimes be split into multiple awards, depending on circumstances. Please read the individual ROSES Appendix and consult with the POC.

VI. Proposal Review Information

(a) Evaluation Criteria

As stated in the *NASA Guidebook for Proposers*, proposals are evaluated on three criteria: intrinsic merit, relevance, and cost realism and reasonableness. *NASA Guidebook for Proposers* Section 1.2.3 Proposal Review and Selection indicates that peer review will be used to determine merit, and that "NASA peer review members may also participate in determining the relevance…and cost realism and reasonableness", but that the evaluation of cost and relevance may be done by NASA. Consistent with this, ROSES proposals may be scored by peer reviewers for all three criteria, or may be scored for only merit, with comments provided for relevance and cost, or the peer review panel may not be asked to comment on relevance and cost at all. NASA may return a proposal without peer review if it is not relevant. Note the following specific points:

- Some of the program elements discussed in Appendices A through E will give specific factors, based on the solicited research objectives, which will be considered when evaluating a proposal's science and/or technical merits and/or its relevance to program objectives.
- Unless otherwise stated, relevance will be judged by whether the proposal addresses goals and objectives for that ROSES Appendix and/or specific program element, rather than NASA's broader goals. This focus on relevance to the program element supersedes the instructions in the *NASA Guidebook for Proposers*. Unless otherwise stated in the program element, relevance of the proposed work is judged based on whether the work proposed is deemed to be relevant, independent of whether or not it includes an overt, clear and direct statement of relevance. That is, unless otherwise stated in the program element, no proposal will be returned as noncompliant for lack of a relevance section or statement, but inclusion of a relevance section or statement is no guarantee that the proposal will be judged relevant. A few program elements in Appendix C do require an explicit relevance section. Please read the program elements carefully.
- Cost data for U.S. proposals may be evaluated both by peer review (for cost realism and cost reasonableness) and by NASA program personnel (for total cost and comparison to available funds). Proposers must follow the budget requirements in Section 2.3.10 of the *NASA Guidebook for Proposers*. In evaluating the cost reasonableness of the proposals, reviewers will assess whether the proposed level of effort (i.e., labor FTEs) and the proposed other direct costs (i.e., supplies, equipment, travel) are commensurate with those required to accomplish the goals of the investigation. Salary levels, fringe benefit rates, and overhead rates are not part of that evaluation.
- Except in rare instances where it is explicitly acknowledged in the program element, neither the existence of proposed voluntary cost sharing nor the lack thereof or the magnitude of such cost sharing will be used as evaluation criteria or as a precondition for award. If voluntary cost sharing is proposed, the proposer should describe, in detail, any proposed cost sharing arrangements. (see Section III(d) above). Please note that the Summary of Proposal Personnel and Work Effort is no longer within in the budget section and the guidebook explicitly notes that any planned work commitment not funded by NASA is not considered cost sharing as defined in 2 CFR § 215.23 (OMB Circular A-110).

(b) Review and Selection Processes

Review of proposals submitted to this NRA will be consistent with the general policies and provisions given in Sections C.1 through C.4 of Appendix C of the *NASA Guidebook for Proposers*, and selection procedures will be consistent with the provisions of Section C.5 of that document. In this NRA, the desire to achieve a balance of efforts across the solicited program objectives may play a role in the selections.

Unless otherwise specified, the SMD Division Director responsible for a research program element (or his/her delegate) is its Selection Official.

(c) Selection Announcement and Award Dates

SMD's goal is to announce selections within 150 days of the proposal due date and within 60 days after the conclusion of the peer review. Selections are typically announced between 150 days and 220 days after the proposal due date. Although there are many reasons why selections are not announced earlier, the most common are the uncertainty in the NASA budget at the time

selection decisions could be made and the time required to conduct an appropriate peer review and selection process. NASA does not usually announce new selections until the funds needed for those awards are approved through the Federal budget process. Therefore, a delay in the budget process for NASA usually results in a delay of the selection announcement date. After 150 days have passed since the proposal due date, proposers may contact the responsible Program Officer listed at the conclusion of that program element and on the SARA web page (see Section VIII). If the program officer does not respond proposers may send an inquiry to SARA@nasa.gov

In order to announce selection decisions as soon as is practical, even in the presence of budget uncertainties, the Selection Official may make and announce selection decisions about some proposals and defer decisions on others. If a Selection Official uses this option, then proposers may be told that a proposal has been "selected", "declined", or that a decision has not yet been made. If a decision has not yet been made then those proposals remain "selectable" and will be considered for a supplemental selection when circumstances allow. Eventually proposers will be notified whether their proposal is selected or is no longer being considered for selection. All proposers will be notified via NSPIRES and provided with a written review (usually the panel evaluation) of the proposal. Proposers may contact the Program Officer for a "debriefing" e.g., to clarify something that is unclear in the evaluation or for an explanation of whether there were factors other than the peer review that played a role in the decision.

(d) Processes for Appeals

(i) Reconsideration by SMD

SMD has a process for requesting reconsideration of the declination of a proposal submitted in response to an SMD NASA Research Announcement. Reconsideration may be requested if the PI believes that the proposal was not handled correctly. This process may be found at in the SMD Reconsideration Policy document available in the Library section of the SARA website at http://nasascience.nasa.gov/researchers/sara/library-and-useful-links (the SARA website is at http://sara.nasa.gov).

(ii) Ombudsman Program

The NASA Procurement Ombudsman Program is available under this NRA as a procedure for addressing concerns and disagreements. The clause at NASA FAR Supplement (NFS) 1852.215-84 ("Ombudsman") is incorporated into this NRA.

The cognizant ombudsman is

Director, Contract Management Division
Office of Procurement
NASA Headquarters
Washington, DC 20546-0001
Telephone: 202-358-0445

(iii) Protests

Only contract awards are subject to bid protest, either at the Government Accountability Office (GAO) or with the Agency, as defined in FAR 33.101. The provisions at FAR 52.233-2 (Service of Protest) and NFS 1852.233-70 (Protests to NASA) are incorporated into this NRA. Under

both of these provisions, the designated official for receipt of protests to the Agency and copies of protests filed with the GAO is

Assistant Administrator for Procurement
Office of Procurement
NASA Headquarters
Washington, DC 20546-0001
Telephone: 202-358-2090

(e) Service as a Peer Reviewer

The success of NASA's research program rests on the quality of peer review. NASA will contact expert investigators and ask them to serve as peer reviewers. Since those whose proposals were selected in prior competitions are highly qualified and may not be submitting a proposal to the current competition, they are highly encouraged to serve on SMD peer review panels. Potential reviewers are encouraged to volunteer to be reviewers by filling out one of the review forms at http://science.nasa.gov/researchers/volunteer-review-panels/ or by sending an E-mail to one of the program officers or to sara@nasa.gov. It is good experience for early-career scientists, and the influx of new reviewers is healthy for the process.

VII. AWARD ADMINISTRATION INFORMATION

(a) Notice of Award

Notification of both the selected, as well as the nonselected, proposers will be consistent with the policy given in Section C.5.3 of the *NASA Guidebook for Proposers.* For selected proposers, the offeror's business office will be contacted by a NASA Awards Officer, who is the only official authorized to obligate the Government. Any costs incurred by the offeror in anticipation of an award will be subject to the policies and regulations of the *Grants Handbook* (see Section B, §1260.125(e), Revision of Budget and Program Plans).

(b) Administrative and National Policy Requirements

This solicitation does not invoke any special administrative or national policy requirements, nor do the awards that will be made involve any special terms and conditions that differ from NASA's general terms and conditions as given in the *NASA Grants Handbook*.

(c) Award Reporting Requirements

The reporting requirements for awards made through this NRA will be consistent with Exhibit G of the *NASA Grants Handbook*.

For science projects that receive assistance from the U.S. Antarctic Program, the acknowledgement should include: "Logistical support for this project in Antarctica was provided by the U.S. National Science Foundation through the U.S. Antarctic Program."

Any additional requirements will be specified in the program element description.

VIII. POINTS OF CONTACT FOR FURTHER INFORMATION

General questions and comments about the policies of this NRA may be directed to:

Max Bernstein
SMD Lead for Research

Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
E-mail: sara@nasa.gov (preferred)
Telephone: (202) 358-0879

Note: Proposals must not be submitted to this address. Proposals must be submitted electronically as described in Section IV above.

Specific questions about a given program element in this NRA should be directed to the Program Officer(s) listed in the Summary Table of Key Information at the end of each program element appendix. Up-to-date contact information for program officers can also be found online at the SARA web page's Program Officers List at http://nasascience.nasa.gov/researchers/sara/program-officers-list.

Inquiries about accessing or using the NASA proposal data base located at http://nspires.nasaprs.com should be directed by an E-mail that includes a telephone number to nspires-help@nasaprs.com or by calling (202) 479-9376. This help center is staffed Monday through Friday, 8:00 a.m. – 6:00 p.m. Eastern Time.

Inquiries about accessing or using Grants.gov located at http://www.grants.gov should be directed by an E-mail to support@grants.gov or by calling (800) 518-4726. This customer support contact center is staffed Monday through Friday, 7:00 a.m. – 9:00 p.m. Eastern Time.

IX. Ancillary Information

(a) Announcement of Updates/Amendments to Solicitation

Because this NRA is released far in advance of many of the deadlines given in Tables 2 and 3, additional programmatic information for any of its programs may develop before their proposal due dates. If so, such information will be added as a formal amendment to this NRA no later than 30 days before the proposal due date, or, if that is not possible, the proposal due date will be extended to allow 30 days for proposal submission from the date of the amendment. All amendments are posted on the ROSES-15 homepage, which can be found at http://solicitation.nasaprs.com/ROSES2015 (or by going to http://solicitation.nasaprs.com/open and selecting "NNH15ZDA001N"). Also, an RSS feed for amendments, clarifications, and corrections to ROSES can be found in one place (and there is an RSS feed) at http://nasascience.nasa.gov/researchers/sara/grant-solicitations/roses-2015/. NASA SMD will also send an electronic notification of any such amendments to all subscribers of its electronic notification system (see Section IX(c) below), it is the responsibility of the prospective proposer to check this NRA's homepage for updates concerning the program(s) of interest.

Any clarifications or questions and answers that are published will be posted on the relevant program element's web page, which can be found as described above.

(b) Electronic Submission of Proposal Information

On-time electronic submission over the Internet is required for every proposal. While every effort is made to ensure the reliability and accessibility of the electronic proposal submission systems (NSPIRES and Grants.gov) and to maintain help centers via E-mail and telephone, difficulty may arise at any point, including the user's own equipment. Therefore, prospective proposers are urged to familiarize themselves with the submission system(s) and to submit the

required proposal materials well in advance of the deadline of the program of interest. Difficulty in registering with or using a proposal submission system is not, in and of itself, a sufficient reason for NASA to consider a proposal that is submitted after the proposal due date (see Section IV(c) above). After submission via NSPIRES, proposers can verify proposal delivery by logging into NSPIRES and selecting "proposals" and "Submitted Proposals/NOIs."

(c) Electronic Notification of SMD Research Solicitations

SMD maintains an electronic notification system to alert interested researchers of its research program announcements. Subscription to this service is free to all registered users of the NASA proposal data base system at http://nspires.nasaprs.com. To add or change a subscription to the electronic notification system, users should login to the data base system and select "Account Management" then "E-mail Subscriptions." Owing to the increasingly multidisciplinary nature of SMD programs, this E-mail service will notify all subscribers of (i) all NASA SMD research program solicitations regardless of their type or science objectives; (ii) amendments to all SMD solicitations that have been released for which the proposal due dates have not passed; and (iii) special information that SMD wishes to communicate to those interested in proposing to its sponsored research programs. Altogether, a subscriber may receive 50–75 notifications per year. SMD maintains this subscription list in confidence and does not attempt to discern the identity of its subscribers. Regardless of whether or not this service is used, all SMD research announcements may be accessed at http://solicitation.nasaprs.com/open by selecting "NNH15ZDA001N" as soon as they are posted (typically by ~9:00 a.m. Eastern Time on their release date).

Note: Automated spam filtering software may identify SMD's electronic notifications as spam or junk mail. Subscribers are advised to ensure that E-mail received from "NSPIRES-help@nasaprs.com" or "nspires@nasaprs.com" are not identified by any automated E-mail filtering system as unwanted E-mail.

NRAs issued by SMD are synopsized on Grants.gov (http://www.grants.gov) at the time they are released. This ROSES NRA will be synopsized upon its release. Amendments to this NRA that create new proposal opportunities will also be synopsized on Grants.gov at the time of their release.

(d) Further Information on SMD Research and Analysis Programs

SMD maintains a website for improving communication with the research community. This site is maintained by the SMD Research Lead, is referred to as the SARA website, and is located at http://sara.nasa.gov. The SARA website contains information related to NASA's Science Research Programs, including the solicitations, selections, an RSS feed for changes to ROSES, and contact information for program officers.

(e) Archives of Past Selections

For more information about the types of research supported by the program elements solicited in previous editions of this NRA and other predecessor NRAs, the titles and abstracts of all investigations selected through previous solicitations (issued after January 1, 2005) are available by solicitation by year at http://nspires.nasaprs.com: click "Solicitations" and then "Closed/Past Solicitations and Selections," choose the year from the pop-down menu, and click the find button to see the abstracts in a PDF file. One can search the grants (only) that resulted from all NASA programs at http://www.research.gov/ by selecting "Search awards" and then using the

"Advanced Search" to search for NASA awards only. One can also search the grants (only) that resulted from all NASA programs, but not abstracts at https://www.nssc.nasa.gov/grantstatus.

(f) Meeting Geospatial Standards

NASA pioneered the development of metadata and the accessibility and interoperability of space and Earth science data. When grants result in the development of data that NASA both identifies as geospatial and intends to distribute, then NASA awards will require that documentation (metadata) meet Federal Geographic Data Committee standards. NASA will assure that this documentation is electronically accessible to the Clearinghouse network (http://www.fgdc.gov/dataandservices/) and discoverable through Geospatial One Stop (http://geo.data.gov/).

X. Concluding Statement

Through this ROSES NRA, NASA encourages the participation of the space and Earth science communities in its Science Mission Directorate research and technology programs. These programs, while quite diverse in objectives and types, in fact form the foundation of both the basic and applied research that allows NASA's space and Earth science programs to be properly planned and carried through to the successful interpretation of data and its application to the needs of end users. Comments about this NRA are welcome and may be directed to the point of contact for general questions and comments identified in Section VIII above.

Michael H. Freilich
Director
Earth Science Division

Jeffrey S Newmark
Director
Heliophysics Division

James L. Green
Director
Planetary Science Division

Paul L. Hertz
Director
Astrophysics Division

John M. Grunsfeld
Associate Administrator
Science Mission Directorate

Table 1: Checklist for ROSES-2015 Proposals

This list does not apply to Step-1 proposals. Many items on this checklist may be superseded by the program element and, if there is a difference, the text in the program element takes precedence. See Also the 2015 version of the *NASA Guidebook for Proposers*.		
Cover pages: Table 1 lists the few aspects that most commonly cause difficulties to proposers. There are many required parts to the cover pages, see the NSPIRES instructions.		
	Team	Investigators must indicate participation via NSPIRES, except proposals submitted via grants.gov. If any team member doesn't confirm their participation the AOR will get an error that prevents submission.
	Team	If that person is being paid then he or she is not collaborator.
	Project Summary	Project Summary (abstract) must be in the text box in the cover pages, not main body of the proposal. It has a built in 4000-character limit
	DMP	For most programs, the Data Management Plan (DMP) or statement that it is not needed must be in the text box in the cover pages, not in the main body of the proposal, unless otherwise stated in the program element. It is limited to 8000 characters. See the ROSES FAQ for important information.
	Budget	Include Direct and Indirect costs for all but NASA Civil Servants. Don't include NASA Civil servant labor or overhead costs. Those costs are submitted separately.
	Submission	Both the author must "release" the proposal and the AOR must "submit" prior to the due date.
	Other	There are cover page questions that must be answered and there may be other required content, e.g., some program elements in Appendix C collect a relevance statement here, see VI (a).
Proposal document		
Table of contents		First required component of proposal. One page only
Scientific/Technical /Management Section		Second required component and the main part of the proposal. **The sequence for science content here is recommended, but proposers may order the elements as they prefer [Clarified May 12, 2015]**
	Length restriction	Typically 15 pages (except for a Step-1 proposal) and more may be permitted for some (e.g., suborbital) programs and less for others (e.g., Planetary Major Equipment). Please read the program element and refer to the summary table of key information.
	Format	8.5" x 11.0" page size
	Format	Single spaced, single column text (unless otherwise specified).
	Format	One-inch margins on all four sides. No reviewable content in margins.
	Format	No more than 5.5 lines per inch
	Format	No more than 15 characters per inch
	Format	Times New Roman Font size 12 is always safe
	Figure Format	Text and content on/in figures must be easily legible without magnification.
	Captions Format	Figure captions follow the same font restrictions as body of proposal. Don’t put anything crucial only in the captions.

Table 1 Continued: Checklist for ROSES-2015 Proposals

	Table Format	Text and content on/in Tables must be easily legible without magnification.
	Content	Discuss objectives and their significance.
	Content	Discuss perceived impact of the work.
	Content	Discuss relevance of the work to the solicitation. See VI (a)
	Content	Explain the technical approach and methodology.
	Content	Discuss potential sources of uncertainty
	Content	Present mitigation strategy or alternate approach given obstacles
	Content	Present roles of all team members so its clear what they are doing
	Content	Present a work plan, with milestones, management structure
	Content	Present a data sharing and/or archiving plan here in the text only if it is required by program element.
	Special Content	Provide other special requirements of program element, e.g., special statements for participating scientists, team leads, etc.
References: Third component of proposal		
	Length	No page limit
	Excluded	No references to documents (e.g., unpublished manuscripts) unavailable to reviewers. No links to personal websites.
Biographical sketches/Curriculum Vitaes (CVs): fourth component of proposal		
	Required	One for the PI and each Co-I
	Length restriction	CV for PI - two pages or fewer, unless otherwise specified, such as Early Career Fellowship, which allows three pages
	Length restriction	CVs for Co-Is are limited to one page
	Excluded	CVs for collaborators are not included
Summary of work effort: This is a new fifth section of the proposal. **[Note, location differs from and supersedes that given in Guidebook. [Clarified May 12, 2015]**		
	General	Note this table has been moved from the budget Section. Where names are not known, include the position, such as postdoctoral fellow or technician.
	Required	Names and/or titles of all personnel to perform the proposed effort
	Required	Planned work commitment (e.g., in fractions of a work year) to be funded by NASA
	Required	Planned work commitment (e.g., in fractions of a work year) that will not be funded by NASA, if any. Note: time commitment included here that is not funded by NASA is not considered cost sharing, as defined in 2 CFR § 215.23.
Current and Pending Support: Sixth part of the proposal, not page limited.		
	Required	**Required for the PI. Also required** for all team members who are proposed to perform a significant share (>10 percent) of the proposed work. ~~Where names are not known, include the position, such as "postdoctoral fellow."~~ **[Clarified and corrected on May 12, 2015]**

Table 1 Continued: Checklist for ROSES-2015 Proposals

	Required	For each current project or pending proposal list the level of effort ~~and~~

		~~cost~~ for that one team member (only) per year. ~~Do not list the entire~~ **No** award value**s are required**. **This supersedes the Guidebook for proposers. [Corrected on May 12, 2015]**
	Excluded	Current and Pending for collaborators are not included
	Excluded	Do not self-reference this proposal in the current and pending
Statements of Commitment and Letters of Support, feasibility and Endorsement		
	General	Statements of Commitment by team members have been replaced by an indication of participation via the NSPIRES web interface.
	Statements of Commitment	Statements of Commitment must be included for proposals that were submitted via grants.gov since web confirmation is not possible
	Letter of Endorsement	Foreign Co-Is must include letters of endorsement from their government agency or funding/sponsoring institution in their country
	Letter of Support	A letter of support is required from the owner of any facility or resource that is not under the PI's direct control, acknowledging that the facility or resource is available for the proposed use during the proposed period. See Section 2.3.9 of the *Guidebook for Proposers*
	Letter of feasibility	A letter of feasibility from the NASA Space Station Payload Office must be included with proposals to use ISS.
	Letter of Endorsement	Letters from commercial vendor are required for proposals for investigations using sRLVs as platforms.
	Letter of affirmation	In general, letters of affirmation are not permitted for normal research proposals, but letters from the community may be included only where explicitly allowed, e.g., for C.17 PME and E.2 TWSC.
Budget Justification: The eight part of the proposal, no page limit overall.		
	General	Although there are budgets in the cover pages and at the end of the proposal, please explain in words what is being purchased and why it is reasonable. See the *Guidebook for Proposers*
	Required	Budget Narrative: Give the "basis of estimate" for each proposed component of cost, including direct labor, subcontracts/subawards, consultants, other direct costs (including travel), and facilities and equipment. Quotes need not be provided, but the proposal should indicate that the cost was based upon a quote, prior experience, etc.
	Excluded	Do not include NASA Civil Servant salary or overhead anywhere in the proposal. This is reported elsewhere.
Facilities and Equipment: The ninth part of the proposal**, no page limit**.		
	Length restriction	**As needed** ~~2 pages or fewer~~. **[Corrected, October 2, 2015]**
	Excluded content	Does not add scientific or technical information beyond a description of the facilities and equipment, i.e., don't add here what should be in the page-limited Scientific/technical Section.

Table 1 Continued: Checklist for ROSES-2015 Proposals

Detailed Budget: The tenth and final part of the proposal.	
Required	Detailed budget table for entire proposal, itemizing expenses within major categories and clearly indicating subawards or separately awarded funds to

	government laboratories.
Recommended	Separate detailed budget from each subaward organization.
Excluded	Do not include NASA Civil Servant salary or overhead anywhere in the proposal. This is reported elsewhere.

TABLE 2: SOLICITED RESEARCH PROGRAMS (IN ORDER OF PROPOSAL DUE DATES)

TABLE 3: SOLICITED RESEARCH PROGRAMS (IN ORDER OF APPENDICES A–E)

Table 2 and Table 3 of this NRA are posted as separate documents on the web and can be reached either by following the hypertext links above embedded in the electronic version of this document or by going to http://solicitation.nasaprs.com/ROSES2015 or to http://solicitation.nasaprs.com/open and selecting "NNH15ZDA001N".

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TABLE 2: SOLICITED RESEARCH PROGRAMS (In Order of Proposal Due Date) [1]

Appendix	Program	NOI/Step 1 Due Date [2]	Proposal Due Date
B.6	Heliophysics Living With a Star Science	03/13/2015 (Step 1)	05/01/2015 (Step 2)
A.13	Modeling, Analysis, and Prediction	03/17/2015	05/14/2015
A.10	Surface Water and Ocean Topography Science Team	04/15/2015	05/15/2015
A.19	KORUS-AQ: An International Cooperative Air Quality Field Study in Korea	04/01/2015	05/15/2015
D.2	Astrophysics Data Analysis	03/27/2015	05/15/2015
A.15	IceBridge Observations	N/A	05/18/2015
E.3	Exoplanet Research Program [3] [4]	03/27/2015 (Step 1)	05/22/2015 (Step 2)
A.42	**In-Space Validation of Earth Science Technologies**	**03/27/2015 (Mandatory)**	**05/29/2015**
C.20	**Mars Science Laboratory Participating Scientist Program**	**05/06/2015 (Step 1)**	**06/03/2015 (Step 2)**
C.2	Emerging Worlds [3] [4]	03/31/2015 (Step 1)	06/05/2015 (Step 2)
A.43	**NASA ISRO Synthetic Aperture Radar mission Science Definition Team**	**05/01/2015**	**06/08/2015**
C.6	Solar System Observations [3] [4]	04/10/2015 (Step 1)	06/12/2015 (Step 2)
A.27	GRACE and GRACE-FO Science Team	05/08/15	06/19/2015
C.18	Laboratory Analysis of Returned Samples [3] [4]	04/24/2015 (Step 1)	06/26/2015 (Step 2)
A.8	Physical Oceanography	03/27/2015	06/30/2015
A.23	Precipitation Measurement Missions Science Team	04/30/2015	06/30/2015
D.7	K2 Guest Observer – Cycle 3	**06/02/2015** (Step 1)	**07/01/2015** (Step 2)
C.21	**Citizen science Asteroid Data, Education, and Tools**	**06/15/2015 (Step 1)**	**07/15/2015 (Step 2)**
C.7	**Planetary Data Archiving, Restoration, and Tools**	05/15/2015 (Step 1)	07/17/2015 (Step 2)
C.22	**New Frontiers Homesteader**	**06/05/2015 (Step 1)**	**07/20/2015 (Step 2)**
A.36	Advancing Collaborative Connections for Earth System Science	**05/22/2015**	**07/24/2015**
B.7	Heliophysics Infrastructure and Data Environment Enhancements	05/22/2015 (Step 1)	07/24/2015 (Step 2)
C.5	Exobiology [3] [4]	**05/22/2015 (Step 1)**	**07/24/2015 (Step 2)**
A.14	Cryospheric Science	N/A	**7/29/2015**

A.33	CloudSat and CALIPSO Science Team Recompete	05/26/2015	**07/31/2015**
B.4	Heliophysics Guest Investigators	03/13/2015 (Step 1)	**07/31/2015 (Step 2)**
C.10	**Cassini Data Analysis and Participating Scientists** [3]	06/01/2015 (Step 1)	08/18/2015 (Step 2)
B.3	**Heliophysics Technology and Instrument Development for Science**	**06/26/2015 (Step 1)**	**08/28/2015 (Step 2)**
A.35	New (Early Career) Investigator Program in Earth Science	06/30/2015	08/31/2015
C.15	Planetary Protection Research [4]	06/26/2015 (NOI)	09/04/2015
C.3	Solar System Workings [3] [4]	06/11/2015 (Step 1)	09/10/2015 (Step 2.1)
B.2	Heliophysics Supporting Research	05/**29**/2015 (Step 1)	09/11/2015 (Step 2)
A.25	**Earth Surface and Interior**	**7/16/2015**	**9/16/2015**
C.14	Planetary Science and Technology Through Analog Research [3] [4]	07/24/2015 (Step 1)	09/25/2015 (Step 2)
D.5	Swift Guest Investigator – Cycle 12	N/A	09/25/2015
C.9	Mars Data Analysis [3]	08/28/2015 (Step 1)	10/02/2015 (Step 2)
C.19	**Hayabusa2 Participating Scientist**	**04/01/2015 (Step 1)**	**10/05/2015 (Step 2)**
D.12	**SOFIA Third Generation Science Instrument**	**08/19/2015 (Step 1)**	**10/07/2015 (Step 2)**
D.11	**WFIRST Science Investigation Teams**	**08/17/2015 (mandatory)**	**10/15/2015**
C.8	Lunar Data Analysis [3]	8/28/2015 (Step 1)	10/30/2015 (Step 2)
D.9	Nancy Grace Roman Technology Fellowships	09/04/2015	11/06/2015
C.12	Planetary Instrument Concepts for the Advancement of Solar System Observations [3]	09/14/2015 (Step 1)	11/13/2015 (Step 2)
C.11	Discovery Data Analysis [3]	09/10/2015 (Step 1)	11/20/2015 (Step 2)
A.34	Satellite Calibration Interconsistency Studies	**10/14/2015**	**12/08/2015**
D.10	**NuSTAR Guest Observer - Cycle 2**	**N/A**	**12/11/2015**
A.22	**Science Utilization of the Soil Moisture Active-Passive Mission**	**12/02/2015**	**01/20/2016**
C.4	Habitable Worlds [3] [4]	11/20/2015 (Step 1)	01/22/2016 (Step 2)
D.6	**Fermi Guest Investigator – Cycle 9**	N/A	01/22/2016
C.3	Solar System Workings [3] [4]	06/11/2015 (Step 1)	02/25/2016 (Step 2.2)
A.3	**Ocean Biology and Biogeochemistry**	**01/07/2016**	**03/03/2016**
D.13	**K2 Guest Observer – Cycle 4**	**02/05/2016 (Step 1)**	**03/04/2016 (Step 2)**
A.46	**Health and Air Quality Applied Sciences Team**	**01/14/2016**	**03/11/2016**

A.6	**Biodiversity**	**01/15/2016**	**03/18/2016**
D.3	Astrophysics Research and Analysis	01/22/2016	**03/18/2016**
D.8	Strategic Astrophysics Technology	01/22/2016	**03/18/2016**
A.45	**Earth Science Applications: Socioeconomic Benefits**	**01/22/2016**	**03/24/2016**
A.7	**Carbon Monitoring System**	**01/29/2016**	**03/29/2016**
A.47	**Sustainable Land Imaging-Technology**	**01/22/2016**	**03/30/2016**
A.26	Rapid Response and Novel Research in Earth Science	N/A	Rolling Submissions through 03/31/2016
E.2	Topical Workshops, Symposia, and Conferences	N/A	Rolling submissions through 03/31/2016
C.16	**Fellowships for Early Career Researchers (current fellows) [3]**	N/A	**Rolling submissions through 03/31/2016**
A.48	**Understanding Changes in High Mountain Asia**	**03/07/2016**	**04/15/2016**
A.44	**SERVIR Applied Sciences Team**	**11/16/2015**	**04/29/2016**
A.2	Land Cover / Land Use Change	12/01/2015 (Step 1)	6/01/2016 (Step 2)
C.16	**Fellowships for Early Career Researchers (new applicants) [3]**	See Program of Interest	
C.17	Planetary Major Equipment [4]	See Program of Interest	
A.4	Terrestrial Ecology	Not solicited this year	
A.5	Carbon Cycle Science	Not solicited this year	
A.9	Ocean Salinity Science Team	Not solicited this year	
A.11	Ocean Surface Topography Science Team	Not solicited this year	
A.12	Ocean Vector Winds Science Team	Not solicited this year	
A.16	Upper Atmosphere Research Program and Aura Science Team	Not solicited this year	
A.17	Radiation Sciences Program	Not solicited this year	
A.18	Atmospheric Composition: Modeling and Analysis	Not solicited this year	
A.20	Terrestrial Hydrology	Not solicited this year	
A.21	NASA Energy and Water Cycle Study	Not solicited this year	
A.24	Weather Focus Area	Not solicited this year	
A.28	Space Archaeology	**Not solicited this year**	
A.29	Airborne Instrument Technology Transition	Not solicited this year	
A.30	Earth Science U.S. Participating Investigator	Not solicited this year	
A.31	Interdisciplinary Research in Earth Science	Not solicited this year	
A.32	NASA Data for Operation and Assessment	Not solicited this year	
A.37	Making Earth System Data Records for Use in Research Environments	Not solicited this year	
A.38	Computational Modeling Algorithms and Cyberinfrastructure	Not solicited this year	

A.39	Advanced Information Systems Technology	Not solicited this year	
A.40	Instrument Incubator Program	Not solicited this year	
A.41	Advanced Component Technology	Not solicited this year	
B.5	Heliophysics Grand Challenges Research	Not solicited this year	
C.13	Maturation of Instruments for Solar System Exploration [3]	Not solicited this year	
C.23	**InSight Participating Scientist Program**	**Not solicited this year**	
D.4	Astrophysics Theory	Not solicited this year	
A.1	Earth Science Research Overview	N/A	N/A
B.1	Heliophysics Research Program Overview	N/A	N/A
C.1	Planetary Science Research Program Overview	N/A	N/A
D.1	Astrophysics Research Program Overview	N/A	N/A
E.1	Cross Division Overview	N/A	N/A

Notes:

[1] Amended due dates and new program elements will be indicated with bold red text as ROSES-2015 is amended through the 2015 calendar year.

[2] See Sections IV(b)(vi) and IV(b)(vii) of the *Summary of Solicitation* for a discussion of Notice of Intent (NOI) vs. a Step-1 proposal.

[3] The proposals for program element Fellowships for Early Career Researchers (C.16) may be submitted only in conjunction with program elements Emerging Worlds (Appendix C.2); Solar System Workings (Appendix C.3); Habitable Worlds (Appendix C.4); Exobiology (Appendix C.5); Solar System Observations (Appendix C.6); Lunar Data Analysis (Appendix C.8), Mars Data Analysis (Appendix C.9); Cassini Data Analysis and Participating Scientists (Appendix C.10); Discovery Data Analysis (Appendix C.11), Planetary Instrument Concepts for the Advancement of Solar System Observations (Appendix C.12), Maturation of Instruments for Solar System Exploration (Appendix C.13); Planetary Science and Technology Through Analog Research (Appendix C.14); Laboratory Analysis of Returned Samples (Appendix C.18); and Exoplanet Research Program (Appendix E.3).

[4] The proposals for program element Planetary Major Equipment (C.17) may be submitted only in conjunction with program elements Emerging Worlds (Appendix C.2); Solar System Workings (Appendix C.3); Habitable Worlds (Appendix C.4); Exobiology (Appendix C.5); Solar System Observations (Appendix C.6); Planetary Science and Technology Through Analog Research (Appendix C.14); Planetary Protection Research (Appendix C.15); Laboratory Analysis of Returned Samples (Appendix C.18); and Exoplanet Research Program (Appendix E.3).

ROSES 2015

TABLE 3: SOLICITED RESEARCH PROGRAMS (In Order of Appendices A-E) [1]

Appendix	Program	NOI/Step 1 Due Date [2]	Proposal Due Date
A.1	Earth Science Research Overview	N/A	N/A
A.2	Land Cover / Land Use Change	12/01/2015 (Step 1)	6/01/2016 (Step 2)
A.3	**Ocean Biology and Biogeochemistry**	**01/07/2016**	**03/03/2016**
A.4	Terrestrial Ecology	Not solicited this year	
A.5	Carbon Cycle Science	Not solicited this year	
A.6	**Biodiversity**	**01/15/2016**	**03/18/2016**
A.7	**Carbon Monitoring System**	**01/29/2016**	**03/29/2016**
A.8	Physical Oceanography	03/27/2015	06/30/2015
A.9	Ocean Salinity Science Team	Not solicited this year	
A.10	Surface Water and Ocean Topography Science Team	04/15/2015	05/15/2015
A.11	Ocean Surface Topography Science Team	Not solicited this year	
A.12	Ocean Vector Winds Science Team	Not solicited this year	
A.13	Modeling, Analysis, and Prediction	03/17/2015	05/14/2015
A.14	Cryospheric Science	N/A	**7/29/2015**
A.15	IceBridge Observations	N/A	05/18/2015
A.16	Upper Atmosphere Research Program and Aura Science Team	Not solicited this year	
A.17	Radiation Sciences Program	Not solicited this year	
A.18	Atmospheric Composition: Modeling and Analysis	Not solicited this year	
A.19	KORUS-AQ: An International Cooperative Air Quality Field Study in Korea	04/01/2015	05/15/2015
A.20	Terrestrial Hydrology	Not solicited this year	
A.21	NASA Energy and Water Cycle Study	Not solicited this year	
A.22	**Science Utilization of the Soil Moisture Active-Passive Mission**	**12/02/2015**	**01/20/2016**
A.23	Precipitation Measurement Missions Science Team	04/30/2015	06/30/2015
A.24	Weather Focus Area	Not solicited this year	
A.25	**Earth Surface and Interior**	**7/16/2015**	**9/16/2015**
A.26	Rapid Response and Novel Research in Earth Science	N/A	Rolling Submissions through 03/31/2016
A.27	GRACE and GRACE-FO Science Team	05/08/15	06/19/2015
A.28	Space Archaeology	**Not solicited this year**	
A.29	Airborne Instrument Technology Transition	Not solicited this year	
A.30	Earth Science U.S. Participating Investigator	Not solicited this year	
A.31	Interdisciplinary Research in Earth Science	Not solicited this year	
A.32	NASA Data for Operation and Assessment	Not solicited this year	

A.33	CloudSat and CALIPSO Science Team Recompete	05/26/2015	**07/31/2015**
A.34	Satellite Calibration Interconsistency Studies	**10/14/2015**	**12/08/2015**
A.35	New (Early Career) Investigator Program in Earth Science	06/30/2015	08/31/2015
A.36	Advancing Collaborative Connections for Earth System Science	**05/22/2015**	**07/24/2015**
A.37	Making Earth System Data Records for Use in Research Environments	Not solicited this year	
A.38	Computational Modeling Algorithms and Cyberinfrastructure	Not solicited this year	
A.39	Advanced Information Systems Technology	Not solicited this year	
A.40	Instrument Incubator Program	Not solicited this year	
A.41	Advanced Component Technology	Not solicited this year	
A.42	**In-Space Validation of Earth Science Technologies**	**03/27/2015 (Mandatory)**	**05/29/2015**
A.43	**NASA ISRO Synthetic Aperture Radar mission Science Definition Team**	**05/01/2015**	**06/08/2015**
A.44	**SERVIR Applied Sciences Team**	**11/16/2015**	**04/29/2016**
A.45	**Earth Science Applications: Socioeconomic Benefits**	**01/22/2016**	**03/24/2016**
A.46	**Health and Air Quality Applied Sciences Team**	**01/14/2016**	**03/11/2016**
A.47	**Sustainable Land Imaging-Technology**	**01/22/2016**	**03/30/2016**
A.48	**Understanding Changes in High Mountain Asia**	**03/07/2016**	**04/15/2016**
B.1	Heliophysics Research Program Overview	N/A	N/A
B.2	Heliophysics Supporting Research	05/**29**/2015 (Step 1)	09/11/2015 (Step 2)
B.3	**Heliophysics Technology and Instrument Development for Science**	**06/26/2015 (Step 1)**	**08/28/2015 (Step 2)**
B.4	Heliophysics Guest Investigators	03/13/2015 (Step 1)	**07/31/2015 (Step 2)**
B.5	Heliophysics Grand Challenges Research	Not solicited this year	
B.6	Heliophysics Living With a Star Science	03/13/2015 (Step 1)	05/01/2015 (Step 2)
B.7	Heliophysics Infrastructure and Data Environment Enhancements	05/22/2015 (Step 1)	07/24/2015 (Step 2)
C.1	Planetary Science Research Program Overview	N/A	N/A
C.2	Emerging Worlds [3] [4]	03/31/2015 (Step 1)	06/05/2015 (Step 2)
C.3	Solar System Workings [3] [4]	06/11/2015 (Step 1)	09/10/2015 (Step 2.1) 02/25/2016 (Step 2.2)
C.4	Habitable Worlds [3] [4]	11/20/2015 (Step 1)	01/22/2016 (Step 2)
C.5	Exobiology [3] [4]	**05/22/2015 (Step 1)**	**07/24/2015 (Step 2)**
C.6	Solar System Observations [3] [4]	04/10/2015	06/12/2015

		(Step 1)	(Step 2)
C.7	**Planetary Data Archiving, Restoration, and Tools**	05/15/2015 (Step 1)	07/17/2015 (Step 2)
C.8	Lunar Data Analysis [3]	8/28/2015 (Step 1)	10/30/2015 (Step 2)
C.9	Mars Data Analysis [3]	08/28/2015 (Step 1)	10/02/2015 (Step 2)
C.10	**Cassini Data Analysis and Participating Scientists** [3]	06/01/2015 (Step 1)	08/18/2015 (Step 2)
C.11	Discovery Data Analysis [3]	09/10/2015 (Step 1)	11/20/2015 (Step 2)
C.12	Planetary Instrument Concepts for the Advancement of Solar System Observations [3]	09/14/2015 (Step 1)	11/13/2015 (Step 2)
C.13	Maturation of Instruments for Solar System Exploration [3]	Not solicited this year	
C.14	Planetary Science and Technology Through Analog Research [3] [4]	07/24/2015 (Step 1)	09/25/2015 (Step 2)
C.15	Planetary Protection Research [4]	06/26/2015 (NOI)	09/04/2015
C.16	**Fellowships for Early Career Researchers (new applicants) [3]**	See Program of Interest	
	Fellowships for Early Career Researchers (current fellows) [3]	N/A	**Rolling submissions through 03/31/2016**
C.17	Planetary Major Equipment [4]	See Program of Interest	
C.18	Laboratory Analysis of Returned Samples [3] [4]	04/24/2015 (Step 1)	06/26/2015 (Step 2)
C.19	**Hayabusa2 Participating Scientist**	**04/01**/2015 (Step 1)	**10/05/2015 (Step 2)**
C.20	**Mars Science Laboratory Participating Scientist Program**	**05/06/2015 (Step 1)**	**06/03/2015 (Step 2)**
C.21	**Citizen science Asteroid Data, Education, and Tools**	**06/15/2015 (Step 1)**	**07/15/2015 (Step 2)**
C.22	**New Frontiers Homesteader**	**06/05/2015 (Step 1)**	**07/20/2015 (Step 2)**
C.23	**InSight Participating Scientist Program**	**Not solicited this year**	
D.1	Astrophysics Research Program Overview	N/A	N/A
D.2	Astrophysics Data Analysis	03/27/2015	05/15/2015
D.3	Astrophysics Research and Analysis	01/22/2016	**03/18/2016**
D.4	Astrophysics Theory	Not solicited this year	
D.5	Swift Guest Investigator – Cycle 12	N/A	09/25/2015
D.6	**Fermi Guest Investigator – Cycle 9**	N/A	01/22/2016
D.7	K2 Guest Observer – Cycle 3	**06/02/2015** (Step 1)	**07/01/2015** (Step 2)
D.8	Strategic Astrophysics Technology	01/22/2016	**03/18/2016**
D.9	Nancy Grace Roman Technology Fellowships	09/04/2015	11/06/2015
D.10	**NuSTAR Guest Observer - Cycle 2**	**N/A**	**12/11/2015**

D.11	**WFIRST Science Investigation Teams**	**08/17/2015 (mandatory)**	**10/15/2015**
D.12	**SOFIA Third Generation Science Instrument**	**08/19/2015 (Step 1)**	**10/07/2015 (Step 2)**
D.13	**K2 Guest Observer – Cycle 4**	**02/05/2016 (Step 1)**	**03/04/2016 (Step 2)**
E.1	Cross Division Overview	N/A	N/A
E.2	Topical Workshops, Symposia, and Conferences	N/A	Rolling submissions through 03/31/2016
E.3	Exoplanet Research Program [3] [4]	03/27/2015 (Step 1)	05/22/2015 (Step 2)

Notes:

[1] Amended due dates and new program elements will be indicated with bold red text as ROSES-2015 is amended through the 2015 calendar year.

[2] See Sections IV(b)(vi) and IV(b)(vii) of the *Summary of Solicitation* for a discussion of Notice of Intent (NOI) vs. a Step-1 proposal.

[3] The proposals for program element Fellowships for Early Career Researchers (C.16) may be submitted only in conjunction with program elements Emerging Worlds (Appendix C.2); Solar System Workings (Appendix C.3); Habitable Worlds (Appendix C.4); Exobiology (Appendix C.5); Solar System Observations (Appendix C.6); Lunar Data Analysis (Appendix C.8), Mars Data Analysis (Appendix C.9); Cassini Data Analysis and Participating Scientists (Appendix C.10); Discovery Data Analysis (Appendix C.11), Planetary Instrument Concepts for the Advancement of Solar System Observations (Appendix C.12), Maturation of Instruments for Solar System Exploration (Appendix C.13); Planetary Science and Technology Through Analog Research (Appendix C.14); Laboratory Analysis of Returned Samples (Appendix C.18); and Exoplanet Research Program (Appendix E.3).

[4] The proposals for program element Planetary Major Equipment (C.17) may be submitted only in conjunction with program elements Emerging Worlds (Appendix C.2); Solar System Workings (Appendix C.3); Habitable Worlds (Appendix C.4); Exobiology (Appendix C.5); Solar System Observations (Appendix C.6); Planetary Science and Technology Through Analog Research (Appendix C.14); Planetary Protection Research (Appendix C.15); Laboratory Analysis of Returned Samples (Appendix C.18); and Exoplanet Research Program (Appendix E.3).

APPENDIX A. EARTH SCIENCE RESEARCH PROGRAM

A.1 EARTH SCIENCE RESEARCH OVERVIEW

1. Introduction

NASA's Earth Science Research Program supports research activities that address the Earth system to characterize its properties on a broad range of spatial and temporal scales, to understand the naturally occurring and human-induced processes that drive them, and to improve our capability for predicting its future evolution. The focus of the Earth Science Research Program is the use of space-based measurements to provide information not available by other means. NASA's program is an end-to-end one that starts with the development of observational techniques and the instrument technology needed to implement them; tests them in the laboratory and from an appropriate set of surface-, balloon-, aircraft-, and/or space-based platforms; uses the results to increase basic process knowledge; incorporates results into complex computational models that can be used to more fully characterize the present state and future evolution of the Earth system; and develops partnerships with other national and international organizations that can use the generated information in environmental forecasting and in policy, business, and management decisions.

The scientific documentation underlying the Earth Science Research Program provides a comprehensive background for the science addressing its objectives. The science carried out addresses NASA's Strategic Goal 2.1 to "Advance Earth System Science to meet the challenges of climate and environmental change." (See the most recent *NASA Strategic Plan* (see http://nasascience.nasa.gov/about-us/science-strategy/)). In particular, it addresses the more specific Science Goals (see the *Science Plan for NASA's Science Mission Directorate* (hereafter the *NASA Science Plan*), also available at http://nasascience.nasa.gov/about-us/science-strategy/), which are to:

- Advance the understanding of changes in the Earth's radiation balance, air quality, and the ozone layer that result from changes in atmospheric composition;
- Improve the capability to predict weather and extreme weather events;
- Detect and predict changes in Earth's ecological and chemical cycles, including land cover, biodiversity, and the global carbon cycle;
- Enable better assessment and management of water quality and quantity to accurately predict how the global water cycle evolves in response to climate change;
- Improve the ability to predict climate changes by better understanding the roles and interactions of the oceans, atmosphere, land, and ice;
- Characterize the dynamics of the Earth's surface and interior, improving the capability to assess and respond to natural hazards and extreme events; and
- Further the use of Earth system science research to inform decisions and provide benefits to society.

The most up-to-date description of the Earth Science Research Program may be found in Section 4.2 of the *NASA Science Plan* at http://nasascience.nasa.gov/about-us/science-strategy. A decadal study for the satellite component of NASA's Earth science activities has been carried out by the

National Academy of Sciences (NAS); the report *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* is available at http://www.nap.edu/catalog.php?record_id=11820; more recently, NAS released a midterm assessment of NASA's implementation of the Decadal Survey (http://www.nap.edu/catalog.php?record_id=13405). A description of the most recent plans by the Earth Science Division to implement a series of climate-oriented missions beyond those suggested by the decadal survey (*Responding to the Challenge of Climate and Environmental Change: NASA's Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space*) was released in June 2010, and may be found at http://science.nasa.gov/media/medialibrary/2010/07/01/Climate_Architecture_Final.pdf). An earlier study by the NAS documenting the advances in the study of Earth from space, which draws significantly on NASA-produced results, was also released recently and is available at http://dels.nas.edu/Report/Earth-Observations-from-Space-First/11991.

NASA's Earth Science Research Program is a major contributor to several interagency efforts within the U.S. Government, most notably the U.S. Global Change Research Program (USGCRP, see http://www.globalchange.gov), to which NASA is the major contributor. This program released its strategic plan in 2012, the *National Global Change Research Plan 2012-2021: A Strategic Plan for the U. S. Global Change Research Program* (http://www.globalchange.gov/browse/reports/national-global-change-research-plan-2012%E2%80%932021-strategic-plan-us-global-change). Similarly, there are interagency programs related to Oceans and the Arctic. In particular, the Implementation Plan (http://www.whitehouse.gov//sites/default/files/national_ocean_policy_implementation_plan.pdf) for the National Ocean Policy (http://www.whitehouse.gov/administration/eop/oceans), the Research Plan (http://www.whitehouse.gov/sites/default/files/microsites/ostp/2013_arctic_research_plan.pdf) for the Interagency Arctic Policy Research Council (IARPC, see http://www.nsf.gov/od/opp/arctic/iarpc/start.jsp), and the National Strategy for the Arctic Region (http://www.whitehouse.gov/sites/default/files/docs/nat_arctic_strategy.pdf) with its associated implementation plan (http://www.whitehouse.gov/sites/default/files/docs/implementation_plan_for_the_national_strategy_for_the_arctic_region_-_fi....pdf). In addition, there are several other subgroups of the Committee on the Environment, Natural Resources and Sustainability (CENRS, see http://www.whitehouse.gov/administration/eop/ostp/nstc/committees/cenrs) that serve to provide interagency coordination in areas covered by NASA's Earth Science Research Program. In addition, the NASA Earth Science Research Program has focused bilateral efforts with other Federal agencies on transitioning knowledge and approaches from research to operations, most notably with the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS).

Research is solicited in four major areas for the Earth Science Research Program: research and analysis, satellite missions, applied sciences, and enabling capabilities, with the bulk of the solicited research coming in the first of these. Research and analysis (R&A) emphasizes the development of new scientific knowledge, including the analysis of data from NASA satellite missions and the development and application of complex models that assimilate these science data products and/or use them for improving predictive capabilities. Within the Earth Science

Research Program, the research and analysis activities include those historically coming under R&A, mission science team, interdisciplinary science, and calibration/validation activities. The applied sciences area supports efforts to discover and demonstrate innovative and practical uses of NASA Earth science observations and research through applications projects carried out in partnership with end user organizations (http://AppliedSciences.nasa.gov/). Applied sciences, thus, serves as a bridge between the data, modeling, and knowledge generated by NASA Earth science and the information required by Government agencies, companies, and organizations to improve their products, services, and decision making.

Enabling capabilities include those programmatic elements with sufficient breadth to contribute to a broad range of activities within the Earth Science Research Program and typically involve the development of some kind of capability whose sustained availability is considered to be important for the Program's future. These include focused activities in support of education; data, information, and management; and airborne science, as well as some broadly based technology-related elements (others which are very focused towards a single scientific area of the Earth Science Research Program will be solicited through the research and analysis area).

Most proposals to ROSES will require a data management plan (DMP) or an explanation of why one is not necessary given the nature of the work proposed. Proposers will satisfy this requirement by responding to the compulsory NSPIRES cover page question about the DMP. The kinds of proposals that require a data management plan are described in the NASA Plan for increasing access to results of Federally funded research and in the SARA FAQs for ROSES. Proposals to instrument development programs (Advanced Information Systems Technology, The Instrument Incubator Program, Advanced Component Technology and In-Space Validation of Earth Science Technologies) do not require a DMP. Moreover, select calls, such as Making Earth System data records for Use in Research Environments (MEaSUREs) and Advancing Collaborative Connections for Earth System Science (ACCESS) include data requirements in the text that make redundant the cover page DMP.

2. Earth Science Research and Analysis Focus Areas

The Earth Science R&A activity is built around the creation of new scientific knowledge about the Earth system. The analysis and interpretation of data from NASA's satellites form the heart of the R&A program in the Earth Science Research Program, although a full range of underlying scientific activity needed to establish a rigorous base for the satellite data and their use in computational models, including those for assimilation and forecasting, is also included. The complexity of the Earth system, in which spatial and temporal variability exists on a range of scales, requires that an organized scientific approach be developed for addressing the complex, interdisciplinary problems that exist, taking good care that in doing so there is a recognition of the objective to integrate science across the programmatic elements towards a comprehensive understanding of the Earth system.

In the Earth system, these elements may be built around aspects of the Earth that emphasize the particular attributes that make it stand out among known planetary bodies. These include the presence of carbon-based life; water in multiple, interacting phases; a fluid atmosphere and ocean that redistribute heat over the planetary surface; an oxidizing and protective atmosphere,

albeit one subject to a wide range of fluctuations in its physical properties (especially temperature, moisture, and winds); a solid but dynamically active surface that makes up a significant fraction of the planet's surface; and an external environment driven by a large and varying star whose magnetic field also serves to shield the Earth from the broader astronomical environment. The resulting structure is comprised of six interdisciplinary science Focus Areas:

- Carbon Cycle and Ecosystems,
- Water and Energy Cycle,
- Climate Variability and Change,
- Atmospheric Composition,
- Weather, and
- Earth Surface and Interior.

These Focus Areas form the basis around which R&A activity is solicited for the Earth Science Research Program. Given the interconnectedness of these science Focus Areas, research that crosses individual Focus Areas is also sought, and a number of specific cases of such connectivity will be identified in the specific research opportunities identified below. In particular, several instrument science teams for NASA satellite missions are solicited through this NRA. These can contribute to scientific advances in several areas, and potential investigators may want to look carefully at all such teams for opportunities that may be relevant to them. In addition, there are several cross-cutting elements included within this appendix, most notably one that solicits proposals that address rapid response to significant Earth system events, as well as allowing for work that doesn't easily fit into standard ROSES elements (Rapid Response and Novel Research in Earth Science – Program Element A.26).

Several elements solicited in prior years are not being solicited this year, but have program-specific ROSES-2015 elements for completeness, as well as to provide potential proposers with plans about the anticipated dates of the next solicitation. Elements for which it has not yet been decided whether or not to solicit during the period of applicability of ROSES-2015 are not included in this list, but are included by focus area and/or program component later in Appendix A. Note that not all elements which have been solicited in previous ROSES are included this year; some will reappear in future solicitations at an appropriate time that should allow for smooth transition between the currently funded tasks and those that would come out of the next solicitation.

- Terrestrial Ecology (Element A.4);
- Carbon Cycle Science (Element A.5);
- Carbon Monitoring System (Element A.7);
- Ocean Salinity Science Team (Element A.9);
- Ocean Surface Topography Science Team (Element A.11);
- Ocean Vector Winds Science Team (Element A.12);
- Upper Atmosphere Research/Aura Science Team (Element A.16);
- Radiation Science (Element A.17);
- Atmospheric Composition: Modeling and Analysis (Element A.18)
- Terrestrial Hydrology (Element A.20);

- NASA Energy and Water Cycle Study (Element A.21);
- Weather Focus Area (Element A.24);
- Airborne Instrument Technology Transition (Element A.29);
- U.S. Participating Investigator (Element A.30);
- Interdisciplinary Research in Earth Science (Element A.31);
- NASA Data for Operation and Assessment (Element A.32);
- Making Earth System data records for Use in Research Environments (Element A.37);
- Computational Modeling Algorithms and Cyberinfrastructure (Element A.38);
- Advanced Information Systems Technology (Element A.39);
- Instrument Incubator Program (Element A.40); and
- Advanced Component Technology (Element A.41).

2.1 Carbon Cycle and Ecosystems

The carbon cycle is the basis for the food, fiber, and energy that sustain life on planet Earth. The cycling of carbon dioxide and methane into the atmosphere contributes to the planetary greenhouse effect and global climate. Ecosystems provide a wide variety of essential goods and services to humans and also affect the climate system by exchanging energy, momentum, trace gases, and aerosols with the atmosphere. Earth's carbon cycle and ecosystems are being subjected to human intervention and environmental changes on an unprecedented scale, in both rate and geographical extent. Our ability to ameliorate, adapt to, or benefit from these rapid changes requires fundamental knowledge of the responses of the carbon cycle and terrestrial and marine ecosystems to global change. Also required is an understanding of the implications of these changes for food production, biodiversity, sustainable resource management, and the maintenance of a healthy, productive environment.

The Carbon Cycle and Ecosystems Focus Area addresses: (i) the distribution and cycling of carbon among the active terrestrial, oceanic, and atmospheric reservoirs and (ii) ecosystems as they are affected by human activity, as they change due to their own intrinsic biogeochemical dynamics, and as they respond to climatic variations and, in turn, affect climate. Research activities focus on providing data and information derived from remote sensing systems to answer the following science questions:

- How are global ecosystems changing?
- What changes are occurring in global land cover and land use, and what are their causes?
- How do ecosystems, land cover, and biogeochemical cycles respond to and affect global environmental change?
- What are the consequences of land cover and land use change for human societies and the sustainability of ecosystems?
- What are the consequences of climate change and increased human activities for coastal regions?
- How will carbon cycle dynamics and terrestrial and marine ecosystems change in the future?

Frequent, repeat observations from space, at both moderate and high spatial resolutions, are required to address the heterogeneity of living systems. Complementary airborne and *in situ* observations, intensive field campaigns and related process studies, fundamental research, data and information systems, and modeling are employed to interpret the satellite observations and answer the science questions.

The goal of the Carbon Cycle and Ecosystems Focus Area is to:

- Quantify, understand, and predict changes in Earth's ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity.

Anticipated products and payoffs include:

- Assessments of ecosystem response to climatic and other environmental changes and the effects on food, fiber, biodiversity, primary productivity, and other ecological goods and services;
- Quantitative carbon budgets for key ecosystems along with the identification of sources and sinks of carbon dioxide and other greenhouse gases;
- Documentation and prediction of land cover and land use change, as well as assessments of consequences to society and for resource sustainability;
- Understanding of ecosystem interactions with the atmosphere and hydrosphere leading to comprehensive modeling of the exchange of gases, aerosols, water, and energy among the components of the Earth system; and
- Improved representations of ecosystem and carbon cycling processes within global climate models leading to more credible predictions of climate and other Earth system functions.

Interdisciplinary collaborations with other Earth Science Research Program Focus Areas include:

- Work with the Water and Energy Cycle Focus Area on land-atmosphere exchanges of water and energy and the effects of land cover and land use change on water resources;
- Work with the Atmospheric Composition Focus Area on surface emissions and atmospheric transport of trace gases and aerosols and on measurement of carbon-containing greenhouse gases;
- Work with the Climate Variability and Change and Weather Focus Areas on air-sea CO_2 exchange and to share the observations of climate, weather, ecosystems, and land cover that are needed to drive Earth system models; and
- Coordinate with the Earth Surface and Interior Focus Area to advance and/or exploit radar, lidar, and hyperspectral remote sensing technologies for surface properties.

The ROSES elements most closely directed towards the Carbon Cycle and Ecosystems Focus Area that are or may be soliciting proposals in ROSES-2015 are:

- Land Cover and Land Use Change (Program Element A.2); and
- Ocean Biology and Biogeochemistry (Program Element A.3).

Topics relevant to the Carbon Cycle and Ecosystems Focus Area that are actively or potentially soliciting this fiscal year include the following program elements:

- Biodiversity (Program Element A.6);
- Science Utilization of the Soil Moisture Active-Passive Mission (Element A.22);
- Rapid Response and Novel Research in Earth Science (Element A.26);
- Satellite Calibration Interconsistency Studies (Element A.34);
- New (Early Career) Investigator Program in Earth Science (Element A.35);
- Advancing Collaborative Connections for Earth System Science (Element A.36).

2.2 Climate Variability and Change

Climate change is one of the major themes guiding Earth System Science today. NASA is at the forefront of quantifying forcings and feedbacks of recent and future climate change. Our comprehensive end-to-end program goes from global high-resolution observations to data assimilation and model predictions. Recently, the Climate Variability and Change Focus Area has directed its research toward addressing five specific questions:

- How is global ocean circulation varying on interannual, decadal, and longer time scales?
- What changes are occurring in the mass of the Earth's ice cover?
- How can climate variations induce changes in the global ocean circulation?
- How is global sea level affected by natural variability and human-induced change in the Earth system?
- How can predictions of climate variability and change be improved?

Climate-variability and change research is now not just a global issue, but also a research problem that directly impacts regional to local environments. In fact, local-to-regional anthropogenic-induced changes are having global impacts whose magnitudes are expected to increase in the future. Climate models have moved toward higher and higher spatial resolution as computer resources have improved. During the next decade, climate models are expected to approach the spatial resolution of weather and regional models as more details of Earth System processes are incorporated.

The oceans are a major part of the climate system, and a unique NASA contribution to climate science is the near-global coverage of observations from space of selected ocean properties every two to ten days. Additionally, NASA provides observations of the vast expanses of polar ice, including both ice sheets and sea ice, on the temporal and spatial scales necessary to detect change and sampling of the other critical elements of the climate system that link climate to other Focus Areas, such as cloud distribution, snow cover, surface temperatures, humidity characteristics, etc.

NASA makes substantial investments to characterize and understand the nature and variability of the climate system. As part of those investments, NASA maintains an active research program to utilize data from satellites to both improve our understanding of these components of the Earth system and the interactions between them and to assess how satellite observations can be used to

improve predictive capability. Current capabilities include global measurements of sea-surface topography, ocean-vector winds, ice topography and motion, and mass movements of the Earth's fluid envelope and cryosphere.

Understanding interactions within the climate system also requires strong modeling and analysis efforts. The climate system is dynamic and complex, and modeling is the only way we can effectively integrate the observations and current knowledge of individual components fully to characterize current conditions and underlying mechanisms, as well as to project the future states of the climate system. This modeling requires a concerted effort both to improve the representation of physical, chemical, and biological processes and to incorporate observations into climate models through data assimilation and other techniques. The ultimate objective is to enable a predictive capability of climate change on time scales ranging from seasonal to multidecadal.

The ROSES elements most closely directed towards the Climate Variability and Change Focus Area that are or may be soliciting proposals in ROSES-2015 are:

- Physical Oceanography (Program Element A.8);
- Surface Water and Ocean Topography (SWOT) Science Team (Element A.10);
- Modeling, Analysis, and Prediction (Program Element A.13);
- Cryospheric Science (Program Element A.14);
- IceBridge Observations (Program Element A.15).

Topics relevant to the Climate Variability and Change Focus Area that are actively or potentially soliciting this fiscal year include the following program elements:

- Science Utilization of the Soil Moisture Active-Passive Mission (Element A.22);
- Precipitation Measurement Missions Science Team (Element A.23);
- Rapid Response and Novel Research in Earth Science (Element A.26);
- GRACE and GRACE-FO Science Team (Element A.27);
- Space Archaeology (Element A.28);
- Cloudsat/CALIPSO Science Team (Element A.33);
- Satellite Calibration Interconsistency Studies (Element A.34);
- New (Early Career) Investigator Program in Earth Science (Element A.35);
- Advancing Collaborative Connections for Earth System Science (Element A.36)

2.3 Atmospheric Composition

Atmospheric composition changes affect air quality, weather, climate, and critical constituents, such as ozone and aerosols. Atmospheric exchange links terrestrial and oceanic pools within the carbon cycle and other biogeochemical cycles. Solar radiation affects atmospheric chemistry and is, thus, a critical factor in atmospheric composition. Atmospheric composition is central to Earth system dynamics, since the atmosphere integrates surface emissions globally on time scales from weeks to years and couples several environmental issues. NASA's research for furthering our understanding of atmospheric composition is geared to providing an improved prognostic capability for such issues (e.g., the recovery of stratospheric ozone and its impacts on surface

ultraviolet radiation, the evolution of greenhouse gases and their impacts on climate, and the evolution of aerosols and tropospheric ozone and their impacts on climate and air quality). Toward this end, research within the Atmospheric Composition Focus Area addresses the following science questions:

- How is atmospheric composition changing?
- What trends in atmospheric composition and solar radiation are driving global climate?
- How does atmospheric composition respond to and affect global environmental change?
- What are the effects of global atmospheric composition and climate changes on regional air quality?
- How will future changes in atmospheric composition affect ozone, climate, and global air quality?

NASA expects to provide the necessary monitoring and evaluation tools to assess the effects of climate change on ozone recovery and future atmospheric composition, improved climate forecasts based on our understanding of the forcings of global environmental change, and air quality forecasts that take into account the feedbacks between regional air quality and global climate change. Achievements in these areas via advances in observations, data assimilation, and modeling enable improved predictive capabilities for describing how future changes in atmospheric composition affect ozone, climate, and air quality. Drawing on global observations from space, augmented by airborne, balloon, and ground-based measurements, NASA is uniquely poised to address these issues. This integrated observational strategy is furthered via studies of atmospheric processes using unique suborbital platform-sensor combinations to investigate, for example: (1) the processes responsible for the emission, uptake, transport, and chemical transformation of ozone and precursor molecules associated with its production in the troposphere and its destruction in the stratosphere; and (2) the formation, properties, and transport of aerosols in the Earth's troposphere and stratosphere, as well as aerosol interaction with clouds. NASA's research strategy for atmospheric composition encompasses an end-to-end approach for instrument design, data collection, analysis, interpretation, and prognostic studies.

The ROSES elements most closely directed towards the Atmospheric Composition Focus Area that are or may be soliciting for proposals in ROSES-2015 are:

- Atmospheric Composition: KORUS-AQ: An International Cooperative Air Quality Field Study in Korea (Element A.19)

Topics relevant to the Atmospheric Composition Focus Area are also included in the following program elements that are actively or potentially soliciting this fiscal year include the following program elements:

- Rapid Response and Novel Research in Earth Science (Element A.26);
- Cloudsat/CALIPSO Science Team (Element A.33)
- Satellite Calibration Interconsistency Studies (Element A.34);
- New (Early Career) Investigator Program in Earth Science (Element A.35);
- Advancing Collaborative Connections for Earth System Science (Element A.36)

2.4 Water and Energy Cycle

Earth is a unique, living planet in our Solar System due to the abundance of water and the vigorous cycling and replenishing of that water throughout its global environment. The global water cycle represents the transport and transformation of water within the Earth system, and, as such, distributes fresh water over the Earth's surface. The water cycle operates on a continuum of time and space scales and exchanges large amounts of energy as water undergoes phase changes and is moved from one part of the Earth system to another. Through latent heat release from condensation and sublimation, the water cycle is a major driving agent of global atmospheric circulation. Clouds play a critical role in modulating the flow of energy into and out of the Earth system, while at the same time modulating the continuous supply of solar energy that keeps the water cycle in motion. So while the water cycle delivers the hydrologic consequences of climate changes, the global water cycle is both a consequence of, and influence on, the global energy cycle. The global water and energy cycles are intimately entwined.

The global water and energy cycles maintain a considerable influence upon the global pathways of biogeochemical cycles. The cycling of water and energy and nutrient exchanges among the atmosphere, ocean, and land help determine the Earth's climate and cause much of the climate's natural variability. Natural and human-induced changes to the water and energy cycle have major impacts on industry, agriculture, and other human activities. Increased exposure and density of human settlements in flood plains and coastal regions amplify the potential loss of life, property, and commodities that are at risk from intense precipitation events. Improved monitoring and prediction of the global water and energy cycle enable improved knowledge of the Earth system that must be nurtured to proactively mitigate future adversities. Current and forthcoming projections of such impacts will remain speculative unless fundamental understanding is assimilated into effective global prediction systems and effective decision-support tools applicable to local conditions. Predicting the consequences of global change — whether natural or human induced — and developing useful science-based applications of climate, weather, and hydrologic prediction systems are paramount challenges of NASA's Earth Science Research Program and specifically for its Water and Energy Cycle Focus Area.

Additional information on the Water and Energy Cycle Focus Area can be found at http://nasa-news.org/. Within this Focus Area are the following R&A programs: Precipitation and Atmospheric Dynamics and Terrestrial Hydrology. Also, the Radiation Sciences and Land Cover Land Use Change programs are shared with, respectively, the Atmospheric Composition and Carbon Cycle and Ecosystems Focus Areas. In brief, the Water and Energy Cycle Focus Area seeks to address the topics discussed above by enhancing our understanding of the transfer and storage of water and energy in the Earth system. For the water cycle, the emphasis is on atmospheric and terrestrial stores, including seasonal snow cover. Permanent snow and ice, as well as ocean dynamics, are studied within the Climate Variability and Change Focus Area. The Water and Energy Cycle Focus Area aims to resolve all fluxes of water and the corresponding energy fluxes involved with the water changing phase. High priority is placed on understanding, observing, and modeling clouds and their interaction with energy fluxes, though this is done along with activities of three other Focus Areas (Atmospheric Composition, Climate, and Weather).

In addition to the study of the individual components of the water and energy cycle, this Focus Area places a high priority on integrating these components in a coherent fashion as is pursued by the NASA Energy and Water Cycle Study (NEWS), for which more information can be found at http://nasa-news.org/. NEWS has been established to create a mechanism to export and import information, results, and technology to and from other U.S. agencies and international partners concerned with the study and observation of water and energy cycles.

All of the Focus Area's activities should enhance the community's ability to answer these research questions:

- How are global precipitation, evaporation, and the cycling of water changing?
- What are the effects of clouds and surface hydrologic processes on Earth's climate?
- How are variations in local weather, precipitation, and water resources related to global climate variation?
- What are the consequences of land cover and land use change for human societies and the sustainability of ecosystems?
- How can weather forecast duration and reliability be improved?
- How can prediction of climate variability and change be improved?
- How will water cycle dynamics change in the future?

Pursuit of answers to these questions should lead to research products, such as satellite data and model outputs, that are useful to activities sponsored by the Applied Sciences Program, in particular, the Applications areas of water resources, disasters, and ecological forecasting (see Section 3 for more details on the Applied Sciences Program). Ultimately, Water and Energy Cycle Focus Area-sponsored activities will lead to the fulfillment of its goal: "Models capable of predicting the water cycle, including floods and droughts, down to tens of kilometers resolution."

The ROSES elements most closely directed towards the Water and Energy Cycle Focus Area that are or may be soliciting for proposals in ROSES-2015 are:

- Science Utilization of the Soil Moisture Active-Passive Mission (Element A.22).

Topics relevant to the Water and Energy Cycle Focus Area are included in the following program elements that are actively or potentially soliciting this fiscal year include the following program elements:

- Surface Water and Ocean Topography (SWOT) Science Team (Element A.10);
- Precipitation Measurement Missions Science Team (Element A.23);
- Rapid Response and Novel Research in Earth Science (Element A.26);
- GRACE and GRACE-FO Science Team (Element A.27);
- Cloudsat/CALIPSO Science Team (Element A.33)
- Satellite Calibration Interconsistency Studies (Element A.34);
- New (Early Career) Investigator Program in Earth Science (Element A.35);
- Advancing Collaborative Connections for Earth System Science (Element A.36)

2.5 Weather

The Weather Focus Area represents the cooperation among NASA programs for Atmospheric Dynamics, Weather Forecast Improvement, and Ocean and Land Remote Sensing. It has strong ties to other Focus Areas, especially Climate Variability and Change and Water and Energy Cycle, and it has a supporting role in Carbon Cycle and Ecosystems and the Atmospheric Composition Focus Areas.

The Weather Focus Area is primarily designed to apply NASA scientific remote sensing expertise to the problem of obtaining accurate and globally distributed measurements of the atmosphere and the assimilation of these measurements into research and operational weather forecast models in order to improve and extend U.S. and global weather prediction. This Focus Area is implemented in coordination with other U.S. agencies' programs and it is guided by the question from the 2003 Earth Science Enterprise Strategy:

- How can weather forecast duration and reliability be improved?

NASA sponsored research continues to gain new insight into weather and extreme-weather events by the utilization of data obtained from a variety of NASA- and partner satellite platforms and hurricane field experiments. Major numerical weather prediction (NWP) centers both outside (European Centre for Medium Range Weather Forecasts (ECMWF) and in the U.S. – NOAA/National Centers for Environmental Prediction (NCEP), NASA Global Modeling and Assimilation Office (GMAO), and the U.S. Navy – have shown notable improvements from the assimilation of Atmospheric Infrared Sounder (AIRS) data into their operational forecast systems.

An extra benefit of AIRS data assimilation at NWP centers is its use in establishing readiness to assimilate data from other current and future operational instruments, as has been demonstrated for the Crosstrack Infrared Sounder (CrIS) l on the Suomi National Polar-orbiting Partnership (NPP) satellite launched in October 2011.

Through collaborations in the Joint Center for Satellite Data Assimilation (JCSDA) (http://www.jcsda.noaa.gov/), observations from Suomi-NPP were assimilated into the operational weather forecast systems in a record seven months after the satellite launch. Observation impact analyses conducted with NASA Goddard Earth Observing System model, version 5 (GEOS-5) in the NASA Global Modeling and Assimilation Office, showed that, in concert with other observations, the Advanced Technology Microwave Sounder (ATMS) makes a significant impact on a global integrated forecast metric. Preparatory work and channel selection for the assimilation of the CrIS data and tests of the impact of that sensor have been completed. The preparations involved modifications to the Community Radiative Transfer model, passive monitoring of systematic and random errors in the CrIS data products, observation minus forecast residuals, and finally preoperational data assimilation/forecast experiments.

The NASA Short-term Prediction Research and Transition (SPoRT) (http://weather.msfc.nasa.gov/sport/) program is an end-to-end research-to-operations (R2O)

activity focused on improving short-term weather forecasts through the use of unique high-resolution, multispectral observations from NASA and NOAA satellites, nowcasting tools, and advanced modeling and data assimilation techniques. The SPoRT program has established a successful R2O paradigm in which the end-users (mainly forecasters at NOAA/NWS forecast offices and National Centers) are involved in the entire process. SPoRT also partners with universities and other Government agencies to develop new products that are transitioned to applicable end user decision support systems. SPoRT has recently succeeded in broadening its activities to other National Weather Service (NWS) Regions and its active participation in NOAA Proving Ground activities and Testbeds.

NASA periodically provides opportunities for participation in the JCSDA and SPoRT programs. The most recent such activity was ROSES 13 element A.33 (NASA Data for Operation and Assessment (http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={649CE75A-9095-4146-CD72-2427D2071D10}&path=closedPast).

NASA also has a long history of conducting airborne field campaigns in support of hurricane research (http://airbornescience.nsstc.nasa.gov/field/). Most recently, the Hurricane and Severe Storm Sentinel (HS3) Mission, a five-year Earth Venture Class Suborbital mission that was awarded in 2010, has been obtaining data from its base at the Wallops Flight Facility (WFF) on the coastline of Virginia during the hurricane seasons of 2012-2014 (https://espo.nasa.gov/missions/hs3/). This campaign uses two Global Hawk (GH) unmanned aircraft systems (UAS) with distinct payloads to address both over-storm and near-storm environmental issues. The HS3 Mission is designed to investigate some basic questions regarding changes in hurricane intensity:

1. What impact does the large-scale environment, particularly the Saharan Air Layer (SAL), have on intensity change?
2. What is the role of storm internal processes such as deep convective towers?
3. To what extent are these intensification processes predictable?

In June 2012, NASA selected the Cyclone Global Navigation Satellite System (CYGNSS) satellite mission under its Earth Venture program. CYGNSS data will enable scientists, for the first time, to probe key air-sea interaction processes that take place near the inner core of the storms, which are rapidly changing and play large roles in the genesis and intensification of hurricanes. The CYGNSS Mission satellites are expected to launch in 2016. While this is a Principal-Investigator led mission, NASA provided an opportunity for community members not part of the original proposal to be involved with the mission in ROSES13 (Appendix A.22 – Weather; see http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={6E74C972-BD4C-2286-AF21-D6B43CF3BA4C}&path=closedPast).

The ROSES elements most closely directed towards the Weather Focus Area that are or may be soliciting for proposals in ROSES-2015 are:

- Precipitation Measurement Missions Science Team (Appendix A.23).

Topics relevant to the Weather Focus Area are included in the following program elements that are actively or potentially soliciting this fiscal year include the following program elements:

- Rapid Response and Novel Research in Earth Science (Element A.26);
- Cloudsat/CALIPSO Science Team (Element A.33)
- Satellite Calibration Interconsistency Studies (Element A.34);
- New (Early Career) Investigator Program in Earth Science (Element A.35);
- Advancing Collaborative Connections for Earth System Science (Element A.36).

2.6 Earth Surface and Interior

The Earth Surface and Interior Focus Area promotes the development and application of remote sensing to address the questions:

- How is the Earth's surface being transformed by naturally occurring tectonic and climatic processes?
- What are the motions of the Earth's interior, and how do they directly impact our environment?
- How can our knowledge of Earth surface change be used to predict and mitigate natural hazards?
- How is global sea level affected by natural variability and human induced change in the Earth System?

The overarching goal of the Focus Area is to assess, mitigate, and forecast natural hazards that affect society, including such phenomena as earthquakes, landslides, coastal and interior erosion, floods, and volcanic eruptions. The path to prediction includes comprehensively recording and understanding the variability of surface changes controlled by two types of forces: external forces, such as climate, and internal forces that are in turn driven by the dynamics of the Earth's interior. In order to develop a predictive capability, these observations of the Earth's transformation must be modeled, interpreted, and understood. Space-based remote sensing is vital to forecasting in the solid Earth sciences, providing a truly comprehensive perspective for monitoring the entire solid Earth system.

Modeling, calibration, and validation are essential components in the development of accurate forecasting capabilities. The Earth Surface and Interior Focus Area views natural laboratories as a critical component for the validation and verification of remote sensing algorithms. NASA joins with the National Science Foundation (NSF) and U.S. Geologic Survey (USGS) in support of the EarthScope initiative to apply modern observational, analytical, and telecommunications technologies to investigate the structure and evolution of the North American continent and the physical processes controlling Earthquakes and volcanic eruptions.

Among the many activities carried out by the Earth Surface and Interior Focus Area are the following:

- Geodetic and thermal imaging of the precise metrology of Earth's surface and its changes through lidar, radar constellations, and optical arrays, coupled with geopotential field measurements to understand the dynamics of the Earth's surface and interior;
- Development of a stable terrestrial reference frame, highly precise realization of topography and topographic change, and understanding of changes in the Earth's angular momentum and gravity fields, which can be applied to issues such as sea-level change, polar mass balance, and land subsidence;
- Use of gravitational and magnetic observables for studying the inner dynamics of the Earth, as well as for studies of how the ionosphere responds to changes in the Earth's surface; and
- Improved predictions of earthquakes and volcanic eruptions through the use of a broad range of Earth surface remote sensing and space geodesy approaches.

The ROSES elements most closely directed towards the Earth Surface and Interior Focus Area that are or may be soliciting for proposals in ROSES-2015 are:

- Earth Surface and Interior (Element A.25)
- Space Archaeology (Element A.28)

Topics relevant to the Earth Surface and Interior Focus Area are included in the following program elements:

- Rapid Response and Novel Research in Earth Science (Element A.26);
- Satellite Calibration Interconsistency Studies (Element A.34);
- New (Early Career) Investigator Program in Earth Science (Element A.35);
- Advancing Collaborative Connections for Earth System Science (Element A.36).

2.7 Cross-Cutting and Interdisciplinary

There are several cross-cutting and interdisciplinary elements in ROSES-2015, all of which have been identified as related elements to specific research focus areas in Sections 2.1 through 2.6 (and also briefly summarized in the overview to Section 2). These elements, all of which are being actively solicited in ROSES-2015 or are being evaluated for possible solicitation, are:

- Rapid Response and Novel Research in Earth Science (Element A.26) – This solicitation allows for two types of proposals not normally solicited through ROSES – (a) immediate research activity to take advantage of a target of opportunity due to an unforeseen event in the Earth system, and (b) exceptionally novel and innovative ideas to advance Earth remote sensing that do not fit within ESD's current slate of solicitations and or programs;
- GRACE and GRACE-FO Science Team (Element A.27) - This ROSES element seeks proposals that will advance the development of new methods, algorithms, and models for the exploitation of gravity field observations to be made by GRACE, GRACE-Follow on (FO), and future space based gravity field missions for the broad spectrum of Earth system science challenges. This solicitation also seeks the development of techniques and algorithms capable of bridging gravity field observation across different gravity missions.

- Space Archaeology (Element A.28) - This potential ROSES element will, if actively solicited this year, allow for proposals to use the unique vantage point of space to improve our understanding of past human settlement patterns and the relationships between the natural environment and cultural adaptations as functions of time and space. Cloudsat/CALIPSO Science Team (Element A.33) – This ROSES element allows for proposals to enhance the state of atmospheric and climate science through the substantive utilization of CloudSat and CALIPSO data products. These can be taken alone, but preferably will be used in conjunction with data from other satellites (e.g., others in the A-Train), suborbital campaigns, ground-based networks, and/or model-produced results. The inventive combination of CloudSat and CALIPSO data with other sensors (such as other A-Train sensors or the CATS lidar on ISS) is encouraged.
- Satellite Calibration Interconsistency Studies (Element A.34) – This ROSES element provides an opportunity for the research community to participate in the quantitative comparison of multiple satellite data products to facilitate the development of multi-instrument/multi-platform data sets involving satellites from multiple providers. Proposals responsive to this call MUST address interconsistency issues of two or more satellites, at least one of which must be one currently supported through NASA's Earth Science Program, and at least one of which must be supported by some other organization (U.S. or foreign).

3. Applied Sciences

The Applied Sciences Program supports efforts to discover and demonstrate innovative and practical uses of NASA Earth science data, knowledge, and technology. The program (http://AppliedSciences.NASA.gov/) develops applications knowledge and understanding of how Earth science can be applied to serve society, increasing the benefits of the nation's investments in NASA Earth science. The Program funds applied science research and applications projects to enable near-term uses of Earth science, transition applied knowledge to public and private organizations, and integrate Earth science and satellite observations as inputs to organizations' decision-making and services. The projects are carried out in partnership with end user organizations. The Program, thus, serves as a bridge between the data and knowledge generated by NASA Earth science and the information needs and decision making of Government agencies, companies, regional associations, international organizations, not-for-profit organizations, and others.

The Program's applications themes align with the U.S. Group on Earth Observations (USGEO) Societal Benefit Areas, with current emphasis on Water Resources, Health and Air Quality, Disasters, Weather, and Ecological Forecasting. Applied Sciences projects leverage products, knowledge, and outcomes of Research and Analysis activities described in Section 2.

Applied Sciences plans to solicit activities in ROSES-2015, and the final text will be released as an amendment(s) to ROSES. In addition, topics relevant to the Applied Sciences Program that are actively or potentially soliciting this fiscal year include the following program elements:

- Precipitation Measurements Missions Science Team (Element A.23);
- Earth Surface and Interior (Element A.25);

- GRACE and GRACE-FO Science Team (Element A.27);
- Space Archaeology (Element A.28);
- Cloudsat/CALIPSO Science Team (Element A.33);
- New (Early Career) Investigator Program in Earth Science (Element A.35);
- Advancing Collaborative Connections for Earth System Science (Element A.36).

4. Enabling Capability

Enabling capabilities include those programmatic elements that are of sufficient breadth that they contribute to a broad range of activities within the Earth Science Research Program. They typically involve the development of some kind of capability whose sustained availability is considered to be important for the Earth Science Research Program's future. These include focused activities in support of education; data, information, and management; and airborne science, as well as some broadly based technology-related elements (others which are very focused towards a single scientific area of the Earth Science Research Program will be solicited through the research and analysis area).

4.1 Education

The Earth Science Research Program also recognizes its essential role in NASA's mission to inspire the scientists and engineers of tomorrow. The Earth system science concept pioneered by NASA is changing not only how science research is conducted, but also the way Earth and space science education is taught at elementary through postgraduate levels, as well as the way space exploration is presented to the public by the media and informal learning communities.

In early 2015, SMD announced – through the release of a Science Education Cooperative Agreement Notice – an opportunity for the submission of proposals to collaborate with SMD in the execution of its science education efforts. The desired outcome of this CAN is to increase the overall coherence of the SMD science education program leading to more effective, sustainable, and efficient utilization of SMD science discoveries and learning experiences to meet overall SMD science education objectives. Fundamental to achieving this outcome is to enable NASA scientists and engineers to engage more effectively with learners of all ages. In addition, SMD is moving away from mission-by-mission products and services and towards aggregating efforts into science-based disciplines aligned with SMD Divisions.

While the NASA science education efforts embedded in SMD missions undergo the transition in 2015, the Earth Science Research Program will continue its management of the Global Learning and Observations to Benefit the Environment (GLOBE) Program and oversight of the GLOBE Implementation Office that is responsible for the coordination of the worldwide community in relation to GLOBE science, education, evaluation, communication, and other common functions.

4.2 Graduate and Early-Career Research

With a focus on continued workforce enrichment, the Earth Science component of the NASA Earth and Space Science Fellowship (NESSF) program, which supports the training of graduate students in Earth system science and/or remote sensing, is solicited outside of ROSES with new

applications due February 1 of each year (NESSF is posted at http://nspires.nasaprs.com/ in November). The New (Early Career) Investigator Program in Earth Science (Appendix A.35), which is directed towards scientists and/or engineers within five years of their receipt of a Ph.D. degree, is solicited every two years, and is included in ROSES-2015.

4.3 Data and Information Management

NASA's space observation capabilities are a central part of the Agency's contribution to Earth system science, along with the science information systems that compile and organize observations and related data for research purposes. The Earth Science Research Program has established a number of strategic principles for the development and deployment of its observing and information systems, recognizing the importance of providing active and informed stewardship for the large volumes of data that are returned to Earth every day. The broad range of uses to which the data are put and the large and diverse user community require multiple temporal and spatial scales, emphasize the need for having a range of data products, and place stringent requirements on NASA for its data processing, archival, and data dissemination activities. These products and services will be variously useful to multiple classes of users, from sophisticated scientific users to other Government and private sector entities that use NASA's information for policy and resource management decisions and including scientifically attentive members of the public who utilize data and information for general information and recreation.

Two program elements have been solicited periodically by the Data and Information Management programs of the Earth Science Division – The Advancing Collaborative Connections for Earth System Science (ACCESS) and the Making Earth System Data Records for Use in Research Environments (MEaSUREs). In ROSES 2015, only the ACCESS program (Appendix A. 36) is being solicited.

Unless otherwise specified, any data proposed to be analyzed in response to Appendix A solicitations from any source, including NASA and other satellite data, ancillary data, and data from commercial sources, must use publicly available data, in the sense that they are openly accessible. Commercial data need not be free, but it must be purchasable by all potential investigators. Proposals that utilize any data that is not, or not yet, publicly available will *not* be considered unless permitted by the call for proposals or associated Frequently Asked Questions. Please read the individual appendices and associated amendments to ROSES carefully and contact the program officers if you have any questions regarding whether a restricted dataset is permissible for a given call.

4.4 High-End Computing, Networking, and Storage

High-end computing, networking, and storage are critical enabling capabilities for Earth system science. Satellite observations must be converted into scientific data products through retrieval and/or data assimilation processes. Long-term data sets must be synthesized together and become a physically consistent climate-research quality data set through reanalysis. These data products, in turn, provide initial and boundary conditions, validation and verification references, and internal and external constraints to the models that describe the behavior of the Earth system.

None of the above will be possible without advanced techniques in high-end computing, networking, and storage.

SMD recognizes the need of such an enabling capability and maintains the high-end computing, networking, and storage within its programs. Computing resources are provided through various program elements. Proposers to this NRA must follow the instructions in Section I(d) of the *Summary of Solicitation* of this NRA to request computing resources.

NASA also supports computational science research and development, including parallelization of codes to an advanced computing architecture for the advancement of Earth system modeling and data assimilation.

In ROSES-2015 no program elements specifically targeted towards High End Computing, Networking, and Storage will be solicited. A relevant ROSES element, Computational Modeling Algorithms and Cyberinfrastructure, was last solicited in ROSES-2013 (see Appendix A.38). This element provides research opportunities for new or improved computational modeling algorithms; the exploitation of new computing, storage, and networking architectures; or the development of programming and analysis environments relevant to NASA's modeling and data assimilation systems.

4.5 NASA Earth Exchange

For large-scale global high resolution Earth science data analysis and modeling projects, especially in areas of land surface hydrology, land cover, land use, carbon management, and terrestrial ecosystems, NASA encourages using the new NASA Earth Exchange (NEX) collaboration facility. The NEX facility includes a state-of-the-art Earth system modeling and data analytics system for the use of remote sensing data from NASA and other agencies. It is supported by a world-class supercomputing and data storage system. Much of the global Landsat, MODIS, AVHRR and related data have been staged online for easy access. NEX (http://nex.nasa.gov) represents a scientific collaboration platform to deliver a complete work environment in which users can explore and analyze large Earth science data sets, run modeling codes, collaborate on new or existing projects, and share results.

Since it is a unique platform for large-scale data analyses that cannot be easily accommodated by a single Principal Investigator (PI) or small research group-based data analysis system, PIs who require the use of such a system are encouraged to register on the NEX Website at https://nex.nasa.gov/nex/auth/register/. Proposals should include a section that justifies the need for using NEX, specifies the data storage and processing needs, and includes a data management plan. The resource availability will be considered during the proposal review and selection process.

Proposals that involve the use of NEX must be submitted to the appropriate ROSES program element depending on the science addressed by the proposed investigation. Additional constraints and requirements for proposals to use NEX are available at https://nex.nasa.gov/nex/resource_updates.

4.6 Airborne Science

The Earth Science Research Program airborne science program provides access to airborne platforms that can be used to obtain measurements of the Earth. Airborne platforms may be used to test new measurement approaches, collect detailed *in situ* and remote-sensing observations that are needed to better document and test models of Earth system processes, and/or provide calibration/validation information for satellites. Airborne platforms can also be an important part of training the next generation of scientists because of the fact that students can be engaged in all aspects of science, from sensor development, through utilization, to completing analysis of data obtained.

Aircraft have proven to be of significant value in Earth system science research, particularly for investigation into atmospheric processes. NASA makes use of several existing aircraft through an annual Call Letter process, most notably the NASA-owned DC-8, G-III, ER-2, P-3B, and Global Hawk, as well as several independently owned aircraft, including, but not limited to, those operated by other Federal agencies. By working with the Aeronautics Mission Directorate of NASA, SMD hopes to pioneer new types of airborne missions that capitalize on NASA's unique expertise in platforms, sensors, and aeronautical operations.

The FY 2016 Call Letter for Flight Requests supporting approved investigations is expected to be released in April 2015. Proposals that require the acquisition of new airborne data may be submitted in response to other active ROSES elements unless otherwise specified in the element. In any such cases, proposers are encouraged to contact the program manager indicated prior to submitting such proposals.

The NASA Headquarters science concurrence is provided by the manager of the NASA Research Program under which the grant or contract is issued. User fees are paid by the investigator's funding source’s research program or directly from the investigator's grant funds.

Any airborne science experiment using NASA assets, personnel, instruments, or funds, must be in compliance with NASA Policy Directive 7900 and NASA Procedural Requirement Series 7900. It is NASA policy that when utilizing other than NASA aircraft, including foreign owned or leased aircraft, those aircraft are subject to the same compliance requirements.

4.7 Technology

Advanced technology plays a major role in enabling Earth research and applications. The Earth Science Technology Program (ESTP) enables previously infeasible science investigations, improves existing measurement capabilities, and reduces the cost, risk, and/or development times for Earth science instruments.

As the implementer of the ESTP, the Earth Science Technology Office (ESTO) performs strategic technology planning and manages the development of a range of advanced technologies to enable new science observations or reduce the cost of current observations. ESTO employs an open, flexible, science-driven strategy that relies on competitive solicitations and peer-review to produce a portfolio of cutting-edge technologies for NASA Earth science endeavors. This is done

through:

- Planning investments by careful analyses of science requirements
- Selecting and funding technologies through competitive solicitations and partnership opportunities
- Actively managing the progress of funded projects
- Facilitating the infusion of mature technologies into science measurements

Needs for advanced technology development are based on Earth science measurement and system requirements articulated in chapter 4 of the *Science Plan for NASA's Science Mission Directorate* (http://nasascience.nasa.gov/about-us/science-strategy), the 2010 NASA plan for climate-centric observations: *Responding to the Challenge of Climate and Environmental Change: NASA's Plan for a Climate-Centric Architecture for Earth Observations from Space* (http://science.nasa.gov/media/medialibrary/2010/07/01/Climate_Architecture_Final.pdf), and the 2007 *Earth Science Decadal Survey: Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* by the National Research Council (NRC) of the National Academies (http://www.nap.edu/catalog.php?record_id=11820).

The Earth Science Technology Office (http://esto.nasa.gov/) maintains several program lines through which technology investments are regularly competed through ROSES, and that cover a range of technology readiness levels (TRLs). Currently, only the In Space Validation of Earth Science Technologies (InVEST) program (Element A.42) will be solicited in ROSES-2015:

- InVEST (Element A.42): The In-Space Validation of Earth Science Technologies program provides a path for some new technologies to be validated in space prior to use in science mission.

Other ESTO programs that are periodically solicited are NOT being solicited in ROSES 2015:

- AIST (Element A.39): The Advanced Information Systems Technology program advances information systems that are used to process, archive, access, visualize, and communicate science data;
- IIP (Element A.40): The Instrument Incubator Program funds technology development that leads directly to new Earth observing instruments, sensors, and systems. From concept through field demonstrations and infusion, IIP developments yield smaller, less resource intensive, and easier-to-build flight instruments; and
- ACT (Element A.41): The Advanced Component Technology program develops a broad array of components and subsystems for instruments and observing systems.

A.2 LAND-COVER/LAND-USE CHANGE (LCLUC)

NOTICE: January 13, 2016. NASA has removed the requirement (towards the bottom of Section 2.3) that Step-2 proposals discuss changes made in response to NASA's response to the Step-1 proposals. NASA will not provide panel evaluations to those invited to submit a Step-2 proposal.

This program element uses a binding two-step proposal process (see Section 2.3), in which only those who are invited may submit a Step-2 proposal.

1. The LCLUC Program

The LCLUC program is developing interdisciplinary approaches combining aspects of physical, social, and economic sciences, with a high level of societal relevance, using remote sensing tools, methods, and data. One of its stated goals is to develop the capability for periodic satellite-based inventories of land cover and monitoring and characterizing land-cover and land-use change. Additional information on the NASA LCLUC program can be found at http://lcluc.hq.nasa.gov or contact Dr. Garik Gutman, the NASA Land-Cover/Land-Use Change Program Manager, see Section 3, below.

1.1 The Scope of the Current Solicitation

The current solicitation consists of two components:

A) LCLUC in rural and urban areas in South Asia. - South Asia is experiencing rapid land transformation, driven by food security, industrialization and urbanization. The population of the region is expected to rise from 1.6 billion to 2.3 billion by 2050. Feeding the increased population will be a significant challenge. South Asia currently has 14% of global cropland and 34% of global irrigated lands. Increasing demand for land and increased agricultural production is leading to land cover and land use change. Changes in the supply and demand for agricultural products are leading to changes in agricultural practices. For example, over recent years, the changes in the land-use pattern in the coastal belt of southern India have been creating considerable negative effects on the ecology and society. For example, almost half of paddy fields were converted for construction of buildings or for planting other crops, which has affected ground water sources. At the same time, land speculation has taken farmers off the land and reduced agricultural production. Rapid urban expansion in South Asia has presented a significant land-cover change over the last few decades, as the population becomes increasingly urban. 28% of South Asian population currently lives in urban areas and this is projected to grow to 55% by 2030. India's loss of agricultural land to urban growth has reached 0.7-1 million hectares in this Century and the amount of agriculture land converted has been steadily increasing, with implications for national food security. These significant types of land-cover change can be quantified and characterized using different types of satellite-based remote sensing.

This solicitation is focused on improving the detection and monitoring of, explaining and attributing LCLUC changes in urban and rural areas to their primary causes, and examining the implications of the changes in terms of their impacts, for example, on the vulnerability of the associated land use or social systems and their adaptability to a changing climate. The South Asia geographic region of interest for this solicitation extends from Pakistan in the west to Myanmar in the east and from the Indian Ocean in the south to Nepal in the north. The LCLUC Program is considering a regional science initiative in South Asia and successful proposals will provide a foundation for this initiative - (http://lcluc.umd.edu/Documents/ScienceTeamMtg/2014APR/Presentations/23_Program_SARI_RN.pdf.)

For regional proposals on South Asia, the LCLUC program strongly encourages the participation of regional science collaborators with experience and insight on the topic of the proposal. It is intended that such collaboration will strengthen the research with local knowledge. Collaboration will need to be developed following the guidelines provided below (Section 1.2.3) and with the appropriate letters of support at Step 2.

B) Synthesis of LCLUC studies. - With the growth in land-cover and land-use research around the globe in recent years and the proliferation of case studies, the LCLUC program has embarked on the development of synthesis studies. Synthesis is an essential component of scientific research, which integrates and in some cases augments information from previous studies. Synthesis requires developing a new understanding and conceptual framework. This process should enhance the conceptual underpinning of LCLUC science and summarize the state-of-the-art knowledge to advance our understanding of some aspect of the processes, drivers, or impacts of changes in land-cover and land-use. The way to accomplish this includes, but is not limited to, compilation of available relevant datasets and comparative research analysis, data integration and model development, and articulating and publishing a refined or a new conceptual framework for an aspect of LCLUC research. Synthesis can be useful for identifying gaps in data and research and proposing ways to fill these gaps, as well as opening new research areas. The goal is to generate critical syntheses that will produce new, emergent insights that are more than the sum of their individual parts (e.g., individual research projects or a suite of publications). The focus would be on integration and synthesis of existing results rather than development of new data, models, or studies. For a Synthesis proposal to be competitive, it must include a social or economic sciences component, such as the use of socioeconomic data or a socioeconomic model, as an integral part of the study, preferably based on available data or data being collected by an ongoing study funded by another agency. Studies could involve small synthesis teams or one to two scientists and should include at least one community workshop, for example, using workshops funded through Program Element E.2, TWSC to support broader community participation. Note that TWSC solicits proposals for scientific meetings, so the LCLUC proposal should not include this in its budget, but the intention to propose to the TWSC element should be mentioned.

1.2 Principles of the LCLUC program to be reflected in proposals

1.2.1 *Social and economic sciences in the NASA LCLUC program*

The NASA LCLUC program is aimed at using satellite observations to improve our understanding of land-cover and land-use change as an important component of global and climate change. The LCLUC program includes studies that quantify land-cover and land-use changes; examine their impact on the environment, climate, and society; or model future scenarios of land-cover and land-use change and its various impacts and feedbacks. Humans play an important role in modifying land cover and are instrumental in land-use change. To understand the process of land-use change it is, therefore, important to address its human dimensions.

Social and economic science research plays an important role in the NASA LCLUC program and includes analyses of the impacts of changes in human behavior at various levels on land use, studies of the resultant impacts of land-use change on society, or how the social and economic aspects of land-use systems adapt to climate change.

The LCLUC program evaluates a proposal's responsiveness to the above aspects in terms of a meaningful integration of social and economic science theories, perspectives, methods, and data (quantitative and/or qualitative) with innovative analyses of land system dynamics in the proposed research. In this context, simple treatments of human dimensions, such as mere correlations of socioeconomic variables in lieu of rich empirical analyses linked to theorized social dynamics, or summary descriptions of potential societal or policy benefits of the proposed study without demonstrable linkages to the same, are not considered adequately responsive to the socio-economic aspect of the program. Successful proposals will fully integrate social and economic sciences into the research questions, data used, and analytical approaches in order to couple remote sensing observations of land-cover with research on the human dimensions of land-use change.

1.2.2 *Remote Sensing Component*

The NASA LCLUC program will only support proposals with a strong remote sensing component. The use of observations and data products from U.S. and non-U.S. Earth-observing satellites, especially those of NASA, is a requirement for each proposal. The use of commercial satellites with fine spatial resolution is also encouraged (see, e.g., http://www.digitalglobe.com/).

To get the most out of current remote sensing capabilities, we encourage data fusion from various sources with different spatial and/or temporal resolution and different parts of the solar and microwave spectra. Proposals that undertake fusion of data from various sources of Landsat- type data (e.g., Landsat, Indian Remote-Sensing Satellite (IRS), China–Brazil Earth Resources Satellite (CBERS), Satellite Pour l'Observation de la Terre (SPOT) Sentinel-2), with coarser or higher resolution data, as well as radar observations, are welcome. This approach may provide better temporal-spatial coverage and contribute to a Land Surface Imaging constellation paradigm for future systems

(http://www.ceos.org/index.php?option=com_content&view=category&layout=blog&id=47&Ite mid=38). Special attention should be given to the dissemination of data and products associated with the proposed research. We also encourage using NASA's new collaboration facility for the NASA Earth science community: NASA Earth Exchange (NEX) web portal. This portal includes a state-of-the-art supercomputing Earth system modeling system for the use of remote sensing data from NASA and other agencies. Much of the global Landsat data have been transferred to that facility. The NEX web portal represents a scientific social networking platform to deliver a complete work environment in which users can explore and analyze large Earth science data sets, run modeling codes, collaborate on new or existing projects, and share results. Principal Investigators of the selected proposals are encouraged to register on the NEX website at https://c3.nasa.gov/nex/.

1.2.3 *International Collaboration*

NASA's policy welcomes the opportunity to conduct research with non-U.S. organizations on a cooperative, no-exchange-of-funds basis. Although Co-Is or collaborators employed by non-U.S. organizations may be identified as part of a proposal submitted by a U.S. organization, NASA funding may not normally be used to support research efforts by non-U.S. organizations at any level. Paragraph (c)(8)(iv) of Appendix B of the *NASA Guidebook for Proposers* states "NASA funding may not be used for foreign research efforts at any level, whether as a collaborator or a subcontract. The direct purchase of supplies and/or services, which do not constitute research, from non-U.S. sources by U.S. award recipients is permitted." Note that travel by a non-U.S. participant in the research investigation, whether for the purpose of conducting the research, for collaboration, or for attending a conference, is considered to be a research expense. Therefore, NASA funding may not be used for research efforts by foreign organizations at any level, including payment of travel expenses by any participant who is not employed either full-time or part-time by a U.S. organization (see Section 1.6 of the *NASA Guidebook for Proposers*; see also Appendix B, part (c)(8)(iv) of that document and Section III (c) of the *Summary of Solicitation* of this document for restrictions involving China).

2.0 Programmatic Information

2.1 Period of Performance for Selected Proposals

Research awards will be for three-year period of performance (or less) with annual funding contingent upon satisfactory progress reporting and available funding.

2.2 Funding Available for Support of Selected Proposals

Approximately $2M per year is expected to be available for this solicitation. Support can be anticipated for eight to ten investigations each with annual budgets in the $200-250K range. NASA will make selections for this announcement in the fall of 2016. Anticipated starts for selected projects will be in the spring of 2017.

A budget for travel to at least one LCLUC Science Team Meeting per year is required in the proposal. In addition, international travel should be included in the proposal budget if the region of investigation is outside of the U.S. Involvement of local scientists from the selected region is strongly encouraged and letters of endorsement from foreign partners, with financial commitments, although not needed at Step-1, will be required at Step-2. Note that direct support of research by foreign investigators is not allowed (see the *NASA Guidebook for Proposers*, Sections 1.6 and 2.3.11(b)(vi)). Services and supplies that constitute research are not allowed. See more details above in Section 1.1 on what is and what is not allowed in the budget concerning non-U.S. participation.

2.3 The Two-Step Proposal Process

To streamline the proposal process and relieve the work load on the community of interested applicants and those that help NASA in reviewing proposals, the LCLUC program is using a two-step process (see also Section IV(b)(vii) of the *ROSES Summary of Solicitation*). Step-1 Proposals replace the Notice of Intent (NOI). Step-1 Proposals must be submitted electronically by the NOI/Step-1 Due Date (see Tables 2 and 3 in the *ROSES Summary of Solicitation*). Unlike a NOI, Step-1 Proposals must be submitted by one of the officials at the P.I.'s organization who is authorized to make such a submission.

NSPIRES will be open for the submission of Step-1 Proposals starting ~30 days in advance of the Step-1 Due Date. NASA will then review each Step-1 Proposal to determine whether or not the anticipated research project is considered of sufficient merit, responsiveness, and relevance to warrant submission of a full Step-2 Proposal. A separate Step-1 Proposal must be submitted for each intended (and thus corresponding) Step-2 Proposal.

Only proposers who submit a Step-1 Proposal and are invited to submit a Step-2 Proposal are eligible to submit a Step-2 Proposal. Submission of a Step-1 Proposal is, therefore, required in order to submit a Step-2 Proposal. Step-2 Proposals must contain the same scientific goals proposed in Step-1, but the proposal team identified at Step-1 is not considered binding and (other than the Principal Investigator) can be adjusted in an invited Step-2 Proposal. However, the submission of a Step-1 Proposal is not a commitment to submit a Step-2 Proposal.

The NSPIRES system will guide proposers through submission of all required proposal information. Please note that the Proposal Summary, Business Data, Program Specific Data, and Proposal Team are required Cover Page Elements for a Step-1 Proposal. A budget should not be included with the Step-1 Proposal, but will be needed with a budget explanation at Step-2.

To facilitate the work by reviewers on Step-1 Proposals, the following abbreviated guidance is suggested: Step-1 Proposals must be uploaded as a PDF document not to exceed five pages, including any references or citations. The five-page, Step-1 Proposal should:

a) Emphasize responsiveness, clearly indicating how it addresses the call and which remote sensing assets are to be used. Identify social science aspects in the proposed study.

b) Describe the proposed research, showing knowledge of previous research carried out by the international scientific community in the subject area. Identify new research aspects being proposed.

c) Outline the expected outcomes of the research. Identify proposed deliverables. Provide a tentative schedule.

Step-2 Proposals should provide more detail on the previous studies related to the research topic and the proposed research methodology, the anticipated results and deliverables, and schedule. Step-2 Proposals should include a budget and the associated explanation. For consistency and to ease the burden of reviewing, it is preferable that Step-2 Proposals follow approximately the same structure as outlined for the Step-1 Proposals, but are expanded to 15 pages. ~~A Step-2 Proposal will also need to indicate how it responds to the Step-1 Panel Review feedback.~~ **[Removed January 13, 2016]**

Step-2 Proposals must be submitted electronically by the Proposal Due Date (see Tables 2 and 3 in this NRA's *Summary of Solicitation*) in full compliance with the requirements specified in this NRA's *Summary of Solicitation* and the *NASA Guidebook for Proposers* (see Section 3 below).

2.4 Evaluation of Proposals

All proposals will be submitted to the NASA peer review process in accordance with the guidelines provided in this NRA and the *NASA Guidebook for Proposers*. This peer review will be followed by a programmatic review in which NASA will assess program balance across the competitive range of proposals, and evaluate any logistical, implementation, cost, and/or management concerns. The funding recommendations will then be forwarded to the Selecting Official for confirmation. NASA then will announce the official selection of proposals for award via NSPIRES.

3. Summary of Key Information

Expected program budget for new awards	~ $2M per year
Number of new awards pending adequate proposals of merit	8-10
Maximum duration of awards	3 years
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Step-2 (full) proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of Investigation	Spring of 2017

Page limit for the central Science-Technical-Management section of proposal	5 pages for Step-1 proposals.15 pp for Step-2 proposals; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-LCLUC
NASA point of contact concerning this program	Garik Gutman Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: 202-358-0276 Email: ggutman@nasa.gov

A.3 OCEAN BIOLOGY AND BIOGEOCHEMISTRY

NOTICE: Clarified on February 17, 2016. New text was added to Section 2.6 to clarify requirements for proposed budgets for HPLC pigment analysis and for travel to meetings. The proposal due date has not changed; proposals remain due on March 3, 2016.

NOTICE: Amended on December 3, 2015. This Amendment releases final text for this program element. Notices of intent are requested by January 7, 2016 and proposals are due by March 3, 2016. Proposers to this program will not be asked to provide a data management plan via the NSPIRES cover pages, because it must be provided in the proposal, see Section 3.4.

1. Scope of Program

NASA's Ocean Biology and Biogeochemistry program focuses on describing, understanding, and predicting the biological, ecological, and biogeochemical regimes of the upper ocean, as determined by observation of aquatic optical properties using remote sensing data, including those from space, aircraft, and other suborbital platforms.

Overarching programmatic goals include:

- Understanding and quantifying the impacts and feedbacks of Earth System processes, particularly oceanographic mechanisms, on the global and regional spatial and temporal variability of ocean biology and ecology, including phytoplankton and organisms from other trophic levels;
- Understanding and quantifying the impacts and feedbacks of Earth System processes, particularly oceanographic mechanisms, on the global and regional spatial and temporal variability of ocean biogeochemistry, including carbon sources and sinks and the fate of other chemical species or components in the ocean;
- Exploring the development of new biological, ecological, and biogeochemical observations beyond traditional ocean color (e.g., phytoplankton chlorophyll *a*) from space-based assets, as well as furthering the climate research enabled by existing time series of climate observations (Earth System Data Records); and
- Improving future climate predictions (impacts and feedbacks) by incorporating a dynamic understanding of ocean biology, ecology, and biogeochemistry into global biogeochemical and ecological models to understand the ocean's role in the Earth System.

Ocean Biology and Biogeochemistry research mainly supports the Carbon Cycle and Ecosystem Focus Area (http://nasascience.nasa.gov/earth-science/carbon-cycle-and-ecosystems). Each of the Earth Science Focus Areas portrays a strategy for a decade of progress through 2015, based on a suite of systematic observations, novel new Earth Science observations, and specific programmatic elements. NASA’s Ocean Biology and Biogeochemistry program utilizes remotely sensed observations from land, ocean, and atmosphere, as well as field studies and campaigns, and interdisciplinary data assimilation and modeling efforts to better understand the ocean’s role

in the Earth System and to predict future causes of change and feedbacks on ocean biology and biogeochemistry within the Earth System.

In support of the Carbon Cycle and Ecosystems Roadmap, scientific questions of interest to the Ocean Biology and Biogeochemistry Program include (but are not limited to):

- How are ocean ecosystems and the biodiversity they support influenced by climate and environmental variability and change, and how will these changes occur over time?
- How do carbon and other elements transition between ocean pools and pass through the Earth System, and how do biogeochemical fluxes impact the ocean and Earth's climate over time?
- How (and why) are the diversity and geographical distribution of coastal marine habitats changing, and what are the implications for the well being of human society?
- How do hazards and pollutants impact the hydrography and biology of the coastal zone? How do they affect us, and can we mitigate their effects?

Appendix A.1 of ROSES ("Earth Science Research Program") provides an overview of how the Ocean Biology and Biogeochemistry program fits into the Earth Science Division within NASA's Science Mission Directorate. Program goals and objectives for the coming decades can be found in the Ocean Biology and Biogeochemistry program's advance plan (http://oceancolor.gsfc.nasa.gov/DOCS/OBB_Report_5.12.2008.pdf).

2. Description of Solicited Research

Priorities for new research within NASA's Ocean Biology and Biogeochemistry program continue to derive from the goals and objectives for Earth Science in NASA's Strategic Plan (http://nasascience.nasa.gov/about-us/science-strategy), the research agenda of the U.S. Global Change Research Program (USGCRP) (http://www.globalchange.gov/), the science priorities of the U.S. Carbon Cycle Science Program (http://www.carboncyclescience.us/), and the National Ocean Policy Implementation Plan (https://www.whitehouse.gov/sites/default/files/national_ocean_policy_implementation_plan.pdf) of the National Ocean Council (NOC). This solicitation calls for research on specific topics of current, strong scientific interest, and programmatic relevance. The NASA Ocean Biology and Biogeochemistry program requests the following types of research investigations:

- Research in ocean ecology, specifically to prepare scientifically for new ocean measurements from the Pre-Aerosol, Cloud, ocean Ecosystem (PACE) mission recommended by "Responding to the Challenge of Climate and Environmental Change: NASA's Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space Science" (http://science.nasa.gov/media/medialibrary/2010/07/01/Climate_Architecture_Final.pdf) or to advance ocean ecology research based on data from historical, existing, and new sensors such as OCO-2;
- Global data set development and modeling activities to enable a predictive understanding of the export and fate of global ocean primary production and its implications for the Earth's carbon cycle, specifically in support of a planned field campaign in the Northeast Pacific and North Atlantic Oceans,
- Studies to support the trilateral *Galway Statement on Atlantic Ocean Cooperation* of May 2013, among the European Union (EU), Canada, and the United States (US) (available at http://www.coopeus.eu/galway-statement/); and

- Successor studies that offer to significantly advance the results of prior NASA Ocean Biology and Biogeochemistry research toward meaningful answers to important NASA goals, relevant USGCRP, and NOC carbon cycle and ecosystems research questions, and current and future NASA missions..

2.1 Research in Ocean Ecology

Aquatic ecosystems respond to global change in a variety of ways, but ecosystems vary in both their vulnerability (i.e., exposure, sensitivity, resilience) to and impacts from environmental and climate variability and change. Some impacts of global environmental change are major, greatly affecting the sustainability of ecosystem dynamics or functions, and/or causing large feedbacks to the climate system. Some ecosystem changes or responses to environmental or climate change are abrupt, while others take much longer (decades or even centuries) to become manifest. Research is needed to identify the most significant of these ecosystem impacts and vulnerabilities, to understand the processes controlling them, and to assess the likely magnitude of change(s) associated with them.

This research is essential if we are to anticipate the type and degree of future environmental changes and to devise strategies for mitigation and/or adaptation. Additionally, this research is critical if current and future ocean color and other satellite missions, such as the Pre-Aerosol, Cloud, ocean Ecosystem (PACE) mission's data, are to be used not only for research, but to better inform monitoring, management, and decision and policy makers. Research proposals submitted to this subelement can utilize existing ocean satellite observations and should clearly connect to future remote sensing missions or requirements, such as the PACE mission.

Integrative research is sought to apply remote sensing observations to the characterization of ocean biology and ecology impacts from and/or vulnerability to global climate and environmental variability and change. Within the domain of ocean ecology, a wide variety of aquatic ecosystem impacts and vulnerabilities could be addressed in the proposals submitted in response to this element of the solicitation, but not all will be equally important. Therefore, proposals must offer compelling rationales as to 1) the clear definition and "geographic" boundaries of the ecosystem under study, 2) why the impacts and/or vulnerabilities of a given ecosystem to be studied are expected to be highly significant, representing major perturbations to the Earth system, and 3) how the remote sensing data and data products to be utilized in the study provide unique and powerful information for addressing the ecosystem research issues/questions posed. Ecosystem in this context could be defined on any number of scales, but the ecosystem under study must be compellingly defined and justified in the global context.

Characterization of uncertainties will be essential in all analyses of potential ecosystem impacts and vulnerabilities, so for a proposal to be considered responsive to this element, it must explain how error and uncertainty will be considered, incorporated into results, and reported.

NASA is seeking research under this subelement that is centrally focused on the vulnerabilities to and response of ocean ecosystems to global environmental change. While aspects of and consequences to biogeochemical cycling may be addressed in such studies, proposers offering studies centrally focused on carbon cycle science are encouraged to respond instead to ROSES

2016 Carbon Cycle Science, in Appendix A of the 2016 ROSES omnibus solicitation (to be released February 2016).

2.2 Global Data Sets and Modeling In Support of Planned Northeast Pacific and North Atlantic Export Flux Studies

A major scientific challenge in the ocean sciences is to identify and quantify the mechanisms that determine the export of biogenic carbon from the euphotic zone and its transformation in the mesopelagic zone at regional and global scales. Observations and models at many scales will need to be combined to address the questions and challenges of understanding and quantifying export fluxes of carbon and associated materials, and the biogeochemical-ecological interactions that impact the biological pump. The quantification of the magnitude, efficiency, and variability of the biological pump is critical for understanding the ocean's carbon cycle in response to a changing environment and climate.

To address the above challenges, the NASA Ocean Biology and Biogeochemistry Program is planning the EXport Processes in the Ocean from RemoTe Sensing (EXPORTS) field campaign (see http://cce.nasa.gov/cce/ocean.htm for the EXPORTS Final Science Plan, Executive Summary, and other relevant materials). The EXPORTS field campaign is focused on sampling the ocean carbon pathways over a range of contrasting ecosystem/carbon cycle states in order to formulate a predictive understanding of the export and fate of global Net Primary Production (NPP). The research to be conducted will involve data mining, observations, process-oriented analyses, scientific syntheses, and modeling. The EXPORTS field campaign will emphasize the pathways that lead to the export and fate of global NPP and will integrate and synthesize geospatial data collected by airborne and spaceborne sensors with information obtained from ship-based observations. Data mining of previous experimental *in situ* and remotely sensed data (details provided below) will expand the possible range of ecosystem states available for assessing the export and fate of global ocean NPP and for help with planning and executing the field program. Further, modeling studies are needed to help guide field campaign planning, such as an Observing System Simulation Experiments (OSSE).

The detailed study design for EXPORTS will be developed over the next year, but it is not too early to begin assembling key existing data sets within and outside the study region to support its planning and eventual synthesis. The exact location of the study region has not yet been determined. However, for the purposes of this solicitation, proposers should assume that the study region includes the North Atlantic circa the 2008 North Atlantic Bloom Experiment study area and Northeast Pacific near Station P, as defined in the EXPORTS science plan. Thus, data sets of obvious importance for the Northeast Pacific and North Atlantic biogeochemical-ecosystem research and modeling, as well as data sets that would inform study planning and preparation, are of interest. This opportunity is not for the collection of new *in situ* data, but rather to access and refine existing data for use in the future EXPORTS field campaign research.

Data mining of existing *in situ* and remotely sensed data sets, as well as modeling results from other areas of the ocean that specifically expand the dynamic range of ecosystem and carbon cycle states identified in the EXPORTS Science Plan, are also of interest. The aim is to supplement the relatively small number of ecosystem/carbon cycle states that will be directly

observed by EXPORTS by conducting an intensive data-mining effort. These additional states may not be sampled as completely as the EXPORTS observational suite is likely to be, and will likely be missing some important carbon cycling pathways or spatial/temporal scales of variability. However the data-mining exercise will ensure that the EXPORTS program will have a broad range of ecosystem and carbon cycle states needed for the development of broadly applicable remote sensing and numerical models of the export and fate of global NPP. Again, this opportunity is not for the collection of new field observations.

Numerical modeling activities may also prove to be very useful in the planning and execution of sampling strategies for the EXPORTS field campaign. In particular, physical, ecological and biogeochemical numerical models could be used as part of an Observing System Simulation Experiment (OSSE) to assess different observational strategies. Model fields can be sampled and analyzed as the observed data fields would be, to test how well the EXPORTS science questions can be answered given a particular observational strategy. This work must be conducted at the appropriate spatial and temporal scales to inform the field campaign planning. Other modeling approaches, data assimilation, process modeling of particular processes, etc. will also be considered, but again must contribute to the planning of the EXPORTS field campaign.

NASA requests proposals for investigations to assemble, prepare, develop, refine, data mine, and/or integrate data sets for use in preparing for and conducting North Atlantic or Northeast Pacific field campaign research. Research activities may involve: obtaining and compiling existing data sets not otherwise widely available; subsetting and/or custom processing of satellite data for the study region; combining related data sets in an integrated, consistent synthesis; data mining a suite of *in situ* and geospatial data sets with consistent formatting, metadata, map projections, etc., suitable for use in relevant ecosystem models. NASA also requests modeling studies to help guide field campaign planning. Proposals must explain the overall importance of the data set or numerical model simulation proposed and its anticipated use(s) for the planning and/or execution of the EXPORTS field campaign. They must also explain the relevance of the proposed data set or model to a remote sensing-oriented research program. NASA intends to select only the most obviously important, high priority data mining and numerical modeling activities for "pre-EXPORTS" investment.

All selected data mining and modeling studies will be subject to the standard Earth Science Data Policy described below.

2.3 Research In Support of the Galway Statement: North Atlantic - Arctic Oceanographic Processes

The trilateral *Galway Statement on Atlantic Ocean Cooperation* of May 2013, among the European Union (EU), Canada, and the United States (US) (available at http://www.coopeus.eu/galway-statement/) emphasizes the need for international cooperation in discovering and understanding processes influencing this dynamic region of the oceans. From 2013 to 2014, NASA sponsored the EXport Processes in the Ocean from RemoTe Sensing (EXPORTS) field program science planning effort (final science plan available at http://cce.nasa.gov/cce/ocean.htm), which focused on identifying and quantifying the

mechanisms that determine the export of biogenic carbon from the euphotic zone and its transformation in the mesopelagic zone at regional and global scales.

NASA welcomes proposals to conduct research to address the goals and objectives of the Galway Statement and its implementation, particularly those science objectives that are in line with preliminary research to inform planning for the EXPORTS field campaign based on the final science plan. The proposed work plan's relationship and direct link to the Galway Statement and the Galway Statement's research goals and objectives must be explicitly justified within the proposal. Proposed research must clearly demonstrate a firm partnership with scientists from Canada or the European Union in support of the Galway Statement. Proposals seeking to address the goals of the EXPORTS draft science plan that are not clearly and explicitly linked to the Galway Statement research goals and objectives are not solicited at this time.

2.4 Successor Studies

This solicitation provides opportunities for integrative research relevant to the goals and objectives of the Ocean Biology and Biogeochemistry (OBB) program element that will significantly advance the results of prior research toward meaningful answers to NASA's goals, relevant USGCRP, and NOC carbon cycle and ecosystems research questions, and current and future NASA missions. Successor proposals and follow-on research from past NASA Ocean Biology and Biogeochemistry research projects will be considered. Such proposals must offer demonstrable scientific advances beyond the earlier study and explain the continuing relevance and priority of the research to be pursued to the Ocean Biology and Biogeochemistry Program. If new studies do not cite the specific prior NASA-OBB funded study, and do not document the progress made in that study, then the proposed research that remains the prompt for the present study will be considered nonresponsive under this element.

3. Additional Proposal Requirements

3.1 Requirement Regarding Remote Sensing

For proposals to develop new data sets (i.e., responding to Section 2.2 above), use of remote sensing data is strongly encouraged. However, in cases where the data set cannot be assembled from existing remote sensing data and the data set is of clear utility and priority for NASA Ocean Biology and Biogeochemistry research, use of remote sensing data will not be required. Instead, the proposal must explain how the data set will meet a priority NASA Ocean Biology and Biogeochemistry need and be used in future research to complement satellite remote sensing data analysis.

For ocean ecology (Section 2.1), Galway Statement research (Section 2.3) and successor proposals responding to Section 2.4 above, substantive use of remote sensing data is required.

3.2 Requirement Regarding Duration of Study

It is anticipated that many data set development and modeling activities that exploit existing data sources can be completed within one to two years. Also, some follow-on or successor studies that focus on remote sensing science and remote sensing methods may be achievable in less than three years. Therefore, proposers submitting in response to this program element are encouraged to consider award durations of less than three years. While proposers may request up to three years of support, they must document and carefully justify the need for the amount of time requested.

3.3 Requirement to Address Errors and Uncertainties

All proposals submitted in response to this solicitation must include a section in the statement of work describing how errors and uncertainties will be addressed. The research supported will be expected to characterize uncertainties and quantify errors associated with data, analytical approaches, model results, and scientific interpretations. This work must be described in the proposal.

3.4 Requirement for a Data Management Plan

Proposals must include a data management plan of no more than two pages that addresses the dissemination and sharing of research results and compliance with NASA Earth Science data policy (http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/). The data management plan should include, when relevant to the type of study being proposed, the types of data and data products or other materials to be produced in the course of the project, the standards to be used for data and metadata formats and plans for providing access to and/or archiving the data and other research products. The data sharing plan called for in Section 2.3.5 of the *Guidebook for Proposers* may be included in the data management plan. The data management plan must be included within the 15-page limit for the Scientific/Technical/Management section of the proposal. A valid data management plan may include only the statement that no detailed plan is needed, as long as a clear justification is provided.

For new data sets proposed under Section 2.2 above, the data management plan must include plans for quality assessment, timely public release, and long-term archive of the data set(s).

3.5 Requirement for Proposals Requesting Acquisition of New Airborne or Shipborne Data

Proposals requiring data from airborne sensors must detail in their cost plan all costs for acquiring the new data sets, including costs for aircraft hours, deployment costs, mission peculiar costs, data processing costs, and other costs associated with deploying the sensors and aircraft (this includes NASA sensors and platforms, as well as non-NASA sensors and platforms). In addition, for any proposed activities requiring NASA aircraft or NASA facility sensors, proposers should submit a Flight Request to the Airborne Science Flight Request system at http://airbornescience.nasa.gov (and then click on "FLIGHT REQUEST"). Questions regarding the flight request system or process should be addressed to Marilyn Vasques, Flight Request

Manager (Marilyn.Vasques@nasa.gov or 650-604-6120). If the instrument or aircraft platform are not NASA facilities, proposers must take responsibility for making all arrangements to secure the availability of the needed sensors and aircraft and explain these plans in the proposal.

Proposers should include any required supporting paperwork that provides insight into costs or requests in support of the use of the vessel. Proposers must take responsibility for making all arrangements to secure the availability of the needed sensors and vessel and explain these plans in the proposal.

3.6 Other Requirements Regarding General Content

Unless otherwise specified above, proposed investigations must utilize remotely sensed (e.g., ocean color) observations as a primary research tool, but may also seek to improve existing ocean color observations or explore the development of new biological properties from space-based assets beyond traditional ocean color in support of the project objectives. Coordinated or individual efforts may be linked with other projects or proposals and these linkages must clearly and explicitly be called out by all involved proposals and investigators. Regardless of any clearly identified "linked" status, each individual proposal will be evaluated as a stand-alone effort using the Proposal Evaluation Criteria identified in Section 3.7 of this program element. Each individual proposal must address all required elements of the solicitation.

Investigators should make clear any special requirements or platform needs, i.e., ship modifications, additional boats, specific sampling requirements, or high-end computing requirements (see Section I(d) of the *ROSES Summary of Solicitation*), in a separate section.

All data collected will be subject to the standard NASA Earth Science data policy (http://nasascience.nasa.gov/earth-science/earth-science-data/data-information-policy/). Proposals planning to collect field data should contain a table that, to the extent possible, details what data will be collected, on what cruise or field visit and when, and provide a detailed plan for submission to a NASA data center, such as the SeaWiFS Bio-optical Archive and Storage System (SeaBASS- http://seabass.gsfc.nasa.gov), within one year of collection.

Investigators proposing high performance liquid chromatography (HPLC) phytoplankton pigment sample analysis must include the analytical cost for such measurements within their proposal budgets. The current cost for HPLC pigment analysis is $100 per sample at the NASA-supported analytical facility (currently Goddard Space Flight Center; GSFC) for a complete suite of acetone-extractable pigments (http://oceancolor.gsfc.nasa.gov/cms/hplc). Approximately 5% of the pigment samples should be submitted in duplicate for assessment of replicate sample precision. Proposed budgets should also include shipping costs of samples and return of shipping container. Investigators may make separate arrangements with a non-NASA supported analytical facility for HPLC pigment sample analysis. However, investigators that do not use the NASA-supported facility must send a sub-set of duplicate samples (~10% of total) to the GSFC facility and budget for these samples accordingly. This allows for lab-to-lab inter-comparison of pigment results and assessment of uncertainties. Furthermore, PIs should

also complete the table of planned field measurement collection and include the table as an appendix to the proposal.

Investigators selected under this call will be strongly encouraged to participate in any meetings and coordination workshops sponsored or co-sponsored by NASA (e.g., post-cruise data workshops, pre-cruise planning meetings, etc.). PIs will also be encouraged to attend annual NASA co-sponsored science coordination meetings with international research programs, as needed. Investigators selected by the Ocean Biology and Biogeochemistry program are strongly encouraged to attend the annual NASA Ocean Color Research Team meeting or equivalent within the United States (e.g., PIs should budget a three day trip to the farthest coast once per year, unless specified otherwise). [Clarified February 17, 2016.]

3.7 Proposal Evaluation Criteria

Proposals will be evaluated according to the criteria specified in Section VI (a) of the ROSES Summary of Solicitation and Section C.2 of the *Guidebook for Proposers*. In addition to the factors given in the *Guidebook for Proposers*, the determination of a proposal's intrinsic merit shall take into account the following additional considerations as aspects of the offeror's and investigator team's capabilities:

• The experience of the investigators and their institutions in engaging in data sharing and providing timely access to data and research products on related and relevant projects, and

• The quality and completeness of the data management plan.

NASA reserves the right to select or not select proposals in any given program subelement based on the aforementioned specific and existing NASA review and selection criteria, see Section II a of the ROSES Summary of Solicitation.

4.0 Summary of Key Information

Expected annual program budget for new awards	Up to $2.5M; Subelements 2.1-2.3 ~$1.5M; Subelement 2.4 ~$1.0M
Number of new awards pending adequate proposals of merit	~ 10-20
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	January 7, 2016
Due date for Proposals	March 3, 2016
Planning date for start of investigation	July 1, 2016
Page limit for the central Scientific/Technical section of proposal	15 pp.; see also Chapter 2 of the *NASA NRA/CAN Proposers Guidebook*

Relevance to NASA	This program is relevant to the Earth science strategic goals and subgoals in NASA's *Strategic Plan*; see Table 1 and the references therein. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA NRA/CAN Proposers Guidebook* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA NRA/CAN Proposers Guidebook*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-OBB
NASA point of contact concerning this program	Paula S. Bontempi Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1508 E-mail: paula.bontempi@nasa.gov

A.4 TERRESTRIAL ECOLOGY

NOTICE: The Terrestrial Ecology program does not currently plan to solicit proposals in ROSES-2015. All funds available for Terrestrial Ecology research have been reserved for support of awards to be selected through the ROSES-2014 Terrestrial Ecology solicitation focused on the Arctic-Boreal Vulnerability Experiment (ABoVE). This program will be competed again in ROSES-2016.

NASA Terrestrial Ecology research addresses changes in Earth's carbon cycle and ecosystems using space-based observations. The goals of NASA's Terrestrial Ecology research are to improve understanding of the structure and function of global terrestrial ecosystems, their interactions with the atmosphere and hydrosphere, and their role in the cycling of the major biogeochemical elements and water. This program of research addresses variability in terrestrial ecosystems, how terrestrial ecosystems and biogeochemical cycles respond to and affect global environmental change, and future changes in carbon cycle dynamics and terrestrial ecosystems. The research approach combines (i) use of remote sensing to observe terrestrial ecosystems and their responses; (ii) field campaigns and related process studies to elucidate ecosystem function; and (iii) ecosystem and biogeochemical cycle modeling to analyze and predict responses. Research to establish a theoretical and scientific basis for measuring Earth surface properties using reflected, emitted, and scattered electromagnetic radiation and to develop the methodologies and technical approaches to analyze and interpret such measurements is an important component of the Terrestrial Ecology research program.

Priorities for new research within NASA's Terrestrial Ecology program continue to derive from the goals and objectives for Earth Science in NASA's Strategic Plan (http://nasascience.nasa.gov/about-us/science-strategy), the research agenda of the U.S. Global Change Research Program (USGCRP) (http://www.globalchange.gov/), and the science priorities of the U.S. Carbon Cycle Science Program (https://www.carboncyclescience.us). A new emphasis within the Terrestrial Ecology program is its next major field campaign, the Arctic-Boreal Vulnerability Experiment (ABoVE). Thus, the *ABoVE Concise Experiment Plan* (ACEP; http://above.nasa.gov/acep.html) is an additional guide to the types of research of interest to NASA under the Terrestrial Ecology Program.

NASA anticipates that the ROSES-2016 Terrestrial Ecology Program solicitation will focus on additional ABoVE research to include airborne science, collaborations with ABoVE partner organizations to fill research gaps and take advantage of new opportunities for collaboration, and tightly focused opportunities for other Terrestrial Ecology research in support of major program goals and NASA missions.

For further information on this program, contact:

Eric Kasischke
Earth Science Division
Science Mission Directorate
NASA Headquarters

Washington, DC 20546-0001
Telephone: (202) 358-0245
E-mail: Eric.S.Kasischke@nasa.gov

A.5 CARBON CYCLE SCIENCE

NOTICE: The Carbon Cycle Science program will not solicit proposals in ROSES-2015. All funds currently available for a dedicated carbon cycle science opportunity are committed to the support of awards selected through the 2013 Carbon Cycle Science solicitation. These carbon cycle science funds will be competed again in ROSES-2016. NASA expects to continue to solicit some carbon cycle research through its core research and analysis programs, in particular, the Terrestrial Ecology, Ocean Biology and Biogeochemistry, Land Cover and Land Use Change, and Atmospheric Composition programs. Interested researchers are encouraged to consult these other program elements for potential funding opportunities.

NASA's Carbon Cycle Science research opportunity is offered every three years and usually in partnership with one or more U.S. Government agencies, most recently with the U.S. Department of Agriculture (USDA), National Institute of Food and Agriculture (NIFA), Agriculture and Food Research Initiative Competitive Grants Program (AFRI); the U.S. Department of Energy (DOE) Terrestrial Ecosystem Science Program; and the Atmospheric Chemistry, Carbon Cycle, and Climate (AC4) Program within the National Oceanic and Atmospheric Administration's (NOAA's) Climate Program Office. Proposals were sought to improve the understanding of changes in the distribution and cycling of carbon among the active land, ocean, and atmospheric reservoirs and how that understanding can be used to establish a scientific foundation for societal responses to global environmental change.

The goals of the NASA Earth Science Program for Carbon Cycle Science are to improve the understanding of the global carbon cycle and to quantify changes in atmospheric CO_2 and CH_4 concentrations, as well as terrestrial and aquatic carbon storage in response to fossil fuel combustion, land use and land cover change, and other human activities and natural events. NASA carbon cycle research encompasses multiple temporal and spatial scales and addresses atmospheric, terrestrial, and aquatic carbon reservoirs, their coupling within the global carbon cycle, and interactions with climate and other aspects of the Earth system. A focus on observations from space pervades carbon cycle research by NASA and is a basis for partnerships with other U.S. Government agencies and institutions. NASA carbon cycle research contributes toward the goals of major USGCRP activities, including the Carbon Cycle Science Program's U.S. North American Carbon Program (NACP) and the Ocean Carbon and Climate Change Program (OCCC) (http://www.globalchange.gov/, https://www.carboncyclescience.us, http://www.nacarbon.org/nacp/, and http://www.us-ocb.org/about/projects.html). NASA carbon cycle research also contributes toward the goals of the National Ocean Council's National Ocean Policy planning documents (http://www.whitehouse.gov/administration/eop/oceans/policy).

For further information on this program, contact:

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A.6 BIODIVERSITY

NOTICE: Clarified on March 4, 2016. To address questions regarding the last paragraph in Section 2.1 ("A proposed field campaign scoping study must…") vs. the second paragraph in Section 2.1.1 ("Proposals should identify the scientific questions…") we have added the following text to section 2.1.1: "Please note that a funded scoping study will develop the final key questions and the study design to implement them. The proposal should identify initial questions/topics to be pursued by the scoping study. These questions/topics should be developed, fleshed out, and refined by the scoping study." New text is in bold. The due date has not changed. Proposals are due March 18, 2016.

Amended on December 17, 2015. This Amendment announces the release of final text for Biodiversity. Notices of Intent (NOIs) to propose are requested by January 15, 2016, and proposals are due by March 18, 2016.

1. Scope of Program

Biodiversity is the measure of the variety of life on Earth at all levels of organization, from ecosystems to species to genes. Biodiversity results from variations in the compositional, structural, and functional aspects of life at these different levels. Biodiversity enables and represents life's responses to changing environments on our dynamic planet, while also serving as a driver of environmental change. It encapsulates life's evolutionary history. Earth's biodiversity provides humanity and all life with a tremendous resource of opportunities to survive and thrive on an evolving planet.

Recent efforts to track the status of biodiversity globally have consistently reported significant declines throughout its levels of organization. A growing scientific consensus posits that biodiversity is declining at rates comparable to those seen in major extinction events documented in the geologic record. Concerns over the loss of the many benefits, goods, and services we derive from biodiversity demand efforts to understand biodiversity levels and distributions, and how and why they are changing over time. In addition, there is a need to understand biodiversity because it drives changes in the wider Earth system. Thus, NASA seeks tools to understand the condition of biodiversity and how it is changing.

This NASA program focuses on determining and monitoring the distribution and abundance of biodiversity across its levels of organization: ecosystems, species, and genes, as well as how and why these distributions and abundances are changing through time. Another focus of the NASA program is to increase knowledge of how biodiversity drives changes in the wider Earth System of which it is a part. NASA studies biodiversity and its change by combining observations from satellites, airborne platforms, and *in situ* sensors to explore biodiversity patterns in terrestrial, freshwater, and marine systems. Our macroscopic observations illuminate patterns of biodiversity through direct identification of ecosystems and certain species distributions and abundances. Understanding the processes behind these patterns often requires the use of models to integrate observations across spatial and temporal scales.

2. Description of Solicited Research

This solicitation seeks proposals for (Section 2.1) targeted scoping studies for potential biodiversity-related field campaigns and (Section 2.2) workshops on specific biodiversity topics. These scoping studies and workshops will provide guidance for the future of the Biodiversity program. A proposal should only address one of the four topics described in Sections 2.1 and 2.2. However, an investigator may submit more than one proposal.

2.1 Scoping Studies for Potential Field Campaigns

NASA has traditionally mounted field campaigns to address scientific problems lending themselves to a combination of satellite, airborne, and *in situ* sensing. This solicitation offers resources to facilitate planning for and the design of a notional, future, biodiversity-related field campaign. Proposals should build upon NASA's capacity to organize and operate coordinated field campaigns.

This solicitation requests scoping studies for field campaigns addressing either "Synergistic Use of Imaging Spectroscopy and Lidar Remote Sensing for Biodiversity," or "The Living Atmosphere: Exploration Aerobiology." Each topic is described in detail below.

A proposed field campaign scoping study must (1) identify the key scientific questions to be addressed should the campaign be carried out and (2) develop an initial study design and implementation concept.

2.1.1. Synergistic Use of Imaging Spectroscopy and Lidar Remote Sensing for Biodiversity

The NASA Earth Science Division is funding enhancements of three imaging spectrometers and a scanning laser altimeter to enable flight on its high altitude ER-2 aircraft. The spectrometers are the Portable Remote Imaging Spectrometer (PRISM) operating in the near-ultraviolet to the near-infrared region of the electromagnetic spectrum (350 to 1050 nm), the Next Generation Airborne Visible/Infrared Imaging Spectrometer (AVIRIS-NG) operating in the visible to shortwave infrared region (380 to 2510 nm), and the Hyperspectral Thermal Emission Spectrometer (HyTES) operating in the thermal infrared region (7.5 to 12 μm). The laser altimeter is the Land, Vegetation, and Ice Sensor (LVIS). The combination of these imaging spectrometers with the LVIS lidar constitutes a uniquely powerful sensor suite for biodiversity observation. Together, these sensors provide imagery directly relevant to the composition, function, and structure of ecosystems. PRISM is particularly designed to support imaging of marine and coastal environments.

Proposals should identify the scientific questions to be addressed by, and develop an initial study design and implementation concept for, a field campaign that would include the following elements:

- *in situ* surface sensors that complement the airborne measurements (the airborne measurements must be the central focus and core observations of the campaign);
- the ER-2 aircraft outfitted with at least two of the following three imaging spectrometers PRISM, AVIRIS-NG, and HyTES, along with the LVIS scanning laser altimeter; and

- relevant satellite datasets from NASA and other sources (e.g., radars, other thermal infrared sensors, other lidars, etc.).

Observations from other airborne sensors, not listed above, will also be considered in proposals for this scoping study—but would be in addition to the required ER-2 aircraft sensor observations described above. The use of other sensors must be clearly justified, specifically coincident with, and scientifically complementary to the ER-2 airborne sensor data that is the focus of this solicitation.

Please note that a funded scoping study will develop the final key questions and the study design to implement them. The proposal should identify initial questions/topics to be pursued by the scoping study. These questions/topics should be developed, fleshed out, and refined by the scoping study. [Added March 3, 2016]

These proposed field campaigns must include a combination of sites that together allow data acquisitions from terrestrial, freshwater, and marine ecosystems.

Proposed field campaigns under this topic should be designed to provide airborne and other data that will help inform NASA about the measurements' potential for biodiversity investigations if obtained globally from future satellite missions.

In identifying key scientific questions, proposals under this topic should address one or both of the following themes.

- The distribution and/or abundance of components of biodiversity (focusing on one or more of ecosystems, species, and genes) and the drivers and mechanisms of change in the distribution and/or abundance of these components of biodiversity (ecosystems, species and genes)
- The impacts of changing biodiversity on the wider Earth System, e.g., the feedbacks from biodiversity to climate and/or other aspects of the Earth system

Information about the three spectrometers, laser altimeter, and ER-2 aircraft is available at the following URLs.

PRISM	http://prism.jpl.nasa.gov
AVIRIS-NG	http://avirisng.jpl.nasa.gov
HyTES	http://hytes.jpl.nasa.gov
LVIS	http://lvis.gsfc.nasa.gov/index.html
ER-2 Aircraft	http://www.nasa.gov/centers/armstrong/aircraft/ER-2/index.html

2.1.2. The Living Atmosphere: Exploration Aerobiology

The atmosphere, like the ocean, is a fluid medium that is increasingly known to harbor a rich diversity of living microscopic, as well as macroscopic organisms. NASA seeks proposals for integrated airborne, satellite, and *in situ* field campaigns to improve understanding of the distribution and abundance of life in the atmosphere and its movement within this fluid medium. Here, life includes organisms (macroscopic and microscopic) and their propagules. We are

interested in demonstrating directly how NASA instruments (e.g., those observing atmospheric aerosols) and models can be used to document and investigate the richness of atmospheric life and its interactions with other atmospheric, terrestrial, and marine life—including humans. Overall, this topic represents foundational discovery science.

The primary area of focus for a field campaign under this topic should include one of the following themes.

- Enhancing our understanding of the biogeography of the atmosphere, including its potential organization into dynamic functional ecosystems and biomes
- Movement and the resulting dispersal of organisms and propagules within the atmosphere and between the atmosphere, ocean, and land
- The impact of life in the atmosphere upon physical processes in the Earth system (e.g., the possibility of enhanced formation of cloud nuclei by living atmospheric particles and propagules)

Proposals should identify the scientific questions to be addressed by, and develop an initial study design and implementation concept for, a field campaign that would include the following elements:

- any NASA aircraft platform and associated sensors, for both *in situ* sensing within and remote sensing of the atmosphere;
- relevant satellite imagery; and
- ground- and in water-based surface sensors that allow understanding of the interactions between life in the atmosphere and life on the terrestrial and marine surfaces of Earth through the medium of the planetary/atmospheric boundary layer.

2.2 Workshops

NASA often supports workshops to assemble experts to explore means of advancing a particular scientific discipline through space-based observations and related models.

This solicitation requests proposals for a workshop(s) addressing either "Lessons from Climate Modeling for Improved Large-scale Biodiversity Modeling" or "Mapping and Understanding with Satellites the Interface of Life and Earth Science." Proposals should both (1) identify a key scientific question(s) for a topic and (2) develop an outline for a workshop or series of workshops to address the question(s) and inform the topic. Each topic is described in detail below.

2.2.1. Lessons from Climate Modeling for Improved Large-scale Biodiversity Modeling

General concerns over global trends in biodiversity, the need to provide inputs for Working Group II and other elements of the Intergovernmental Panel on Climate Change (IPCC), and the advent of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) as the global body for the assessment of conditions and trends in biodiversity have all driven efforts to design and build large-scale to global models of biodiversity in both terrestrial and marine realms. Much biodiversity science and its associated modeling focuses on only one taxon or a

small number of taxa at fine spatial scales of square meters to a few hectares. This makes the creation of biodiversity models that are both general and large-scale quite challenging.

NASA seeks proposals for a workshop or a series of workshops that would bring together individuals from two groups:

- climate modelers working at regional to global scales and
- the growing community of modelers exploring concepts and implementing designs for large-scale biodiversity models to support global assessments and efforts by national governments to comply with international conventions demanding the development of national strategies and action plans for biodiversity.

Proposals should bring together approximately equal numbers of modelers from these two communities to transfer lessons learned from advances in general circulation models, Earth system models, regional climate models, and data assimilation for weather and hydrological forecasting into large-scale biodiversity modeling. A common theme for all workshop proposals must be the use of satellite remote sensing to address challenges of working at large spatial scales. Such a workshop or series of workshops should not only move forward the state of biodiversity modeling, but also provide Earth system and climate modelers with new insights that enhance the role of living systems (e.g., through trophic webs) in their models.

2.2.2. Mapping and Understanding with Satellites the Interface of Life and Earth Science

Efforts to designate areas critical for biodiversity conservation are frequently frustrated by a lack of knowledge of biodiversity on the ground—and even more so in the water. Recently, there has been a call to develop a strategy for conserving elements of Nature's geophysical stage (here defined as the geological, hydrological, and oceanic and atmospheric fluid dynamics components of the Earth system) as a means of conserving the players on Nature's stage (i.e., its living elements or biodiversity). Currently lacking is a detailed understanding of the degree to which conserving examples of broadly defined geophysical features might actually conserve important biodiversity. At issue is whether we can meet a fundamental goal of conservation biology—saving all of the pieces of Nature, i.e., its critical biodiversity—by saving key geophysical environments, i.e., the stage upon which Nature's play (the evolution of life) operates. Efficiently protecting a smaller and perhaps more easily managed number of geophysical environments (on the order of hundreds to thousands) in order to conserve a much larger number of, for example, species (on the order of millions) requires more knowledge of the relationship between geophysical diversity and biodiversity.

NASA seeks proposals for a workshop or a series of workshops that would explore the relationship of geophysical diversity or geodiversity to important components of biodiversity. A key element of such a workshop(s) is the integrated use of satellite and airborne remote sensing with *in situ* observations to map relationships between geophysical diversity (as represented by one or more of the following: geology, hydrology, and/or ocean and atmosphere fluid dynamics) and biodiversity (as represented by one or more of the following: ecosystems, species, and genes). This mapping is not an end in itself, but must serve to enlighten both the biological and geophysical sciences as to the processes driving the patterns arising in observations and models.

The end goal is the advancement of improved approaches for the conservation of biodiversity through the mechanism of conserving underlying geophysical diversity.

3. General Information

The most important aspect of proposals for all topics of this solicitation, including those for both scoping studies for potential field campaigns and for workshops, will be identification of the scientific question(s) and issues to be addressed by the field campaigns and workshops. All proposals must describe:

- the current state of the science,
- the potential for a significant scientific advance,
- the concepts for implementation of next steps, and
- the central and critical role for use of, or impact on planning for, NASA remote sensing systems (please remember this is a NASA solicitation).

Scoping study and workshop proposals should include the essential scientific components of the study and why coordinated teamwork is required in their implementation. They must develop an overall study design identifying the required observational (e.g., spaceborne, airborne, and/or supporting *in situ*) and analytical (e.g., models, data, and/or information systems) infrastructure. They must also address the technical, budgetary, and logistical feasibility of the proposed activities. Scoping study and workshop proposals must engage the broader research community in order to seek feedback on the ideas proposed and to allow objective determination of the breadth and depth of community interest and priority.

Selected and funded scoping studies and/or workshops must produce a written report providing a scientific justification and the initial design for a field campaign or the next steps arising from a workshop.

Proposers are advised that the award of a scoping study for a field campaign or a workshop does not obligate NASA to conduct the field campaign or implement any recommendations arising from the workshop. NASA will likely solicit proposals for an actual field campaign or to implement actions resulting from a workshop when NASA is ready programmatically and otherwise to proceed. That said, selected proposals will likely play significant roles in shaping NASA's future thinking for its Biodiversity program.

4. Summary of Key Information

Expected total program budget for all new awards in both areas solicited	$600,000
Number of new awards pending adequate proposals of merit	Scoping Studies for Potential Field Campaigns: 1-2 Workshops: 1-3
Maximum duration of awards	1.5 years
Due date for Notice of Intent to propose (NOI)	January 15, 2016 [Corrected December 18, 2015]

Due date for Proposals	March 18, 2016 [Corrected December 18, 2015]
Planning date for start of investigation	May 1, 2016
Page limit for the central Scientific/Technical section of proposal	15 pp.; see also Chapter 2 of the *NASA NRA/CAN Proposers Guidebook*
Relevance to NASA	This program is relevant to the Earth science strategic goals and subgoals in NASA's *Strategic Plan*; see Table 1 and the references therein. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA NRA/CAN Proposers Guidebook* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA NRA/CAN Proposers Guidebook*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-BIODIV
NASA point of contact concerning this program	Woody Turner Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1662 E-mail: woody.turner@nasa.gov

A.7 CARBON MONITORING SYSTEM: CONTINUING PROTOTYPE PRODUCT DEVELOPMENT, RESEARCH, AND SCOPING

NOTICE: This amendment adds a new opportunity for the Carbon Monitoring System program element, which had previously been designated as not solicited this year. Notices of Intent to propose are requested by January 29, 2016, and proposals are due March 29, 2016. Proposers to this program do not need to submit a data management plan via the NSPIRES cover pages, because the data management plan is part of the evaluation of Merit, see Sections 2.2.7 and 3.2.

1. Scope of Program

The NASA Carbon Monitoring System (CMS) is a forward-looking initiative designed to make significant contributions to characterizing, quantifying, understanding, and predicting the evolution of global carbon sources and sinks through improved monitoring of carbon stocks and fluxes. Initially implemented in response to language in NASA's 2010 Congressional Appropriation, this program is now included in NASA's multiyear budget; as presently implemented, the program conducts pre-Phase A and pilot initiatives for the development of a carbon monitoring system.

NASA's approach toward a carbon monitoring system emphasizes exploitation of current and future satellite remote sensing resources, computational capabilities, scientific knowledge, airborne science capabilities, and end-to-end system expertise that are major strengths of the NASA Earth Science program. Significant effort is being devoted to rigorous evaluation of the carbon monitoring products being produced, as well as to the characterization and quantification of errors and uncertainties in those products. The emphasis has been on regional, national, and global satellite-based carbon monitoring products relevant to national needs for completely transparent carbon and biomass inventory processes that provide statistical precision and accuracy with geospatially explicit associated attribute data.

NASA's approach takes into account data and expertise that are the domain of other U.S. Government agencies and anticipates continuing close communications and/or partnerships with those agencies and their scientific and technical experts as U.S. national efforts toward integrated carbon monitoring mature, especially as coordinated through the Carbon Cycle Interagency Working Group of the U.S. Global Change Research Program (http://www.carboncyclescience.us).

NASA also recognizes a need for complementary local-scale (airborne and *in situ*) information to demonstrate quantitative remote sensing methods; to aid in scaling up from project, county, and/or state levels; and for essential evaluation of regional-, national-, and global-scale products. Such work is critically important for advancing Monitoring Reporting and Verification (MRV) system capabilities in support of Reducing Emissions from Deforestation and Forest Degradation (REDD) in developing nations. Additionally, the current approach lays the groundwork for CMS-related applications of future NASA satellite sensors now in operation and development (i.e., Orbiting Carbon Observatory-2 (OCO-2); Ice, Cloud, and Land Elevation Satellite-2

(ICESat-2); Global Ecosystem Dynamics Investigation (GEDI), Pre-Aerosol; Clouds; and ocean Ecosystem (PACE), and the NISAR (NASA-Indian Space Research Organization L- and S-band synthetic aperture radars)) or in preformulation, i.e., Active Sensing of CO_2 Emissions Over Nights, Days, and Seasons (ASCENDS) and Hyperspectral Infrared Imager (HyspIRI).

In a first phase of activities, NASA initiated two CMS pilot studies and several scoping efforts focused on the utilization of satellite data:

- A Biomass and Carbon Storage Pilot Product
- An Integrated Emission/Uptake ("Flux") Pilot Product
- Scoping studies and research to understand the needs of end users and scope potential new carbon monitoring products

A second phase of activities focused on:

- Building upon the foundation established and lessons learned in the initial pilot studies and scoping efforts and to further integrate NASA products and capabilities with those of other U.S. agencies and international entities (solicited in ROSES-2011)
- Acquisition, field sampling, quantification, and development of prototype Monitoring Reporting and Verification (MRV) system capabilities, with an emphasis on use of commercial off-the-shelf technologies and support of Reducing Emissions from Deforestation and Forest Degradation (REDD and REDD+; see http://www.un-redd.org/aboutredd/tabid/102614/default.aspx) projects in developing nations and, in particular, U.S. SilvaCarbon (http://www.silvacarbon.org/) activities (solicited in ROSES-2013).

A following phase of activities (ROSES14) focused on:

- Studies using commercial off-the-shelf technologies to produce and evaluate prototype monitoring, reporting and verification system approaches, and/or calibration and validation data sets for future NASA missions, including, but not limited to, monitoring reporting and verification work in support of REDD, REDD+, or SilvaCarbon projects;
- Studies that address research needs to advance remote sensing-based approaches to monitoring, reporting, and verification (e.g., quantification of forest degradation; independent assessment of the accuracy of airborne remote sensing observations of biomass and carbon stocks; use of airborne flux observations and satellite remote sensing, as alternative methods for quantifying net carbon emissions/storage).
- Studies that advance upon, extend, and/or improve the existing CMS products for biomass and flux resulting from NASA's first phases of CMS pilot studies; such studies may include, for example, product improvements, refined characterization and quantification of errors and uncertainties, and/or preparation and delivery of a mature product for long-term archive at an established NASA Distributed Active Archive Center, or equivalent data center.

Studies to improve the characterization and quantification of errors and uncertainties and to understand and engage the user community for carbon monitoring products have been emphasized throughout.

A NASA Carbon Monitoring System Science Team (CMS ST) has been established to include members from all NASA CMS investigations. The CMS ST is responsible for providing broad research community involvement in the development and evaluation of NASA CMS products; coordinating their NASA-funded CMS activities to ensure maximum returns for science, management, and policy; and providing scientific, technical, and policy-relevant inputs to help set priorities and directions for future NASA CMS activities. As current proposals are completed, their Principal Investigators (PIs) will rotate off the CMS ST and be replaced by those of the newly-selected investigators.

Additional information on these initial activities, progress reports, the CMS ST, and links to available data and data products are provided at http://carbon.nasa.gov. The work conducted in this prototyping effort to date has leveraged the much larger investment currently made by NASA in remote sensing observations of carbon-related properties of the Earth, as well as in carbon cycle science and carbon management research.

2. Research Solicited

NASA requests proposals for investigations to advance the development of a carbon monitoring system. Emphasis is to be directed towards continued development of the established CMS pilot studies, acquisition, field sampling, quantification and development of prototype MRV see: http://www.un-redd.org/UNREDDProgramme/InternationalSupport/MeasurementReportingandVerification/tabid/1050/language/en-US/Default.aspx) system capabilities which can provide transparent data products achieving levels of precision and accuracy required by current carbon trading protocols. NASA is also looking for advancements from past CMS activities that will substantially contribute to the above activity. Successful applicants will become members of the NASA CMS ST.

2.1 Research Topics

NASA is interested in receiving proposals for the following types of prototyping, research, and scoping activities for carbon monitoring:

- Studies using remote sensing data products to produce and evaluate prototype MRV system approaches and/or calibration and validation data sets for future NASA missions;
- Studies that conduct MRV-related work in support of international REDD or REDD+ projects;
- Studies that address research needs to advance remote sensing-based approaches to MRV (e.g., quantification of forest degradation; independent assessment of the accuracy of airborne remote sensing observations of biomass and carbon stocks; use of airborne flux observations as an alternative method for quantifying net carbon emissions/storage).
- Studies to improve the characterization and quantification of errors and uncertainties in existing and/or proposed NASA CMS products, including errors and uncertainties in the algorithms, models, and associated methodologies utilized in creating them; and
- Studies of stakeholder interests and requirements that offer to 1) understand and engage the user community for carbon monitoring products and/or 2) evaluate current and planned NASA CMS products with regard to their value for decision making by these users and to

assist in having existing products used for stake-holder activities. Priority will be given to proposals where potential stakeholders have in-kind contributions to ensure transfer of CMS activities into their own ongoing or future activity.

Data from airborne or spaceborne remote sensing must be an essential element in all proposed carbon monitoring investigations. All sources of remotely sensed data to be used must be well justified in terms of their importance and appropriateness for the work to be conducted, as well as their overall utility and priority for monitoring carbon for science, management, and policy.

The NASA CMS program continues to emphasize the importance of characterizing and quantifying uncertainties and errors in all CMS products and analyses, and such work must be included in all investigations proposed (see also section 2.2.7).

Proposals must explain the societal relevance of the carbon monitoring activities proposed and provide justification regarding the importance of this work to U.S. national interests in current or potential carbon monitoring for science, management, and policy. Proposers are strongly encouraged to address stakeholder interests in their studies and to contribute to CMS ST activities to understand and engage the user community for carbon monitoring products.

Many of the studies funded through the ROSES-2013 CMS solicitation (A.7; see PDF document with titles and abstracts of ROSES-2013 awards) will be expiring, while all the investigations funded in the ROSES-2014 solicitation (A.7; see PDF document with titles and abstracts of ROSES 2014 awards) have two more years until completion. Proposals to further develop or expand upon the funded ROSES-2014 activities are, therefore, not as high a priority this year as the research topics listed in this solicitation. It is anticipated that activities selected in ROSES-2014 will be given higher priority in future CMS-related solicitations.

2.2 Additional Proposal Requirements

2.2.1 *Requirements Regarding the Duration of Award*

The scientific tasks of the ST members will be of no more than three years duration and proposers may not propose for a longer period of performance. If the proposed research can be conducted in less than three years, a shorter period of performance is encouraged.

2.2.2 *Carbon Monitoring System Science Team Membership*

All proposals must request CMS ST membership for one or more key investigators and include 1-2 paragraphs describing the contributions they anticipate making to the activities of the CMS ST. This section should address one or more of the following:

- Representing concerns of the broad carbon monitoring community with respect to the nature, quality, and utility of NASA CMS products;
- Coordinating their CMS activities to ensure maximum returns and enhance or create complementarity, integration, and synergy;
- Providing important perspectives on product development, implementation, and evaluation;
- Providing insights on the relative merits of alternative approaches and products;

- Making connections to ongoing and newly developing activities with similar and/or complementary objectives being undertaken by other entities, especially other U.S. agencies; and/or
- Providing scientific, technical, and policy-relevant inputs to help set priorities and directions for future NASA CMS activities, including the participation with the existing working groups within CMS.

The CMS ST will conduct its business through periodic meetings with more frequent interactions through teleconference calls and E-mail. Proposals are not being solicited here for the Science Team leader, as one was selected in the ROSES-2014 CMS solicitation. It is anticipated that proposals for this role will be solicited in a future ROSES call.

2.2.3 *Requirements for the Cost Plan*

Given the differing types of investigations solicited, NASA expects to fund a range of investigation sizes. It is expected that proposals requiring acquisition of new airborne or commercial satellite data will have budget profiles that have a significant peak during the year of data purchase/acquisition, but for the other years of such studies and for all other investigation types, NASA would not expect the per year budget, even for the most ambitious of investigations, to exceed $500,000.

All proposals must include in their cost plans resources for activities to be undertaken as a CMS ST member, including funds for travel to ST meetings. The proposed budget should include funds to participate in two CMS-related meetings per year lasting three days each. For planning purposes, proposers should budget each year for one meeting in the western U.S. and one meeting in the Washington, DC area.

2.2.4 *Requirements for Proposals Requesting Acquisition of New Airborne Data*

New proposals requiring data from airborne sensors must detail in their cost plan all costs for acquiring the new data sets, including costs for aircraft hours, deployment costs, mission peculiar costs, data processing costs, and other costs associated with deploying the sensors, aircraft, and personnel (this provision applies to all sensors and platforms, including any NASA sensors and platforms, as well as non-NASA sensors and platforms). If the instrument or aircraft platform are not NASA assets, proposers must take responsibility for making all arrangements to secure the availability of the needed sensors and aircraft and explain these plans in the proposal.

All proposers must submit a Flight Request to the NASA Airborne Science Flight Request system at http://airbornescience.nasa.gov (and then click on "FLIGHT REQUEST"). This is required whether the request involves NASA sensors, platforms, and personnel or not because the flight request is used to help NASA to understand and track all of the airborne science it supports. Questions regarding the flight request system or process should be addressed to Marilyn Vasques, Flight Request Manager (Marilyn.Vasques@nasa.gov or 650-604-6120).

Given that this solicitation allows the use of commercial off-the-shelf technologies, which includes commercial airborne sensors and platforms, it is important to note that all such activities must be conducted according to required NASA policies and procedures. All aircraft operations,

including operations of commercially acquired aircraft, will be reviewed in accordance with NPR 7900.3 (http://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=7900&s=3C). At a minimum, this will include meeting NASA safety requirements.

2.2.5 *Requirements for International Agreements, Permissions, and Flight Clearances*

CMS activities proposing airborne and *in situ* data acquisitions outside the U.S. (e.g., for REDD, REDD+, or SilvaCarbon projects) and/or cooperation with foreign institutions may require international agreements, permissions (e.g., research/data collection permits), overflight clearances, or other formal arrangements. Proposals must detail plans for meeting such requirements.

Proposals requesting use of NASA aircraft or NASA sensors and/or involving NASA personnel in international work will be required to follow all NASA policies and procedures regarding such activities. In some cases, it may either be required or preferable that NASA take the lead in securing all or certain ones of the required agreements, permissions, or clearances. In most cases where the use of NASA aircraft or sensors is not requested and NASA personnel are not involved, proposers will be fully responsible for securing their own arrangements.

Research involving participants at foreign organizations must be proposed and performed on a no-exchange-of-funds basis, whether on a proposal from a foreign or a U.S. organization. For more information see http://science.nasa.gov/researchers/sara/faqs/#14.

2.2.6 *Requirements to Address Errors, Uncertainties, and Instrument Calibration*

Given the importance of MRV data and information for decision-making, it is essential that the research supported under NASA's CMS program characterize uncertainties and quantify errors associated with data and derived information products, as well as with analytical approaches, model results, and/or scientific interpretations. When new data are acquired as part of the proposed activities, it is equally important that instrument calibration be documented and traceable so that different types of data and data products can be intercompared with a high degree of confidence. Therefore, all proposals submitted in response to this solicitation must describe how errors and uncertainties will be addressed within their research project, including, if relevant to their study, errors and uncertainties associated with instrument calibration. The characterization of errors and uncertainties must be described in a separate subsection of the Scientific/Technical/Management section of the proposal. If new observations are to be made in the study, then this subsection should also describe their calibration, accuracy, and traceability.

2.2.7 *Data Policy and Data Management Plan Requirements*

All data and information acquired and data products produced under the NASA CMS program must be made publicly available, with no period of exclusive use, in compliance with NASA's Earth Science data policy (http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/). Proposals must include a data management plan of no more than two pages that addresses the dissemination and sharing of research results, how data and information will be provided, and the proposer's compliance with the NASA Earth Science data policy. The data management plan should include the types of data and data products, algorithms, models and model outputs, or other materials to be produced in the course of the project; the standards to be used for data and metadata formats; the types of errors and uncertainties to be quantified and

how they will be reported; and plans for providing access to and/or archiving the data and other research products. The data sharing plan called for in Section 2.3.5 of the *Guidebook for Proposers* may be included in the data management plan. For any proposed new data products, the data management plan must include provisions for quality assessment, timely public release consistent with NASA policies, and long-term archive of the data product(s). The data management plan must be included within the 15-page limit for the Scientific/Technical/Management section of the proposal.

3. Programmatic Information

3.1 Funding Allocations

Of the $10M of Fiscal Year 2016 funding provided for continuing CMS efforts, $5.5M is committed to ongoing competitive research commitments from prior years. Therefore, $4.5M in FY 2016 funding is available to support new research under this solicitation.

3.2 Evaluation Criteria

Proposals will be evaluated according to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*, with additional factors noted in this section.

In addition to the factors given in the *Guidebook for Proposers*, the determination of a proposal's intrinsic merit shall take into account the following additional considerations:

- The quality and appropriateness of the proposed approach to product prototyping, product evaluation, and/or characterization of uncertainties and quantification of errors, including those associated with instrument calibration, and
- The quality and completeness of the data management plan.

In addition to the factors given in Section 2.1, the determination of a proposal's relevance shall take into account the relative priority of the activities proposed for support of carbon monitoring-related decision making.

4. Summary of Key Information

Expected program budget for first year of new awards	$4.5M
Number of new awards pending adequate proposals of merit	~8-15
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	January 29, 2016. See also Tables 2 and 3 in the *ROSES Summary of Solicitation*
Due date for Proposals	March 29, 2016. See also Tables 2 and 3 in the *ROSES Summary of Solicitation*
Planning date for start of investigation	September 2016

Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	This program is relevant to the Earth Science questions and goals in the NASA Science Plan; see Table 1 of ROSES and the reference therein. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-CMS
NASA points of contact concerning this program, all of whom share the following postal address: Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001	Kenneth W. Jucks Telephone: 202-358-0476 Email: Kenneth.W.Jucks@nasa.gov Kathleen Hibbard Telephone: (202) 358-0245 E-mail: Kathleen.A.Hibbard@nasa.gov Hank Margolis Telephone: (202) 358-4760 E-mail: Hank.A.Margolis@nasa.gov

A.8 PHYSICAL OCEANOGRAPHY

1. Scope of Program

NASA's Physical Oceanography program supports basic research and analysis activities that enable development of NASA's current and future physical oceanography satellite missions and the scientific interpretation of data from them. The primary centers of support for the Physical Oceanography program are the NASA Jet Propulsion Laboratory Earth Science Directorate and the external (non-NASA) scientific community. This announcement serves as the vehicle for participation in the Physical Oceanography program for all institutions.

The primary scientific thrust for physical oceanography at NASA is toward understanding the ocean's role in climate variability and its prediction. Since the general ocean circulation plays a critical role in the global heat balance and materially changes atmospheric properties through air-sea exchange, understanding and modeling the state of the coupled ocean-atmosphere system are fundamental to climate studies. NASA utilizes the unique vantage point of space to enable rapid collection of global ocean data sets and intends to contribute significantly to the World Climate Research Program's Climate Variability and Predictability (CLIVAR) Program.

An emerging area of increased emphasis in NASA's Physical Oceanography program is research on the coastal ocean. While NASA's focus will remain global in nature, it is recognized that many of the practical problems with respect to human interaction with the ocean lie within the coastal seas.

Two research themes are identified in the Physical Oceanography program and represent priority areas for proposals solicited through this announcement.

- Analysis and interpretation of the ocean circulation using satellite and *in situ* data. - NASA will support modest proposals undertaking analysis of satellite altimetry, surface wind stress, and other relevant data in support of the U.S. CLIVAR Program (http://www.usclivar.org).

- Development of new remote sensing techniques for physical oceanography. - NASA has successfully developed remote sensing techniques for ocean surface winds, sea level, sea surface temperature, and sea surface salinity. Each of these variables has a science team and dedicated research activity. NASA will support modest proposals that explore new concepts for remote sensing of interest to physical oceanography. This opportunity is NOT for technology or instrument development but for concept articulation and exploration.

2. Programmatic Information

Total funds available for work selected under this solicitation are approximately $1.0M per year for three years.

Programmatic priority will be given to those proposals making the strongest links to analysis of satellite data and addressing oceanographic problems at basin or global scale.

Based on the quality of proposals received, awards will be distributed across the two research themes identified in Section 1. Proposals outside these research themes may be considered but must be highly meritorious.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $1M
Number of new awards pending adequate proposals of merit	~ 5-10
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	1 January 2016
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-PO

NASA point of contact concerning this program	Eric Lindstrom Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-4540 E-mail: eric.j.lindstrom@nasa.gov

A.9 OCEAN SALINITY SCIENCE TEAM

NOTICE: Ocean Salinity Science Team (OSST) will not be competed in ROSES this year. The OSST is tentatively scheduled to next solicit proposals in ROSES-2016.

The NASA Ocean Salinity Science Team (OSST) supports basic research and analysis activities associated with the joint Aquarius/SAC-D mission. Proposals were last received in July 2013, and it is anticipated that proposals will be solicited again in ROSES-2016.

The goals of the OSST are to provide the scientific underpinning for production of the best possible satellite-derived ocean salinity data sets and to demonstrate the Earth science and applications arising from analyses of the ocean surface salinity data. The team assures that data made available from Aquarius are of the highest quality and validated for scientific exploitation. It also conducts ocean science investigations that are possible only through exploitation of Aquarius data.

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A.10 SURFACE WATER AND OCEAN TOPOGRAPHY (SWOT) SCIENCE TEAM

1. Introduction

Surface Water and Ocean Topography (SWOT) is a satellite mission being jointly developed by NASA and CNES (Centre National d'Etudes Spatiales), the French space agency, with contributions from the Canadian Space Agency (CSA) and the United Kingdon Space Agency (UKSA) and is currently scheduled for launch in October 2020. Information on the SWOT mission and its capability to fulfill the objectives laid out for it can be found at the SWOT web site (http://swot.jpl.nasa.gov/).

SWOT is an ambitious mission that will make a transformational impact in terrestrial hydrology and create breakthroughs in mapping ocean surface topography. Technical and scientific challenges include reducing measurement noise by two orders of magnitude below that of conventional altimetry missions like Ocean TOPography EXperiment (TOPEX)/Poseidon and Jason. The systematic measurement errors (e.g., baseline roll and metrology, water-vapor induced range errors, etc.) must also be reduced at oceanic mesoscales to more than one order of magnitude below the signal levels. Mesoscale tidal errors caused by coastal and internal tides must be corrected for. The effects of vegetation, target layover, and water mask accuracy over land are challenges to be met by the mission's measurement system.

The SWOT mission will use Ka-band radar interferometry to produce a swath of elevation measurements collected over land surface waters and over the ocean water surface (i.e., the ocean surface topography, OST). These elevation measurements are necessary for studying changes in the amount of water stored and flowing through the world's rivers, lakes, wetlands, reservoirs, etc. The measurements are fundamental for studying OST and mesoscale and submesoscale processes in the ocean. On land, the SWOT mission will make the first high-resolution, mapping of the height and area variations of water bodies such as lakes, reservoirs, and wetlands. SWOT will also provide measurements necessary for estimating river discharge. All of these elements are of key importance to monitoring and understanding the shifting freshwater resources. Over the ocean, the SWOT mission will extend the capability of existing nadir profiling altimeters to two-dimensional mapping at higher resolution enabling the study of energetic ocean currents, eddies, and fronts that contain most of the kinetic energy of the ocean.

The objective of this solicitation is to select a Science Team (ST) to assist with prelaunch planning and scientific development for the SWOT mission. The selection will be conducted in coordination with CNES, CSA and UKSA. The ST will function for the period Calendar Year (CY) 2016 through CY 2019, finishing approximately one year prior to the currently planned launch date. Its role, along with relevant scientific research, will be to provide expert guidance to the SWOT project in the areas of measurement requirements, product definition, geophysical error sources, algorithm development, calibration, validation, and liaison with the broader science and applications communities.

2. Primary Research Priorities for the Science Team

2.1 Hydrology Priorities

The primary objective of SWOT hydrology, described in the Science Requirements Document at http://swot.jpl.nasa.gov/files/swot/SWOT_Science_Requirements_Document.pdf, is to "characterize the spatial and temporal variations in surface waters, globally." In particular, SWOT aims to measure variations in lake and wetland water storage and river discharge at submonthly, seasonal, and annual timescales. These measurements will constitute the first globally consistent database of surface water storage and fluxes from space and will substantially advance hydrologic science in several areas, as specified in the Science Description Document at http://swot.jpl.nasa.gov/files/SWOT_MSD_final-3-26-12.pdf. The following are key areas of that must be addressed by the mission's Science Team before launch:

2.1.1 *Lake Processes*

Water stored in lakes and reservoirs represents a key term in global and regional water balance studies, as well as an important source of water resources. It is expected that SWOT will provide a unique dataset of water storage variations for lakes as small as $(250\ m)^2$. The science team will need to develop ways to leverage this data to address important scientific questions. For example, the team will need to determine the locations of lakes likely to be observable by SWOT prior to launch. It will also need to characterize the potentially important influences on accuracy of SWOT lake storage, including lakeshore characteristics, water surface roughness, lake shape, and water surface height dynamics. The Science Team will also need to develop robust modules for assimilating SWOT measurements of lake water storage into global and regional hydrologic models.

2.1.2 *River Discharge*

At continental margins, rivers represent the primary transfer of surface water from terrestrial to oceanic reservoirs, and existing *in situ* stream gauges have characterized mean values for global discharge to the oceans. It is difficult to understand most hydrologic processes at these large scales, however, and current measurements do not adequately capture finer scale patterns of discharge for most of the world. SWOT will provide these measurements for rivers wider than 50-100 m globally. However, the science team must comprehensively validate discharge algorithms to ensure they function well in a range of different river types. In addition, it must determine how to use data assimilation tools to develop continuous discharge fields from temporally isolated SWOT measurements. Finally, it must determine how to best leverage the resulting datasets to address key science questions related to river processes.

2.1.3 *Integration of SWOT Measurements into Models*

While direct observation of surface water storage and fluxes during the lifetime of the SWOT mission will provide new insights into the workings of the hydrologic cycle on seasonal and annual timescales, advances in understanding of climate-scale processes will largely come through integration of SWOT measurements into hydrologic, hydrodynamic, land surface, and

climate models. More accurate representation of lake and wetland water storage and flux through rivers will improve representation of the water cycle in these models. Studies aiming to develop novel ways of assimilating SWOT data into models and studies comparing different modeling frameworks across a range of locations will be necessary prior to launch.

2.1.4 *Wetland Water Surface Elevation, Storage, and Connectivity*

Because they are generally vegetated and often have diffuse and ill-defined boundaries, wetland environments will represent complex targets for SWOT measurements. At the same time, because of their critical roles in the global water and carbon cycles, observation of wetlands will likely lead to some of the most important hydrologic science outcomes from SWOT. The Science Team must work to improve understanding of SWOT error characteristics in different types of wetlands and to determine the best ways in which SWOT can be used to address interlinked problems of carbon, water, and climate in wetland environments. In addition, we encourage studies that demonstrate how SWOT measurements can be used to assess changing connectivity of wetlands to rivers, lakes, and other water bodies.

2.1.5 *Calibration/Validation*

Calibration and Validation of SWOT measurements will require ground-based and airborne measurements at many locations in a wide variety of different environments worldwide. As such, development of novel methods and new partnerships for validating water surface heights, inundation extents, river slopes, water storage in lakes and reservoirs, river discharge, and other relevant SWOT measurements will be critical prior to launch. The Science Team, in particular, should seek to develop new relationships and leverage existing partnerships with scientists and hydrologic measurement agencies from around the world.

2.1.6 *Water/Land Classification Algorithms*

SWOT is the first space-based sensor to use near-nadir Ka-band radar returns to measure water surface elevation and inundation extent. As such, there is remaining uncertainty regarding how to use SWOT returns and ancillary information from SWOT, other sensors, and *in situ* datasets to most effectively make these measurements. The Science Team will need to use data from AirSWOT, simulators, and other tools to develop robust algorithms for classification of water vs. land in a range of different land cover types. This activity will also include assessments of how accurately SWOT will detect the presence of water under a range of vegetation types.

2.1.7 *Measurement Phenomenology and Corrections*

SWOT will collect data at near-nadir incidences using Ka-band frequencies, where there is little experience in interpreting the return signal. Investigations to characterize the contamination in elevation due to vegetation and topographic layover, as well as providing correction algorithms, are encouraged. In addition, various phenomena (wet troposphere, snow, rain) will impact the accuracy of estimated heights. Studies to improve the corrections or flagging under these circumstances are also encouraged. Finally, studies of the use of SWOT data to optimize measurements of floodplain topography, with and without vegetation, are encouraged.

2.1.8 *Higher Level Products*

The SWOT Mission will produce discharge and lake water storage products based directly on SWOT observations and, in some cases, comparatively simple statistical models. However, additional products that use SWOT measurements in combination with hydrologic, hydrodynamic, land surface, and climate models will also represent important outcomes of the SWOT mission. Development and testing of these products will be the responsibility of the Science Team, and we encourage proposals that lay the groundwork for them.

2.2 Oceanography Priorities

As stated in the mission's Science Requirement Document (http://swot.jpl.nasa.gov/files/swot/SWOT_Science_Requirements_Document.pdf), the primary measurement objective in oceanography is "to characterize the ocean mesoscale and submesoscale circulation determined from the ocean surface topography at spatial resolutions of 15 km (for 68% of the ocean)." The potential advancement in ocean dynamics and societal benefits from achieving this objective has been documented in the mission's Science Description Document (http://swot.jpl.nasa.gov/files/SWOT_MSD_final-3-26-12.pdf). Also described in the document are the scientific and technical challenges that are to be met in order to achive the mission's objectives. The following are the topics that are to be addressed by the mission's Science Team to fulfill the oceanographic objectives.

2.2.1 *Mesoscale and Submesoscale Processes*

Most of the kinetic energy of ocean circulation is contained in the mesoscale, of which the long wavelength (greater than 200 km in two dimensions) component has been resolved by the conventional altimetry observations. However, the energy at wavelengths shorter than 200 km is key to understanding the energy flux both upward and downward in spatial and time scales, a key challenge in making ocean circulation models realistic in closing the energy cycle, in particular the mechanism of eddy dissipation. Furthermore, the vertical transports of heat and chemical properties of the ocean are critically tied to the knowledge of ocean dynamics at short wavelengths. Both modeling and observational studies will be needed to develop ideas and methodologies to maximize the science return of SWOT observations.

2.2.2 *Tides and High-Frequency Motions*

At wavelengths shorter than 200 km, accurate knowledge of coastal and internal tides is essential to the success of the mission. It is expected that the Science Team will provide prelaunch tide models for inclusion in the mission's data products for users to separate the tides from ocean circulation signals. It is also anticipated that the Science Team will develop methodologies for utilizing the SWOT observations for improving the tide models after launch. There are intrinsic values in the tidal knowledge in advancing both science and societal applications.

In addition to tides, high-frequency internal waves and sea state conditions associated with wind and waves have certain effects on the accuracy of the Sea Surface Height (SSH) observations.

Studies focused on these effects on SWOT measurement are required to achieve the measurement objectives. During the first 180 days of the mission the satellite will fly in a 1-day repeat orbit. A minimum of 60 days' worth of observations will be available in nominal performance for studying these high-frequency processes.

2.2.3 *Interaction of Ocean Circulation with Mesoscale/Submesoscales*

Radar interferometry measurement has phase drift at wavelengths longer than 1000 km due to roll errors and other factors. However, the nadir altimeter will provide accurate measurement at long wavelengths along the nadir track. This will allow studies of the interaction between large-scale circulation and mesoscale/submesocale variability, leading to advancement in understanding the full spectrum of ocean circulation, as well as to ensure the compatibility of SWOT observations with the long-standing data record from conventional altimetry.

2.2.4 *Calibration/Validation*

As noted above, a minimum of 60 days' worth of observations will be available in a one-day repeat orbit during the first 180 days of the mission. These data will have nominal performance for calibration/validation purposes, including calibration/validation of the spectral requirement of SSH accuracy with comparisons to *in situ* observations and the onboard nadir altimeter and other satellite observations. Long-term calibration/validation studies beyond the initial mission phase will also be part of the mission's science plan.

2.2.5 *Geophysical Corrections and Algorithms*

There are anticipated contributions from the Science Team to better understanding of the measurement physics and the mission's algorithm development. Particular challenges include the correction for the electromagnetic bias at the Ka band frequency and its spatial variability across the measurement swath; the estimation of wind speed and significant wave height across the swath; the use of radar imagery to estimate surface current features; the detection of land, ice, and rain contamination; and, finally, the removal of errors due to the presence of ocean waves.

2.2.6 *High-Level Products*

The number of observations at a given location in a repeat cycle ranges from two near the equator to more than ten at the highest latitudes. To reconstruct SSH from the irregularly sampled observations with complex error characteristics will pose a significant challenge for advancing the study of ocean circulation from this new type of observation. Development of methodology for producing optimally estimated products on regular space and time grids on both global and regional basis will be an important activity of the Science Team.

3. Secondary Research Priorities for the Science Team

3.1 Coastal and Estuarine Processes

The limitation of land contamination of conventional altimeter observations near coasts will be alleviated by the radar interferometry measurement. This improvement, plus the availability of high-resolution data (~ 50 m) in the region where river meets the ocean, or the estuarine regions, will provide unprecedented opportunities to advance understanding of the complex water flow and its affects on this important environment.

Understanding coastal and estuarine processes, as well as removing tidal signals, will be aided by using the improved knowledge of coastal bathymetry, which will be derived from SWOT measurements of deviations from the vertical, for the development of better coastal tides and circulation models.

3.2 Terrestrial and Marine Cryosphere

SWOT is required to identify water covered by floating ice. Additionally, it is possible that SWOT will provide useful measurements of snow surface elevation, especially during snowmelt when liquid water is present within the snowpack. Similarly, SWOT may provide some information on variations in elevation of glaciers and ice sheets, especially in low-slope regions. These measurements may provide useful information on variations in the cryosphere of importance to understanding of the terrestrial water cycle.

SWOT measurement will be useful to determine the freeboard of sea ice to allow an estimate of the sea ice volume. The high-resolution observation, at 1-km everywhere with limited data at resolution ~100 m, will allow better determination of ocean surface topography in the polar ocean in the midst of sea ice. SWOT will also be useful to determine the height of ice sheets and thus provide all-weather information for studying the evolution of polar ice sheet topography. Water cycles involving melting of glaciers and ice sheets are a potentially fruitful subject of investigation.

3.3 Marine Geophysics

The SSH slope accuracy achieved by conventional altimetry is about 2 microradians, equivalent to 2 miligals in gravity anomaly. Every SWOT measurement promises to achieve 1 microradian slope accuracy at 15 km wavelength over two dimensions as opposed to one-dimensional measurement by conventional altimetry. Over the lifetime of the mission, the precision of the measurement, as well as contamination due to mesoscale eddy slopes, will improve by an order of magnitude due to temporal averaging. Such global measurement is anticipated to result in an order of magnitude improvement in the accuracy of estimating seafloor depth at small scales. This would reveal the currently hidden abyssal hill fabric of the slow-spreading rate seafloor, as well as perhaps 10-20 thousand uncharted seamounts taller than 1000 m.

4. Programmatic Information

Significant interagency and international contributions to SWOT ST are being planned, but are not yet fully realized. Paralleling the mission development, proposals that involve joint work between NASA and CNES investigators are encouraged. It is expected that international research partnerships will be considered when rating proposals. NASA will be considering only proposals from PIs in U.S. institutions. Foreign investigator participation in U.S. proposals is encouraged but strictly on a no exchange of funds basis. Proposals for participation in the SWOT science team via in-kind support directly from foreign institutions are encouraged to propose to CNES. CNES will review SWOT proposals through their TOSCA (Earth, Ocean, Continental Surfaces and Atmosphere committee; http://www.cnes.fr/web/CNES-en/7454-earth-sciences.php). NASA and CNES are coordinating their review and selection of SWOT proposals.

Science Team proposals must convincingly demonstrate that the projects proposed would address one or more of the Mission goals and priorities listed above. While priority in selection will be given to proposals that address the primary hydrology and oceanography objectives cited above, the secondary or other priorities of the mission remain in focus to enable scientific synergy and enhance opportunity for the mission.

As part of the development of the SWOT mission, an aircraft program, called AirSWOT, has been established for flying a radar interferometry system similar to that designed for SWOT over selected ocean and land targets. The objectives of AirSWOT are to validate the key assumptions underlying the science requirements and estimated error budget, to aid the development of science algorithms, to prescribe the cal/val approach, and to test ground systems. The ST will provide advice and guidance for AirSWOT activities.

Simulated SWOT data is available at http://sourceforge.net/projects/swotsimulatorforoceanscience/ to support proposals to this announcement.

5. Summary of Key Information

Expected program budget for first year of new awards	~ $3M
Number of new awards pending adequate proposals of merit	~ 15-20
Maximum duration of awards	4 years
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	January 1, 2016
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*

Relevance to NASA	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-SWOT
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A.11 OCEAN SURFACE TOPOGRAPHY SCIENCE TEAM

NOTICE: Ocean Surface Topography Science Team (OSTST) will not be competed in ROSES this year. The OSTST is tentatively scheduled to next solicit proposals in ROSES-2016.

The joint NASA/CNES Ocean Surface Topography Science Team (OSTST) supports basic research and analysis activities associated with joint satellite altimetry missions (TOPEX/Poseidon (TP), Jason-1, and Ocean Surface Topography Mission) and other ocean altimetry data sets. The team is recompeted every four years. Proposals were last received in March 2012, and it is anticipated that proposals will be solicited again in ROSES-2016.

The goals of the OSTST are to provide the scientific underpinning for production of the best possible satellite-derived ocean surface topography data sets and to demonstrate the Earth science and applications arising from analyses of the ocean surface topography data. The team is also involved in the calibration and validation for the Ocean Surface Topography Mission (OSTM), a cooperative mission between NASA, CNES, the National Oceanic and Atmospheric Administration (NOAA), and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), which successfully launched in June 2008.

For information on this program, contact:

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A.12 OCEAN VECTOR WINDS SCIENCE TEAM

NOTICE: Ocean Vector Winds Science Team (OVWST) will not be competed in ROSES this year. The OVWST is tentatively scheduled to next solicit proposals in ROSES-2017.

The Ocean Vector Wind Science Team (OVWST) supports the analysis and interpretation of ocean vector winds and other applications derived from Earth-observing missions carrying scatterometers and polarimetric radiometers. Every four years, this program element solicits scientific investigations that require the accurate and extensive vector wind and backscatter measurements. This element was last competed in 2013 and is anticipated to be open again in ROSES-2017.

Extensive background on NASA's ocean vector wind science program and missions is available at http://winds.jpl.nasa.gov/.

For information on this program, contact:

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A.13 MODELING, ANALYSIS, AND PREDICTION

1. Scope of Program

1.1 Overview

NASA's Science Mission Directorate (SMD) supports a broad portfolio of research in the Earth Science Research Program. Key questions that drive the core research efforts of the Earth Science Division within SMD include:

- How is the Earth system changing?
- What are the sources of change in the Earth system and their magnitudes and trends?
- How will the Earth system change in the future?
- How can Earth system science improve mitigation of and adaptation to global change?

Within Earth Science Research, the Modeling, Analysis, and Prediction (MAP) program seeks an understanding of the Earth as a complete, dynamic system. It also seeks to understand how to generate through the integration of observations and models best estimates of the current and past states of the Earth system.

The MAP program supports observation-driven modeling and data assimilation. The modeling is distinguished by rigorous examination and utilization of observations in a global Earth system context, for the purpose of extracting from the observations the maximum information about the structure, function and evolution of the Earth system as possible. The modeling integrates across all the research activities in NASA's Earth science research program, and spans the spatial and temporal scales that characterize satellite observations and observations from ground and air based campaigns. This approach facilitates the validation of the satellite observations and leads to observationally-based improvements of Earth system model components, resulting in models that accurately represent the Earth system with diagnostic and predictive skill. MAP strives to generate models and model components that are well-documented, thoroughly evaluated, interoperable, robust, and consistent with current coding standards and practices.

1.2 Background

MAP funds several large projects and/or functional organizations that comprise the core activities of the program. These efforts include:

Goddard Institute for Space Studies (GISS; http://www.giss.nasa.gov/projects/gcm) supports research on natural and anthropogenic global climate change that may occur on the decadal to centennial timescale. GISS makes use of analyses of comprehensive global datasets and develops and utilizes integrated global models of the Earth system. The research includes the study of paleoclimate and the study of other planets as an aid to prediction of future evolution of Earth on a planetary scale. The primary GISS modeling tool supported by the MAP program is the GISS Model E (http://www.giss.nasa.gov/tools/modelE/), a coupled atmosphere-ocean Earth system model.

NASA Goddard Global Modeling and Assimilation Office (GMAO; http://gmao.gsfc.nasa.gov) addresses the optimal use of satellite and *in situ* observations to generate research quality data sets for climate analyses and also for weather, climate, and air quality forecasts. The modeling and assimilation research includes coupling to and assimilation of atmospheric aerosols and chemistry, and ocean biology and carbon. GMAO develops and maintains world-class data assimilation systems in order to maximize satellite data utility and serve as a central resource for testing and validating as wide a range of modeling and observational efforts as possible. The goal is to undertake modeling and assimilation as components of an end-to-end process, spanning instrument definition and development, characterization of in-flight performance, development of algorithms and forward models for data assimilation, integrating data into assimilation products, and assessing the impact of the data on the products of the assimilation system. GMAO is supported by MAP to develop and utilize the Goddard Earth Observing System, Version 5 (GEOS 5). GEOS 5 includes both a coupled atmosphere-ocean GCM and a data assimilation system (DAS). More information is available at: http://gmao.gsfc.nasa.gov/systems/geos5/.

1.3 Modeling, Analysis, and Prediction Research Themes

The specific research themes included in this Modeling, Analysis, and Prediction solicitation are as follows:

1.3.1 Ocean Modeling and Data Assimilation including the Cryosphere

A long-term goal of the MAP program is the development of an Integrated Earth System Analysis (IESA) capability. IESA is the process of consistently combining all available observations of the Earth System (atmosphere, ocean, land surface, sea-ice, and biogeochemistry) at some time with a model of the Earth System in such a way to produce a best estimate of the state of the Earth System at that time. This capability is not currently available given the start-of-the-art in modeling the global Earth System and the high computational requirements necessary for such a task.

At the present time, MAP is funding efforts to produce atmospheric analyses and reanalyses, and funds a related effort aimed at developing a best estimate of the evolution of the ocean state at high resolution, including sea ice, ice shelves, and ice sheet processes over the time period when significant ocean observations are available.

In this solicitation, MAP seeks proposals aimed at furthering NASA's capabilities in the area of ocean modeling and data assimilation, with a particular focus on development toward an integrated Earth System analysis. Issues MAP is interested in addressing in the area of ocean modeling and data assimilation include:

- Improvements of the representation of ice sheets and their interaction with ice shelves, sea ice, and oceans in coupled ocean/atmosphere GCMs.
- Ocean state estimation including interactions between the ocean and the cryosphere, incorporating all relevant observations and including evaluation of the state estimates.
- Improved understanding and representation in global models of atmosphere/ocean interactions, including exchanges of heat, momentum, and carbon dioxide.

- Improved understanding of ocean/ice sheet/ice shelf interactions.
- Combined ocean/atmosphere data analysis systems.

Proposals funded under the ocean modeling and data assimilation research theme must demonstrate a tie to either the GISS Model E or GMAO GEOS5 GCM/Data Assimilation System.

1.3.2 Earth System Modeling Framework for MAP-supported modeling efforts

The National Research Council (NRC) Committee on a National Strategy for Advancing Climate Modeling released a report that recommended that climate models evolve toward utilization of a common software infrastructure capable of supporting a diverse set of models. The rationale for this recommendation is that the common infrastructure would serve to promote a number of desired outcomes, such as increased reliability, easier migration of models to new computing platforms, increased computational efficiency, increased interoperability and code portability, and consistency of output formats. This recommendation is consistent with a long-standing MAP program requirement that the code developed with MAP support be written using standardized software tools that increase code interoperability and utility, and reduce sources of error. The Earth System Modeling Framework (ESMF) is a software package designed to facilitate the development of Earth Science codes with increased interoperability, reuse, ease of use, and portability which has been extensively used in the design of GEOS5 and is increasingly used in GISS Model E. (See http://www.earthsystemmodeling.org for a full description of the software.)

The standard ESMF distribution has been augmented over the past few years with the development of two "usability" layers, which facilitate the implementation of ESMF in Earth system models. These are the Modeling Analysis and Prediction Layer (MAPL), developed at the NASA Goddard Space Flight Center and extensively used in the GEOS-5 and GISS models, and the National Unified Operational Prediction Capability (NUOPC) Layer, which was developed jointly by Navy and NOAA personnel. These two usability layers have much in common, but differences exist. MAPL is more fine-grained, allowing standardized component coupling from the parameterization level to large model components (e.g., ocean, atmosphere), while the NUOPC layer is more focused on the coupling of the larger model components. However, the development of two separate usability layers threatens to compromise the goals that precipitated the development of ESMF in the first place, and there is a need to unify the two layers or at least make them highly interoperable.

The NASA MAP program is interested in continuing the process of utilizing ESMF in MAP-supported codes, and in supporting continued development of the ESMF in ways that address MAP-supported software needs. The MAP program is, therefore, soliciting proposals that contribute to utilization of ESMF software within MAP-supported code, and propose work to further develop ESMF software in directions that are demonstratively of benefit to NASA's modeling interests. Specific efforts of interest to NASA include:

- Efforts to continue incorporation of MAPL within the base ESMF implementation, including documentation of MAPL software, development of tests to confirm correct

operation on all computational platforms on which ESMF runs, and unification of the NUOPC and MAPL usability layers.;
- Development of the base ESMF implementation to expand its utility in ways that are demonstrably advantageous to MAP-supported ESMs.
- Efforts to enhance the ESMF compliance of MAP-supported ESMs.

2. Programmatic Information

2.1 Programmatic Priorities

Characterizing the limits of validity of models and model components and identifying the sources of uncertainties is important to realizing the goal of enabling whole Earth System Models. Therefore, preference will be given to proposals that: 1) characterize and/or help reduce uncertainties in the models and products; 2) extend the range of model or product validity by using new components; 3) exploit these products to address NASA Earth Science Division (ESD) research questions; 4) are in alignment with the goals and objectives of the core MAP elements described above; and 5) enable independent community validation and characterization of the core MAP elements leading to improvement of the models or products.

Proposals for new model component capabilities must include an evaluation activity that characterizes their limits of validity by comparing to observational data. In all cases, the proposer must explain how the validation methodology will help identify the source of uncertainty within the model or analysis product.

2.2 MAP Infrastructure

Adherence to the multiagency Earth System Modeling Framework (http://www.earthsystemmodeling.org) which provides a robust software infrastructure for coupling model elements, is desired by the program. Independent resources have been allocated to provide software engineering and interface support to successful proposals of this announcement to assure that the final product meets ESMF standards and investigator verification that the ESMF-compatible product yields desired results. Additional infrastructure support will be provided to the selected PIs as aids to increase productivity and to increase integration. There are three key types of support available:

- High-end computing (HEC) support from NASA Center for Climate Simulation (NCCS, https://nccs.nasa.gov/) and the NASA Advanced Supercomputing facility (NAS, http://www.nas.nasa.gov/) (see Section I(d) of the ROSES *Summary of Solicitation*);
- Expert assistance from computational scientists for optimization, porting, ESMF implementation, refactoring, testing, and other techniques to improve software; and
- Assistance with ancillary tools, including GUI-based workflow tools to assist in the set up and execution of model experiments with selected experiments preconfigured, assistance with visualization tools, support for access to modeling software, and an active collective learning repository of modeling development knowledge. A full list of services is available at the MAP Program web site (http://map.nasa.gov/).

Proposers who require computing time at NCCS or NAS must provide an estimate and justification of the number of node-hours required each year of the proposal. This is in addition to indicating on the NSPIRES cover pages that HEC resources are requested. Proposers should also identify their need, if any, for expert assistance resources. These requirements should be covered in clearly identified subsection of the Scientific/Technical/Management portion of the proposal.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $1.5M
Number of new awards pending adequate proposals of merit	~ 3-6
Maximum duration of awards	4 years
Planning date for start of investigation	6 months after proposal due date.
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-MAP

NASA point of contact concerning this program	David B. Considine Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-2277 E-mail: david.b.considine@nasa.gov

A.14 CRYOSPHERIC SCIENCE

NOTICE: Amended on June 11, 2015. The due date for proposals to this program element has been delayed by six weeks to July 29, 2015.

1. Program Overview

1.1 Background

NASA's Cryospheric Sciences Program supports basic research on the Earth's sea- and land-based ice to understand its connections to the global system. Recent satellite observations show dramatic changes in the Earth's polar ice sheets, especially in the thickness and extent of Arctic and Antarctic sea ice, and thinning of the outlet glaciers draining the ice sheets covering Greenland and Antarctica. Given the tremendous areas that must be studied to characterize this change, space-based and other remote sensing techniques are required.

Overall, the program seeks to understand the mechanisms of change in ice in the polar regions and their implications for global climate, sea level, and the polar environment. Supported studies use space-based, aircraft-based, and other remote sensing techniques to understand the factors controlling the retreat and growth of the world's major sea- and land-based ice sheets and their interactions with the ocean, atmosphere, solid Earth, and solar radiation.

1.2 Scope of Program

This solicitation calls for proposals to understand the mechanisms of change in ice in the polar regions and their implications for global climate, sea level, and the polar environment. Proposed studies should use space-based, aircraft based, and other remote sensing techniques to understand the factors controlling the retreat and growth of the world's major sea- and land-based ice sheets and their interactions with the ocean, atmosphere, solid Earth, and solar radiation. To this end, NASA is soliciting studies of (a) the Greenland and Antarctic ice sheets to understand the controls on their mass balance, and (b) the northern and southern hemisphere ice-covered oceans to determine their response to climate change. Field studies are considered only if closely tied to remote sensing efforts.

In general, the program seeks to:

- Determine the mechanisms controlling sea ice cover, including quantification of the connections between sea ice and the ocean and atmosphere;
- Use remote sensing to validate and improve predictive models of changes in sea ice cover, especially on decadal timescales and to elucidate connections to the global system;
- Determine the mechanisms controlling mass balance and dynamics of the ice sheets of Greenland and Antarctica; including studies aimed at improving fundamental understanding of ice flow, ice shelves, grounding lines, bed, melt water formation and role, and connections to the ocean, sea ice cover, and atmosphere;
- Use remote sensing data to validate and improve predictive models of the contribution of land-based ice to sea level change, especially in the coming century.

This year the program also has the following specific goals:

- Innovative uses of satellite-based remote sensing and IceBridge observations to assess melt ponds and snow accumulation on Arctic sea ice, especially to improve regional climate models and reanalyses that reproduce these effects;
- Simulation of the potential scientific uses of observations from ICESat-2 (http://icesat.gsfc.nasa.gov/icesat2/) to determine sea ice thickness in the context of extending the times series of ICESat, IceBridge, and CryoSat-2.
- Quantification of the surface mass balance of the Greenland and Antarctic Ice Sheets, especially through innovative uses of satellite-based remote sensing and IceBridge data;
- Synthesis of information on the role of liquid water within the Greenland Ice Sheet, including quantifying its fate and its role in both mass balance and dynamics.
- Simulation of the potential scientific uses of observations from ICESat-2 (http://icesat.gsfc.nasa.gov/icesat2/) and/or Gravity Recovery and Climate Experiment (GRACE) Follow On (http://www.jpl.nasa.gov/missions/gravity-recovery-and-climate-experiment-follow-on-grace-fo/) to determine ice sheet mass balance, especially in the context of extending the times series of ICESat, IceBridge, and GRACE.

Studies of polar and nonpolar mountain glaciers and small ice caps will be considered, if such studies cover broad geographical areas and are of consequence to understanding systemic impacts of global climate change and sea level change or help elucidate fundamental processes that control glacier dynamics with application to polar ice sheets. Studies aimed at improving records of snow cover will be considered, if specifically tied to questions of ice sheet mass balance, sea ice thickness, or improvement of regional climate and precipitation models.

In addition, NASA expects synergy among observations, modeling, and field campaigns and strongly encourages all projects to consider recommendations identified by the various polar research organizations and their white papers and reports. Some recent examples are as follows:

Understanding the Dynamic Response of Greenland's Marine Terminating Glaciers to Oceanic and Atmospheric Forcing from U.S. CLIVAR available at http://www.usclivar.org/sites/default/files/documents/2014/2013GRISOWorkshopReport_v2_0.pdf

Seasonal-to-Decadal Predictions of Arctic Sea Ice: Challenges and Strategies from the National Research Council available at http://www.nap.edu/catalog.php?record_id=13515

SEARCH 5-year Science Goals from The Study of Environmental Arctic Change (SEARCH) available at http://www.arcus.org/search/goals

Climate and Cryosphere (CLiC) of the World Climate Change Research Program available at http://www.climate-cryosphere.org/

IARPC Research Plan from the Interagency Arctic Policy Committee (IARPC) available at http://www.nsf.gov/od/opp/arctic/iarpc/start.jsp

Use of the extensive data sets collected by NASA and other satellite and airborne remote sensing campaigns is required, and all projects should consider utilizing the data collected under NASA's IceBridge mission (http://www.nasa.gov/mission_pages/icebridge/index.html), an airborne remote sensing mission collecting altimetry, radar, gravity and other data in both polar regions. Data are available at the National Snow and Ice Data Center (NSIDC; http://nsidc.org/data/icebridge/).

The program's focus is on the use of remote sensing data to study the Earth's cryosphere. Field projects will be considered, but must be intimately tied to remote sensing work or improving the utility of remote sensing techniques. As well, projects developing numerical models of cryospheric processes will be considered, but must use remote sensing datasets for development and validation.

1.3 Arctic Studies

For Arctic sea ice, the program's focus is to understand the observed changes — in extent, concentration, thickness, and dynamics — in the context of ocean and atmospheric circulation and northern hemisphere climate. Understanding the feedback mechanisms associated with sea ice cover and the surrounding land, ocean, atmosphere, and sunlight is intended to both improve predictive models for the Arctic and establish links between high-latitude and low-latitude climates. Among the data sets available to support such efforts are those stored at the Distributed Active Archive Center (DAAC) at the National Snow and Ice Data Center (http://nsidc.org/), such as those for the ICESat and IceBridge missions.

For Arctic land ice, understanding the changes in the mass balance of the Greenland and other northern hemisphere glaciers is essential to understanding and modeling their dynamics and contributions to sea level. Given the crucial role of certain northern hemisphere glaciers and the Greenland ice sheet to sea level rise, the program's focus is to advance understanding of land-ice processes, especially connections among the warming ocean and increases in glacial flow rates; determining how the ice sheet interior is tapped by outlet glaciers; and determining the connections between glacial dynamics, bed characteristics, and melt water. The program is also focused on determining surface mass balance to support overall ice sheet mass balance estimates. Some unique data resources available to support this work include the altimetry, radar, and other data collected by NASA's IceBridge mission (http://www.nasa.gov/mission_pages/icebridge/index.html), as well as that available from ICESat, GRACE, and various international radar satellites.

For proposals requiring Arctic fieldwork in Greenland utilizing the National Science Foundation's (NSF's) Arctic Program resources, proposers must obtain a cost estimate for the proposed fieldwork as discussed in NSF's Arctic Sciences research solicitation (http://www.nsf.gov/div/index.jsp?div=ARC). A copy of the summary costs must be included with the proposal.

1.4 Antarctic Studies

For the Southern Ocean and the Antarctic ice sheet, the program is focused on the dynamics and mass balance of the overall ice sheet, the potential instability of the West Antarctic ice sheet, the interaction of the warming ocean with ice shelves, characteristics and changes of the glacial grounding lines, subice sheet hydrology, and changes in the extent of sea ice. There is also a need to assess the likelihood of rapid ice sheet response to the large changes in elevation and mass loss observed in some outlet glaciers and ice shelves—by ICESat, GRACE, IceBridge, and radar satellites—and how changes in these outlet glaciers may affect the stability of the interior ice sheet.

For proposals requiring Antarctic fieldwork, proposers must contact the Cryosphere program manager at NASA Headquarters and the Glaciology Program Manager at NSF's Antarctic Sciences Program (http://www.nsf.gov/div/index.jsp?div=ANT) prior to submitting the proposal. Proposers are required to review the information at http://www.usap.gov/proposalInformation/ and put enough information in the proposal to allow for adequate review of the plan, its utility, and expected costs.

For projects that receive assistance from the U.S. Antarctic Program, acknowledgements should include: "Logistical support for this project in Antarctica was provided by the U.S. National Science Foundation through the U.S. Antarctic Program."

2. Programmatic Information

Results from investigations supported under this solicitation are expected to advance the goals that are articulated in one or more of the Science Mission Directorate's Science Focus Area roadmaps (see http://nasascience.nasa.gov/about-us/science-strategy/), as well as a number of Presidential Mandates and associated Federal research objectives, e.g., the U.S. Global Climate Change Science Program (see http://www.globalchange.gov/) and its strategic plan, which address aspects on understanding the role of glaciers, ice sheets and sea ice within the Earth system.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $3M
Number of new awards pending adequate proposals of merit	~ 8-15
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	Not Requested.
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*. **July 29, 2015 [Amended June 11, 2015]**
Planning date for start of investigation	6 months after proposal due date.

Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-CRYO
NASA point of contact concerning this program	Thomas Wagner Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-4682 E-mail: thomas.wagner@nasa.gov

A.15 ICEBRIDGE OBSERVATIONS

NOTICE: All proposers are strongly recommended to read this solicitation in its entirety. All required details, e.g., data delivery plan, should be discussed in the proposal.

First-time proposers should be aware that it has a number of specific requirements. Proposals to provide new instruments require benchmarking against previously flown instruments to ensure continuity of the data record. Proposals to support aircraft operations need to consider and include a variety of specific information, including contacting the NASA Airborne Science Program manager prior to submission.

Returning proposers should note that proposals to support instruments that have been deployed previously for the IceBridge mission are expected to demonstrate efficiencies in operation that reduce overall cost, minimize the required logistical footprint, and decrease data delivery time. As a cost-capped mission, NASA is targeting a 20 percent reduction in operational costs to increase the funds available for flight time.

There is no Antarctic Campaign planned for Fiscal Year 2019 operations.

1. Program Overview

1.1 Background

IceBridge (http://www.nasa.gov/mission_pages/icebridge/index.html) is a NASA airborne mission making altimetry, radar, and other geophysical measurements to monitor and characterize major portions of the Earth's cryosphere. The IceBridge mission began in 2009 and is currently planned to continue until 2019.

The Earth's cryosphere is in a period of rapid change. Understanding these changes, their causes, and impacts are critically important to understanding the Earth as a global system. Data collected under the IceBridge program has improved our knowledge of the contribution of the world's major ice sheets in Greenland and Antarctica to sea level rise and is making fundamental contributions to understanding changes occurring in the extent and thickness of the polar sea ice.

IceBridge is managed by the project office at NASA Goddard Space Flight Center (GSFC). The mission is guided by recommendations from the IceBridge Science Team, membership for which is solicited separately. Research using IceBridge observations is also solicited separately and is supported at NASA by the following programs: Cryospheric Sciences, Interdisciplinary Sciences; IceBridge Research; Studies with ICESat and CryoSat-2; and Sea Level Change. IceBridge has also performed surveys of Alaskan and Canadian glaciers and ice caps to understand their change in mass and connection to sea level rise.

Mission details, including flight lines, is accessible at http://www.nasa.gov/mission_pages/icebridge/#.VFvmsRD4oQJ.

Data and instrument information from the previous IceBridge campaigns is accessible at http://nsidc.org/data/icebridge/.

1.2 Scope of Program

This solicitation primarily supports the instrumentation to be used for this third phase of the IceBridge Mission with campaigns from FY 2017 through FY 2019. During this period, IceBridge will predominantly consist of two major airborne data collection campaigns per year; with one in the Antarctic and another in the Arctic in their respective spring seasons to get an assessment of yearly changes in elevation and make other geophysical measurements relevant to assessing change in the major polar ice sheets on land and sea. These missions will be flown using the NASA DC-8 and NASA P-3. Solicited proposals for these campaigns are only to supply the instrumentation to be used on those flights. The flights costs, mission details, and management will be handled separately by NASA through its IceBridge Project Office. Proposals should be to supply and operate the instrumentation and deliver the data to the NASA Distributed Active Archive Center (DAAC) at National Snow and Ice Data Center (NSIDC).

At a lower priority, and pending the availability of funds, this solicitation will also consider proposals for modest, secondary campaigns to survey Alaskan and Canadian glaciers and ice caps; and melt-season campaigns to the Arctic sea ice and Greenland in the northern hemisphere fall. Proposals should be for complete campaigns through to data delivery to the NASA DAAC at NSIDC, and include all costs, such as but not limited to aircraft, flights, instruments, personnel and logistical costs.

Scientific research with IceBridge observations and membership on the IceBridge Science Team is not specifically supported under this solicitation.

1.2.1 *Aircraft and Campaigns*

Though other aircraft may be considered, it is anticipated that the NASA P-3 and DC-8 will be the primary observation platforms for the major Arctic and Antarctic campaigns over Greenland, Antarctica and the sea ice in the spring. Other aircraft—piloted or unmanned—may be proposed for this or any component of the IceBridge program, but must be capable of measurements at comparable scales and costs to the NASA aircraft; that includes using instrumentation at least equivalent to the specifications and precision listed at http://nsidc.org/data/icebridge/instr_data_summary.html under "IceBridge Instruments." Proposers should focus on instruments that have been used for the majority of the previous campaigns since data continuity is key aspect of this mission.

For the secondary campaigns—to survey smaller Alaskan and Canadian glaciers and ice caps and provide melt-season flights over sea ice and Greenland—smaller aircraft are encouraged and should be proposed as complete campaigns through to data delivery along with instrumentation. These surveys must be designed to cover broad geographical areas and be of consequence to understanding systemic impacts of global climate change on land and sea ice. They must be of sufficient scope to improve our understanding of ice contribution to sea level change or climate drivers and impacts of changes in sea ice cover.

1.2.2 *Observations and sensors*

The specific observations and science goals for this third phase of IceBridge are as follows:

- Make airborne altimetry measurements over the ice sheets and sea ice to extend the record of observations begun by ICESat.
- Link the measurements made by ICESat, ICESat-2, and CryoSat-2 to allow accurate comparison and production of a long-term, ice altimetry record.
- Using airborne altimetry to monitor key, rapidly changing areas of ice in the Arctic and Antarctic to maintain a long term observation record, improve understanding of glacial dynamics, and improve predictive models of sea level rise and sea ice cover.
- In conjunction with altimetry measurements, collect other remotely sensed data to improve knowledge of sea level change and changes in sea ice cover, especially the following:

    - Snow thickness, especially over Arctic sea ice;
    - Ice thickness and structure;
    - Bed topography and character underlying land-based ice;
    - Bathymetry beneath floating ice shelves;
    - Snow accumulation and firn structure; and
    - Other geophysical constraints that will improve estimates of the geothermal and oceanic heat flux into the land ice.

It is anticipated that the airborne sensor suite will include various instruments such as, but not limited to: lidars to map ice elevation and sea ice freeboard; ice-penetrating radars to map the underlying bed; snow and surface radars to map snow and firn depth; and gravimeters and magnetometers to characterize regional geology and map the continental shelf and water depth variations that underlie ice shelves.

Not all instruments are expected to be available for each platform, but altimetry measurements are required and are the main focus of the mission.

The instruments and data from the previous IceBridge campaigns are available at the NASA DAAC at NSIDC at http://nsidc.org/data/icebridge/instr_data_summary.html. Proposers are recommended to consider the intent of IceBridge to bridge ICESat and ICESat-2 altimetry records with an emphasis on continuity. Instruments that have flown on the majority of the previous campaigns are the best standards against which to judge the precision and utility of newly proposed instruments.

As well, proposals to support instruments that have previously been deployed on IceBridge are expected to demonstrate efficiencies in operation that reduce overall cost, minimize the required logistical footprint, and decrease data delivery time. As a cost-capped mission, NASA is targeting a 20 percent reduction in operational costs to increase the funds available for flight time.

1.3 Award Type and Funding

The vehicle for projects selected through this solicitation will be a Cooperative Agreement (CA). Proposers should be aware of the differences between a CA and a grant, and should see the *NASA Guidebook for Proposers* and the *Grant and Cooperative Agreement Handbook* for guidance.

2. Proposal Information

2.1 Parameters and Schedule

2.1.1 *General Parameters and Aircraft*

This phase of the IceBridge data collection program involves three major components:

a) Collection of altimetry data to extend the record of observations begun by ICESat over key areas of the land-based ice sheets in Greenland and Antarctica, and the sea ice in the Arctic and Southern Ocean.

b) Collection of critical data to support numerical models of the Greenland and Antarctic ice sheet, especially maps of the underlying bed and ice internal structure and any information on ice sheet surface mass balance or other properties relevant to modeling; and

c) Collection of critical data to support estimates of the sea ice thickness, especially sea ice freeboard and snow thickness to understand the drivers of change in sea ice cover.

IceBridge will primarily utilize the NASA P-3 and the NASA DC-8 and be conducted during the northern and southern hemisphere spring season with a goal of catching the ice maximum. As a lower priority, and pending availability of funds, modest, complete, secondary campaigns to survey Alaskan and Canadian glaciers and ice caps; and melt-season campaigns to the Arctic sea ice and Greenland in the northern hemisphere fall.

The aircraft platform will always be fully exploited to collect the other measurements discussed in the scope of work. It is also expected that there will be synergy among these components, and that they will be planned together at flight-line planning meetings held before each deployment. As well, planning will take into account potential overlap with observations made by CryoSat-2 and planned field campaigns, such as sea ice camps, to aid in calibration and validation.

2.1.2 *Anticipated Schedule*

The tentative dates of campaigns and aircraft are as follows:

Dates	Goal	Aircraft
October 2016 to January 2017	Antarctic land ice, related floating ice shelves, and Southern Ocean sea ice	NASA DC-8 operating from Punta Arenas
March 2017 to May 2017	Greenland land ice and related floating ice, and Arctic sea ice, and other select areas of Arctic, e.g., Alaskan glaciers	NASA P-3, operating from Alaska and Greenland; TBD aircraft for other select areas.
September 2017	Arctic sea ice and Greenland land ice	TBD, tentative
October 2017 to January 2018	Antarctic land ice, related floating ice shelves, and Southern Ocean sea ice	P-3 Operating from McMurdo (tentative)
March 2018 to May 2018	Greenland land ice and related floating ice, and Arctic sea ice, and other select areas of Arctic, e.g., Alaskan glaciers	NASA P-3, operating from Alaska and Greenland; TBD aircraft for other select areas.
September 2018	Arctic sea ice and Greenland land ice	TBD, tentative
October 2018 to January 2019	No planned Antarctic campaign.	-
March 2019 to May 2019	Greenland land ice and related floating ice, and Arctic sea ice, and other select areas of Arctic, e.g., Alaskan glaciers	NASA P-3, operating from Alaska and Greenland; TBD aircraft for other select areas.

2.1.3 *Measurements*

The measurements and their priorities for these campaigns are as follows:

Measurement	Notes	Priority
Altimetry	Altimetry measurements for mapping of the ice-surface on land-based ice in the Arctic and Antarctic. Measurements must be at sufficient precision to allow for determination of elevation change over outlet glaciers at the decimeter scale or better on a yearly basis.	Critical

Measurement	Notes	Priority
Altimetry continued	Altimetry measurements for mapping of the surface and freeboard of sea ice in the Arctic and Southern Ocean. Measurements must be at sufficient precision to allow for determination of sea ice freeboard with an uncertainty of several centimeters	Critical
Radar mapping of the bed of land-based ice sheets	Radar for mapping and characterization of the bed beneath land-based ice in Greenland and Antarctica. These measurements are intended to inform models of ice sheet dynamics and should include topography and bed character.	Critical/Desirable
Radar mapping of snow	Radar for mapping of snow accumulation sea ice in the Arctic is critical. Radar for mapping of snow accumulation on land-based ice in the Arctic and Antarctic, and sea ice in the Antarctic is desirable.	Critical/Desirable
Gravity measurements	Gravity field measurements to infer bathymetry beneath ice shelves and subice sheet bed topography beneath outlet glaciers that cannot be mapped by radar is critical. Collection of gravity field measurements for other purposes is desirable, but not critical.	Desirable
Radar mapping of ice structure	Mapping of ice layers will only be considered as a component of bed mapping efforts.	Desirable
Other measurements	Other measurements, such as surface radar, magnetics, photogrammetry, etc., will be considered, but must have direct application to extending the series of measurements begun by ICESat to characterize polar ice and or improve models of ice sheet dynamics or characterization of sea ice cover to understand its response to global climate change.	Desirable

2.2 Proposal details

2.2.1 *General Details*

Proposals are solicited to provide instruments and deploy, operate, and process data from them. This subelement will not support instrument development or significant adaptation. Instruments must be flight ready. Proposals should be for three years and include resources to participate in the listed campaigns, each of which will last approximately eight weeks. Proposals may be for any or all of the campaigns. Proposers should be aware that the solicitation is open to consideration of any altimetry proposals, but NASA anticipates supporting lidar measurements at least equivalent to NASA Wallops Flight Facility's Airborne Topographic Mapper (ATM) (http://atm.wff.nasa.gov/).

Proposals must include the following: 1) a description of the instrument, measurements to be made, and flight requirements; 2) a statement of how these measurements further the goals of the IceBridge program; 3) a distinct list of the field campaigns for which the instrument will be used; 4) choice of aircraft and justification; and 5) a management plan and budget that includes the entire program from preparation to field deployment to delivery of data products to the National Snow and Ice Data Center (NSIDC) (http://nsidc.org/), which is the NASA DAAC archiving the IceBridge data (http://nsidc.org/data/icebridge/). The management plan must describe the personnel participating in the field deployment.

Where deployments are listed as tentative, proposers are instructed to provide appropriate budget options separately in the proposal.

2.2.2 *Data Access Requirements*

With regards to data, as per NASA's Earth Science Data policy for missions (see http://nasascience.nasa.gov/earth-science/earth-science-data/data-information-policy/), there will be no period of exclusive access to IceBridge data. Following a brief postcollection checkout period, all data will be made available to the user community. As well, data will be released along with the source code for algorithm software, coefficients, and ancillary data used to generate these products. Data will be archived at the NASA Distributed Active Archive Center (DAAC) at the National Snow and Ice Data Center (http://nsidc.org/) in formats that can be readily used for a range of research needs and ingested into ice sheet, climate, and other models in gridded formats.

Proposals must include a plan and budget for data processing to meet the following deadlines and EOS Data Product Level Standards (http://observer.gsfc.nasa.gov/sec3/ProductLevels.html).

- Level 1B—As soon as possible after conclusion of field season, but no later than eight weeks.
- Level 2—within four months of data collection.
- Level 3—within six months of data collection.

Note that meeting data distribution milestones will be used to track progress of awarded projects.

2.2.3 *Data Product Requirements*

The science data product formats from awarded projects shall conform to one of the Earth Science Division (ESD) approved Data System Standards and science data products shall have accompanying spatial, temporal, and product metadata that conform to ESD-approved metadata specifications. Prior to the end of the project, awarded projects will be required to deliver all data products, along with the scientific algorithm software, coefficients, and ancillary data used to generate these products, to the NSIDC DAAC. All terms and conditions of the transfer of data products and associated information to the NSIDC DAAC will need to be documented in a Data Management Plan.

2.2.4 *Other information on budgets and aircraft*

Budgets should include support for instrument integration to the aircraft and support for the measurement team for the entire field campaign, including transportation to the location, housing, meals, and per diem. Budgets should include support for travel to two, three-day-long flight planning meetings per year; one at the NASA Goddard Space Flight Center and one at the NASA Jet Propulsion Laboratory.

Proposals to supply instruments to the campaigns planned on the NASA DC-8 and P-3 should see the details on these aircraft at http://airbornescience.nasa.gov/. Note that these proposals need not consider flight costs.

Proposals for alternate aircraft must contact Mr. Bruce Tagg, the NASA Airborne Science Program Manager, at Bruce.Tagg@nasa.gov during proposal preparation to discuss aircraft selection and budgeting. NASA has a range of options, but also some requirements that must be met. Such proposals need to include the cost of the flight time for the specified field program for these aircraft in their budget.

Proposals to use alternate aircraft in Antarctica are encouraged to contact the NASA's Cryosphere Program Manager at thomas.wagner@nasa.gov during proposal preparation to discuss the feasibility and appropriate ways of budgeting those activities.

2.2.5 *Other Requirements*

Proposals to support instruments that have been previously been deployed on IceBridge are expected to demonstrate efficiencies in operation that reduce overall cost, minimize the required logistical footprint, and decrease data delivery time. As a cost-capped mission, NASA is targeting a 20 percent reduction in operational costs to increase the funds available for flight time.

A tailored Data Rights section will be applied to resultant Cooperative Agreement (CA), under which scientific data and scientific software (software used for processing raw instrument data into scientific data) will be exchanged without restriction as to its disclosure, use, or duplication.

3. Programmatic Information

3.1 NASA and National Relevance

Results from investigations supported under this solicitation are expected to advance the goals that are articulated in one or more of the Science Mission Directorate's Science Focus Area roadmaps (see http://nasascience.nasa.gov/about-us/science-strategy/), as well as a number of Presidential Mandates and associated Federal research objectives, e.g., the U.S. Global Climate Change Science Program (see http://www.globalchange.gov/) and its strategic plan, which address aspects on understanding the role of glaciers, ice sheets, and sea ice within the Earth system.

4. Summary of Key Information

Expected program budget for first year of new awards	~$7.5M in total for the first year
Number of new awards pending adequate proposals of merit	~5
Maximum duration of awards	3 years
Due date for Notice of Intent to propose	None requested
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of Investigation	August 1, 2016
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for*
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-ICEB
NASA point of contact concerning this program	Thomas Wagner Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-4682 E-mail: thomas.wagner@nasa.gov

A.16 ATMOSPHERIC COMPOSITION: UPPER ATMOSPHERE RESEARCH PROGRAM AND AURA SCIENCE TEAM

NOTICE: The Upper Atmosphere Research program and the Aura Science Team will not solicit proposals in ROSES-2015. All funds currently available for a dedicated Upper Atmosphere Research Program are committed to the support of awards selected through the 2012 Upper Atmosphere Composition Observations and the 2014 Atmospheric Composition Laboratory Research solicitations. All funds currently available for a dedicated Aura Science Team are committed to the support of awards selected through the 2013 Aura Science Team solicitation. The Upper Atmosphere Composition Observations and Aura Science Team funds will be competed again in ROSES-2016. Interested researchers are encouraged to consult other program elements for potential funding opportunities.

1. Scope of Program

Atmospheric composition changes affect air quality, weather, climate, and critical constituents, such as ozone. Atmospheric exchange links terrestrial and oceanic pools within the carbon cycle and other biogeochemical cycles. Solar radiation affects atmospheric chemistry and is, thus, a critical factor in atmospheric composition. Atmospheric composition is central to Earth system dynamics, since the atmosphere integrates surface emissions globally on time scales from weeks to years and couples several environmental issues. NASA's research for furthering our understanding of atmospheric composition is geared to providing an improved prognostic capability for such issues (e.g., the recovery of stratospheric ozone and its impacts on surface ultraviolet radiation, the evolution of greenhouse gases and their impacts on climate, and the evolution of tropospheric ozone and aerosols and their impacts on climate and air quality). Toward this end, research within the Atmospheric Composition Focus Area addresses the following science questions:

- How is atmospheric composition changing?
- What trends in atmospheric composition and solar radiation are driving global climate?
- How does atmospheric composition respond to and affect global environmental change?
- What are the effects of global atmospheric composition and climate changes on regional air quality?
- How will future changes in atmospheric composition affect ozone, climate, and global air quality?

NASA expects to provide the necessary monitoring and evaluation tools to assess the effects of climate change on ozone recovery and future atmospheric composition and improved climate forecasts, based on our understanding of the forcings of global environmental change and air quality forecasts that take into account the feedbacks between regional air quality and global climate change. Achievements in these areas via advances in observations, data assimilation, and modeling enable improved predictive capabilities for describing how future changes in atmospheric composition affect ozone, climate, and air quality. Drawing on global observations from space, augmented by suborbital and ground-based measurements, NASA is uniquely poised

to address these issues. This integrated observational strategy is furthered via studies of atmospheric processes using unique suborbital platform-sensor combinations to investigate, for example: (1) the processes responsible for the emission, uptake, transport, and chemical transformation of ozone and precursor molecules associated with its production in the troposphere and its destruction in the stratosphere; and (2) the formation, properties, and transport of aerosols in the Earth's troposphere and stratosphere, as well as aerosol interaction with clouds. NASA's research strategy for atmospheric composition encompasses an end-to-end approach for instrument design, data collection, analysis, interpretation, and prognostic studies.

2. Point of Contact

For further information on this program, contact:

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A.17 ATMOSPHERIC COMPOSITION: RADIATION SCIENCES PROGRAM

NOTICE: The Radiation Sciences program will not solicit proposals in ROSES-2015. Funds currently available in fiscal year 2015 for the Radiation Sciences Program are committed to the support of awards selected from previous solicitations. The Radiation Sciences Program expects to solicit proposals for an airborne campaign in ROSES-2016. Interested researchers are encouraged to consult other program elements for potential funding opportunities.

1. Scope of Program

Atmospheric composition changes affect air quality, weather, climate, and critical constituents, such as ozone. Atmospheric exchange links terrestrial and oceanic pools within the carbon cycle and other biogeochemical cycles. Solar radiation affects atmospheric chemistry and is, thus, a critical factor in atmospheric composition. Atmospheric composition is central to Earth system dynamics, since the atmosphere integrates surface emissions globally on time scales from weeks to years and couples several environmental issues. NASA's research for furthering our understanding of atmospheric composition is geared to providing an improved prognostic capability for such issues (e.g., the recovery of stratospheric ozone and its impacts on surface ultraviolet radiation, the evolution of greenhouse gases and their impacts on climate, and the evolution of tropospheric ozone and aerosols and their impacts on climate and air quality). Toward this end, research within the Atmospheric Composition Focus Area addresses the following science questions:

- How is atmospheric composition changing?
- What trends in atmospheric composition and solar radiation are driving global climate?
- How does atmospheric composition respond to and affect global environmental change?
- What are the effects of global atmospheric composition and climate changes on regional air quality?
- How will future changes in atmospheric composition affect ozone, climate, and global air quality?

NASA expects to provide the necessary monitoring and evaluation tools to assess the effects of climate change on ozone recovery and future atmospheric composition, improved climate forecasts, based on our understanding of the forcings of global environmental change and air quality forecasts that take into account the feedbacks between regional air quality and global climate change. Achievements in these areas via advances in observations, data assimilation, and modeling enable improved predictive capabilities for describing how future changes in atmospheric composition affect ozone, climate, and air quality. Drawing on global observations from space, augmented by suborbital and ground-based measurements, NASA is uniquely poised to address these issues. This integrated observational strategy is furthered via studies of atmospheric processes using unique suborbital platform-sensor combinations to investigate, for example: (1) the processes responsible for the emission, uptake, transport, and chemical transformation of ozone and precursor molecules associated with its production in the troposphere and its destruction in the stratosphere; and (2) the formation, properties, and

transport of aerosols in the Earth's troposphere and stratosphere, as well as aerosol interaction with clouds. NASA's research strategy for atmospheric composition encompasses an end-to-end approach for instrument design, data collection, analysis, interpretation, and prognostic studies.

2. Point of Contact

For further information on this program, contact:

Hal Maring
Earth Science Division
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Telephone: (202) 358-1679
E-mail: hal.maring@nasa.gov

A.18 ATMOSPHERIC COMPOSITION: MODELING AND ANALYSIS

NOTICE: The Atmospheric Composition Modeling and Analysis program will not be competed in ROSES-2015. The Atmospheric Composition Modeling and Analysis program is tentatively scheduled to next solicit proposals in ROSES-2016.

The Atmospheric Composition Modeling and Analysis program (ACMAP) addresses the issues of tropospheric air quality and oxidation efficiency, pollution sourced aerosol and its impact on cloud properties, stratospheric chemistry and ozone depletion, and chemistry/climate interactions. Studies of long-term trends in atmospheric composition (potentially using both current and past mission data sets) are also of interest to the program, where the connection between cause and effect is elucidated using models. The program is interested in studies that integrate observations from multiple instruments with models to address attribution and predictions. The use of satellite and suborbital data sets and ground-based measurements are encouraged for modeling constraints and verification, where applicable. Proposals were last received in July 2014, and it is anticipated that proposals will be solicited again in ROSES-2016.

For information on this program, contact:

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A.19 KORUS-AQ: An International Cooperative Air Quality Field Study in Korea

NOTICE: May 5, 2015. New text in Section 3.2 clarifies investigator travel expenses and shipping of equipment and supplies. In addition, the point of contact has been changed to Hal Maring, see Section 4, the Summary of Key Information.

1. Scope of Atmospheric Composition Focus Area Programs

Variations in constituents such as ozone and aerosols affect air quality, weather, and climate. Atmospheric composition is central to Earth system dynamics because the atmosphere integrates spatially varying surface emissions globally on time scales from weeks to years. NASA works to provide monitoring and evaluation tools to assess the effects of climate change on ozone recovery and future atmospheric composition, improved climate forecasts based on the understanding of the forcings of global environmental change, and air quality modeling that take into account the relationship between regional air quality and global climate change. Achievements in these areas via advances in observations, data assimilation, and modeling enable improved predictive capabilities for describing how future changes in atmospheric composition affect air quality, weather, and climate. NASA draws on global observations from space, augmented by suborbital and ground-based measurements to address these issues. Toward this end, research within the Atmospheric Composition Focus Area (ACFA) addresses the following overarching science questions:

- How is atmospheric composition changing?
- What trends in atmospheric composition and solar radiation influence global climate?
- How does atmospheric composition respond to and affect global environmental change?
- What are the effects of global atmospheric composition and climate changes on regional air quality?
- How will future changes in atmospheric composition affect ozone, climate, and global air quality?

The Tropospheric Chemistry Program (TCP) seeks to improve the utility of satellite measurements in understanding of global tropospheric ozone and aerosols, including their precursors and transformation processes in the atmosphere. Ozone and aerosols are fundamental to both air quality and climate. The program emphasizes suborbital and ground-based measurements acquired during focused field deployments. Along with the other Atmospheric Composition programs, TCP also sponsors interpretation of these comprehensive, but infrequent, measurements to improve the continuous monitoring of tropospheric ozone and aerosols from space and the improvement of prognostic models. TCP also supports limited laboratory studies that are directly relevant to improved understanding of tropospheric chemistry.

2. Motivation for This Solicitation

Air quality is an environmental concern of fundamental importance across the globe. The need to monitor and understand air quality requires continual effort as populations grow, energy use increases, and industrial activity evolves. Air quality goals have also evolved as improved

understanding of health effects has demonstrated the added benefit of setting lower targets for exposure of humans and ecosystems to ozone, fine particles, and other toxic pollutants in the air. Long-term efforts have relied primarily on ground-based observations to diagnose regions of poor air quality and modeling to develop mitigation strategies. In recent years, however, satellites in low Earth orbit (LEO) have demonstrated the ability to observe the critical constituents affecting air quality, but the impact of LEO observations has been limited by their infrequent nature and coarse resolution with respect to source distributions and timing (approximately once per day at horizontal scales of tens of km), insufficient to observe the details of air quality events that can develop over timescales of a single day. The promise of geostationary (GEO) observations as a vantage point for studying air quality can overcome these problems by providing observations many times throughout the day and at higher spatial resolution by taking advantage of longer viewing times. The drawback of GEO is the limited viewing domain, preventing global observations with a single satellite. This has led to an international effort to launch a constellation of satellite instruments focused on air quality over Asia, North America, and Europe. These instruments will provide hourly observations of those regions throughout the day at horizontal resolutions of better than 10 km. The funded GEO atmospheric chemistry instruments expected to launch in 2018-2020, include the Geostationary Environment Spectrometer (GEMS) by the Republic of Korea, Tropospheric Emissions: Monitoring of Pollution (TEMPO) by the U.S., and Sentinel-4 by Europe. Also, with its planned launch in 2016, the Sentinel-5 Precursor (S5P) mission will begin providing the next generation of once-daily global measurements from LEO at horizontal resolution similar to the GEO missions.

Preparation is critical to ensure that the international air quality community is ready to capitalize on the information available from these satellites to improve air quality forecasts, models, and strategies for addressing the problem. The Korea-U.S. Air Quality Study (KORUS-AQ) serves as a model for international collaboration with Korean and U.S. scientists cooperating on all aspects of air quality research. The campaign will build relationships and strengthen future collaboration critical to the success of the constellation of geostationary air quality satellites to be launched by NASA, KARI (Korea Aerospace Research Institute), and ESA (European Space Agency) later this decade.

3. Programmatic Information

3.1 Programmatic Priorities

TCP will be the primary supporter of KORUS-AQ. Other ACFA programs may provide support, as well. Proposals are solicited for participation in a ~six-week long airborne campaign to be conducted in the May – June 2016 timeframe to investigate atmospheric processes related to tropospheric chemistry over the Republic of Korea and adjacent ocean areas. Through this call NASA seeks teams for instrumentation deployment and initial campaign data analysis according to the priorities described in the mission white paper available at https://espo.nasa.gov/home/korus-aq. Proposals requesting support for *in situ* and remote-sensing measurements to be deployed on the NASA DC-8 will be considered under this solicitation. In addition, proposals for relevant surface-based remote and *in situ* observations will be considered. To aid onsite flight planning, expertise is also sought in meteorological/chemical forecasting and in providing and interpreting real time satellite data products. Highest priority will be given to

measurements that will directly aid retrieval algorithm development for current and future air quality satellites; instruments should have proven performance heritage. Explicit, documented collaboration with South Korean researchers is encouraged and will be viewed favorably, but is not required. As per NASA funding guidelines, such collaboration would preclude direct funding of foreign colleagues. It is not appropriate to propose for significant new instrument development under this call; however, consideration will be given for minor modifications and improvements to existing instruments as may be required to address mission goals.

3.2 Funding Guidelines

Proposals may request up to three years of funding to cover the costs of preparation, integration (in the case of measurement teams), field deployment, data processing and initial analysis and interpretive modeling. Personnel support at an appropriate and justifiable level related to these activities will be considered. Because it is not possible to accurately budget travel costs until deployment sites are finalized, proposers should submit a workforce plan for the deployment that includes the total number of personnel and their respective schedules for participation in the aircraft integration and field intensive as consistent with the programmatic priorities. Proposal budgets should not include travel costs.

The following items provide clarification with regard to investigator travel expenses and shipping of equipment and supplies.

Investigator Travel Budget:
Do not propose funds for travel to:

- **Precampaign science team meeting,**
- **Instrument integration at Palmdale,**
- **Campaign in Korea, and**
- **Postcampaign science team meeting.**

The cost for the travel associated with these activities will handled via a central account.
Do propose funds to cover all other travel (e.g., AGU, etc.), if appropriate.

Shipping Expenses:
Do propose funds to cover shipping of equipment and supplies to Palmdale.
Do not propose funds to cover shipping of equipment and supplies from Palmdale to/from Korea. [added May 5, 2015]

In order to facilitate prompt evaluation and selection of proposals, the Notice of Intent (NOI) to propose is strongly encouraged for this ROSES-15 element.

Proposers are encouraged to discuss budget requests and phasing with the NASA point of contact named below early during proposal development.

4. Summary of Key Information

Expected annual program budget for new awards.	~$3.5M

Number of new awards pending adequate proposals of merit	~15
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigations	October 1, 2015.
Page limit for the central Science-Technical-Management section of proposal	15 pp for all proposals; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-KORUS
NASA points of contact concerning this program:	**Hal Maring** Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 **Telephone: (202) 358-1679** **E-mail: hal.maring@nasa.gov** **[Changed May 5, 2015]**

A.20 TERRESTRIAL HYDROLOGY

NOTICE: The Terrestrial Hydrology program will not be competed in ROSES-2015.

1. Scope of Program

The NASA Terrestrial Hydrology program (THP) has the scientific objective to use remote sensing to develop a predictive understanding of the role of water in land-atmosphere interactions and to further the scientific basis of water resources management. The NASA THP is a component of the Water and Energy Cycle Focus Area (see Section 2 of Appendix A.1 for a description of Earth science focus areas).

THP uses NASA's unique view from space to study hydrologic processes associated with runoff production, hydrologic fluxes at the land-air interface, and terrestrial water stores. THP fosters the development of hydrologic remote sensing theory, new hydrologic satellite missions, hydrologic remote sensing field experiments, and the interface of hydrology with other disciplines, such as ecology or modeling. Particular emphasis is placed on the application of satellite based remotely sensed data for characterizing, understanding, and predicting the terrestrially linked components of the hydrologic cycle and the dynamics of large-scale river basins. THP is currently focused on research relating to multiple missions, either currently operational, such as AQUA and Gravity Recovery and Climate Experiment (GRACE), or with approaching launch dates, such as Soil Moisture Active Passive (SMAP) and Global Precipitation Measurement (GPM), or earlier stages of planning and development, such as SWOT and Gravity Recovery and Climate Experiment Follow-on (GRACE-FO). THP projects are also extensively using data collected at previous or current field campaigns and projects, such as SMEX, SMAPVEX, AirMOSS, CLPX or numerous others, both national and international. THP furthers study of the relationship between satellite interferometric measurements of surface deformation and changes in underground water stores.

THP continues to encourage use of NASA investments to improve the use of remote sensing information in weather and climate models, primarily through data assimilation approaches involving land surface models. The Land Information System (LIS; http://lis.gsfc.nasa.gov) provides a modeling test bed for potential investigations of this domain along with an entrée into activities of other U.S. agencies.

More information on current THP projects and plans, as well as links to related field campaigns, can be found at mission specific websites e.g., http://smap.jpl.nasa.gov/ or http://swot.jpl.nasa.gov/.

2. Point of Contact for Further Information

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A.21 NASA ENERGY AND WATER CYCLE STUDY

NOTICE: The NASA Energy and Water Cycle Study (NEWS) program will not be competed in ROSES-2015.

1. Scope of Program

The current state and evolution of the environment are critically intertwined with the water and energy cycles of the climate system. Progress towards comprehensive understanding of both cycles is enabling a better description of the current state of the climate, as well as the subtle shifts that may be going on. While global warming is often summarized as an index of mean temperatures, it is alterations of the water cycle that may be most relevant to life on Earth, especially human society. Water is fundamentally within the center of what all life needs to survive and thrive on the planet and it is no different for human society whose agriculture, energy production, recreation, etc., all require water.

Accomplishing any goals related to better understanding these two cycles requires, in part, an accurate accounting of the key reservoirs and associated fluxes, including their spatial and temporal variability. To accomplish this, integration of existing observations and research tools is a requirement. To achieve this, the NASA Energy and Water Cycle Study (NEWS) grand challenge can be summarized as documenting and enabling improved, observationally based, predictions of water and energy cycle consequences of Earth system variability and change. This challenge requires documenting and predicting trends in the rate of the Earth's water and energy cycling that corresponds to climate change and changes in the frequency and intensity of naturally occurring related meteorological and hydrologic events, which may vary as climate may vary in the future. The cycling of water and energy has obvious and significant implications for the health and prosperity of our society. The importance of documenting and predicting water and energy cycle variations and extremes is necessary to accomplish this benefit to society.

A coordinated team effort is required that will integrate NASA's global water and energy cycle resources to directly address the NEWS challenge. More information on NEWS is available at http://nasa-news.org. Interested collaborators with NEWS are specifically recommended to review progress and plans of current NEWS activities that are available at this web location.

Through national and international relationships, NEWS will ultimately facilitate NASA providing added value to the Earth observations resulting from NASA research and development, assist in bringing in added satellite calibration/evaluation data sources, and deliver independent observationally-based data sets for evaluating 4-dimensional data assimilation (4DDA) and prediction capabilities on a regional and global basis.

The overarching goal of NEWS investigations is to integrate Earth Science Research Program components to make decisive progress toward the NEWS challenge. To achieve this objective, the NEWS investigations will integrate and interpret past, current, and future space based and *in situ* observations into assimilation and prediction products and models that are global in scope. These activities will serve efforts to improve understanding, modeling, and information for global prediction systems. To achieve these goals, the NEWS investigations must recognize that

accurate prediction of not only trends in the mean, but also extremes and abrupt changes, is a key step toward useful applications. The critical feedbacks within the overall NEWS strategy are the lessons that scientific analysis, modeling, prediction, and consequences can guide and identify the technological and observational requirements of future NASA missions.

2. Point of Contact for Further Information

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A.22 SCIENCE UTILIZATION OF THE SOIL MOISTURE ACTIVE-PASSIVE MISSION

NOTICE: Amended on October 19, 2015. On July 7, 2015, SMAP's radar instrument stopped collecting data, though its radiometer continues to function nominally. Due to the change in SMAP data collections, this amendment allows previous proposers an opportunity to withdraw previous submissions and submit revised proposals. New proposers may respond to the amended solicitation. New text is in bold and deleted text is struckthrough. Notices of Intent (NOIs) are requested to inform NASA regarding both withdrawal and submission of proposals to this amendment. Notices of Intent are requested by December 2, 2015. Proposals are due January 20, 2016.

1. Scope of Program

Proposals are solicited for science investigations that ~~exploit~~ **utilize** data from the Soil Moisture Active-Passive (SMAP) mission.

The SMAP satellite launched on January 31, 2015, and started taking science data in April. The radar instrument functioned nominally until July 7 when it stopped returning data. Level one data for both instruments (i.e., backscatters and radiances) can be found at https://www.asf.alaska.edu/smap/data-imagery/ and http://nsidc.org/data/smap/smap-data.html, respectively. As the radiometer continues to function and return high quality observations, SMAP will be an important data sources to aid Earth system modeling and studies.

The Soil Moisture Active-Passive mission will **primarily** use ~~both active (radar) and~~ passive (radiometer) L-band microwave remote sensing to determine the land surface soil moisture and freeze/thaw state. These measurements will advance the study of the water, carbon, and energy cycles, both individually and at their points of interconnection.

SMAP is identified as a first-tier mission in the National Research Council report *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (http://www.nap.edu/catalog.php?record_id=11820). This report is hereafter referred to as the Decadal Survey. Information on the SMAP mission and its capability to fulfill the objectives laid out for it in the Decadal Survey can be found in the SMAP Workshop report (http://nasascience.nasa.gov/earth-science/decadal-surveys), as well as at http://nasascience.nasa.gov/missions/smap. SMAP is the first planned mission from the Decadal Survey recommended series of missions.

The objective of this solicitation is to select research projects that will respond to the Decadal Survey outlined science priorities for the SMAP mission, as well as enable pursuit of new methods of exploiting SMAP's observations for Earth System Science. These priorities and possibilities include:

1) Enabling advances in the study of the water, carbon, and energy cycles, especially on those topics that deal with the intersections of these cycles.
2) Exploring the impact of soil moisture variability and its role as the 'memory' for the land surface, on weather and climate.
3) The role of soil moisture in floods, droughts, agricultural productivity, and public health related concerns (e.g., vector borne diseases).

2. Types of Proposals Solicited

2.1 Utilization of SMAP Products for Process Studies

The state and amount of water in the soil is a critical determinant in many complex Earth System processes. For example, it can limit or enable photosynthesis. It can determine the ratio of precipitation and snowmelt that percolates into the ground or runs off. The amount of water in the soil will affect if incoming radiation is used to heat the lowest layer of the atmosphere or to evaporate water, which might later be used to form clouds and/or precipitation. Studies are encouraged that use the SMAP observations to improve our understanding of these and other processes, be they aspects of the water, carbon, or energy cycles.

2.2 Utilization of SMAP for Model Evaluation and Improvement

SMAP's ~~9-km active-passive product~~ **36 km passive product**, with some inherent radio frequency interference mitigation, will offer an unprecedented look at global soil moisture variability. This should be instrumental in global evaluation of land surface model performance and highlight areas that can be improved. Through this work, evaluation and improvement of other types of models (i.e., those used for weather forecast, climate prediction, or vegetation activity) should also be possible.

2.3 New Algorithms

2.3.1 *Novel topics*

The L-band observations of the SMAP ~~radar and~~ radiometer could be used to observe aspects of the Earth System other than land surface moisture. NASA will accept proposals that seek to develop new uses for SMAP data that are not duplicative to other supported efforts (e.g., L-band measurements for sea surface salinity are already supported by the Aquarius project). New uses of the SMAP data will be viable only if they pursue high priority gaps in our global observing system.

2.3.2 *Similar Data products*

The level one data products (e.g., brightness temperatures~~, radar backscatters~~) can be used in other fashions than planned by the SMAP project to produce soil moisture (both surface and root-zone), freeze-thaw state, and carbon-cycle metrics (e.g., net ecosystem exchange). NASA will accept efforts that propose new algorithms that would offer data products that would be significantly different than those produced by the SMAP project, provided that they present

substantial added value. This may be accomplished by combining SMAP data with other satellite data products (e.g., surface temperature or precipitation). Proposed new algorithms should not require ongoing ingesting of limited area land-based or airborne-based observations. **With the loss of SMAP's radar, NASA is interested in alternative methods to downscale the radiometer soil moisture to finer spatial scales.**

2.4 Exploitation of Radar informed data products

Although of limited temporal coverage, the SMAP data products that incorporate its radar data may be used for successful scientific study, particularly the possibility of evaluating NASA's intended approach to create a 9 km active-passive product. Significant use of these discontinued radar-informed data products may contribute to remotely-sensed earth system science studies.

3. Requirements

All proposals submitted in response to this solicitation must exhibit comprehensive knowledge of the relevant SMAP data products to be employed. Details on these products are available in the SMAP handbook (http://smap.jpl.nasa.gov/mission/description/) and Algorithm Theoretical Basis Documents (ATBDs). Proposers should also be knowledgeable of the currently planned SMAP calibration and validation efforts and should not look to duplicate those. Any proposed activities that might replicate calibration and/or validation activities should explicitly defend those with a description of their well-documented additional value.

All proposed studies must plan to use SMAP data in a critical way. Proposed studies should not be accomplishable without SMAP data. Proposers must, therefore, be cognizant of the temporal limitations of SMAP data availability during the lifetime of their projects. Therefore, climatological studies are less likely to be relevant to this solicitation, given that no more than three years of SMAP data would be available to inform the proposed project.

New algorithms (Section 2.3) should be globally implementable, with an expectation of adequate performance over a majority of the relevant Earth surface. Proposals to develop new algorithms should include a description of:

a.) Preparing and writing an ATBD
b.) Product calibration and validation
c.) Error characterization

Proposals from currently funded NASA investigators, especially those connected with the SMAP science team, Terrestrial Hydrology, and/or Ecology programs should make clear in their proposals how the proposed work is different from their currently funded projects.

4. Programmatic Information

Total funds available for work selected under this solicitation are approximately $4.5M per year for three years. The program anticipates making a total of approximately 30 selections. There is

no a priori planned distribution of projects across the solicited areas of Section 2. Proposals that are outside of the research areas described in Section 2 and/or those that do not meet the requirements of Section 3 will not be considered. It is anticipated that project start dates would be **on or soon after April 1, 2016.** ~~between October 1, 2015, and January 1, 2016.~~

5 Science Team Membership

The current science team of the SMAP mission is focused on calibration and validation of the SMAP data products. This team will be active for a majority of the three-year operational phase of the mission. Principal Investigators of the selected investigations, solicited here, would be invited to join this team, and, as such, be invited to future SMAP science team meetings and should plan accordingly.

6. Instructions Regarding Previous Submissions

Investigators who have previously submitted proposals to this program element who wish to submit modified proposals must withdraw their previous submissions and resubmit the modified proposal. Investigators who wish to have their previous submission to this program element considered without modification need not resubmit.

7. Summary of Key Information

Expected annual program budget for new awards	~ $4,500K
Number of investigator awards pending adequate proposals of merit	~30
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	**December 2, 2015**
Due date for proposals	**January 20, 2016**
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	Every proposal must address one or more Decadal Survey outlined science priorities for the SMAP mission and/or the priorities and possibilities in Section 1 of this Program Element.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.

Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-SUSMP
NASA point of contact concerning this program	Jared Entin Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-0275 Email: jared.k.entin@nasa.gov

A.23 PRECIPITATION MEASUREMENT MISSIONS (PMM) SCIENCE TEAM

1. Scope of Program

The Precipitation Measurement Missions (PMM) science team seeks investigations related to satellite observations of precipitation using measurements from, but not limited to, the Tropical Rainfall Measuring Mission (TRMM) 1997-2015, the Global Precipitation Measurement (GPM) Core Observatory launched February 2014, and GPM mission constellation partner spacecraft. This program supports scientific investigations in three research categories: (1) development, evaluation, and validation of TRMM and GPM retrieval algorithms; (2) development of methodologies for improved applications of satellite measurements; and (3) the use of satellite and ground measurements for physical process studies to gain a better understanding of the global water cycle, climate, and weather and concomitant improvements in numerical models on cloud resolving to climate scales.

These research activities will utilize satellite observations and products associated with a number of research missions and operational sensors. While the major focus of the expected research will be on the TRMM and GPM instruments, observations from other research sensors, such as the microwave humidity profiler (SAPHIR) on the Indo-French Megha-Tropiques satellite and the Advanced Microwave Scanning Radiometer-2 (AMSR-2) instrument on the Japanese Global Change Observation Mission – Water (GCOM-W1) satellite, as well as operational sensors, such as the Special Sensor Microwave Imager/Sounder (SSMIS), Advance Microwave Sounding Unit (AMSU), Microwave Humidity Sounder (MHS), Advanced Technology Microwave Sounder (ATMS), and others, such as CloudSat, may be used to provide information to complement scientific investigations and facilitate remote-sensing algorithm development.

Specific topics within each research category are identified below to help investigators focus on priority research needs. While research may span more than one topic, proposers should identify the primary category (only one) under which they are submitting the proposal.

2. Research Categories

2.1. Algorithm/Product Validation and Enhancement (50% of available funding)

This research focus emphasizes specific topics that must be addressed to improve radar and radiometer algorithms and data products in the GPM era. Of high priority are validations and enhancements of facility algorithms over all surface types for the GPM core and constellation and physical-based retrieval algorithms over-land that make use of the full range of microwave frequencies for light to heavy precipitation and falling snow. Important topics include:

- Validation and enhancement of precipitation algorithms for GPM Core Observatory Sensors and GPM constellation radiometers contributing to global precipitation sampling;
- Development of methodologies for the intercalibration of measurements from microwave sensors;
- Validation and enhancement of dual-frequency (Ka/Ku-band) precipitation radar retrieval algorithms and/or combined radar/radiometer algorithms;

- Development, testing, and validation of radiometer retrieval algorithms over land, with emphasis on physically based techniques to extract precipitation information from measurements over the range of 10-183 GHz;
- Validation and enhancement of radiometer retrieval algorithms for improved detection and estimation of light rain and falling snow over land and ocean in the middle and high latitudes;
- Development, testing, and evaluation of algorithms supporting the transition and extension of TRMM products into the GPM era;
- Development of practical downscaling/data assimilation methodologies leading to operational precipitation algorithms (e.g., routinely produced research products) incorporating data assimilation of satellite products.

The NASA PMM program has conducted a series of field experiments designed to refine the assumptions and physical parameters in GPM precipitation algorithms. Proposals that consolidate microphysical information from GPM-related ground validation (GV) field experiments (e.g., C3VP, LPVEx, MC3E, GCPEX, IFloodS, IPHEx, OLYMPEX) in such a way that they can be more readily implemented by the algorithms will receive priority consideration. Acronym naming and information on field campaign focus areas and data product availability can be found at: http://pmm.nasa.gov/science/ground-validation. Close collaboration between the analysis effort and GPM algorithm validation is expected for proposals in this category:

- Validation and enhancement of surface emissivity estimation methods and datasets, both static and dynamic, for use in GPM radiometer and combined radar-radiometer algorithms to improve the extraction of precipitation information from microwave signals over land;
- Error characterization of satellite rainfall retrievals and/or ground-based measurements to facilitate multisatellite algorithm development and the convergence between satellite and GV rain estimates;
- Development of innovative methods to improve the fusion of precipitation information from multiinstrument and multisatellite platforms within the general framework of statistical estimation; and
- Collaborative analysis of field campaign data sets to support algorithm improvements and validation.

2.2 Utilization of Satellite/GV Products for Process Studies and Model Development (25% of available funding)

This research focus area covers climate and physical process studies utilizing satellite and GV data and the application of existing data sets to improve atmospheric and land surface models ranging from cloud-resolving to climate scales. The topics include:

- Use of satellite and field campaign data to study precipitation and microphysical processes, particularly for mixed phase and frozen precipitation, and their improved representation in cloud resolving and climate models;
- Use of satellite and field campaign data to evaluate and improve land surface and hydrological models and parameterizations; and

- Analysis of TRMM and other current satellite-based precipitation information for modeling studies of climate (global and regional variability, ENSO, etc.) and weather (tropical convection, hurricanes, midlatitude weather systems); and
- Development of statistical modeling to support downscaled products.

2.3. Methodology Development for Improved Applications of Satellite Products (25% of available funding)

This research area focuses on the development of methodologies that combine information from observations and models to produce improved analyses of rainfall, downscaling of satellite rainfall estimates to hydrometeorologically relevant spatial and temporal scales, and improved application of satellite products in numerical weather prediction and data assimilation. The topics include:

- Development and implementation of data assimilation techniques for improved precipitation analyses and downscaling of satellite precipitation information for hydrological modeling and prediction;
- Development of metrics and methodologies for assessing satellite precipitation products in hydrological applications;
- Development and implementation of data assimilation techniques for improved forecasts of significant weather (e.g., tropical cyclones and floods) and 4D assimilated climate data sets using satellite-based precipitation measurements.
- Development of other precipitation related applications in areas as described at http://pmm.nasa.gov/applications .

3. Other Federal Agencies

Principal and Co-Investigators from other U.S. Federal agencies can respond to this solicitation. However, they must provide a brief explanation for why their own agencies are not supporting the proposed research and how the proposed work relates to the ongoing work at their agency.

4. Number of Review Panels

All submitted proposals will be reviewed in one of two panels. The first review panel will address Research Category 2.1 and will use 50% of the available funds. The second review panel will address Research Categories 2.2 and 2.3 and will use the remaining 50% of the available funds.

5. Summary of Key Information

Expected annual program budget for new awards	~$7.5M/year
Number of new awards pending adequate proposals of merit	~50-60
Maximum duration of awards	3 years.

Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-PMM
NASA point of contact concerning this program	Ramesh K. Kakar Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0240 E-mail: ramesh.k.kakar@nasa.gov

A.24 WEATHER FOCUS AREA

NOTICE: The Weather Focus Area programs will not be competed in ROSES-2015.

1. Scope of Program

The Weather Focus Area represents the cooperation among NASA programs for Atmospheric Dynamics, Weather Forecast Improvement, and Ocean and Land Remote Sensing. It has strong ties to other Focus Areas, especially Climate Variability and Change and Water and Energy Cycle, and it has a supporting role in Carbon Cycle and Ecosystems and the Atmospheric Composition Focus Areas.

The Weather Focus Area is primarily designed to apply NASA scientific remote sensing expertise to the problem of obtaining accurate and globally distributed measurements of the atmosphere and the assimilation of these measurements into research and operational weather forecast models in order to improve and extend U.S. and global weather prediction. This Focus Area is implemented in coordination with other U.S. agencies' programs, and it is guided by the question from the 2003 Earth Science Enterprise Strategy:

How can weather forecast duration and reliability be improved?

NASA sponsored research continues to gain new insight into weather and extreme-weather events by the utilization of data obtained from a variety of satellite platforms: Geostationary Operational Environmental Satellite (GOES), Tropical Rainfall Measuring Mission (TRMM), Aqua, Terra, CloudSat, and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) and a hurricane field experiment. The European Centre for Medium-Range Weather Forecasts (ECMWF) was the first center to adopt operational use of Atmospheric Infrared Sounder (AIRS) data and has found the impact on operational forecasts of assimilating AIRS and Infrared Atmospheric Sounding Interferometer (IASI) data to be roughly comparable and second only to the collective impact of assimilating four AMSU units. Major Numerical Weather Prediction (NWP) centers in the U.S. – National Oceanic and Atmospheric Administration (NOAA)/National Centers for Environmental Prediction (NCEP), NASA Global Modeling and Assimilation Office (GMAO), and the U.S. Navy – have also all shown notable improvements from the assimilation of AIRS data into their operational forecast systems. One study concludes that a consensus exists among NWP centers that AIRS is one of the highest-ranked contributors to forecast skill.

An extra benefit of AIRS data assimilation at NWP centers is its use in establishing readiness to assimilate data from other current and future operational instruments, as has been demonstrated for the Crosstrack Infrared Sounder (CrIS) launched on the Suomi NPP satellite in October 2011.

Through collaborations in the NASA-NOAA-DOD Joint Center for Satellite Data Assimilation (JCSDA), observations from Suomi-NPP were assimilated into the operational weather forecast systems in a record seven months after the satellite launch in October 2011. Subsequent tests with the NOAA operational system showed that the Advanced Technology Microwave Sensor

(ATMS) had a neutral impact on 500 hPa forecast skill. However, observation impact analyses conducted with NASA Goddard Earth Observing System model, version 5 (GEOS-5) in the NASA Global Modeling and Assimilation Office, showed that, in concert with other observations, ATMS makes a significant impact on a global integrated forecast metric. Preparatory work and channel selection for the assimilation of the Cross-track Infrared Sounder (CrIS) data and tests of the impact of that sensor have been completed. The preparations involved modifications to the Community Radiative Transfer model, passive monitoring of systematic and random errors in the CrIS data products, observation minus forecast residuals, and finally preoperational data assimilation/forecast experiments. CrIS was assimilated operationally into the NCEP operational forecast system starting late August 2013.

The NASA Short-term Prediction Research and Transition (SPoRT) program is an end-to-end research-to-operations (R2O) activity focused on improving short-term weather forecasts through the use of unique high-resolution, multispectral observations from NASA and NOAA satellites, nowcasting tools, and advanced modeling and data assimilation techniques. The SPoRT program has established a successful R2O paradigm in which the end-users (mainly forecasters at NOAA/NWS forecast offices and National Centers) are involved in the entire process. SPoRT also partners with universities and other Government agencies to develop new products that are transitioned to applicable end user decision support systems (DSS; typically the Advanced Weather Interactive Processing System [AWIPS], next-generation AWIPS [AWIPS II], and the National Centers AWIPS [N-AWIPS]). A review by an external Science Advisory Committee (SAC) in March 2012 noted SPoRT's success in broadening its activities to other NWS Regions, including Alaska and Hawaii and its active participation in NOAA Proving Ground activities and Testbeds as key contributions to the NWS mission. Recent advancements in product development and dissemination, modeling and data assimilation (DA); product applications in various DSS; and transition, training, and assessment activities have significantly helped in improving operational weather forecasts and in disaster response. Extensive progress was made to transition new, cutting-edge satellite datasets and products to existing and new operational partners. A NWS Southern Region modeling collaboration was established with the forecast offices in Houston, TX, and Mobile, AL, to assess the impacts of these datasets on their local model forecasts of CI, and to provide in-house model verification capabilities. Data assimilation research has focused on a collaborative project with NOAA's Hydrometeorological Testbed (HMT), in which AIRS temperature and moisture profiles are assimilated over a Pacific domain to improve the tracking of atmospheric rivers affecting the U.S. West Coast.

The Hurricane and Severe Storm Sentinel (HS3) Mission is a five-year Earth Venture Class Suborbital mission that was awarded in 2010. The mission involved three deployments to the Wallops Island Flight Facility (WFF) on the coastline of Virginia during the hurricane seasons of 2012-2014, and used two Global Hawk (GH) unmanned aircraft systems (UAS) with distinct payloads. WFF provides easy access to Atlantic, Gulf of Mexico, or Caribbean storms. The HS3 Mission was designed to investigate some basic questions regarding changes in hurricane intensity:

1. What impact does the large-scale environment, particularly the Saharan Air Layer (SAL), have on intensity change?
2. What is the role of storm internal processes such as deep convective towers?

3. To what extent are these intensification processes predictable?

HS3's first deployment in September 2012 involved only one GH, which carried three instruments to examine the environment and outflow layer of storms. The scanning High-resolution Interferometer Sounder (S-HIS), the Advanced Vertical Atmospheric Profiling System (AVAPS), also known as dropsondes, and the Cloud Physics Lidar (CPL) collectively provided measurements of the vertical structure of temperature, relative humidity, winds, Saharan dust, and clouds. Both GHs flew in 2013. The over-storm Global Hawk has flown over hurricanes before and it was its first time in support of HS3. The High-Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP) conically scanning Doppler radar provided three-dimensional wind and precipitation fields; the Hurricane Imaging Radiometer (HIRAD) measured surface wind speeds and rainfall; and the High-Altitude Monolithic Microwave Integrated Circuit Sounding Radiometer (HAMSR) microwave sounder provided measurements of temperature, water vapor, and liquid water profiles, total precipitable water, sea-surface temperature, rain rates, and vertical precipitation profiles. Most of these instruments represent advanced technologies developed by NASA that in some cases are precursors to future satellite sensors.

In June 2012, NASA selected the Cyclone Global Navigation Satellite System (CYGNSS) satellite mission under its Earth Venture program. CYGNSS data will enable scientists, for the first time, to probe key air-sea interaction processes that take place near the inner core of the storms, which are rapidly changing and play large roles in the genesis and intensification of hurricanes. The CYGNSS Mission satellites are expected to launch in 2016.

2. Point of Contact for Further Information

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A.25 EARTH SURFACE AND INTERIOR

NOTICE: Amended on June 16, 2015. This amendment releases final text for this program element. Notices of Intent (NOIs) are requested by July 16, 2015, and proposals are due by September 16, 2015

1. Scope of Program

NASA's Earth Surface and Interior focus area (ESI, http://science.nasa.gov/earth-science/focus-areas/surface-and-interior) supports research and analysis of solid-Earth processes and properties from crust to core. The overarching goal of ESI is to use NASA's unique capabilities and observational resources to better understand core, mantle, and lithospheric structure and dynamics, and interactions between these processes and Earth's fluid envelopes.

ESI studies provide the basic understanding and data products needed to inform the assessment, mitigation, and forecasting of the natural hazards, including phenomena such as earthquakes, tsunamis, landslides, and volcanic eruptions. These investigations also exploit the time-variable signals associated with other natural and anthropogenic perturbations to the Earth system, including those associated with the production and management of natural resources.

ESI's Space Geodesy Program (SGP) produces observations that refine our knowledge of Earth's shape, rotation, orientation, and gravity, advancing our understanding of the motion and rotation of tectonic plates, elastic properties of the crust and mantle, mantle-core interactions, solid Earth tides, and the effects of surface loading resulting from surface water, ground water, glaciers, and ice sheets. SGP infrastructure enables the establishment and maintenance of a precise terrestrial reference frame that is foundational to many Earth missions and location-based observations.

It is NASA's intent to compete portions of this program on an annual basis, pending sufficient availability of funds.

2. Description of Solicited Research

Priorities for new research within ESI continue to derive from the goals and objectives for Earth science presented in several strategic documents:

- NASA's Strategic Plan (http://nasascience.nasa.gov/about-us/science-strategy)
- The Solid Earth Science Working Group (SESWG) report, *Living on a Restless Planet* (2002) (http://solidearth.jpl.nasa.gov/seswg.html)
- Review of the SESWG report by the National Research Council (NRC), *Review of NASA's Solid-Earth Science Strategy* (2004) (http://books.nap.edu/catalog/11084.html)
- The NRC Decadal Survey, *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (2007) (http://www.nap.edu/catalog/11820)
- NASA's report highlighting future pathways for GRACE, *Responding to the Challenge of Climate and Environmental Change: NASA's Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space* (2010) (http://science.nasa.gov/media/medialibrary/2010/07/01/Climate_Architecture_Final.pdf)
- The NRC report *Precise Geodetic Infrastructure: National Requirements for a Shared*

Resource (2010) (http://www.nap.edu/catalog.php?record_id=12954)

- The report *A Foundation for Innovation: Grand Challenges in Geodesy* (2012) (http://www.unavco.org/pubs_reports/geodesy_science_plan/GrandChallengesInGeodesy-Final-Singles-LR.pdf)

The ESI strategic plan is founded on the six scientific challenges identified in *Living on a Restless Planet*: 1) What is the nature of deformation at plate boundaries and what are the implications for earthquake hazards, 2) how do tectonics and climate interact to shape the Earth's surface and create natural hazards, 3) what are the interactions among ice masses, oceans, and the solid Earth and their implications for sea level change, 4) how do magmatic systems evolve and under what conditions do volcanoes erupt, 5) what are the dynamics of the mantle and crust and how does the Earth's surface respond, and 6) what are the dynamics of the Earth's magnetic field and its interactions with the Earth system?

Guided by these core questions, ESI requests the following types of research investigations addressing Earth's surface and interior, and solid-Earth dynamic events. Pending sufficient availability of funds, it is NASA's intent to update these foci on an annual basis to best address scientific and programmatic priorities:

- Scientific investigations to advance the understanding of processes in the Earth's deep interior and their impacts on the Earth system. This includes the development of innovative methods to improve the precision of measurements towards these goals.
- Science to address solid-Earth surface or near-surface processes or properties using signals associated with natural resource production and management (e.g., water, hydrocarbons).
- New methods and associated science for characterizing dynamic solid-Earth events. Proposals that help to advance the development or later utility of the NISAR mission are especially encouraged.

2.1 Deep-Earth Processes

The dynamics of the mantle and core fundamentally drive the evolution of the Earth's shape, its orientation and rotation, plate motions and deformation, and the generation of the magnetic field. Complete understanding of these global-scale processes requires the perspectives provided by space-based and other remote-sensing observations. This subsection seeks research using gravity, topography, magnetic, or other geodetic methods and associated modeling and analysis to advance the understanding of the Earth's deep interior and its interdependencies with the rest of the Earth system. Towards advancing these science goals, NASA solicits proposals to develop and/or simulate innovative methods to facilitate leaps in measurement precision, including tying together geodetic observing systems. The NRC report *Precise Geodetic Infrastructure: National Requirements for a Shared Resource* identified the need for scientific and/or technological innovation to improve precision positioning, and geodynamics and dependent signals such as sea-level rise carry the most stringent requirements in this space.

Proposals under this subsection must 1) propose research on processes in the Earth's mantle or

core utilizing remote sensing data, or 2) propose studies that couple innovative methods to improve geodetic measurement precision to advancements in understanding of specific scientific questions about the deep Earth.

2.2 Anthropogenic Lithospheric Processes

The NRC Decadal Survey identified natural resources as one of three key strategic roles for solid-Earth science and observations. Global growth in energy and other natural-resource demands, and associated efforts to discover, exploit, and mitigate the impacts of the utilization of resources drive unique solid-Earth signals (i.e., deformation, mass-change). These signals present an opportunity to study near-surface solid-Earth systems under constraints on source terms that natural settings don't typically afford (i.e., pumping histories, stress measurements). Changes in fluid balance on the surface or in the subsurface drive crustal dynamics that can be used to constrain rheology and inform our understanding of deformation processes and earthquake physics. Anthropogenic sources can also produce signals that mask or mimic natural processes of interest. Improved characterization of these signals is necessary to distinguish human-induced motions from tectonic or geomorphologic deformation. Surface and near-surface mass redistribution can also affect Earth rotational parameters observable by space geodetic methods, introducing errors into the determination of scale and center of mass of the terrestrial reference frame. As NASA invests in the deployment of new geodetic infrastructure, this subsection further welcomes proposals that address these anthropogenic geophysical sources surrounding observational noise.

NASA seeks research under this subsection that applies remote-sensing observations to the characterization of solid-Earth processes or properties informed by anthropogenic natural-resource signals. Proposals must include 1) an emphasis on solid-Earth science questions, and 2) explicit descriptions of how NASA remote-sensing datasets will be used in the study to contribute to answering the questions posed.

2.3 Dynamic Solid-Earth Events

One of the overarching goals of ESI is to provide the basic understanding and data products needed to inform the assessment, mitigation, and forecasting of dynamic solid-Earth events such as earthquakes, tsunami genesis, landslides, and volcanic eruptions. This subsection solicits proposals that will develop new methods to advance research of geohazards using advanced time-variable observations. This includes time-variable gravity, spectroscopy, and high-rate repeat geodetic imaging to capture topographic change. As the global constellation of radar satellites and their archives continue to expand, it is now becoming possible to characterize dynamic processes in regions where traditional Interferometric Synthetic Aperture Radar (InSAR) methods have previously had limited success, including areas of steep topography, dense vegetation, and high atmospheric propagation variations. The near-global 30-meter Shuttle Radar Topography Mission (SRTM) dataset, scheduled for complete release by the end of the year, will provide a consistent topographic base that can expand processing to areas with previously limited topographic coverage. Proposals are encouraged, but not required, to use L-band SAR data towards addressing objectives within the surface deformation science focus area of the planned NISAR mission. Historic ALOS L-band SAR and repeat-pass L-band UAVSAR

data are available through the Alaska Satellite Facility Distributed Active Archive Center (ASF-DAAC). New UAVSAR flights can be requested to support successful proposals. Future ALOS-2 and SAOCOM imagery may provide new sources of L-band imagery to consider. Research based in other remote-sensing methods that meet the above scientific goals are also of interest.

Proposals to this subsection must include 1) a focus on and clear description of fundamental science contributions to understanding dynamic solid-Earth events, and 2) a description of the observational, analytical, and/or modeling challenge that has limited understanding of the system under investigation, and how the approach will address this challenge.

Proposers are encouraged to utilize existing or planned ground, airborne, and space-based observational capabilities and their associated data sets in responding to all three of the above subsections. These resources include the existing high-resolution SRTM dataset, ongoing satellite and airborne LIDAR, and spectral imaging that provide structural and compositional models to inform tectonic and climatic influences on evolving terrains. Geodetic observations utilizing GPS and InSAR provide insights into dynamic processes. Ongoing and future missions such as ALOS-2, Sentinel-1, TerraSAR-X, COSMO-SkyMed, SAOCOM, and NISAR provide additional and upcoming opportunities in this realm. Geomagnetic and gravity missions, such as the historical SAC-C, Øersted, CHAMP, and GOCE, ongoing SWARM and GRACE, and future GRACE-FO, offer long-term records that inform models of the geodynamo and the structure, composition, and dynamics of the Earth's mantle, lithosphere, and fluid envelopes. These and other NASA datasets are cataloged in the Earth Observing System Data and Information System (EOSIDS, https://earthdata.nasa.gov) and provided by several Distributed Active Archive Centers (DAACS).

3. Summary of Key Information

Expected annual program budget for new awards	~$4M
Number of new awards pending adequate proposals of merit	~20-30
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	July 16, 2015. See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	September 16, 2015. See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	March 1, 2016
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Earth science strategic goals and subgoals in NASA's *Strategic Plan*; see Table 1 of ROSES and the reference therein. Proposals that are relevant to this program are, by definition, relevant to NASA.

General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-ESI
NASA point of contact concerning this program	Benjamin R. Phillips Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-5693 E-mail: ben.phillips@nasa.gov

A.26 RAPID RESPONSE AND NOVEL RESEARCH IN EARTH SCIENCE

NOTICE: Before any work is begun on a proposal to this program, potential proposers should read the first section entitled "Important Caveat to Potential Proposers."

Important Caveat to Potential Proposers

Before any effort is expended in preparing a proposal, potential proposers should:

- Read this solicitation in its entirety. It has a number of specific requirements. Failure to meet them will result in a proposal being returned without review.
- Understand that NASA reserves the right to return or decline proposals to this solicitation based on internal review with limited feedback to the proposers.
- Prior to proposal submission, contact the most relevant NASA program officer (http://science.nasa.gov/researchers/sara/program-officers-list/) and the current RRNES program officer (listed below). Proposers that forego this step run an increased risk of having their proposals declined or returned without review.
- Proposals should normally be for support of one year or less, under the assumption that further work will be proposed to another program.
- This solicitation is not intended to support mitigation of active disasters or immediate hazards. Contact the Disasters Program Manager in NASA's Applied Sciences Division and/or the other most relevant NASA program manager directly to discuss expedited options (http://science.nasa.gov/researchers/sara/program-officers-list/).
- Note that support for "limited-duration opportunity for an unanticipated research collaboration" has been eliminated from this new solicitation.
- Be aware that the Earth Science Division (ESD) has not reserved any funds dedicated to this solicitation, but anticipates that its individual programs will consider support of a very small number of meritorious proposals each year.

1. Introduction

In order to address its strategic goals and objectives (see Section I of the *ROSES Summary of Solicitation*), ESD of the Science Mission Directorate (SMD) acknowledges that there are important and highly relevant research topics and opportunities that cannot be anticipated in the annual ROSES solicitation. In particular, it is usually not possible to solicit the following two types of activities:

- Immediate research activity to take advantage of a target of opportunity due to an unforeseen event in the Earth system,
- Exceptionally novel and innovative ideas to advance Earth remote sensing that do not fit within ESD's current slate of solicitations and/or programs.

In the past, SMD has supported such research through unsolicited proposals and/or the former Innovative Research Program. SMD Earth Science no longer considers such unsolicited proposals and instead solicits them through this program element. ESD has not reserved any

funds dedicated to this solicitation, but anticipates that its individual programs will consider support of a very small number of meritorious proposals each year.

2. Scope of Program

This program element solicits proposals that advance the goals and objectives of NASA's Earth Science Division by conducting unique research to investigate 1) unforeseen or unpredictable Earth system events and opportunities that require rapid response, and 2) novel new ideas of potential high merit and relevance for ESD science that have not otherwise been solicited by NASA in the past three years.

2.1 Rapid Response to Earth System Events

This subelement is focused on research proposals having great urgency for action involving quick-response research on natural or anthropogenic extreme events, disasters, and/or similar unanticipated or unpredictable events. Examples are major fires, volcanic eruptions, 100-year floods, episodes of severe and large-scale environmental pollution, harmful algal blooms, coral bleaching events, and other events causing large-scale and rapid environmental change.

The research activities proposed must require rapid, near-term data acquisition, field work, and/or other such research activities. Given the significance of these events, rapid sharing of data and results is expected. Proposers are strongly encouraged to contact the NASA program officer(s) whose expertise best matches the proposal topic before submitting a proposal, in order to determine whether the proposed work is appropriate for this ROSES program element and if funding is likely to be available for a meritorious proposal.

The proposal must include clear statements as to 1) why the proposed research is of an urgent nature, 2) why the proposed research is of high significance and likely to have a long-lasting impact, 3) why this ROSES program element is the only feasible mechanism to request NASA support for the proposed work, and 4) a detailed plan on data dissemination and sharing.

Please note that this element is not intended to support mitigation of active disasters or immediate hazards. Please contact the Disasters Program Manager in NASA's Applied Sciences Division and or the other most relevant NASA program manager directly to discuss expedited options (http://science.nasa.gov/researchers/sara/program-officers-list/).

2.2 Novel Ideas in Earth Remote Sensing

This subelement is intended to provide an open, systematic, competitive process for NASA's ESD to consider proposals for exceptionally novel scientific research on remote sensing of the Earth that cannot be considered relevant to any other NASA solicitation. ESD recognizes that such proposals offer the possibility for major scientific breakthroughs and new approaches to remote sensing and knowledge of the Earth system. ESD offers this sublement as a mechanism for researchers to develop their ideas and justify near-term investment through an important new capability or scientific application that will advance ESD goals and objectives.

Proposals must focus on topics that offer fundamental scientific research to advance Earth remote sensing, including new ways of interpreting remote sensing data or improving knowledge of the Earth system and its processes. Proposals may include calibration and validation work as appropriate.

Discouraged are proposals that focus on instrument or technology development, data and information systems research, or educational activities.

If the topic is relevant to any other ESD ROSES program elements, it should not be submitted here, and should be submitted to the relevant element. In addition, in order for a proposal to be considered responsive as novel Earth science, the topic and approach must not have been solicited or have been considered responsive under any NASA solicitations during the past three years (this includes ROSES-2012 – ROSES-2014, NASA Announcements of Opportunity, etc.). Any proposal that contains research that in the view of cognizant NASA managers violates one or both of these requirements will be considered as nonresponsive and declined without further review.

NASA anticipates that only a very few proposals will meet these criteria each year and that selection and funding of such proposals will be a rare, but strategically important occurrence.

3. Relevance to SMD's Goals and Objectives

Proposals submitted in response to this solicitation must demonstrate the relevance of the proposed activity to ESD by showing how the scientific/technical area(s) to be covered will advance not only high-level ESD goals and objectives, but also specific (existing or anticipated) outcomes identified in ROSES program elements, ESD roadmaps, other ESD program documents, the *NASA Science Plan*, findings in decadal surveys, or the reports of NASA advisory bodies or groups relevant to NASA. Proposers must explicitly state from what source (e.g., ROSES program element, roadmap, or decadal survey) the claim of relevance derives. Proposers are referred to the *Earth Science Overview* in Appendix A.1 of this solicitation for a description of the scope of NASA Earth Science activities and the research programs areas and topics of interest. To be relevant under this program element, proposals must take into consideration ESD's defined scope and its focus on the use of space-based measurements to provide information about the Earth system.

4. Programmatic Information and Additional Requirements

4.1 Proposal Structure, Content, and Budget Requests

All proposers are encouraged in the strongest possible terms to contact the ESD program managers (http://science.nasa.gov/researchers/sara/program-officers-list/) whose expertise are most germane to the proposal topic prior to submission to determine the appropriateness of the work for consideration under this program element. This may include consideration of whether funding is potentially available.

4.1.1 *Proposals for Rapid Response to Earth System Events*

The Technical Plan for proposals submitted for rapid response is limited to a maximum of five pages and must include clear statements as to why the proposed research is of an urgent nature and why this solicitation is the only feasible mechanism to request NASA support for the proposed work, as well as the other requirements listed in the text of the subelement. The bulk of the Technical Plan should be devoted to describing the core scientific objectives and anticipated scientific return, the research work to be done, and the timetable for rapid actions. If NASA facilities will be required to conduct the research (e.g., NASA aircraft or airborne sensors), proposers should contact the relevant facility managers to develop feasibility and cost estimates in parallel with the preparation of their proposal. Feasibility and cost estimates should be submitted as part of the budget justification.

Questions regarding the NASA flight request system or processes should be addressed to Marilyn Vasques, Flight Request Manager (Marilyn.Vasques@nasa.gov or 650-604-6120).

To ensure timely processing of the submitted proposal, "Rapid Response" must be selected as the Primary Investigation Type on the proposal cover sheet.

NASA will initially conduct an internal review of each proposal that may result in a decision, and there may be limited feedback to the proposer. Some proposals may be declined simply for lack of available funding. However, proposals may also be subject to external peer review at the discretion of NASA. The larger the requested funding, the more comprehensive (e.g., the use of external mail review) the review is likely to be.

Budget requests should be commensurate with the nature of the rapid response work to be conducted and, if no other research projects are being leveraged, include sufficient funding for processing of the data and its public distribution, as well as minimal data analysis to achieve the core, near-term objectives of the rapid response. Full exploitation of a successfully acquired data set can be included in future competitive ROSES disciplinary program elements and should not be requested here.

Proposals should normally be for support of one year or less, under the assumption that further work will be proposed to another program. Up to three years of funding may be requested, but proposals requesting more than one year of funding must provide specific and compelling justifications as to why the core, rapid response science objectives require a longer duration for completion.

4.1.2 *Proposals for Novel Ideas in Earth Remote Sensing*

The Technical Plan for novel Earth science proposals is limited to a maximum of 15 pages and must include clear statements as to why the proposed scientific research is novel and not responsive to any other NASA solicitations released in the past three years. The technical plan should emphasize the initial research activities needed to explore the feasibility of the new idea,

prove the concept, and/or provide a first demonstration of the potential utility and benefits to NASA Earth science, as well as the other requirements listed in the text of the subelement. Potential proposers are encouraged to pay close attention to the types of research which are discouraged for this area as noted in Section 2.2 above ("instrument or technology development, data and information systems research, or educational activities").

It is anticipated that most such studies will be conducted in one year and at modest cost (e.g., ~$75-150K). However, up to three years may be requested, but the proposal must fully justify the need for that length of time. In addition, all proposals must describe plans for the publication/documentation/dissemination of their results at the earliest possible date.

NASA will initially conduct an internal review of each proposal that may result in a decision, and there may be limited feedback to the proposer. Some proposals may be declined simply for lack of available funding. In some cases, NASA will at its discretion conduct a full peer-review of the proposal, most likely involving individual evaluations submitted through NSPIRES. However, if sufficient proposals are received, NASA reserves the right to convene a peer review panel. NASA's standard evaluation criteria will be used in reviewing these proposals. The uniqueness of the research proposed and the degree of innovation will be weighed heavily under the intrinsic merit criterion, as well as under relevance.

4.2 Availability of Funding

No specific budget is identified for this program element; selected proposals will be funded by the ESD program managers in the disciplines most closely related to or benefitting from the proposed work. The number of proposals selected will be dependent on the availability of funds, as well as the number and quality of proposals submitted.

Potential proposers should contact both the NASA Point of Contact for this solicitation and the ESD Program Officers in the disciplines and programs most germane to the proposed investigations to discuss the proposed work and the availability of funds. Contact information for SMD Program Officers is available at http://science.nasa.gov/researchers/sara/program-officers-list/ or in the Summary Information table at the end of a ROSES program element description.

4.3. Award Instruments

Awards selected under this solicitation will only be supported as a grant, a cooperative agreement, an interagency agreement, or internal funding to a NASA Center. Contracts will not be used for these awards.

5. Summary of Key Information

Expected annual program budget for new awards	No specific budget is identified; selected proposals will be funded by the benefitting program.
Number of new awards pending adequate proposals of merit	The number of proposals selected will be dependent on the availability of funds from the benefitting program as well as the number and quality of proposals submitted.

Maximum duration of awards	3 years (but see sections 4.1.1 and 4.1.2)
Due date for Notice of Intent to propose (NOI)	No Notices of Intent are requested for this program element.
Due date for proposals	Proposals may be submitted at any time until 11:59 PM (Eastern time) on March 31, 2016
Planning date for start of investigation	1½ months after proposal receipt for Rapid Response and 6 months after proposal receipt for Novel Earth Science
Page limit for the central Science-Technical-Management section of proposal	5 pp for Rapid Response and 15 pp for Novel Earth Science; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	See section 3. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-RRNES
NASA point of contact concerning this program	Thomas Wagner Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-4682 E-mail: thomas.wagner@nasa.gov

A.27 GRACE – GRACE-FO SCIENCE TEAM

1. Scope of the Program

The Gravity Recovery and Climate Experiment (GRACE) twin satellites launched on March 17, 2002, continue to make detailed measurements of Earth's gravitational field. The GRACE mission is an innovative and advanced technology mission to measure the static and time varying components of the Earth's gravitational field. The time-dependent component of gravity is also affected by processes on a wide range of scales, most of them involving water transfer. Determining and understanding these transfers is a high priority in studying climate and related phenomena. Processes causing large enough transfers to be measurable include ocean circulation, annual cycles of snow pack and groundwater, postglacial rebound, sea-level rise, and melting of the ice sheets.

The GRACE mission data and products have multidisciplinary reach with expected contributions to solid Earth science, polar science, physical oceanography, hydrology, and atmospheric science. The high-resolution static and temporal gravity fields measured by GRACE provide first ever opportunities to study global circulation, atmospheric, and hydrologic transport, the internal structure and dynamics of the Earth. These new measurements have demonstrated utility in drought monitoring and are also expected to contribute to the mitigation of flooding and drought through a better understanding of the regional distribution of water and its climatic variability. During the past 12 years of its mission, GRACE and its science teams achieved considerable success and earned its science pathfinder status by demonstrating the importance of precision measurements of planetary gravitational fields to a broad spectrum of interdisciplinary science.

The GRACE Follow-On (GRACE-FO) mission will obtain the same extremely high-resolution global models of Earth's gravity field, including how it varies over time, as in the original GRACE mission to ensuring there is no gap in gravitational field measurements following the currently operating GRACE mission.

The scientific goals of the GRACE and GRACE-FO missions complement a number of international programs, including the World Ocean Circulation Experiment (WOCE), the Climate Variability Program (CLIVAR), and the Global Ocean Observing System (GOOS). The GRACE and GRACE-FO missions are also responsive to NASA's Solid Earth Science Working Group Report *Living on a Restless Planet* (http://solidearth.jpl.nasa.gov/) that identifies the study of the dynamics of the Earth's gravity field as one of six significant challenges for the next twenty-five years.

The primary goal of the GRACE and GRACE-FO missions is to obtain accurate high-resolution global models for temporal and spatial variability of the Earth's gravity field. The spatial and temporal variability of the Earth's gravity field is a direct manifestation of global mass distribution and its movement. The observed variability in the gravity field, satellite altimeter data, and other *in situ* data are used in geophysical models to advance our knowledge concerning changes in ocean heating, sea level, and oceanic currents; regional scale changes in water resources associated with flooding and drought; changes in the Antarctic and Greenland ice

sheets and Alaskan glaciers; structure and dynamics of the Earth's core and mantle; and surface displacements associated with tectonic forces.

A secondary science goal of the GRACE and GRACE-FO missions are to enable advances in the atmospheric sciences by the recovery of refractivity (and the derived quantities of temperature and water vapor profiles) and small scale ionospheric structure from the use of GPS radio occultation data.

For further reference see the 1997 NRC report *Satellite Gravity and the Geosphere* (http://www.nap.edu/catalog.php?record_id=5767), the GRACE web page at http://www.csr.utexas.edu/grace/ or http://www.gfz-potsdam.de/pb1/op/grace/index_GRACE.html.

This solicitation seeks proposals that will advance the development of new methods, algorithms, and models for the exploitation of gravity field observations to be made by GRACE, GRACE-FO, and future space based gravity field missions for the broad spectrum of Earth system science challenges. This solicitation also seeks the development of techniques and algorithms capable of bridging gravity field observation across different gravity missions. Proposals are encouraged which are multidisciplinary in scope and which address the Earth System Science questions defined in the NASA Science Plan (http://nasascience.nasa.gov/about-us/science-strategy/).

Due to the extreme sensitivity of the GRACE measurement technique and its resolution, ground calibration of the mission is problematic. This solicitation, therefore, seeks proposals that provide predictive models for the static and time varying gravity field that can be verified through both ground and GRACE/GRACE-FO space-borne observations. This solicitation seeks improved models for the static gravity field and its short term and secular variations and their influence upon the terrestrial reference frame.

This solicitation seeks proposals for the identification and quantification of atmospheric, oceanographic, hydrospheric, cryospheric and solid Earth structure and dynamics manifested in the GRACE observations. The analysis effort can include other data sources that complement the GRACE measurements, such as Earth rotation and temporal and static gravity field measurements and other innovative approaches, including the use of data from other satellite missions such as CHAllenging Minisatellite Payload (CHAMP) and Laser Geodynamics Satellite (LAGEOS) gravity, radar, and laser altimetry missions such as Jason I and IceSat, and Shuttle Radar Topography Mission (SRTM). Proposers are advised to limit their proposals involving GPS occultation to the improvement and/or validation of GRACE gravity field models only.

The focus of the proposals should be upon the GRACE data set and future GRACE-FO data sets though multidisciplinary and multisensor studies as well as studies that will utilize the GRACE like mission data base to develop new measurement strategies to improve measurements of the Earth's gravity field. In particular, NASA is interested in efforts to advance measurement concepts and algorithms that would utilize other NASA missions, as well as other observing systems, to enhance our understanding of the Earth System through improved accuracy and spatial resolution.

2. Programmatic Information

The GRACE mission is a collaborative mission between the NASA Jet Propulsion Laboratory (JPL) and the German Aerospace Center (DLR). Similarly the GRACE-FO mission is a partnership between NASA and the German Space and Earth Science agencies. Both GRACE and GRACE-FO missions consist of a pair of satellites orbiting in tandem having an instrument suite that includes the Microwave Instrument, which accurately measures changes in the speed and distance between the two spacecraft. The accelerometer instrument measures all nongravitational accelerations (e.g., air drag, solar radiation pressure, attitude control, thruster operation) on each satellite. In addition, as a technology demonstration, the GRACE-FO mission satellites will be instrumented with a Laser Ranging Interferometer. NASA will use the science data from the GRACE-FO mission to generate an updated model of Earth's gravitational field approximately every 30 days for the five-year lifetime of the mission.

NASA has approved extended mission operations for GRACE through September 30, 2016. The Climate Continuity Mission GRACE--FO is scheduled to launch August 2017 and NASA is considering extending the GRACE mission to September 30, 2017, for mission overlap subject to continued performance, achievements, and the availability of funds.

Three advanced gravity field missions have been launched since 2000. These missions include CHAMP (launched July 15, 2000), GRACE (launched March 17, 2002), ESA's Earth Explorer Gravity Field and Steady-State Ocean Circulation (GOCE) (launched March 17, 2009). GRACE-FO is expected to be operational during the time the proposed activities will be implemented. Proposers to this solicitation may consider the use of multiple satellite data sources and they are required to include GRACE and GRACE-FO data.

The investigators associated with the selected proposals will become members of the GRACE and GRACE-FO science team for the term of their grants.

Continuation of studies funded by existing GRACE team grants will be considered, but proposers are urged to describe accomplishments achieved and carefully articulate the progress to be made in the continuation efforts.

3. Summary of Key Information

Expected total program budget for new awards	~ $3M per year
Number of new awards pending adequate proposals of merit	~ 20
Maximum duration of awards	4 years
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after proposal due date.

Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-GRACE
NASA point of contact concerning this program	Lucia Tsaoussi Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-4471 E-mail: Lucia.S.Tsaoussi@nasa.gov

A.28 SPACE ARCHAEOLOGY

NOTICE: Amended on September 2, 2015. This amendment announces that program element A.28 Space Archaeology, will not be competed in ROSES-2015.

The NASA Space Archaeology program has the scientific objective to use the unique vantage point of space to improve our understanding of past human settlement patterns and the relationships between the natural environment and cultural adaptations as functions of time and space. The major goals of this program are:

- To accelerate archaeological discovery and understanding through access to and analysis of remotely-sensed data obtained from space borne and airborne platforms; and
- To facilitate the infusion of technological expertise and capacity in remote sensing into archaeological research by fostering multidisciplinary collaborative relationships.

The NASA Space Archaeology program integrates aspects of research contributing to many of the Earth science research objectives listed in the NASA Strategic Plan and the NASA Science Plan. Proposals must incorporate remote sensing data or derived products and be relevant to one or more of the following NASA research objectives:

- Enable improved predictive capability for weather and extreme weather events;
- Quantify global land cover change and terrestrial and marine productivity, and improve carbon cycle and ecosystem models;
- Quantify the key reservoirs and fluxes in the global water cycle and improve models of water cycle change and fresh water availability;
- Understand the role of oceans, atmosphere, and ice in the climate system and improve predictive capability for its future evolution;
- Characterize and understand Earth surface changes and variability of Earth's gravitational and magnetic fields; and
- Expand and accelerate the realization of societal benefits from Earth system science.

Past solicitations (in 2007, 2009, and 2011) have had the following foci:

- Identification and exploration of the extent and nature of past human settlement patterns;
- Regional landscape analysis and modeling relating human settlement patterns and subsistence strategies to environmental factors derived from remote sensing;
- Protection and preservation of cultural heritage sites and/or planning for the sustainable development of cultural resources;
- Information about the specifics of the solicitations released and proposals selected in response to the three NASA solicitations in this area may be found at NSPIRES: go to http://nspires.nasaprs.com/external/ click on "Solicitations", then "Closed/Past Selected", and then search for "Archaeology"

This program may support limited fieldwork as needed to verify and validate remotely sensed results, but requests for extensive excavation are considered nonresponsive.

For more information on this program, contact:

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A.29 AIRBORNE INSTRUMENT TECHNOLOGY TRANSITION

NOTICE: The Airborne Instrument Technology Transition program will not be competed in ROSES-2015. The program may next solicit proposals in ROSES-2016.

1. Scope of Program

NASA's Earth Science Research Program is a comprehensive effort that develops observational techniques and instrument technologies needed to implement them. These instruments are operated in the laboratory and from suborbital (i.e. surface, balloon, and aircraft) and space-based platforms to support science investigations. In many cases, airborne data are used to increase basic process knowledge and, in other applications, airborne data products are incorporated into complex computational models that characterize the present state and future evolution of the Earth System.

Within the Earth Science Division, the Airborne Science Program is responsible for providing airborne instrument systems capable of delivering data products that advance science and that complement other observing assets, such as satellites. This is accomplished primarily through focused field experiments for process studies, evaluation and risk retirement of new instrument concepts, and calibration and validation of space-based sensors.

This announcement seeks to upgrade mature instruments developed under NASA's Instrument Incubator Program, or by similar NASA programs or activities, for operation from various platforms supported by the Airborne Science Program.[1] This opportunity provides for engineering activities leading to the integration of instruments to airborne platforms that will deploy them as part of organized airborne science campaigns which typically involve multiple instruments and/or platforms. The goal is to upgrade existing operating instruments to campaign-ready airborne configuration(s). No funding is available for research and development of new instrumentation. Management of the tasks selected in response to these Airborne Instrument Technology Transition calls is carried out in conjunction with the Earth Science Technology Office (ESTO)[2], which has significant experience in management of technology-oriented tasks through programs such as the Instrument Incubator Program. A fuller description of ESTO and its activities is included in Appendix A.1.

Proposals submitted to this announcement shall support the objectives of one or more of the Earth science focus areas. Earth science focus areas include: Carbon Cycle and Ecosystems, Climate Variability and Change, Water and Energy Cycle, Atmospheric Composition, Weather, and Earth Surface and Interior (see Appendix A.1 for descriptions of the focus areas). Relevance to these focus areas is indicated by the degree to which instrument products (i.e., science and engineering data) support the goals and activities of existing and future field campaigns sponsored by the NASA Research and Analysis program; it may also be demonstrated by

[1] http://airbornescience.nasa.gov/platforms/platforms.html
[2] http://esto.nasa.gov/

relevance to the goals and activities of NASA's Applied Science Program.[3] Examples of previous field campaigns can be found at the Airborne Science Website.[4]

Proposers may find information on selections from previous calls for this element at NASA's NSPIRES web site.[5]

The following documents identify the relevant missions and programs for this program:

1. *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* may be accessed on the web at http://www.nap.edu/catalog/11820.html. This report is hereinafter referred to as the "*Decadal Survey*."
2. *Responding to the Challenge of Climate and Environmental Change: NASA's Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space* accessible on the web at http://science.nasa.gov/media/medialibrary/2010/07/01/Climate_Architecture_Final.pdf.
3. NASA missions listed in the table found at http://science.nasa.gov/earth-science/missions/.

2. Point of Contact for Further Information

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[3] http://appliedsciences.nasa.gov/
[4] http://airbornescience.nasa.gov/
[5] http://nspires.nasaprs.com/external/

A.30 EARTH SCIENCE U.S. PARTICIPATING INVESTIGATOR

NOTICE: The Earth Science U.S. Participating Investigator (USPI) program will not be competed in ROSES-2015. The Earth Science USPI program is tentatively scheduled to next solicit proposals in ROSES-2016.

The Earth Science U.S. Participating Investigator (USPI) program facilitates participation on a non-NASA space mission as a Co-Investigator (Co-I) for an instrument, experiment, or technology demonstration that is being built and flown by a sponsor agency other than NASA. The Co-I role can include, but is not limited to, instrument design, modeling, and simulation of the instrument's operation and measurement performance; calibration of the instrument; and/or development of innovative data analysis techniques. A USPI may also serve as a member of a non-NASA space mission science or engineering team and participate in science team activities such as mission planning, mission operations, data processing, data analysis, and data archiving. No matter what the nature of the USPI role, an investigation proposed under this category must be for a science or technology investigation and must include a meaningful contribution to the development of products, including, but not limited to, algorithm development and/or testing, calibration/validation, and/or requirements definition (especially as may be carried out in Observing System Simulation Experiments). Proposals were last received in August 2014, and it is anticipated that proposals will be solicited again in ROSES-2016.

For information on this program, contact:

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A.31 INTERDISCIPLINARY RESEARCH IN EARTH SCIENCE

NOTICE: Interdisciplinary Research in Earth Science will not be competed in ROSES-2015. This program is tentatively scheduled to next solicit proposals in ROSES-2016.

1. Scope of the Program

This solicitation is for new and successor interdisciplinary research investigations within NASA's Interdisciplinary Research in Earth Science (IDS) program. Proposed research investigations will meet the following criteria: a) offer a fundamental advance to our understanding of the Earth system; b) be based on remote sensing data, especially satellite observations, but including suborbital sensors as appropriate; c) go beyond correlation of data sets and seek to understand the underlying causality of change through determination of the specific physical, chemical, and/or biological processes involved; d) be truly interdisciplinary in scope by involving traditionally disparate disciplines of the Earth sciences; and e) address at least one of the specific themes listed in any particular IDS solicitation. In ROSES-2012, the themes were:

- Understanding Earth System Vulnerabilities to Climate Extremes
- Impacts of Changing Polar Ice Cover
- Water and Energy Cycle Impacts of Biomass Burning
- Impacts of Population growth on watersheds and coastal ecology
- Role of Permafrost in a Changing Climate

The results of these investigations will improve our capability for both prognostic predictions and retrospective simulations of the Earth system. They will also advance our understanding of the vulnerabilities in human and biogeophysical systems and their relationships to climate extremes, thresholds, and tipping points. Meeting these goals requires approaches that integrate the traditional disciplines of the Earth sciences, as well as innovative and complementary use of models and data.

1.1 Context and History

Since its inception more than a decade ago, NASA's IDS program has advanced the goal of understanding the Earth system by promoting interdisciplinary research and exploiting the vast wealth of data from NASA satellite and airborne sensors. The program's focus has generally aligned with the goals of the U.S. Global Change Research Program (http://globalchange.gov/). Substantial contributions have also been made to Earth system model development, training the next generation of interdisciplinary scientists, and developing the necessary infrastructure to take full advantage of NASA satellite data.

The specific topics of the program have varied through time (see prior solicitations and awards at nspires.nasaprs.com), and this solicitation represents the development of new elements and the continuation of others.

2. Interdisciplinary Research Themes, Proposal Details, and Review information

Specific scientific topics and questions are identified as separate subelements within any given year's solicitation. These topics and questions constitute the complete set of scientific research topics solicited by the IDS program, and no priority should be construed from their relative order. Proposals submitted in response to this element MUST address at least one of these subelements, and proposals MUST identify clearly which subelement or subelements are addressed. Proposed research investigations must also meet all of the following criteria, and each of these should be specifically addressed in the proposal:

- offer a fundamental advance to our understanding of the Earth system;
- be based on remote sensing data, especially satellite observations, but including suborbital sensors as appropriate;
- go beyond correlation of data sets and seek to understand the underlying causality of change through determination of the specific physical, chemical, and/or biological processes involved;
- be truly interdisciplinary in scope by involving traditionally disparate disciplines of the Earth sciences; and
- address at least one of the specific subelements listed in the solicitation.

Proposals developing significant new datasets must include a data management plan.
NASA expects to have separate peer review panels for each subelement, and proposals will be assigned to one or more panels based on the proposer's identification of the appropriate subelement, as well as NASA's assessment of proposal content. While NASA expects to select proposals in each of the subelements, NASA reserves the right to select proposals in none, some, or all of these depending on the nature and distribution of proposals received and the outcome of the peer review process.

3. Point of Contact for Further Information

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A.32 NASA DATA FOR OPERATION AND ASSESSMENT

NOTICE: NASA Data for Operation and Assessment (NDOA) will not be competed in ROSES-2015. The NDOA was competed in ROSES-2013 and is anticipated to be open again in ROSES-2016.

1. Scope of Program

NASA's Earth Science Research Program aims to use global measurements to understand the Earth system and its interactions as steps toward ultimately enabling prediction of Earth system behavior. To achieve this goal, a combination of shorter-term process-oriented measurements is complemented by longer-term satellite measurements of a limited number of environmental properties. For these measurements, NASA's Earth Science Research Program sponsors algorithm development, calibration/validation activities, and modeling studies to produce high-quality data products for scientific research and operational use.

This solicitation recognizes the advances already made by investigations which were solicited by prior NASA Research Announcements and/or National Oceanic and Atmospheric Administration (NOAA) Announcements of Opportunity and which focused in the areas of sensor calibration, algorithm development and refinement, product validation, and scientific data analysis. This solicitation offers investigators an opportunity to analyze, assess, and increase the impact of NASA data in research and operational environments, particularly in the areas of weather prediction, climate projection assessment, and global carbon cycle modeling in anticipation of carbon management regulations.

2. Points of Contact for Further Information

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A.33 CLOUDSAT AND CALIPSO SCIENCE TEAM RECOMPETE

NOTICE: Amended on March 24, 2015. When setting the schedule for ROSES-2015, the proposal due date for this program element was inadvertently placed on Saturday. This amendment corrects that error, shifting the due date to the following Friday. Proposals are now due by July 31, 2015. Notices of Intent to propose are still requested by May 26, 2015.

1. Scope of the Program

1.1 Overview

Nearing nine years of active service, the radar carrying CloudSat and backscatter lidar carrying Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellites have provided unprecedented information on the vertical profile of clouds, cloud liquid water, and aerosol particles over the globe. Taken individually, the CloudSat mission's primary science goal is to furnish data needed to evaluate and improve the way clouds are parameterized in global models, thereby contributing to better predictions of clouds and thus to the poorly understood cloud-climate feedback problem (http://cloudsat.atmos.colostate.edu/). For CALIPSO, the satellite was designed to help scientists answer significant questions and provide new information regarding atmospheric transport of airborne particles and air pollutants, as well as the effects of clouds and aerosol particles on Earth's changing climate (http://www-calipso.larc.nasa.gov/).

The greatest strength in CloudSat and CALIPSO, however, comes from their inclusion in the NASA A-Train. By combining the vertical cloud and aerosol information from these satellites together with aerosol, gas, and cloud data from other A-Train instruments allows for a more comprehensive perspective on how clouds and aerosol plumes form, evolve, and impact the atmosphere. From primary mechanistic studies to climatologies, this system of satellites has opened the observing world to three full dimensions.

This particular solicitation requests proposals for the CloudSat/CALIPSO science team.

1.2 Background

The CALIPSO and CloudSat spacecraft were launched aboard a Delta II rocket on April 28, 2006. The CALIPSO payload consists of the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP), the Imaging Infrared Radiometer (IIR), and the Wide Field Camera (WFC). CALIOP is a two-wavelength (532 and 1054 nm) polarization-sensitive lidar that provides vertical profiles of aerosols and clouds. Information about the spacecraft and its instruments can be found at: http://www.nasa.gov/mission_pages/calipso/main/index.html.

CloudSat carries the Cloud Profiling Radar (CPR), which is a nadir-looking radar measuring in the 94-GHz band. It is designed to measure vertical profiles of clouds and is the only current source for vertical profiles of global cloud liquid, ice water, and precipitation. More information about the instrument can be found at:
http://www.nasa.gov/mission_pages/cloudsat/mission/index.html.

The spacecraft were launched on a joint mission to study the role of aerosols and clouds in the Earth's climate system. As of February 2011, CloudSat data had been used in over 275 peer-reviewed publications, and CALIPSO data had been used in over 300 peer-reviewed publications. Published research highlights for CloudSat include improved understanding of the surface energy balance, improved understanding of atmospheric convection, identification of flaws in the representation of precipitation in weather and climate models, and improved parameterizations of clouds and aerosols in global and process-scale models. Published research highlights for CALIPSO include the first detailed studies of aerosol radiative effects in desert regions, mechanisms of dust generation and lofting, investigations of emission and transport of biomass burning plumes, improved understanding of aerosol-cloud interactions, improved understanding of the surface and atmospheric radiation budget, and better understanding of cloud/radiation/climate feedbacks. This solicitation provides an opportunity to continue to make fundamental advances in our understanding of the role of clouds and aerosols in the climate system.

1.3 Research Themes

While team members may pay strict attention to one satellite or the other, NASA considers this one consolidated science team and encourages cross sensor studies. Specifically, proposals are requested that greatly enhance the state of atmospheric and climate science through the substantive utilization of CloudSat and CALIPSO data products. These can be taken alone, but preferably in conjunction with other satellite (e.g., A-Train), suborbital campaign, ground-based, and/or model data. The inventive combination of CloudSat and CALIPSO data with other sensors (such as other A-Train sensors or the CATS lidar on ISS) is encouraged. Note, however, that CALIPSO and/or CloudSat observations should be the primary basis of the proposed investigation and not relegated to a minor or supplementary role. Example topics include:

- Phenomenological studies of fundamental cloud, precipitation and aerosol processes and evolution, as well as aerosol indirect effects and vertical transport;
- Development and validation of aerosol and cloud parameterizations for regional, global, and climate models;
- Use of CALIPSO and CloudSat products in the development of three dimensional aerosol and cloud climatologies, spatial correlations, or trends;
- Fundamental studies of the information content of CALIPSO and/or CloudSat data products and their use for data assimilation;
- Use of CALIPSO and/or CloudSat in understanding the atmosphere's three-dimensional radiative environment;
- Aerosol/cloud interactions and their impact on cloud microphysics, optics, and radiation;
- Aerosol direct and indirect radiative effects;
- Effects of aerosols on precipitation;
- Development of new or significantly improved level two cloud and aerosol products;
- Development of innovative uses of CALIPSO and/or CloudSat data, such as for oceanography, meteorology, and land studies; and
- Stratospheric aerosols and/or polar stratospheric clouds.

Activities that are not included in this call are:

- Routine instrument algorithm maintenance, incremental improvement, or data visualization;
- Specific field missions or data collects for CloudSat and CALIPSO satellite calibration and validation; and
- Proposals for Science Team Leads.

2. Summary of Key Information

Expected program budget for first year of new awards	~ $5M
Number of new awards pending adequate proposals of merit	~ 30
Maximum duration of awards	3 years
Planning date for start of investigation	6 months after proposal due date.
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	**July 31, 2015.** See Tables 2 and 3 in the *ROSES Summary of Solicitation*. **[Amended March 24, 2015]**
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-CCST

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A.34 SATELLITE CALIBRATION INTERCONSISTENCY STUDIES

NOTICE: Amended on June 9, 2015. Amendment 18 delays the due dates for this program element. Notices of Intent (NOIs) are now requested by October 14, 2015 and proposals are now due by December 8, 2015.

1. Scope of the Program

The quantitative determination of global trends in the Earth's atmosphere, ocean, cryosphere, biosphere, and land surface depends significantly on the ability of the scientific community to construct multiinstrument/multiplatform data sets based on satellite observations covering periods of a decade or longer. This effort, global in scope, also constitutes a global challenge, as most if not all such data sets will rely on satellite programs from multiple agencies and/or nations, in particular, requiring both the use of satellites primarily focused on research and the use of those intended for operations.

The "knitting together" of such data sets requires that the relative calibrations of the different sensors, their degradation over time, and the nature of the algorithms used to convert raw measurements into environmental parameters all be quantitatively understood. Given the diversity of sources of the instruments and algorithms, as well as the unique characteristics of each, focused effort must be placed in creating such combined data sets.

This challenge has been widely recognized by satellite operators and the existing organizations through which they coordinate their activities. In particular, the Committee on Earth Observing Satellites (CEOS) has created a Working Group on Calibration and Validation (WGCV) (http://www.ceos.org/index.php?option=com_content&view=category&layout=blog&id=75&Itemid=113), the World Meteorological Organization (WMO) and the Coordination Group for Meteorological Satellites (http://www.eumetsat.int/website/home/AboutUs/InternationalCooperation/CoordinationGroupforMeteorologicalSatellitesCGMS/index.html) have together established a Global Space-Based Inter-Calibration System (GSICS; see http://gsics.wmo.int/). In the U.S., the National Oceanic and Atmospheric Administration (NOAA) has established a National Calibration Center (http://ncc.nesdis.noaa.gov) to establish traceability to recognized international standards and to reduce uncertainties for meteorological and climate-related satellite measurements. The importance of coordination across platforms and instruments for long-term earth observation has also been identified as a priority by the US Global Change Research Program as part of its objective of Integrated Observations (Objective 1.3) in its 2012-2012 Strategic Plan *The National Global Change Research Plan 2012-2012: A Strategic Plan for the U.S. Global Change Research Program* (http://www.globalchange.gov/browse/reports/national-global-change-research-plan-2012%E2%80%932021-strategic-plan-us-global-change).

This ROSES element provides an opportunity for the research community to participate in the quantitative comparison of multiple satellite data products to facilitate the development of multiinstrument/multiplatform data sets involving satellites from multiple providers. Proposals responsive to this call MUST address interconsistency issues of two or more satellites, at least one of which must be one currently supported through NASA's Earth Science Program, and at

least one of which must be supported by some other organization (U.S. or foreign). Proposals that only address interconsistency issues of NASA satellites or those of non-NASA providers will be considered as nonresponsive and returned without review.

A broad range of techniques for such intercomparisons has been developed by the scientific community, such as simultaneous nadir overpass (SNO), trajectory mapping, and comparison with nonspace (e.g., surface and/or balloon based) data. The use of any or all such techniques (not limited to those listed here) is permitted under this announcement. Issues related to footprint size mismatch, spectral band mismatch and temporal and spatial sampling should be clearly addressed. Proposals submitted in response to this ROSES element should document their responsiveness to ongoing efforts of CEOS/WGCV, GSICS, and/or other broadly recognized national and/or international efforts (e.g., those traceable to the International Council for Science and/or the United Nations and its suite of programs). The importance of the proposed activities should also be clearly stated in the proposal. The proposers are expected to:

- Identify the particular data sets to be analyzed.
- Describe the resulting deliverables from the proposed research, as well as potential uses.
- Provide a statement of the motivation for the proposed research leading to multiinstrument/multiplatform data records involving satellites of two or more providers.
- Quantify, to the extent possible, the expected benefit to Earth science objectives given the successful completion of the proposed efforts.
- Identify possible users, including organizations, and the venues that may facilitate the utilization of the project results.

2. Programmatic Information

This program intends to consider all satellite missions currently in operation as well as missions that are expected to operate in the timeframe of the performed work, i.e., 2016 to 2018. In particular, upcoming and recently launched geostationary platforms, many of which incorporate new generations of instrumentation, may be considered here as non-NASA platforms; a list of these satellites may be found through the satellite status web page of the CGMS (http://www.cgms-info.org/index_.php/cgms/page?cat=ABOUT&page=Satellite+Status). The primary emphasis of this solicitation is on satellites which are currently flying or which are expected to be flying shortly after the submission of these proposals; while proposals relating to satellites further from launch will be considered, they will be given lower priority for funding than those that involve satellites whose on-orbit capabilities are demonstrated. Proposers interested in working with satellites further from launch may want to consider response to a future call for U.S. Participating Investigators (USPI), which is typically carried out biennially, with the next such solicitation coming in ROSES-2016 (see element A.30 in this ROSES for additional information).

While this solicitation element is focused on free-flying satellites, NASA or partner-provided instruments aboard the International Space Station (ISS) may fulfill the requirement for a NASA or non-NASA asset, as appropriate, in proposals to this solicitation element. For purposes of this solicitation, satellites built by NASA for NOAA are considered as partner satellites and not as NASA satellites.

This program will support approximately ten investigators with a total funding of approximately $1.5M per year for proposals of three-year duration, although periods of performance of no more than two years is acceptable. The tasks to be selected in response to this program are expected to be of a one-time nature, so proposers should have no expectations of continuity from any follow on projects to this program beyond the specific solicitation selection. If successful proposers from the initial implementation of this element in ROSES-2011 (http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={55F81729-A67E-EF4B-595D-6687867E65B2}&path=closedPast) propose to this element, they must demonstrate in their proposals how the proposed work is substantially different from that previously funded. It is expected that the advances associated with the work in proposals selected in response to this element will result in actionable information to be openly distributed and shared with satellite agencies and users.

3. Summary of Key Information

Expected total program budget for new awards	~ $1.5M per year
Number of new awards pending adequate proposals of merit	~10-12
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	**October 14, 2015.** See Tables 2 and 3 in the *ROSES Summary of Solicitation*. **[Amended June 9, 2015]**
Due date for proposals	**December 8, 2015.** See Tables 2 and 3 in the *ROSES Summary of Solicitation*. **[Amended June 9, 2015]**
Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *Guidebook for Proposers*
Relevance	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)

Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-SCIS
NASA point of contact concerning this program	Lucia Tsaoussi Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-4471 E-mail: lucia.s.tsaoussi@nasa.gov

A.35 NEW (EARLY CAREER) INVESTIGATOR PROGRAM IN EARTH SCIENCE

1. Scope of Program

1.1 Introduction

The New (Early Career) Investigator Program (NIP) in Earth Science is designed to support outstanding scientific research and career development of scientists and engineers at the early stage of their professional careers. The program aims to encourage innovative research initiatives and cultivate scientific leadership in Earth system science. The Earth Science Division (ESD) places particular emphasis on the investigators' ability to promote and increase the use of space-based remote sensing through the proposed research.

The NIP supports all aspects of scientific and technological research aimed to advance NASA's mission in Earth system science (http://science.nasa.gov/about-us/science-strategy/). In basic research and analysis, the Focus Areas include:

- Carbon Cycle and Ecosystems,
- Climate Variability and Change,
- Water and Energy Cycle,
- Atmospheric Composition,
- Weather, and
- Earth Surface and Interior.

In applied scientific research, the ESD encourages efforts to discover and demonstrate practical uses of NASA Earth science data, knowledge, and technology (see http://appliedsciences.nasa.gov). In technological research, the ESD aims to foster the creation and infusion of new technologies into space missions in order to enable new scientific observations of the Earth system or reduce the cost of current observations (see http://esto.nasa.gov). The ESD also promotes innovative development in computing and information science and engineering of direct relevance to ESD. See Appendix A.1 for more detailed descriptions of the Focus Areas, themes in applied sciences, and related research topics of high priority to the ESD.

The proposed research project must be led by a single, eligible (see further description below for eligibility) investigator serving as the Principal Investigator (PI). Indeed, this individual must be the only essential team member; no Co-Investigators (Co-Is), paid or unpaid, are permitted. The NIP does not accept proposals with Co-PIs nor two types of PIs, such as Science PI and Institutional PI. Students and postdoctoral fellows may participate as paid team members. The proposed research may include collaborations. See the Guidebook for Proposers at http://www.hq.nasa.gov/office/procurement/nraguidebook/ for the definitions of Collaborator vs. Co-Investigator and descriptions of China-related restrictions.

This early career program, NIP in Earth Science, was established in 1996. The frequency of solicitation is currently every two years.

1.2 Eligibility

A NIP proposal PI must be a U.S. citizen or have lawful status of permanent residency (i.e., holder of a U.S. Permanent Resident Card, also referred to as the Green Card)[1]. He/she must be a recent Ph.D. recipient, defined as having graduated on or after January 1 of the year that is no more than five years before the issuance date of this ROSES NRA (i.e., after January 1, 2010).

Institutions and organizations are encouraged to submit proposals under the NIP on behalf of their outstanding new faculty members or employees in Earth system science and associated applications, as long as the individuals are the proposed PIs.

To be eligible for an NIP award, proposed PIs must meet the following requirements:

- Be employed at an institution in the U.S., its territories, or possessions, or the Commonwealth of Puerto Rico, which awards a baccalaureate or advanced degree in a field supporting the objectives of NASA Earth system studies, or be employed at any nonprofit research institution or other nonprofit organization that performs a significant amount of work in fields of research supporting the objectives of NASA Earth Science Program. Such organizations could include museums, observatories, Government or nonprofit research laboratories, as well as nonprofit entities in the private sector.
- Be in tenure- or nontenure-track positions in either teaching or research or both, as long as the employing institution assumes the responsibility of submitting the proposal with the individual as the proposed PI.
- Despite being more than five years beyond the receipt of their Ph.D. degrees, individuals who have interrupted their careers for reasons such as family leave or serious health problems may also be eligible. These applicants should make a written request for prior concurrence from NASA before the due date for Notices of Intent to propose. NASA will provide a written response within three weeks. Such exception is not intended for individuals who have had successful employment in technical fields in science and engineering, even though the employment is not a direct continuation of their Ph.D. research, nor is it intended for individuals with a recent Ph.D. degree after having already established a successful career in Earth system science and related disciplines.
- Not hold or have held tenure (or equivalent) on or before the submission deadline of this program.
- Not be a current or former recipient of the NIP or PECASE (see further below) award.

[1] The prospective PI may submit a proposal to NIP if he or she is reasonably certain that the Green Card will be in hand soon after the proposal submission. The evaluation of proposals takes approximately 5 months, and awards are made within a couple of weeks after the announcement of selections. NASA will not award a grant if the submitting institution cannot certify the PI's eligibility.

2. Programmatic Information

2.1 Funding

Proposals to the NIP are openly solicited approximately every two years. The anticipated average award is $80-90K per year for a period of up to three years, subject to satisfactory progress and availability of funds.

2.2 Relationship between NIP and PECASE

The Presidential Early Career Awards for Scientists and Engineers (PECASE) recognize outstanding scientists and engineers who, early in their career, show exceptional potential for leadership at the frontiers of knowledge. Each year, NASA selects its nominees based on exceptionally meritorious accomplishments in research sponsored by NASA. The nominations are made by the NASA mission directorates and its field centers; individuals cannot apply for PECASE. The NIP awardees constitute an important, but not the only, source of nominations for the PECASE by the Earth Science Division. A current or former recipient of a PECASE award is not eligible to apply to the NIP.

2.3 Proposal Preparation

The NIP proposals should be prepared in accordance with the instructions given in the *ROSES Summary of Solicitation* and the *NASA Guidebook for Proposers*. The Science/Technical/Management section of the proposal should contain a detailed statement of the proposed research of no more than 15 single-spaced pages including figures and tables.

2.4 Budget Requirements

The NIP awards are typically three years in duration. The award amount for each is judged according to the scope of the proposed work and the overall competition. Salary for up to three months per year of PI time is allowable. NASA will not reimburse the salary if the PI is a Civil Service employee at a Federal agency, other than NASA. Funds may be used for support by students (undergraduate or graduate) and/or postdoctoral fellows who are involved in the proposed research; for research expenses, such as costs incurred in field experiments, purchase of equipment and/or supplies, computing, travel, etc. If research collaboration is a component of the proposal, it is presumed that the collaborator(s) have their own means of research support; that is, a NIP award may not include expenses for personnel or activities at collaborating institutions, nor salary costs for senior personnel, consultants, or subcontractors.

NASA strongly encourages, but does not require, that the submitting institution contribute to the cost of the proposed NIP project. Of special interest is cost sharing in which the employing institution would provide release time to enable the applicant to more fully concentrate on the activities related to the proposal. Institutional support of equipment purchase and co-funding of student and/or postdoctoral support would also be recognized as valuable cost sharing. Hardware purchased through start-up funds for a recently hired investigator or salary support provided

through other Federally sponsored research may not count as cost sharing for the purpose of a NIP proposal.

2.5 Proposal Review and Evaluation

The general evaluation factors, relevance to NASA's stated objectives, intrinsic merit, and the realism and reasonableness of its cost, are described in Appendix C of the *NASA Guidebook for Proposers* apply to the NIP proposals with the following exception:

- For the Research Plan, the relative weighting for Relevance to the strategic goals and objectives of Earth Science at NASA, Intrinsic Merit, and Cost is approximately 40%, 40%, and 20%. Furthermore, the Relevance criterion specifically includes the following factor: long-term commitment to the applicant's career development by the employing institution.

3. Summary of Key Information

Expected program budget for first year of new awards	~$1.0M
Number of new awards pending adequate proposals of merit	~12
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	See section 2.5 above. This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)

Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-NIP
NASA point of contact concerning this program	Ming-Ying Wei Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0771 E-mail: mwei@nasa.gov

A.36 ADVANCING COLLABORATIVE CONNECTIONS FOR EARTH SYSTEM SCIENCE

NOTICE: Amended on March 23, 2015. Amendment 5 delays the due dates for this program element. Notices of Intent (NOIs) are now requested by May 22, 2015, and proposals are now due by July 24, 2015.

Amended March 6, 2015. The point of contact for this program has been changed from Curt Tilmes to Kevin Murphy, see Section 3.

1. Scope of the Program

1.1 Introduction

The primary objective of the Advancing Collaborative Connections for Earth System Science (ACCESS) program is to enhance, extend, and improve existing components of NASA's distributed and heterogeneous data and information systems infrastructure. NASA's Earth science data systems, comprised of both core and community elements, directly support agency science and applied science goals and objectives. ACCESS projects increase the interconnectedness and reuse of key information technology software and techniques underpinning the advancement of Earth science research.

The ACCESS program supports the deployment of data and information capabilities that enable the freer movement of data and information within our distributed environment of providers and users. This often requires the use of tools to measurably improve Earth science data access and data usability. Awarded projects are expected to augment NASA's heterogeneous data system components by leveraging mature information technologies in innovative ways along with existing infrastructure to rapidly deploy capabilities that address specific gaps or weaknesses.

The ACCESS program seeks to deploy and reuse existing technological solutions in the support of Earth science data and information needs. The use of mature technologies and practices helps to lower the overall project risk of system deployment, while making these new capabilities readily available to research and applied science communities. The reuse of existing Earth data and information systems infrastructure and interfaces reduces cost, promotes a better environment for technology infusion, and improves NASA's system of systems infrastructure for users. Proposals offering substantively new IT development efforts, the significant use of immature technical components or those not leveraging existing infrastructure components, where appropriate, are not recommended for submission to this ACCESS solicitation. Awarded project work plans must focus on the use of higher TRL (technology readiness level; see http://esto.nasa.gov/files/TRL_definitions.pdf) technology components (generally TRL 7 and above). The program encourages targeted and reusable solutions to current data access and data usability issues by supplying new tools to our Earth science research community.

The ACCESS program awards are intended to help bear the costs of technological deployment of needed tools and not be an ongoing funding source for the operations and maintenance of these tools.

The ACCESS program, while focusing on information technology deployment, is centered on addressing the existing needs of research and applied science communities. Proposal teams must include both information technology and Earth science experts, and proposals must be tied directly to specific Earth science and applied science investigations.

1.2 Solicitation Focus

NASA's Earth Science Division actively promotes a distributed and heterogeneous data and information system architecture to support the growing demands and needs of a diverse and increasingly IT-sophisticated Earth science user community. Future missions being developed will add significantly to the need for robust tools capable of being repurposed and extended to meet new requirements. While some of these new missions will not be in operation for some time, NASA's data systems development in this ACCESS program will continue to be future-looking so that new missions, once deployed, are supported by robust data systems tools.

NASA's Earth science "system of systems" infrastructure exists in a landscape of multiple national and international data systems and data system frameworks governed by Federal, local, and international agencies and other organizations. These other data systems have data that are useful to our user communities and, therefore, it is in NASA's interest to lower the barriers for data access across all such data systems.

In particular, this 2015 announcement supports NASA's contributions to Action 2 of the National Plan for Civil Earth Observations[1] "Improve Data Access, Management, and Interoperability", which specifically describes Federal agency collaboration to accomplish those goals. Proposals including interagency partnerships supporting such collaboration and increasing interoperability between interagency data centers and Earth observation data are encouraged.

NASA is specifically seeking near-term solutions involving the innovative utilization of mature technologies that leverage current NASA data system capabilities and that are robust, sustainable, extensible, and reusable. The ACCESS program is seeking proposals that deploy such technologies to improve data discovery, accessibility, and usability for users of Earth science data by using technologies that improve interoperability and the sense of seamlessness, uniformity, and user experience harmonization. The goal is to increase the efficiency for the user and enable new users to benefit from Earth science data. Proposals must demonstrate a clear understanding of organizational structures and governances of the data systems involved and proposal teams should include members from appropriate organizations.

[1] http://www.whitehouse.gov/sites/default/files/microsites/ostp/NSTC/national_plan_for_civil_earth_observations_-_july_2014.pdf

2. Programmatic Information

2.1 Additional Proposal Requirements

All ACCESS proposals must address the following additional requirements:

- Proposals must clearly identify the Earth science focus area (see Appendix A.1 for focus area descriptions) and/or the science application to be served by the technical work proposed.
- Proposals must have a clear objective and work plan for technology execution and deployment.
- Proposals must clearly explain what current research or applied science user problems are being addressed and how the resulting technology deployed under an ACCESS award will address those problems.
- The period of award for these projects is two years by the end of which all the technologies developed must be operationally deployed. Proposal work plans and deliverables described must be limited to two years.
- Technologies developed under ACCESS funding must achieve a high reuse readiness level (RRL) to increase the likelihood of successful sustainment and infusion elsewhere in Earth science data systems. See http://earthdata.nasa.gov/our-community/esdswg/software-reuse-srwg/recommendation-documents/reuse-readiness-levels-rrls for description of RRLs. Proposers must include appropriate activities in their work plans to achieve a RRL of six or above.
- Proposals must address both the effectiveness and appropriateness of the total life-cycle development, including maintenance costs.
- Proposals submitted in response to this solicitation must provide a reasonable operations concept for continuance of the tools developed for the ACCESS program beyond ACCESS funding.
- Proposals must budget a quarter-time (0.25) FTE for participating in Earth Science Data System Working Groups activities (see Section 2.2.2).

2.2 Additional Evaluation Factors

2.2.1 *Earth Science Data Information Policy and Rights in Data*

All proposers should review the Earth Science Data Information Policy and the Data Rights and Related Issues documents (http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/).

2.2.2 *Participation in Earth Science Data Systems Working Groups*

Proposals selected by the ACCESS program are required to have representation on at least one of the Earth Science Data Systems Working Groups (ESDSWG). Proposals should include a brief statement of which of the working groups the team will be participating and detailing what expertise the member(s) will bring.

Proposals must budget a quarter time (0.25) FTE for working group activities (see http://earthdata.nasa.gov/esdswg for additional information). Proposals must include, or otherwise address, a small travel budget for the annual ESDSWG joint meeting. Participation on a working group is an ACCESS program requirement and not subject to project waivers or negotiation. Selected projects will be expected to submit reports on ESDSWG activities.

2.2.3 *Use of COTS and GOTS*

NASA recognizes that the use of COTS (commercial-off-the-shelf) and GOTS (Government-off-the-shelf) software, software developed through open source licensing, and other "freeware," are of equal consideration for use in ACCESS projects, as appropriate to the particular tool. While it is not always possible to plan with certainty the life cycle of these technologies, proposers must understand and address the risks and benefits of the likely scenario and make a case for meeting project objectives and the uptake of project-developed tools by the communities they are intended to serve.

2.2.4 *Leveraging of Past ACCESS Works*

ACCESS encourages the leveraging of technologies developed under past funding from NASA (e.g., AIST), as well as from funding from other agencies or funding organizations. ACCESS also encourages the leveraging of past ACCESS-developed technologies, where appropriate. However, small or incremental improvements to past ACCESS-developed technologies or improvements to their maintenance and operations are generally considered to be sustaining engineering and not leveraging. Such proposals are not appropriate for ACCESS. Proposals that do leverage or extend past ACCESS works must show how the new tool or technology will result in new and substantive benefit for the targeted user community. The benefits need to substantively exceed the typical operational enhancements included under sustaining engineering.

2.2.5 *Leveraging of NASA-Developed IT Infrastructure Components*

ACCESS encourages the leveraging and reuse of existing NASA-developed IT infrastructure components. The NASA Earth Science Data Systems Program has invested in and matured a number of IT infrastructure components that support the existing distributed Earth science data and information "system of systems" infrastructure with core functionalities. A key component of this infrastructure is the EOS ClearingHOuse (ECHO) (http://earthdata.nasa.gov/echo), a spatial and temporal metadata registry and order broker for all NASA Earth science data. ECHO and other IT components are developed and maintained by the Earth Science Data and Information Systems (ESDIS) Project and have been designed for scalability, extensibility, and reuse with well-designed, stable interfaces. They currently support many broad, discipline-oriented, and interdisciplinary communities of users at the 12 Distributed Active Archive Centers. Proposers are strongly encouraged to leverage and reuse these components where appropriate. See http://earthdata.nasa.gov/about-eosdis.

In particular, proposals should consider leveraging the Earth Data Web development framework (see http://earthdata.nasa.gov) for portal development, testing, and deployment to help lower

costs and risk, and increase long-term sustainment. See http://earthdata.nasa.gov/about-eosdis/system-description for details and capabilities.

Proposals should not seek to duplicate existing infrastructure components or functionality.

2.2.6 *Deploying Technologies at NASA Distributed Active Archive Centers (DAACs)*

For deployments intended for NASA Earth science DAACs (https://earthdata.nasa.gov/about-eosdis/science-system-description/eosdis-components/eosdis-data-centers), proposers should note that NASA has processes involving DAAC managers, DAAC User Working Groups, and Headquarters Program Scientists to evaluate the long-term worthiness of technologies in terms of support, costs, and usefulness for the community. Proposals should not assume that long-term maintenance and operations costs will be covered by a DAAC post ACCESS funding.

2.3 Award Type and Funding

The funding vehicle for any award under this solicitation will be a Cooperative Agreement (CA). Proposers should make themselves aware of the differences between a CA and a grant. For additional information proposers can review the *NASA Grant and Cooperative Agreement Handbook* (http://prod.nais.nasa.gov/pub/pub_library/grcover.htm). Note that the Rights in Data clause (see http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/data-rights-related-issues/) was created for NASA's Earth Science Data Cooperative Agreements and *replaces* the standard Rights in Data clause (1260.30) of the *NASA Grant and Cooperative Agreement Handbook*. Where applicable, work plans must account for the future state of information system software rights. Proposers are also encouraged to discuss this form of agreement with their institutions prior to submission of an ACCESS proposal.

This solicitation intends to provide approximately $3.5M per year for approximately ten to fifteen funded projects for a two-year project period of performance. All work funded under this ACCESS solicitation must be completed within two years from the CA start date. Approximately $200K - $500K per year will be provided for each ACCESS award. No awarded budget will exceed $500K per year (including NASA civil servant salaries). Proposal budgets are expected to vary commensurate with the scale and scope of the activities proposed, however, return on investment and cost reasonableness are key evaluation criteria proposers should be cognizant of when determining proposal costs. Given the two-year development period, we strongly encourage narrowly focused, lower budget proposals.

2.4 Proposal Evaluation

Proposals submitted to NASA in response to this solicitation will be evaluated with respect to the criteria specified in the *NASA Guidebook for Proposers*. In addition to the evaluation factors given in the *NASA Guidebook for Proposers*, the relevancy of a proposal shall include:

- The extent to which the proposed technologies or tools benefit the research science or applied science communities,

and the technical merit shall include:

- The extent to which the proposal addresses the additional proposal requirements and evaluation factors given in Sections 2.1 and 2.2.

In addition to the evaluation factors given in the *NASA Guidebook for Proposers*, the cost realism and reasonableness of a proposal shall include the following factor:

- The effectiveness of the total life-cycle cost of development and maintenance.

3. Summary of Key Information

Expected total program budget for new awards	~ $3.5M
Number of new awards pending adequate proposals of merit	~10-15
Maximum duration of awards	2 years
Due date for Notice of Intent to propose (NOI)	**May 22, 2015.** See Tables 2 and 3 in the *Summary of Solicitation* of this NRA. **[Changed March 23, 2015]**
Due date for Proposals	**July 24. 2015.** See Tables 2 and 3 in the *Summary of Solicitation* of this NRA. **[Changed March 23, 2015]**
Planning date for start of investigation	6 months after proposal due date
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	See Section 2.4. This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *Summary of Solicitation* of this NRA.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/
Submission medium	Electronic proposal submission is required; no hardcopy is required. See also Section IV in the *Summary of Solicitation* of this NRA and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application	NNH15ZDA001N-ACCESS

Point of contact concerning this program	**Kevin Murphy** **Program Executive for Earth Science Data Systems** **Earth Science Division** **Science Mission Directorate,** **NASA Headquarters** **Washington, DC 20546** **Telephone: (202) 358-3042** **E-mail: kevin.j.murphy@nasa.gov or** HQ-ROSES-ACCESS@mail.nasa.gov **[POC changed March 6, 2015]**

A.37 MAKING EARTH SYSTEM DATA RECORDS FOR USE IN RESEARCH ENVIRONMENTS

The Making Earth System data records for Use in Research Environments (MEaSUREs) program will not be competed in ROSES-2015. NASA expects to continue to solicit Earth science data products and system capabilities through future MEaSUREs solicitations. However, currently all funds available for these activities are committed to the support of awards selected through prior year solicitations. The next competition is expected in ROSES-2017.

1. Scope of Program

The overall objective of MEaSUREs solicitations is to select projects providing Earth science data products and services driven by NASA's Earth science goals. MEaSUREs may include infusion or deployment of applicable science tools that contribute to data product quality improvement, consistency, merging or fusion, or understanding.

MEaSUREs does not solicit proposals for systems and information technology. Proposers wishing to support the deployment of data and information systems and services; and tools that enhance NASA's data and information systems infrastructure, increase the interconnection of services for research, and enable freer movement of data and information within the distributed system of users and providers, are invited to apply to the Advancing Collaborative Connections for Earth System Science (ACCESS) Program.

MEaSUREs does not solicit proposals for science data product algorithm development or refinement, or for calibration/validation activities. These research activities are solicited through other Earth Science Research Program opportunities (see Appendix A.1).

2. NASA Point of Contact concerning this Program

Lucia Tsaoussi
Earth Science Division
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A.38 COMPUTATIONAL MODELING ALGORITHMS AND CYBERINFRASTRUCTURE

NOTICE: Computational Modeling Algorithms and Cyberinfrastructure (CMAC) will not be competed in 2015. The CMAC was competed in 2014 and is anticipated to be open again in ROSES-2017.

1. Scope of Program

Satellite observations are typically used for initializing models, constraining the model external forcings, and calibrating the models' parameterizations. They are also used to create long-term assimilated weather and climate records often used in climate assessments and model evaluations. Data-model intercomparisons provide effective ways to evaluate and improve model performance, and thus to advance our understanding of the Earth system.

Because the most advanced models are run on supercomputers available only at computing centers, the Computational Modeling Algorithms and Cyberinfrastructure (CMAC) program funds research and development activities to enhance and modernize the computing, storage, network, and visualization services at high-end computing centers. CMAC builds advanced modeling infrastructure used at NASA computing centers to support Earth system science investigations while fundamentally utilizing both models and data.

This program element provides research and development opportunities for new or improved computational modeling algorithms, the exploitation of new computing, storage, and networking architectures, the development of programming and analysis environment, interfaces between observational data and models, large scale observational input data and model output data management, and the adoption of rigorous software engineering methodologies, practice, and tools.

Not all topics are solicited at the same time. Investigators should always consult the published solicitation and amendments. Questions or comments may be directed to the Computational Modeling Algorithms and Cyberinfrastructure Program Manager at the address given below:

Tsengdar Lee
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Science Mission Directorate
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E-mail: tsengdar.j.lee@nasa.gov

A.39 ADVANCED INFORMATION SYSTEMS TECHNOLOGY

NOTICE: The Advanced Information Systems Technology program will not be competed in ROSES-2015. The Advanced Information Systems Technology program is expected to be competed again in ROSES-2016.

1. Objectives

The objectives of the Advanced Information Systems Technology (AIST) program are to identify, develop, and (where appropriate) demonstrate advanced information system technologies which:

- Reduce the risk, cost, size, and development time of Earth Science Division (ESD) space-based and ground-based information systems;
- Increase the accessibility and utility of science data; and
- Enable new observation measurements and information products.

2. Program Description

Advanced information systems are used to process, archive, access, visualize, and communicate science data. Advanced computing and communications concepts that permit the transmission and management of terabytes of data are essential to our vision of a unified observational network. Information provided to a nationwide community of users will result in significant leaps of knowledge of Earth science dynamics that benefit the global community.

The Earth Science Technology Office's AIST program employs an end-to-end approach to evolve technologies – from the space segment, where the information pipeline begins, to the end user, where knowledge is advanced.

3. Programmatic Information

Michael M. Little
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National Aeronautics and Space Administration
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A.40 INSTRUMENT INCUBATOR PROGRAM

NOTICE: The Instrument Incubator Program will not be competed in ROSES-2015. NASA expects to continue to solicit Earth science instrument technology through future IIP solicitations. The next opportunity is currently anticipated to be included in ROSES-2016.

1. Objectives

The Instrument Incubator Program (IIP) seeks proposals for technology development activities leading to new system and subsystem level airborne and space-based measurement techniques to be developed in support of the Science Mission Directorate's (SMD) Earth Science Division. The objectives of the IIP are to research, develop, and demonstrate new measurement technologies that:

- Reduce the risk, cost, size, volume, mass, and development time of Earth observing instruments, and
- Enable new Earth observation measurements

2. Program Description

The IIP is designed to reduce the risk of new, innovative remote-sensing instrument systems so that they can be successfully used in future science missions to reduce overall development time.

3. Programmatic Information

For further information about the Instrument Incubator Program, contact:

Parminder Ghuman
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National Aeronautics and Space Administration
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Email: p.ghuman@nasa.gov

A.41 ADVANCED COMPONENT TECHNOLOGY

NOTICE: The Advanced Component Technology Program will not be competed in ROSES-2015. NASA expects to continue to solicit Earth science component technology development through future ACT solicitations. The next opportunity is currently anticipated to be included in ROSES-2016.

1. Objectives

The Advanced Component Technology (ACT) program seeks proposals for technology development activities leading to new component- and subsystem-level airborne and space-based measurement techniques to be developed in support of the Science Mission Directorate's Earth Science Division. The objectives of the ACT program are to research, develop, and demonstrate component- and subsystem-level technology development that:

- Enable new Earth observation measurements, and
- Reduce the risk, cost, size, volume, mass, and development time of Earth observing instruments and platforms.

2. Program Description

The ACT program brings instrument components to a maturity level that allows their integration into other NASA technology programs, such as the Instrument Incubator Program. Some of these components are directly infused into mission designs by NASA flight projects and others "graduate" to other technology development programs for further development.

3. Point of Contact for Further Information

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A.42 IN-SPACE VALIDATION OF EARTH SCIENCE TECHNOLOGIES

NOTICE: Amended February 27, 2015. This amendment presents final text for Program element A.42, In-Space Validation of Earth Science Technologies, which replaces the reminder notice that was included in ROSES-2015 on release. A virtual preproposal Q&A will be held March 6, 2015 – March 13, 2015. Notices of Intent are required for this program element, see Section 2.1.1. The due date for Notices of Intent to propose is March 27, 2015, and the due date for proposals is May 29, 2015.

1. Scope of Program

1.1 Introduction

NASA's Earth Science Technology Office (ESTO) manages the development of a range of advanced technologies to meet future Earth science measurement requirements. ESTO technology investments attempt to address the full science measurement process: from instruments needed to make observations to data systems and information products and tools that make those observations useful.

There has been and continues to be a need for new technologies and measurement concepts to be validated in space prior to use in a science mission. This is necessary because the space environment imposes stringent conditions on components and systems, some of which cannot be fully tested on the ground or in airborne systems. The In-Space Validation of Earth Science Technologies (InVEST) program element is intended to fill that gap. Validation of Earth science technologies in space will help reduce the risk of new technologies in future Earth science missions. No funding is available for research and development of new technology. This program only funds advancing technology readiness by space flight demonstration and validation to reduce risk to future missions. The details of this program are described below.

This ESTO solicitation is focused on in space, orbital demonstration and validation only. Airborne, balloon, or sounding rocket flight validations are expressly excluded. Selected technologies and measurement concepts will only be those that require validation in space. Only instruments, instrument subsystems, onboard processing, or other relevant information system technologies that can make or advance the technology to enable relevant Earth science measurements will be accepted; only complete subsystems will be accepted. Complete subsystems shall have a well-defined interface to the spacecraft bus. Spacecraft bus technologies are excluded.

Technologies must be ready for launch within two years after award. Proposers are expected to fully define the period of operation in space that is required for demonstration and validation of their technology. The response should also detail how the team defined this period of operation and their level of confidence in reaching this performance milestone. ESTO seeks to build and demonstrate these capabilities within the three-year timeframe of the call, but is open to allowing teams to continue operation of the instruments through funding from other sources beyond the ESTO task completion. Knowledge of or proof of "next stage" funding is not required for this

call and will not be used for evaluation Once on-orbit, the maximum time for validation of the technology must be one year or less. No science measurement is required. Demonstration of a science measurement, including scientific data analysis, is permitted if it is required to validate the technology or measurement concept, and should be accounted for in the cost of the proposal.

This solicitation is exclusively targeted towards the demonstration of future Earth science measurements from "U-Class" small satellites that are of the 3U to 6U form-factor. A U-Class satellite is a type of nanosatellite where this new terminology characterizes the increased sophistication and capabilities of such spacecraft systems compatible with the CubeSat standard. The base dimension is 10 cm x 10 cm x 10 cm (one "Unit" or "1U"). A 6U satellite is 10 cm x 20 cm x 30 cm and typically has a mass of 12 kg. The final mass is dependent upon the selected dispenser.

For access to space, it is highly recommended that proposers submit a proposal to the annual NASA CubeSat Launch Initiative (CSLI): see: http://www.nasa.gov/sites/default/files/files/CubeSat_Launch_Initiative_Announcement_2014_FINAL%281%29.pdf . To ensure compatibility with the primary payload, the 3U to 6U proposed here should comply with the LSP Users Guide. See: "Launch Services Program, Program Level Dispenser and CubeSat Requirements Document" (LSP-Req-317.01). This guide does not currently address the specific configuration requirements for a 6U form factor U-Class satellite. Upon selection, investigations must work closely with the CSLI program to define the interface requirements to ensure the proposed satellite will be compatible with the 3U or 6U standard that KSC/LSP adopts. No U-Class form factors larger than 6U will be considered under the present call. Non-CSLI options for gaining access to space may be proposed, however, there must be a compelling reason for not pursing the CSLI opportunity.

NASA's Technology Readiness Level (TRL) is an ordinal classification system that allows comparison of the degree of maturity of technologies under development. TRLs range from 1 to 9 (see Section 2.1.2.2, for a link to the TRL definitions document), and indicate completion of increasingly demanding proof-of-performance criteria at various stages of a technology development.

Proposer's instrument subsystems, small instruments, or any relevant Advanced Information Systems Technology (AIST) must be at a TRL 5 or 6 at the time of proposal submission to the InVEST program. No funding will be provided for new technology development under these awards. The intent of this solicitation is only technology maturation through on-orbit validation. Funds are for form/fit/function to the spaceflight environment, launch, operations and postflight evaluation of the demonstration only. Proposers must clearly provide evidence of the claimed entry TRL of the subsystem or instrument proposed for the technology validation.

Current ESTO program lines generally advance technologies to TRL 6: System/subsystem prototype demonstration in the relevant environment (ground or space). ESTO's InVEST program line will flight qualify technologies through successful spaceborne demonstrations to TRL 7.

1.2 Background and Solicitation Justification

The following documents identify the relevant missions, measurements, and programs for this solicitation:

- *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* may be accessed on the web at http://www.nap.edu/catalog/11820.html. This report is hereafter referred to as the "*Decadal Survey.*"

- *Responding to the Challenge of Climate and Environmental Change: NASA's Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space* may be accessed on the web at http://science.nasa.gov/media/medialibrary/2010/07/01/Climate_Architecture_Final.pdf. This report is hereafter referred to as the "*Climate-Centric Architecture.*"

- *Earth Science and Applications from Space: A Midterm Assessment of NASA's Implementation of the Decadal Survey* may be accessed on the web at http://www.nap.edu/catalog/13405.html. This report is hereafter referred to as the "*Midterm Assessment*."

New technology will play a key role in enabling many of the measurements recommended in the *Decadal Survey*, *Midterm Assessment*, and the *Climate-Centric Architecture* and helping to reduce the cost and/or improve the capability of other measurements. This InVEST Program solicitation will facilitate the implementation of the recommended measurements by carefully choosing where to invest in flight validation of subsystems, including other relevant information system technologies, and small instruments using U-Class satellites to ensure the greatest benefit from NASA's technology development funds.

1.3 Proposal Research Topics

The *Decadal Survey*, *Midterm Assessment*, and *Climate-Centric Architecture* recommend an integrated strategy for Earth science and applications from space. This InVEST Program solicitation focuses on flight validation of subsystems, small instruments, and other relevant information system technologies to enable Earth science measurements. These measurements are called out in the documentation and include such things as radiation balance; soil moisture; ice sheet height; surface deformation; vegetation structure; land surface composition; carbon dioxide column integrals; ocean, lake, and river water levels; atmospheric gas columns; ocean color; aerosol and cloud profiles; land surface topography, temperature and humidity sounding; gravity fields; snow accumulation; ozone and trace gas profiles; and tropospheric winds.

This list is illustrative only; proposers should refer to the above-mentioned documents for clarification of the exact measurements desired. An additional consideration is the recommendation made by the midterm assessment to seek "alternative" remote sensing platforms and observing strategies that are emerging and being proven. These include, but are not limited to, small satellites, such as U-Class, and the flight of multiple sensors in formation rather than on a single bus. These alternative mission concepts can offer considerable mission flexibility. This

InVEST solicitation welcomes the demonstration of alternative measurement concepts that can offer flexibility in implementing future Earth science measurements.

Priority will be given to those proposals that most clearly address technology validation for one or more of these science measurements.

2. Programmatic Information

This section provides additional details governing the proposed activities that supersede the general guidelines announced in the *NASA Guidebook for Proposers Responding to a NASA Research Announcement or Cooperative Agreement* and incorporated by reference into this ROSES solicitation. This document is hereinafter referred to as the *NASA Guidebook for Proposers*. The most recent edition of this Guidebook may be accessed on the web at http://www.hq.nasa.gov/office/procurement/nraguidebook/.

The required proposal contents follow the format prescribed in the *NASA Guidebook for Proposers*, Section 2.3, except in the case where additional information is needed to supplement this solicitation. Those additional requirements are noted below.

2.1 Proposal Content and Submission

2.1.1 *Notice of Intent to Propose*

A Notice of Intent (NOI) to propose is required for the submission of proposals to this solicitation. The information contained in the NOI is used to help expedite the proposal review activities and, therefore, is of considerable value to both NASA and the proposer. We require that NOIs be submitted electronically via NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) by the due date given in Section 3.

A virtual preproposal Q&A for the Solicitation will be open March 6, 2015 – March 13, 2015. Potential proposers are welcome to submit questions related to the solicitation to http://esto.nasa.gov/InVEST2015_VirtualConf/. All relevant questions and answers will be made available no later than March 20, 2015, to that same URL and will be available through the proposal due date, May 29, 2015.

2.1.2 *Proposal Content*

2.1.2.1 *Proposal Summary*

Each proposal shall include a proposal summary that describes the proposed work in no more than 300 words. The proposal summary shall include: (a) objectives and benefits; (b) an outline of the proposed work and methodology; (c) the period of performance; and (d) entry and planned exit TRL.

2.1.2.2 *Scientific/Technical/Management Section*

This section has completely unique additional requirements that differ from Section 2.3.5 of the *NASA Guidebook for Proposers*.

The Scientific/Technical/Management Section, or Project Description, must include the following content information in subsections that use the same titles. Failure to provide any of this material may be cause for the proposal to be judged as noncompliant and returned without further review. The Project Description shall be limited to 15 nonreduced, single-spaced typewritten pages. Standard proposal style formats shall be in accordance with Section 2.2 of the *NASA Guidebook for Proposers*. Proposals that exceed the 15-page limit will be truncated at 15 pages.

1. Applicability to Earth Science Measurements – Describe the benefits to future Earth Science missions or measurements that could utilize the technology proposed for flight validation. Proposers shall include a one-page relevancy scenario showing how the proposed technology and flight validation contributes to one or more Earth Science measurements. Proposals that fail to include a relevancy scenario may be considered noncompliant and will be returned without review.

2. Description of Proposed Technology and Flight Validation – Provide a justification for why this particular technology or science measurement approach requires space flight validation. Describe the subsystem, or instrument to be flown, including spacecraft accommodation. Provide estimates of the mass, power, and data rate for the proposed subsystem or instrument.

3. Launch and Operations Plan - Technologies must be ready for launch within two years of award. Once on-orbit, the maximum time for validation of the technology must be one year or less. No science measurement is required; however a demonstration of a science measurement is permitted if it is needed to validate the technology. Science campaigns are expressly excluded and will not be funded.

Since these awards will be limited to only in-space validation, proposers must clearly describe their approach for access to space (e.g., dedicated launch, secondary payload, etc.), as well as the orbit required. Also describe the success criteria for flight validation and how they will be evaluated. This information will be evaluated for realism (technical, schedule, and cost). It is understood that an exact launch date will not necessarily be known at the time of proposal submission. However, details regarding the exact procedures, processes, and steps that will be required to be ready for launch in two years after award initiation must be provided in the proposal. Proposers must describe the plan for the spacecraft for the period after which the build is completed and when the launch provider is willing to accept delivery of the spacecraft.

4. Comparative Technology Assessment – Describe the anticipated advantages of the technology to be flight validated compared to those currently in use - e.g., reduction of size, mass, power, volume or cost, improved performance, or enabling of a new capability not previously possible. Reference the current state of the art and relate it to the proposed work.

5. TRL Assessment – Define the starting point for the instrument technology or measurement technique and the exit point success criteria for the proposed activity. The TRL shall advance by at least one level during the period of performance of the activity.

For this solicitation, the entry TRL shall be between 5 and 6. TRL definitions can be found at http://esto.nasa.gov/files/TRL.doc. The proposer shall identify the entry TRL, the planned exit TRL, and success criteria in their proposal. The proposer shall substantiate the entry TRL in the proposal. Proposals that fail to include and substantiate the entry TRL may be considered noncompliant and may be returned without review.

6. Project Management Plan – Provide a statement of work that concisely describes each task and milestone to be accomplished in the course of the flight validation project. Define the success criteria associated with each task or milestone. Also include a schedule chart that identifies critical milestones. The schedule should indicate any dependencies, a critical path, and margins, and must be consistent with the proposed budget. A sufficient number of milestones per twelve-month period must be defined to ensure understanding of the effort for the performance period.

Subcontracting portions of the research project is acceptable, but overall management and reporting are the responsibility of the proposing organization.

7. Facilities and Equipment – Describe significant facilities and equipment required to complete the work. Before requesting funding to purchase a major item of capital equipment, the proposer should determine if sharing or loan of equipment already available within the proposing organization is a feasible alternative.

8. Special Matters – Include a brief description of the organization, its facilities, and previous work experience in the field of the proposal.

9. Quad Chart – Proposers shall also provide a summary chart (Quad Chart) that contains the following information. This quad chart is not included in the overall page count.

Upper Left Quadrant: "Description and Objectives"
Lower Left Quadrant: "Approach" and "Co-Is/Partners"
Upper Right Quadrant: visual, graphic, or other pertinent information
Lower Right Quadrant: "Milestone Schedule" and "Entry TRL."

A template and example of the quad chart can be downloaded from http://esto.nasa.gov/files/EntryQuad_instructions_template.ppt.

2.1.3 *Proposal Submission*

Proposals shall be submitted electronically via NSPIRES using the procedures described in Chapter 3 of the *NASA Guidebook for Proposers* or via Grants.gov using the funding opportunity number provided in Section 3, the summary table of key information. Proposals submitted after the due date will not be evaluated or selected.

2.2 Award Information

2.2.1 *Funding*

The Government's obligation to make award(s) is contingent upon both the availability of new appropriated funds from which payment can be made and the receipt of proposals that NASA determines are acceptable for award under this solicitation. No additional funds beyond the negotiated award value will be available. NASA does not allow for payment of profit under grant awards, and fees are restricted. See http://science.nasa.gov/researchers/sara/faqs/ for further information.

The funding available for this solicitation will limit the number and magnitude of the proposals awarded. Based on the availability of funding, the ESTO expects that a total of 2 to 3 proposals will be selected. The ESTO anticipates funding of approximately $4 to $5 Million per year for the InVEST program.

Any reserves (schedule and funding) must be expressly noted and will be evaluated in the context of the complete proposal.

2.2.2 *Period of Performance*

The minimum period of performance is twelve months. The total proposed period of performance must not exceed thirty-six months (subject to launch availability). Grants may be awarded for up to a three-year performance period. Annual reviews will be held according to the criteria specified in the *NASA Grants and Cooperative Agreement Handbook* (14 CFR 1260). Proposals must define clear, measurable milestones to be achieved for each year of performance in order to warrant continuation in the second and third years.

2.2.3 *Type of Award*

All selected proposals will result in the award of grants, cooperative agreements, or intra- or inter-Government transfers, as appropriate. Contracts are specifically excluded as an award vehicle for this solicitation. Grants and cooperative agreements will be subject to the provisions of the *NASA Grants and Cooperative Agreement Handbook*. If a commercial organization wants to receive a grant or cooperative agreement, cost sharing is required unless the commercial organization can demonstrate that it does not expect to receive substantial compensating benefits for performance of the work. If this demonstration is made, cost sharing is not required, but may be offered voluntarily (see also Section D, Provision 1274.204, of the Grants Handbook). If a cost sharing arrangement is proposed, appropriate data rights that recognize the proposer's contributions, as well as the Government's rights to access, will be negotiated prior to award.

2.3 Evaluation Criteria

Evaluation criteria are given in Section C.2 of the *NASA Guidebook for Proposers*.

The first criterion, relevance to NASA's objectives, includes the applicability of the proposed investigation for in-orbit technology validation needs in support of Earth Science measurements. In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion "relevance" specifically includes the following factors:

- The relevance and potential contribution of the proposed work to NASA Earth Science scientific and technical areas of emphasis; including the potential to enable new measurements which are part of the NASA Earth Science needs;
- The potential for the subsystem, instrument technology, onboard processing, or other relevant information system technology to reduce the risk, cost, size, and development time of Earth science instruments or to enable new Earth science measurements. Potential cost reductions should be clearly stated and substantiated to the extent possible, with supporting analysis that indicates scalability;
- The potential of the subsystem, instrument, onboard processing, or other relevant information system technology to be integrated, once matured, into future NASA Earth Science missions;
- The potential for the technology to have commercial benefits. Note that commercial benefits are welcome, but are not considered a program requirement, and the proposal review will not be negatively impacted if none are identified.

The second criterion, intrinsic merit, includes the technical merit of the proposed investigation. In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion "intrinsic merit" specifically includes the following factors:

- Feasibility and merit of the proposed technical approach to achieve the technology validation objectives;
- Feasibility and technical merit of the proposed acquisition of launch services;
- Justification for not using CSLI services, if applicable;
- Degree of innovation of the proposed technology validation concepts and approach;
- Feasibility of obtaining the potential reduction in risk, cost, size, and development time, or making the newly enabled measurement, with the proposed sensor or instrument; and feasibility of making a demonstrable TRL increase. The TRL must advance by at least one (1) level during the performance period of the project;
- Substantiated justification and appropriateness of the entry and exit TRL. For this solicitation, the entry TRL is constrained to be 5 or 6, with the exit TRL no higher than 7;
- Qualifications of key personnel and adequacy of facilities, staff, and equipment to support the proposed activity. This factor includes evaluation to ensure that the team has strong subsystem and instrument development skills; and
- Past performance and related experience in the proposed area of technology development.

The third criterion is cost realism and reasonableness. In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion "cost realism" specifically includes the following factors:

- Adequacy and realism of proposed milestones and associated success criteria;
- Adequacy and realism of proposed acquisition of launch services;
- Realism and reasonableness of the proposed cost and comparison of costs to available funds;

- Adherence to sound and consistent management practices appropriate to the TRL of the proposed task;
- Commitment of the organization's management to the proposed technology development. Proposers should identify any previous investment by the organization that bears directly on the proposed project and provide supporting documentation.

Cost sharing is not part of the cost criteria, but cost sharing may considered by the selecting official at the time of selection when deciding between proposals of otherwise equal scientific and technical merit.

2.4 Technical Reporting Requirements

Proposers should be aware that technology programs require more extensive reporting than many other ROSES-2015 elements and these costs should be taken into account in submitted proposals. Following an award, the Principal Investigator (PI) is expected to consult with the InVEST program manager to refine the statement of work, milestone schedule, cost plan, project quad chart, and other tracking elements that will be used during the period of performance. Material associated with deliverables will be submitted to ESTO's electronic document repository.

Once awarded, all status information, presentation material, and report deliverables applicable to this InVEST solicitation shall be submitted to the web-based ESTO InVEST-15 Award Administration e-Book located at https://esto.reisys.com/ebooks/ebooks/index.jsp. A user account on the ESTO e-Book will be provided to the PI upon award. Due to NASA Information Technology (IT) security requirements, all PIs must register with NASA's Identity Management and Account Exchange (IdMAX) system before a user account on e-Book will be established. In order to create an IdMAX account, some personal information will be required.

The following deliverables shall be required of awarded proposals. In cases where subcontract arrangements exist, consolidated project reports are the responsibility of the PI. The proposed budget should provide for these reporting requirements. In this context, "Annual" refers to a twelve-month task effort that commences at award.

2.4.1 *Initial Plans and Reports*

Within fifteen days of award, the PI shall provide a Project Plan; initial Quad Chart, and initial TRL assessment. The project plan, initial (entry) Quad Chart, and initial TRL assessment and supporting data shall be uploaded to the appropriate locations in the ESTO e-Book for this solicitation.

The Project Plan shall identify plans for all technical, schedule, and resource activities for the proposed life of the project.

The Quad Chart with the same information as described above in section 2.1.2.2 item 9, shall be updated at least annually and more often, if appropriate.

An initial TRL assessment, and the basis for that assessment, shall be provided within fifteen days of award for the critical technology developments of the activity. A TRL assessment template will be provided upon award. The TRL assessment shall be updated at least annually, more often if appropriate.

2.4.2 *Bimonthly Technical Reports*

The bimonthly technical report shall focus on the preceding two month's efforts. Each report shall address:

1. Technical status: The PI shall summarize accomplishments for the preceding two months, including technical accomplishments (trade study results, requirements analysis, design, prototype build, environmental testing, flight unit build, etc.), and results of tests and/or demonstrations.
2. Schedule status: The PI shall address the status of major tasks and the variance from planned versus actual schedule, including tasks completed, tasks in process, tasks expected to complete later than planned, and tasks that are delayed in starting, with rationale for each and recovery plans as appropriate.

Bimonthly Technical Reports shall be uploaded to the appropriate location in the ESTO e-Book at two-month intervals, starting on the second-month anniversary date of the signing of the award vehicle. In months for which the PI is providing interim or annual review, the requirement for a bimonthly report is superseded by the interim or annual review requirements discussed in the next two sections.

Reports shall be submitted in PDF, Microsoft Word, or Microsoft PowerPoint compatible file formats by the required due date, or by close of business of the first workday following the due date if the due date falls on a weekend or a holiday. A teleconference or brief meeting may be conducted between the ESTO and the PI to review and discuss each report.

2.4.3 *Interim Reviews*

The PI shall provide an Interim Review at the end of the first six-month calendar period commencing from the date of award and at twelve-month intervals thereafter. The PI must provide a presentation summarizing the work accomplished and results leading up to this Interim Review and must:

1. Describe the primary findings, technology development results, and technical status, e.g., status of proto-flight, or flight systems, results of tests (e.g., thermal, shock, vibe), etc.;
2. Describe the work planned for the remainder of the project and critical issues that need to be resolved to successfully complete the remaining planned work;
3. Summarize the cost and schedule status of the project, including any schedule slippage or acceleration. A schedule milestone chart of all major task activities shall be created and maintained and shown at all reviews. A financial data sheet shall be created and maintained, showing total project costs incurred and, for NASA and Jet Propulsion Laboratory projects

only, obligated and costed, along with a graphical representation of the project cost profile to completion;
4. Provide a summary of anticipated results at the end of the task; and
5. At the second review and subsequent reviews, address the comments and recommendations prepared by the reviewers participating in the most recent review.

The ESTO will conduct the Interim Review via teleconference. The presentation shall be uploaded to the appropriate location in the ESTO e-Book at least two (2) working days prior to the review. Following the review, the presentation, updated in accordance with comments and discussion resulting from the review, will constitute the Interim Report and shall be uploaded to the appropriate location in the ESTO e-Book within ten days after the review.

2.4.4 *Annual Review*

The PI shall provide an Annual Review at the end of each twelve-month calendar period commencing from the date of award. The Annual Reviews are similar to the Interim Reviews and include all of the products required at an Interim Review with the following differences:

1. The review is held at the PI's facility or a mutually agreed to location.
2. The review may be attended by an independent technical reviewer from an organization separately funded by ESTO.
3. If necessary, hardcopy handouts shall be provided by the PI at the review.
4. The PI may provide a laboratory demonstration, if appropriate, to show technical results and status.
5. Report any educational and outreach components of the project, e.g., graduate degrees, educational activities; technology infusion or patents applied for or granted; journal or conference publications; presentations at professional conferences, seminars and symposia; demonstrations; media exposure; and, other activities that contributed to the overall success of the research project.
6. The Quad Chart shall be updated to be current as of the date of the Annual Review, and shall reflect the TRL shown in the annual TRL Assessment Spreadsheet. The Quad Chart shall be included as the first page following the cover page of the review presentation.
7. The TRL Assessment Spreadsheet shall be updated to be current as of the date of the Annual Review and shall be included as an appendix to the review presentation.

The review package shall be uploaded to the appropriate location in the ESTO e-Book at least two (2) working days prior to the review. The presentation, updated in accordance with comments and discussion resulting from the review, shall constitute the Annual Report deliverable and shall be uploaded to the appropriate location in the ESTO e-Book within ten days after the review. The updated Quad Chart and TRL Assessment shall also be updated in the ESTO e-book within ten days after the review.

2.4.5 *Final Review and Final Report*

The PI shall provide a Final Review at the completion of the activity. The Final Review is similar to the Annual Reviews and includes all of the products required at an Annual Review with the following differences:

- The Final Review must provide conclusions of the work performed and make recommendations for follow-on activities that should be pursued.
- As this is the Final Review, there is no need to present future work plans.

The PI shall provide a written Final Report at the completion of the activity. The Final Report shall include the following:

1. Background of the project, including the science rationale for conducting this technology validation;
2. Assessment, and performance analysis results of the validation activities;
3. Tables, graphs, diagrams, curves, sketches, photographs, and drawings in sufficient detail to comprehensively explain the results achieved;
4. An updated TRL Assessment;
5. A final Accomplishments Chart which contains the following information (a template is available in the e-Book):
   - Upper Left: "Description and Objectives."
   - Middle: "Accomplishments."
   - Upper Right: A visual, graphic, or other pertinent information.
   - Bottom: "Co-Is" (name and affiliation), "Entry TRL" and "Exit TRL."

The Accomplishment Chart shall be included as the first page following the cover page of the review presentation.

The Final Report, updated Quad Chart or Accomplishments Chart, and updated TRL Assessment shall be updated with the updated Final Review presentation to the appropriate locations in the ESTO e-Book within ten days of the final review.

2.4.6 *Earth Science Technology Forum and Workshops*

Forums and Meetings*:* The awardee is encouraged to participate in relevant technology forums and other conferences and meetings related to Earth Sciences (please note there are limited slots available for NASA civil servant and contractor personnel for such events). Proposers must include travel costs in their proposals. The awardee should be prepared to make a presentation, provide a paper, or create a poster providing a description of the project, the objectives, approach, technical status, and schedule information.

ESTO hosts an annual Earth Science Technology Forum (ESTF), as an opportunity for NASA planners, managers, technologists, and scientists to review the research funded by the ESTO. It is also an opportunity for researchers from NASA, academia, and industry to meet with their peers and to better understand NASA Earth science requirements. The awardee should include funding

to attend the annual ESTF conference for three years and assume the conference alternates between the east coast DC metropolitan area and the west coast Pasadena CA area, starting with the east coast in 2016.

3. Summary of Key Information

Expected program budget for first year of new awards	Up to $5M
Number of new awards pending adequate proposals of merit	~2-3
Maximum duration of awards	Minimum 1-year / Maximum 3-year awards (subject to launch availability)
Due Date for mandatory Notice of Intent to Propose (NOI)	3/27/2015
Virtual Q&A Open dates	3/6/2015 through 3/13/2015
Virtual Q&A Responses posted	3/20/2015
Due date for submission of mandatory NOIs	3/27/2015
Due date for submission of proposals	5/29/2015
Planning date for start of investigation	12/07/2015
Page length for the Science-Technical-Management section of proposal	15 pages; see also Chapter 2 of the *NASA Guidebook for Proposers*. See Section 2.1.2.2 of this appendix.
Relevance to NASA	See Section 2.1.2.2 of this appendix. This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guideline for Proposers.*
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)

Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-INVEST
NASA point of contact concerning this program	Pamela Millar Earth Science Technology Office Science Mission Directorate National Aeronautics and Space Administration Washington, DC Telephone: (301) 286-0016 E-mail: pamela.s.millar@nasa.gov

A.43 NASA SCIENCE DEFINITION TEAM FOR THE NASA ISRO SYNTHETIC APERTURE RADAR (NISAR) MISSION

NOTICE: Amended March 9, 2015. This amendment releases this new program element, A.43, NASA ISRO Synthetic Aperture Radar (NISAR) mission Science Definition Team. Notices of Intent are requested by May 1, 2015, and proposals are due by June 8, 2015.

1. Scope of the Program

The NASA ISRO Synthetic Aperture Radar (NISAR) mission has evolved from the radar part of the Deformation, Ecosystem Structure, and Dynamics of Ice (DESDynI) mission concept. DESDynI was one of four missions recommended for launch by NASA in the 2010-2013 timeframe by the U.S. National Research Council (NRC) *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (http://www.nap.edu/catalog.php?record_id=11820). The 2012 Administration budget required NASA to reformulate the DESDynI mission as an L-Band SAR only design to meet budget constraints.

Since then, NASA has worked to establish a partnership with the Indian Space Research Organisation (ISRO) as the major international partner of the NISAR mission. NASA will provide the L-band radar instrument with associated reflector and boom assembly, several flight system elements (high rate telecom, GPS receiver, high capacity solid state recorder, and payload data subsystem), and ground data system. ISRO will provide the spacecraft, the launch vehicle, a secondary S-band SAR instrument, and an S-band science data system.

The NASA contribution to the NISAR mission is a directed mission within the NASA Earth Systematic Missions (ESM) Program, with project execution and management responsibility delegated to the Jet Propulsion Laboratory (JPL). The NISAR Mission is currently in formulation and transitioned into Phase B on March 1, 2015. The current launch readiness date is late 2020 or early 2021. Further information on the NISAR mission can be found at http://nisar.jpl.nasa.gov/.

The NISAR mission will provide large scale data sets of Earth surface dynamics that are critical to three Earth Science disciplines: 1) Deformation (Solid Earth), 2) Ecosystems (Vegetation, Carbon Cycle) and 3) Cryosphere (Climate Change). To achieve the science objectives, the NISAR mission will be capable of performing repeat-pass interferometry and collecting polarimetric data. In addition, an applications objective of the NISAR mission relates to its potential role to inform the hazard/disaster management cycle (understanding, hazard/risk assessment, forecast/warning, situational awareness, response, recovery and mitigation).

The core of the payload is an L-band SAR to meet all of the NASA science/applications requirements. An S-band SAR will be contributed by ISRO to meet additional ISRO requirements. The payload includes a large diameter deployable reflector and a dual-frequency antenna feed to implement the SweepSAR concept that provides both wide swath and high resolution. It also includes a Global Positioning System (GPS) receiver for precision orbit

determination. Due to the large amount of expected science data, a high rate data downlink subsystem and a solid state recorder are included in the NISAR payload.

The NISAR mission will be the first NASA radar mission to systematically and globally study the dynamics of solid Earth, the ice masses, and ecosystems, all of which are sparsely sampled at present. The NISAR mission has three science foci (surface deformation, ecosystem dynamics, and cryosphere dynamics) and one application focus (hazard/disaster management). The associated objectives are:

Improve knowledge of surface deformation required for understanding solid Earth dynamics and associated natural hazard risks and resource management

- Observe secular and local surface deformation on active faults to constrain lithospheric and mantle rheology and model earthquakes and earthquake potential.
- Catalog and model aseismic deformation in regions of high hazard risk.
- Characterize magma migration through the lithosphere and observe volcanic deformation to model volcanic interiors and forecast eruptions.
- Map pyroclastic and lahar flows on erupting volcanoes to estimate damage and model potential future risk.
- Map fine-scale potential and extant landslides to assess and model hazard risk.
- Characterize water resources, including aquifer physical and mechanical properties affecting groundwater flow, storage, and management.
- Map and model subsurface reservoirs for efficient resource recovery (e.g., hydrocarbons, geothermal fluids, water) and disposal (e.g., wastewater, CO_2 sequestration).

Enhance knowledge of ecosystem structural dynamics to determine environmental change and ecological impacts

- Determine the changes in carbon storage and uptake resulting from disturbance and subsequent regrowth of woody vegetation.
- Determine the area and crop aboveground biomass of rapidly changing agricultural systems and land use patterns.
- Determine the extent of wetlands and characterize the dynamics of flooded areas.
- Characterize freeze/thaw state, surface deformation, and permafrost degradation.
- Explore the effects of ecosystem structure and its dynamics on biodiversity and habitat.

Advance knowledge of cryosphere dynamics to understand and describe changes of ice sheets, sea ice and glaciers over short and extended time scales

- Understand the response of the ice sheets and glaciers to climate change.
- Determine the displacements of ice sheets to better understand the contribution of ice sheets to sea-level change and coastal zone dynamics.
- Understand the interaction among sea ice, oceans, and climate.
- Characterize freeze/thaw state, surface deformation, and permafrost degradation.
- Characterize the short-term interactions between the changing polar atmosphere and changes in sea ice, snow extent, and surface melting.

Strengthen the use of satellite-dependent information for hazard/disaster management to inform decision-making:

- Detect, characterize, and model hazards and potential disasters, including those from floods, volcanoes, landslides, wildfires, earthquakes, tsunamis, and cyclones.
- Characterize secondary hazards associated with primary events.
- Demonstrate rapid damage assessment to support rescue and recovery activities, system integrity (water and energy utilities), lifelines and public health, levee stability, transportation and urban infrastructure, food security, and environment quality.

These objectives guide development of Level-1 and 2 science requirements that flow down to the NISAR engineering requirements. A competitively selected Science Definition Team (SDT), working iteratively with the NISAR Program Scientist, Program Applications Lead, and the Project Scientist at JPL, develops NASA's baseline and threshold science requirements for the NISAR mission. The initial SDT was selected in 2012 for the DESDynI-Radar mission for a period of three years. This solicitation will recompete the SDT for the NISAR mission (NSDT). The NSDT supports the NISAR project to provide the science requirements flow down, science algorithms definition, guidance on development of algorithms and associated error models, data acquisition plan, data latency and data dissemination plans, definition of a calibration and validation plan, publication of results, and public engagement including liaison with the broader science and applications communities. The SDT also assists in the promotion of early adopter activities that may conduct prelaunch research and evaluation using data (simulated or from field campaigns) to accelerate use of data after launch. The NISAR Science Team is expected to be selected prior to launch to support Phase D and E activities; these include support to the NISAR project on calibration and validation of science data products, refinement of science algorithms and formats, publication of results, and public and user engagement.

Given the global, systematic, and frequent repeat coverage expected for the NISAR mission that will be required in order to accomplish the science objectives, these same data would be available to serve a broad variety of other basic and applied science objectives. The NISAR project, in conjunction with NASA's Applied Sciences Program, holds periodic applications workshops in order for the NISAR project to be better informed of such potential applications, gain feedback on products and algorithms from early adopters, provide education, and ensure the larger community is better prepared for the future availability of the NISAR data and product streams and the prospective generation of value-added products, information, and decision-support services. The first NISAR Applications Workshop was held October 28-29, 2014, in Reston, VA (https://nisar.jpl.nasa.gov/missionthemes/applications/) and ISRO held a Science Workshop November 17-18, 2014, in Ahmedabad, India.

NISAR will be the first free-flying dual-frequency SAR/InSAR mission. While the L-band SAR alone can meet all NASA mission requirements, the provision of S-band opens the opportunity to (1) supplant L-band coverage with S-band and (2) explore the use of dual-frequency data. The S-band SAR will have more limited acquisition time due to increased power and thermal requirements. Overall, the data acquisition plan is constrained by the downlink capabilities. The Science Definition Team will need to evaluate the science and applications opportunities afforded by the S-band capability relative to the mission requirements and provide guidance on options for an associated observation plan to the NISAR Project Scientist and Program Scientist.

This solicitation seeks proposals for membership in a NASA NISAR Science Definition Team (NSDT) to support further prelaunch planning and preparation for the NISAR mission during Phases B and C of formulation and development. The NSDT will function for a three-year period, at which time NISAR is expected to transition into Phase D and NASA will solicit a NISAR Science Team. Subject to NASA programmatic goals and requirements for the NISAR mission, the NSDT will refine the scientific requirements for NASA elements of the NISAR mission in support of the NASA NISAR Project Scientist. ISRO is also expected to separately select an ISRO Science Definition Team and Science Team to support ISRO requirements for NISAR. The NASA and ISRO teams will coordinate and harmonize the joint NISAR science observation plan.

2. NASA Science Definition Team for the NISAR Mission

2.1 Structure of NASA's NISAR Science Definition Team (NSDT)

The NSDT will consist of approximately sixteen members with expertise in radar scientific data analysis, applications, and/or technology. The NSDT is planned to be led by four co-leads representing the three principal scientific disciplines (Solid Earth, Ecosystem Science, and Cryospheric Science) and Applications. The NSDT membership will include balanced representation from these three principal disciplines, along with the inclusion of other scientific disciplines that contribute to the utility of and/or benefit from the NISAR mission, such as Hydrology, Geodesy, and related Hazard/Disaster Science. While the main focus is on the objectives given in Section 1, NASA also seeks to address key applied research and applications questions and to encourage and demonstrate significant applications of NISAR to societal-benefit needs, including Governmental decision making, disaster risk reduction activities, and other matters of societal importance. Therefore, membership on the NSDT is open to members of the applied research and applications communities, including key partners from other Federal and state agencies. Proposers are encouraged to provide information on their NISAR relevant applied sciences expertise and how the NISAR mission can benefit that application area (e.g., subsurface reservoirs, forest and agricultural land use, natural disasters preparedness, response and recovery, hazard exposure and critical infrastructure, and ocean, coastal, and sea ice dynamics).

2.2 NSDT Responsibilities

The NASA NSDT will work closely with the NASA NISAR Project Scientist to provide expert scientific guidance to the NISAR project in the areas of measurement requirements, product definition, algorithm development, calibration, validation, and liaison with the early adopter and broader science and applications user communities. The NSDT will support the NISAR Project Scientist in providing regular and frequent reports on findings and progress to the NISAR Program Scientist, Program Applications Lead, and NISAR Program Executive. The NISAR Level-1/2 requirements and more information on the NISAR cal/val plans can be found at http://nisar.jpl.nasa.gov/nisarmission/.

During NISAR Phases C and D, the members of the NSDT will be responsible for:

- Developing the Science Requirements Document;
- Providing inputs on measurement capabilities for incorporation into the Level-1 Scientific Requirements Document;
- Evaluating, as requested by the Project Scientist, the proposed NISAR mission designs in achieving the goals of the Scientific Requirements Document;
- Drafting and/or advising the NISAR Project on drafting Algorithm Theoretical Basis Documents (ATBD);
- Supporting the development of calibration and validation plans;
- Promoting early adopter activities through participation in the Applications Workshops in coordination with the Program Science and Applications Leads;
- Supporting the NISAR Project Scientist in the development of required analyses and documentation during the development of the NISAR mission including, but not limited to, Level-1/2 requirements documentation and scientific inputs for the several reviews and key decision points leading to the launch of the NISAR mission; and
- Attending the NSDT meetings regularly.

2.3 NSDT Team Member Proposals

The body of the NSDT member proposals for the Principal Investigator's (PI) membership on the NSDT should be limited to fifteen pages, and include the following information:

- The scientific research and/or societal application that the proposer wishes to represent as a member of the NSDT, with supporting documentation of expertise and potential role of NISAR;
- Only the Principal Investigator (PI) will be named to the NSDT. The specific role and contributions of any other team members must be clearly articulated; and
- A budget and budget justification that provides adequate support for the PI's strong contribution to the NSDT. This budget section is not included within the fifteen-page limit of the proposal's body.

2.4 NSDT Proposal Content

The proposals should identify particular scientific expertise and objectives of the team member and should describe how these qualities will support the development of the NISAR mission. Proposals should address how the proposer will contribute to the development of NISAR's scientific and technical capabilities during the remainder of mission formulation (Phase B) and the early part of mission implementation (Phase C). The proposal should identify and describe one or more of these elements that the team member will contribute to the NISAR mission development.

In addition, the NSDT member proposal should address the following:

- The Principal Investigator's experience and facility in the acquisition and analysis of Synthetic Aperture Radar (SAR) and Interferometric Synthetic Aperture Radar (InSAR) data;
- The Principal Investigator's experience and facility with large regional to global scale data sets;

- The Principal Investigator's experience and facility in basic and/or applied research directly relevant to NISAR's goals and objectives; and
- How the proposed work contributes to the development of the NISAR mission and its societal contributions.

The NSDT will conduct its business through regular meetings with more frequent teleconference calls and E-mail. The proposed budget should include funds for the Principal Investigator to participate in three NSDT face-to-face meetings per year and one Applications workshop, lasting three days each. For planning purposes, proposers should budget for two meetings per year in Pasadena, CA, and two meetings per year in the Washington, DC, area. In addition, NSDT members should budget for one trip over the three-year period to attend a three-day meeting held jointly with ISRO, nominally in Ahmedabad, India.

For planning purposes, it is anticipated that NSDT membership budgets will average approximately $115K per year and Co-Leader budgets average approximately $155K per year.

Proposals for participation in the NSDT from other U.S. Government agencies are encouraged to show significant cost sharing and/or in-kind support.

2.5 NSDT Co-Lead Proposals

Proposers who wish to be considered for the four potential Co-Lead positions should indicate their candidacy by answering the relevant cover sheet question and including a Team Leader section within their proposal. NASA reserves the option to select no team Co-Leaders or to select team Co-Leaders from among the team membership proposals should proposals of adequate merit not be received for the four team Co-Lead positions.

The Team Leader section can use up to five additional pages and should include:
- A clear articulation of the proposed Co-Team Leader's vision for the NISAR mission and its contribution to science and society;
- A statement of which Co-Lead position is sought (Solid Earth, Ecosystem Science, Cryospheric Science, or Applications) and the qualifications that make the proposer a prime candidate for NSDT co-leadership;
- A management plan that describes the approach to science team leadership including interactions with other NSDT members within that science or application area, interactions among the four Co-Leaders, and coordination with the NASA Project Scientist;
- The scientific qualifications and leadership skills of the proposing Team Co-Leader;
- The ability of the proposing Team Co-Leader to represent his/her scientific community's interests in the NISAR mission; and
- The ability of the proposing Team Co-Leader to represent the NISAR mission's overall goals and objectives.

In addition, in the Budget and Budget Justification sections of the Team Member proposal, Team Co-Leader proposals should include a budget and justification for that role that is separate from the budget for their team member activities. In addition to the travel expected for all NSDT members, the Team Co-Leaders should also include budget for two additional trips to India,

nominally Ahmedabad for three days, one trip for each of the two years not included on a team member proposal. In other words, the Team Co-Leaders are expected to attend one meeting each year with ISRO in India.

3. Evaluation and Selection of the NASA NISAR Science Definition Team

Proposals will be evaluated by a panel of scientific peers from the three principal scientific disciplines mandated by this call, Solid Earth, Ecosystem Science, and Cryospheric Science along with experts in other disciplines and the applied sciences, as needed.

All proposals will be evaluated according to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*. In addition to the factors given there, the evaluation of intrinsic merit for a proposal shall consider the ability and experience of the Principal Investigator in serving as a constructive, productive team member in related and relevant projects.

4. Summary of Key Information

Expected program budget for first year of new awards	$2.0M, see also Section 2.4
Number of new awards pending adequate proposals of merit	~16
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	May 1, 2015
Due date for proposals	June 8, 2015
Planning date for start of investigation	September 25, 2015
Page limit for the central Science-Technical-Management section of proposal	15 pp for NSDT member proposals and 20 pp for NSDT co-lead proposals; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of	http://grants.gov/ (help desk available at

proposal via Grants.gov	support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-NSDT
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A.44 SERVIR APPLIED SCIENCES TEAM

NOTICE: Amended on October 2, 2015. This program element uses a binding two-step proposal process, in which a Notice of Intent is not requested, but a required five-page Step-1 proposal must be submitted by an Authorized Organizational Representative. Only those organizations that are invited to do so may submit a Step-2 proposal. See Section 4 for details.

Step-1 proposals are due November 16, 2015 and Step-2 proposals are due April 29, 2016, 2016. A Preproposal telecon will occur on October 15, 2015. For more information visit https://www.servirglobal.net/AST-Telecon.

1. Introduction and Background

1.1 Overview

SERVIR, an initiative of NASA and the U.S. Agency for International Development (USAID), fosters applications of Earth observations to help developing countries assess environmental conditions and climate change to improve their planning and actions. This solicitation requests proposals for the SERVIR Applied Sciences Team (AST), which will improve the abilities of SERVIR regional hubs, national stakeholders, and users to apply Earth observations.

The primary purpose of this team is to provide geographic and thematic applied science expertise to regions supported by the SERVIR global network. Geographic regions include Eastern and Southern Africa, Hindu-Kush Himalaya, Lower Mekong, and West Africa. Specific topics for this solicitation include food security, water and water-related disasters, land use and ecosystems, and weather and climate. Each team member will co-develop with, strengthen the capacity of, and transfer application(s) to SERVIR regional hubs to address users' decisionmaking needs. Team members will also communicate, coordinate, and share expertise with each other and SERVIR hubs across thematic and regional interests.

This solicitation will use a two-step selection process. A brief Step-1 proposal/evaluation will identify proposers that NASA will invite to prepare an in depth Step-2 proposal. In Step-2, proposers are expected to collaborate with SERVIR regional hub representatives to define the scope of their projects to ensure the proposals align with regional needs.

1.2 Applied Sciences Program Objectives

Within the Earth Science Division (ESD) of NASA's Science Mission Directorate (SMD), the Applied Sciences Program discovers and demonstrates innovative uses and practical benefits of NASA Earth science and data from Earth-observing satellites. The Program partners with organizations from the public and private sector to apply scientific findings and satellite data in their decisionmaking activities. The Program has three primary areas of operations: applications, capacity building, and mission planning.[1] All Program activities support goals to deliver near-

[1] The Program's applications themes align with the societal benefit areas of the international Group on Earth Observations: Agriculture, Biodiversity, Climate, Disasters, Ecosystems, Energy, Health (including Air Quality),

term uses of Earth observations, build capabilities to apply Earth science data, and contribute to satellite mission planning. By working with partners and continuing to build new collaborations, the Applied Sciences Program is identifying ideas and priorities for new applications.

Within the Applied Sciences Program, the Capacity Building program sponsors projects that improve the capabilities of decision makers, community leaders, and resource managers in the United States and abroad to access and apply Earth observations data, products, and tools. A variety of methods and approaches are employed and experimented with to better build capabilities in individuals and institutions. These activities build capacity within the United States and the developing world to expand the Earth observations user base, and build the capacity of nontraditional audiences to be aware of and able to use Earth observations in decisions and actions. The SERVIR program element is within the Capacity Building program. More information is available through the Applied Sciences Program's website at http://appliedsciences.nasa.gov/.

1.3 SERVIR Objectives

SERVIR partners with regional institutions (SERVIR hubs) around the globe to help them become stronger service providers to assist their member countries to improve the information used in development decisionmaking. Government policy makers and resource managers comprise the primary target audiences for SERVIR hubs. The goal of SERVIR is to improve environmental management and resilience to climate change by strengthening the capacity of governments to integrate Earth observation information and geospatial technologies into development decisionmaking. SERVIR has organized thematic priorities along four thematic service areas: food security, water and related disasters, land use and ecosystems, and weather and climate (see Section 2.4). Within each thematic service area, SERVIR provides data, products, tools, platforms, and training needed to meet the needs of users. SERVIR provides services through three interdependent approaches:

1. Building the capacity of analysts and decision makers to use Earth observation information and geospatial information technologies;
2. Improving awareness of and access to data, products, and tools; and
3. Providing user-tailored data, products, and tools to inform development decisions.

An important related objective is to build the capacity of regional institutions (SERVIR hubs) and their partners to provide high quality services, creating a stronger network at the regional level. NASA sponsors the SERVIR Coordination Office, which provides science coordination and opportunities for exchange among partners to create a global, interconnected network.

SERVIR operates through regional hubs within existing regional institutions that have a unique set of characteristics, including political buy-in from member countries; technical capabilities in remote sensing, geographic information systems, and database management; and relationships with users. SERVIR's network of hubs includes:

Water, and Weather. In addition, there is a cross-cutting theme of Wildfires. Applications refer to the use of remotely sensed observations and derivatives, modeling products, *in-situ* data or any combination thereof, to generate outcomes of relevance and utility to the end user or decision maker.

- Eastern and Southern Africa region. The regional hub is the Regional Center for Mapping of Resources for Development (RCMRD) in Nairobi, Kenya;
- Hindu-Kush Himalayan region. The regional hub is the International Center for Integrated Mountain Development (ICIMOD) in Kathmandu, Nepal;
- Lower Mekong River region. The regional hub is the Asian Disaster Preparedness Center (ADPC) in Bangkok, Thailand; and
- West Africa region. The regional hub is anticipated in early 2016.

Each regional hub works with a number of countries. NASA and USAID have selected subsets of countries as foci for this solicitation:

- SERVIR Eastern and Southern Africa: Foci are Ethiopia, Kenya, Malawi, Rwanda, Tanzania, and Uganda;
- SERVIR Hindu Kush Himalaya: Foci are Bangladesh, Bhutan, Nepal, and Pakistan;
- SERVIR Mekong: Foci are Burma, Cambodia, Laos, and Vietnam; and Thailand as a part of the regional perspective; and
- SERVIR West Africa: Foci will be Burkina Faso, Ghana, Niger, and Senegal.

A list of all countries supported by the respective hubs can be found on www.SERVIRGlobal.net.

SERVIR works with regional hubs and their national users to co-develop data products, tools, applications, and models to meet their specific requirements. SERVIR also makes these available to the public and other potential users via an online portal. The SERVIR website, including region-specific pages linking to regional geoportals, can be found at www.SERVIRGlobal.net, and the product catalog can be found at www.SERVIRcatalog.net.

Additional reference information about SERVIR is provided in Section 6.

2. Scope of Solicitation

This section describes the scope of the SERVIR Applied Sciences Team, Team members, priority topics, and project timeline. This section also provides specific suggestions and considerations.

2.1 SERVIR Applied Sciences Team

The Applied Sciences Program invites proposals for membership on the second SERVIR Applied Sciences Team and Team member projects through this program element. The primary purpose of this Team is to improve, enrich, and expand the use of Earth observations in the countries associated with the SERVIR regions based on the needs of the region. The Team will be a resource and base of expertise in research, applications, information utilization and management, and innovation that the SERVIR Coordination Office and regions can draw on, consult, and engage.

It is expected that the Team will collectively possess a range of experience, skills, and expertise related to user engagement, decision support, Earth science, monitoring and evaluation, applied science, and international development. Selected participants will likely include social scientists and economists, Earth science researchers, technical experts, modelers, geospatial experts, visualization specialists, applications specialists, international development specialists, and others.

A SERVIR Coordination Office representative will serve as the Team Lead. In addition to the Lead, the AST Team will have one "thematic service area lead" for each of the four topic areas (see Section 2.4) with an aim to synergize and integrate the AST projects in that thematic service area across SERVIR regions. Proposers are asked to identify their interest in serving as a Thematic Service Area Lead.

Key objectives of the Team are to:

- Advance innovative and practical uses of Earth observations serving regional and/or national needs for decisionmaking through co-development of applications with SERVIR regional hubs.
- Strengthen the capacity of regional hubs and national users to use Earth observations in decisionmaking.
- Provide an expert knowledge base for the SERVIR regions and the SERVIR Coordination Office.
- Provide feedback to NASA regarding usability and usefulness of satellite data products for developing country decision maker needs[2].
- Identify potential new data products of value to users.

Key responsibilities of the Team are to:

- Share information with each other and the SERVIR network.
- Share lessons learned to assist other AST members and the SERVIR network.
- Communicate across regions along each thematic service area to assist in interhub collaborations.
- Communicate regionally across each thematic service area to assist in holistic multidisciplinary perspectives and decisionmaking.

In addition to the team objectives and responsibilities above, a budget will be held by the program and made available to selected Principal Investigators (PIs) to address natural and/or man-made disasters that may possibly occur in the SERVIR hub regions. This budget will be available for short-term emergency activities to begin immediately by using the budgeted crisis buffer to address the crisis early and limit its effects.

The Team is expected to consist of 10-12 members. The PI of each selected AST project will serve as the Team member. Thus, proposers should not propose an entire Applied Sciences

[2] Feedback may be provided to the NASA SERVIR Coordination Office, the NASA data centers, science teams, the Applied Sciences Program, and/or missions in development including their early adopters programs.

Team.

2.2 Team Members

Each Team member will work primarily with one hub region. In collaboration with regional hub institutions, members will conduct activities, such as workshops and assessments, to identify gaps in hub and user capabilities, present approaches their project is taking to address the gaps to get feedback, and define measures of success. Each Team member will co-develop applications with SERVIR regional hubs to support identified needs in a thematic service area with their respective region's hub personnel and national users. Members will assist the SERVIR Coordination Office and the respective regional hub in product transfer to the user through training and capacity building. The Team members will also support training and capacity building for the other SERVIR regions, as needed.

Beginning with Step-2 proposal development, each selected Team member project is expected to include SERVIR regional hub scientists as collaborators on their project. These scientists will join in the co-development of the product or tool and should be considered a part of the respective project team. SERVIR regional hub participation will be funded separately.

2.3 Thematic Service Area Projects

Each Team member's thematic service area project can include data, products, tools, platforms, and training needed to contribute to the regional hub's service to the users. SERVIR's past experience shows that a clear and comprehensive articulation of assumptions, as well as identification of inputs, outputs, and intended outcomes, is necessary to evaluate project effectiveness. This information (termed theory of change[3]) is used by the SERVIR hubs and should also be used by AST projects. AST projects should establish the baseline approach for users' decisionmaking and include approaches to improve the quantification of impact of their work on this decisionmaking.

2.4 Priority Topics

Applicants for the Team should propose projects aligned with one or more of the thematic service areas and regions based on the needs described below. The following priority thematic service areas and topics are based on a) regional needs assessments conducted in the SERVIR regions and b) Applied Sciences applications areas (see Section 1.2). Investigators are encouraged to propose projects to address needs in all or part of a SERVIR region. In collaboration with the regional hubs, the awardees are expected to develop applications and demonstrate them in the planned user environment. The user environment includes, but is not limited to, geospatial information systems (GIS) and Web map services. Efficient use of available Internet bandwidth is an important consideration given connectivity challenges in some SERVIR regions. The awarded projects, as part of the application development, are expected to transfer the routine execution of the developed applications to the regional hubs and their users.

[3] A theory of change is a description of the logical causal relationships between multiple levels of conditions or interim results needed to achieve a long-term objective. It outlines pathways or steps to get from an initial set of conditions to a desired end result. A theory of change is analogous to a project hypothesis.

In addition, it is expected that the project team will transfer the application, including source code and other relevant information, to the SERVIR Coordination Office for archival purposes.

Priorities are organized by thematic service area and by region. Each AST project is expected to contribute to regional hub thematic services. All projects are expected to address seasonal, interannual, and/or decadal climate scenarios to enable SERVIR's goal to improve environmental management and resilience to climate change. A general overview of regional and thematic service area needs is provided across the SERVIR network, and specific needs are identified for each of the SERVIR regions. The thematic service areas for this solicitation are food security; water and related disasters; land use and ecosystems; and weather and climate.

2.4.1 Food security

For this solicitation, the food security thematic service area includes agriculture, rangeland management and pastoralism, and fisheries and aquaculture, particularly through the lens of increasing climate variability. Key topics include linking agricultural productivity assessments, crop yield models, and use of climate scenarios for assessing the impacts. Proposals are strongly encouraged in a) generating seasonal predictions of crop yield, b) assessments of interannual to decadal climate change on crop yields, and c) potential adaptation tools to monitor and/or mitigate the climate change impacts on agriculture, rangeland management and pastoralism, and/or fisheries and aquaculture.

SERVIR-Eastern and Southern Africa. Proposals are encouraged to address agricultural yield assessments for key agricultural value chains such as maize across timescales from seasonal to annual and longer. Proposals to improve rangeland and pastureland management for livestock are encouraged. Data sets supporting the region's upcoming crop insurance partnerships are also encouraged.

SERVIR-Himalaya. Proposals are encouraged to address agricultural productivity assessments, examining seasonal and longer-term climate scenarios and agricultural drought characterizations and forecasts. Creation and characterization of data sets supporting crop insurance markets would be valuable.

SERVIR-Mekong. Proposals are encouraged to address agricultural productivity assessments, particularly rice, examining the impacts of seasonal and longer-term climate scenarios on food security and the impact of large hydrologic structures (such as dams) on fish stocks and aquaculture. A USAID Regional Development Mission for Asia Adaptation and Resilience to Climate Change (ARCC) project has completed several assessments of crop productivity and climate change. Proposal ideas adding value to those assessments are encouraged.

SERVIR-West Africa. Proposals are encouraged to address agricultural productivity assessments, examining the impacts of seasonal and longer-term climate scenarios, agricultural drought characterizations and forecasts, continental and maritime fisheries, and rangeland management.

2.4.2 Water and related disasters

For this solicitation, the water and related disasters thematic service area includes water quantity (including groundwater), sediment transport, and water quality. This solicitation seeks efforts to address improved estimation and predictability of water resources for integrated water management for SERVIR regions. Proposals are encouraged in a) water quantity, including estimations for water allocation; b) the food-water-energy nexus; and c) disaster investigations including floods, droughts, and rainfall-induced landslides. Tools that will empower decision makers to make informed decisions to develop adaptation strategies are welcome.

SERVIR-Eastern and Southern Africa. In this thematic service area, proposals are encouraged to address holistic assessments of agriculture and water, focusing on seasonal and longer-term climate scenarios; and drought characterizations and forecasts.

SERVIR-Himalaya. In this thematic service area, proposals are encouraged to address downstream water availability under changing cryospheric conditions, hydrologic modeling and short-term to seasonal forecasting of floods, holistic assessments of agriculture and water, focusing on seasonal and longer-team climate scenarios, and drought characterizations and forecasts.

SERVIR-Mekong. In this thematic service area, proposals are encouraged to address coastal erosion, salt-water intrusion; hydrologic modeling and short-term to seasonal forecasting of floods, sediment transport; holistic assessments of agriculture and water, focusing on seasonal and longer-term climate scenarios, and drought characterizations and forecasts.

SERVIR-West Africa. In this thematic service area, proposals are encouraged to address coastal erosion, flood modeling and forecasting, including assessments of seasonal and longer-term climate scenarios, and drought characterization and forecasts.

2.4.3 Land use and ecosystems

For this solicitation, the land use and ecosystems thematic service area focuses on sustainable landscapes through natural capital accounting and ecosystem services. Ecosystem services are critically dependent on natural capital such as the quality of soils, organic and nutrient contents, topography, rainfall, and land cover among other factors. SERVIR regional hubs have been conducting land cover mapping for their regions. Ideas to build capacity to transform land cover maps into natural capital accounting will enable SERVIR regional hubs to become effective leaders in their region to provide ecosystem services to their member countries. Proposals are encouraged to identify areas of low carbon impact for resilient agriculture and development. Proposals with close alignments with SilvaCarbon activities to assist countries in SERVIR regions to monitor their forest and terrestrial carbon are encouraged.

SERVIR-Eastern and Southern Africa. In this thematic service area, proposals are encouraged that can help the regional hub to connect land cover maps with sustainable landscapes and ecosystem services.

SERVIR-Himalaya. In this thematic service area, proposals are encouraged that can help the regional hub to connect land cover maps with sustainable landscapes and ecosystem services. SilvaCarbon has programs in Bangladesh and Nepal, where collaborations are encouraged.

SERVIR-Mekong. In this thematic service area, proposals are encouraged that can help the regional hub to connect land cover maps with sustainable landscapes and ecosystem services. SilvaCarbon has programs in Thailand, Cambodia, and Vietnam, where collaborations are encouraged.

SERVIR-West Africa. In this thematic service area, proposals are encouraged that can help the regional hub to connect land cover maps with sustainable landscapes and ecosystem services. Desertification is a major challenge in West Africa; studies linking climate analysis to this challenge are encouraged. Proposals are encouraged to identify areas of low carbon impact for resilient agriculture and development at large.

2.4.4 Weather and Climate

For this solicitation, the weather and climate thematic services area spans a continuum of time scales, ranging from short-term prediction of weather in SERVIR regions, through seasonal forecasts, and to interannual climate scenarios. Integration of these data sets in applications across the SERVIR science portfolio will bring the latest science to support the needs of regional hubs and their users. This solicitation encourages proposals to build capacity in government ministries in SERVIR regions to use the latest satellite data to address weather-related needs, as well as to obtain, evaluate, and integrate seasonal and longer-term climate data sets in their decisionmaking. Because weather and climate data sets are generally large, proposal ideas should articulate plans for efficient use of internet bandwidth available, especially with the connectivity challenges in some SERVIR regions.

SERVIR has begun generation of global ensembles of climate scenarios using North American Multi Model Ensembles (NMME). It is expected that the SERVIR Coordination Office will make those and longer timescale scenario ensembles available to the AST PIs. Additionally, NASA has recently released the NASA Earth Exchange (NEX), a platform for data dissemination (including long-term climate data sets). SERVIR encourages use of these existing data sets and portals for connecting the latest climate data to the users in SERVIR regions.

SERVIR-Eastern and Southern Africa. In this thematic service area, proposals are encouraged to seek innovative ways to link climate scenarios from weather time scales to seasonal and interannual time scales to help users in SERVIR regions with improved use of climate data. It is anticipated that this effort will involve working with existing climate groups, such as the IGAD Climate Prediction and Applications Center (ICPAC) in Nairobi, Kenya.

SERVIR-Himalaya. In this thematic service area, proposals are encouraged to seek innovative ways to link climate scenarios from weather time scales to seasonal and interannual time scales to help users in SERVIR regions with improved use of climate data. Use of satellite

data is expected to bring improvements in weather information for the region, which will add value to several ongoing SERVIR activities in the region.

SERVIR-Mekong. In this thematic service area, proposals are encouraged to seek innovative ways to link climate scenarios from weather time scales to seasonal and interannual time scales to help users in SERVIR regions with improved use of climate data.

SERVIR-West Africa. In this thematic service area, proposals are encouraged to seek innovative ways to link climate scenarios from weather time scales to seasonal and interannual time scales to help users in SERVIR regions with improved use of climate data.

2.5 Timeline of Projects

2.5.1 Year 1 of Project

During the first year of the project, the Team will be expected to:

- Align the project activities (defined during the Step-2 proposal development process; see Section 4) with the identified needs of the user. During the first year, the regional hub institution will liaise with the users and will make the connection between the project and the user activities.
- Develop a project plan and Product Definition Document[4] and begin work along the project plan.
- Provide quarterly updates and develop an annual report at the end of Year 1 based on the interaction with the regional hub regarding the user needs.
- Actively participate in technical interchange teleconferences and meetings with the SERVIR Coordination Office, USAID-Washington and regional mission SERVIR Coordination team, regional hub personnel, and other Team members.

The Applied Sciences Program will determine project continuations upon review of Year 1 reports. The objective is to identify, prioritize, and implement high-reward applications ideas with SERVIR regional hubs and their users in the region.

The Program will include the following factors in its determination of projects to continue after Year 1:

- Progress reported in quarterly progress updates.
- Quality of project plan and Product Definition Document, including a transition approach with clear objectives to develop and transfer the application into sustained use.
- Successful demonstration of alignment and inclusion of AST projects in a regional hub's work plan with demonstrated feasibility to impact users.

[4] SERVIR uses Product Definition Documents to define the scope of the projects, with active collaboration with all project partners, including national and regional users. This living document is meant to keep everyone aware of all the activities, and changes are communicated to everyone before implementation.

- An annual report that demonstrates the expected outputs from models, applications, and/or decision support tools that will support the user needs; commitment to AST team communications and activities; plans to build regional hub user capacity to sustainably transfer the project outputs; and rationale for project success.

2.5.2 Years 2 and 3 of Project

During the remaining two years of the project, the Team will be expected to:

- Continue and complete the work outlined in the project plan to develop the application or tool.
- Actively collaborate with the regional hub and their users consistent with the joint project developed during the first year. Strengthen capacity of users to use the products.
- Support transfer of products deemed to be operational to the regional hubs and their users. Provide archival copies to the SERVIR Coordination Office.
- Monitor the key indicators of success for the project.
- Support the SERVIR Coordination Office to articulate and communicate the results, benefits and successes of the applications produced by the Team.
- Actively participate in technical interchange teleconferences and meetings with the SERVIR Coordination Office, USAID-Washington and regional mission SERVIR Coordination team, regional hub personnel, and other Team members.
- Continue to provide quarterly updates and annual reports.

Years 2 and 3 will be continued based upon satisfactory progress reporting and continued progress towards the project plan.

2.6 Specific Suggestions and Considerations

The Applied Sciences Program strongly encourages projects to use an array of Earth observations and science research results, including multiple spacecraft observations, geophysical parameters, Earth system models, and predictive capabilities. At least one NASA Earth observation product or model output must be used. The Program encourages project teams to consider and use products from recently launched NASA missions (e.g., SMAP, GPM), as well as simulated products from upcoming, planned missions (e.g., GRACE-FO, SWOT), and NASA-sponsored activities (e.g., SPoRT, NASA Earth Exchange - NEX).[5] In addition, the Program encourages projects that integrate multiple sources of Earth observations and information. Examples include commercial[6] and international satellite Earth observations, airborne observations, *in-situ* (i.e., ground-based) sensor measurements, surface observation networks (e.g., SCAN, SNOTEL, NEON), socioeconomic data

[5] Proposals that request resources on NEX or other NASA high end computing resources should specify the data sets, anticipated data volumes, annual estimated computing requirements (in SBU's, http://www.nas.nasa.gov/hecc/support/kb/Common-Standard-Billing-Unit-(SBU)-Rates_271.pdf) for each year of the project, and any additional requirements or computational needs specific to the proposed project. The proposal should also describe the relevant high end computing and modeling expertise of the proposing team. For a listing of current NEX data resources, please see https://nex.nasa.gov/nex/resources/127/.

[6] Proposals that plan to use commercial data should include the costs in their proposal. SERVIR can facilitate access to limited high-resolution electro-optical multispectral imagery.

(SEDAC, U.S. Census/equivalent), and operational and scientific models. Proposers may propose new *in-situ* and airborne data collection as a small part of the overall proposal.

The Program strongly encourages the use of visualizations and visualization techniques to illustrate alternative scenarios and support decisionmaking activities. The Program strongly encourages multiorganizational, multidisciplinary, and multisectoral teams. Projects are strongly encouraged to have team members familiar with resource management, business, or policy-making activities and users' needs. The Program encourages early interaction with personnel knowledgeable about NASA Earth science, models, and sensors (e.g., science teams and instrument scientists) to understand capabilities and limitations.

Applicants should be aware of existing SERVIR products and capabilities to avoid duplication; information about these and others are available on the SERVIR website in the Product Catalogue. These products can be leveraged. Applicants should also be aware of non-SERVIR projects in the region to avoid duplication. More information on existing SERVIR efforts can be found in the SERVIR Product Catalogue (www.SERVIRcatalogue.net/).

3. Programmatic Information

3.1 Period of Performance

Awards will be for a three-year period of performance with annual funding contingent upon criteria above (Sections 2.5.1 and 2.5.2 above) and available funding.

3.2 Budget

The expected annual program budget for awards is approximately $2.5 million, and proposers are strongly encouraged to keep the total cost per investigation to approximately $200,000 per year per award, depending on the complexity of the proposed effort. This includes NASA civil servant salaries and indirect costs, despite the fact that these costs may not be included in the proposal. (For more information on this, see Section I c of the ROSES Summary of Solicitation and the SARA website at http://science.nasa.gov/researchers/sara/how-to-guide/nspires-CSlabor/). Thus, any NASA civil servant Co-Investigators on proposals submitted by other organizations must share their total costs, including salaries and indirects, with the submitting organization so that the proposing organization knows when they are exceeding $200,000 per year.

The budget for each project should include at least one domestic and one international trip per year for programmatic meetings and for engagement with regional hub personnel; two international trips to train and collaborate with scientists from other hub regions; and one two-day trip per year to Washington, DC, to report annual progress and determine continuation in subsequent years.

Cost sharing is not part of the evaluation criteria. However, cost sharing may become a factor at the time of selection when deciding between proposals of otherwise equal overall merit.

4. The Two-Step Proposal Process

The Program is using a mandatory two-step proposal submission process. The overall description of a two-step process can be found in Section IV. (b) vii of the ROSES-2015 *Summary of Solicitation*. A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). The five-page Step-1 proposal must present the proposed concept based on thematic service areas identified in Section 2.4. In the preparation of their Step-1 proposals, teams may not engage SERVIR regional hubs.

After review of submitted Step-1 proposals and decisions by the selecting official, a subset of the proposers will be invited to submit Step-2 proposals. Only those who are invited to submit a Step-2 proposal will be able to do so. During development of Step-2 proposals, the investigators are expected to collaborate with SERVIR regional hubs to ensure alignment of proposed Step-2 work with the regional hub needs, priorities, and work plans.

4.1 Step-1 Proposals

A Step-1 proposal is required and must be submitted electronically by the AOR by the Step-1 due date (see Section 7, Summary of Key Information). No budget is required for Step-1 proposals. Submission of a Step-1 proposal is required in order to submit a Step-2 Proposal. The NSPIRES system will guide proposers through submission of all required proposal information. Please note that the Proposal Summary, Business Data, Program Specific Data, and Proposal Team are required Cover Page Elements for a Step-1 proposal. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 proposal.

4.1.1 Step-1 Proposal Content

Step-1 proposals must be uploaded as a PDF file not to exceed five pages, including any references or citations. The five-page, Step-1 proposal should:

a. Emphasize responsiveness, clearly indicating how the proposal addresses the solicitation.
b. Specify the SERVIR hub region, subregion, and country(s) for the proposed activity, and how the proposed work aligns with the regional and thematic service area needs outlined in this solicitation.
c. Include a brief description of the proposed applied research, illustrating experience of the team in connecting their work with users in the subject area.
d. Include a brief description of previous research carried out by the international scientific community in the subject area.
e. Briefly identify existing decision methods being used and new approaches/aspects being proposed.
f. List the remote sensing assets, models, or tools the proposed work can potentially use.
g. Identify potential societal impacts of the proposed effort.
h. Outline potential expected outputs and outcomes of the work.
i. Identify proposed deliverables.
j. Provide a tentative schedule.

k. Identify Co-Is and other personnel deemed critical to the success of the proposed activities (see 4.2 below, the identified critical personnel cannot be changed between Steps 1 and 2).

4.1.2 Step-1 Evaluation Criteria

Step-1 proposals will be evaluated for relevance and intrinsic merit. Relevance of the proposed efforts will be assessed based on alignment with the regional needs, USAID and hub regional priorities, and utility and potential alignment of proposed effort with the SERVIR regional hub work plan. Intrinsic merit will be evaluated on the novelty of the proposal ideas, past experience of the PI and the proposing group, and the perceived impact of the proposed work, e.g., the ability to meet the needs of the region as expressed by SERVIR regional hubs. Cost reasonability will not be an evaluation criterion for Step-1 proposals.

A peer-review panel will evaluate the Step-1 proposals. NASA expects to have separate Step-1 peer review panels for each region. Proposals will be assigned to a panel based on a) the proposer's identification of the appropriate region, and b) NASA's assessment of proposal content. While NASA expects to select proposals in each of the regions, NASA reserves the right to select proposals in none, some, or all of these depending on the nature and distribution of proposals received and the outcome of the peer review process. All proposers will be notified of the outcome of the evaluation process.

4.2 Step-2 Proposals

The investigators invited to submit the Step-2 proposals will be required to interact and work with SERVIR regional hubs for their Step-2 proposal development. The Step-2 proposals are intended to closely complement the work plans at the SERVIR regional hubs (regional hub work plans are funded separately through USAID mechanisms). The synergy between Step-2 proposal and hub work plan is expected to result in seamless, innovative science efforts needed by the regional hubs and their users in SERVIR regions.

Because NASA will be deciding which projects are invited to continue to Step-2 based on peer review of the Step-1 proposal, NASA must limit the changes that occur between Step-1 and Step-2. Step-2 proposals must contain the same application goals (thematic service area) proposed in Step-1. The PI may not be changed, nor may Co-Investigators or other critical professional personnel who were proposed to support the Step-1 proposal be removed. Proposers who want to add funded investigators to the Step-2 proposals must inform the points of contact identified in the summary table of key information and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Collaborators, students, and other personnel who are not critical to the success of the project may be changed between Step-1 and Step-2.

The content of Step-2 proposals should adhere to Section 2.3 of *Guidebook for Proposers* and the ROSES-2015 Summary of Solicitation (SOS). Where they disagree the ROSES SOS takes precedence. Step-2 proposals must include a paragraph that details their commitment to being part of the Team. The commitment can include a) what it means to be a team and b) why the proposing PI thinks they are a good team player. In addition to being on the Team, if the PI is

interested in serving as the thematic service area lead for SERVIR AST, the leadership commitment and experience should be included in this section.

4.2.1 Step-2 Proposal Format

Proposers should refer to the PDF entitled "Instructions for Submitting a Step-2 Proposal" that will appear under "Other Documents" on the NSPIRES page for the program of interest. All proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the ROSES *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review.

Following the 15-page Scientific/Technical/Management section of the proposal, the respondents must include an additional two-page section titled "SERVIR Regional Hub Alignment" which will be used to clearly identify how the proposed work will complement the regional hub work plans. The societal impact of the proposed work and planned approaches to qualify or quantify the work's impacts on decisionmaking should be illustrated.

4.2.2 Step-2 Proposal Evaluation Criteria

Step-2 proposals will be evaluated based on the criteria given in Section VI of the ROSES *Summary of Solicitation.* The evaluation will be based on the proposal's relevance, intrinsic merit, and cost. The evaluation of relevance will be based on the proposal's alignment with needs in the region and with the regional hub work plan. The evaluation of intrinsic merit will include the quality of proposed tool or application and methods proposed, demonstrated ability to work with users, the time table for the application development, and the credentials of the proposing team.

NASA may use multiple Step-2 peer review panels for each region, and proposals will be assigned to a panel based on a) the proposer's identification of the appropriate region and b) NASA's assessment of proposal content, including thematic emphasis. While NASA expects to select proposals in each of the regions, NASA reserves the right to select proposals in none, some, or all of these depending on the nature and distribution of proposals received and the outcome of the peer review process.

5. Award Reporting requirements

Each awarded project will be responsible for quarterly maintenance of project information, status updates, highlights, and milestone achievements. NASA will coordinate with each PI at award to provide the necessary information for the online system.

The following reports will be required of awardees. In cases where teams of organizations or subcontractors exist, consolidated project reports, including financial records must be submitted and are the responsibility of the lead organization. The proposed budget should provide for these reporting requirements.

5.1 Quarterly Reports

A one-page project "quad-chart" (format provided at award) with Purpose and Objectives, Approach, a Figure, and Key Milestones and Application Readiness Levels (ARLs, see Section 6.2 below) is required to be updated quarterly, and provided with additional charts to summarize progress. Progress is also verbally reported at quarterly SERVIR AST teleconferences.

5.2 Annual Reports

The Year 1 Report summarizes the first year of project development, regional hub engagement, user engagement, and progress to date. Part 1 of this report should articulate the thematic and regional challenge and decisionmaking activity, application of Earth observations, product definition, and starting and ending ARLs (with justifications). The report should explain any variations in the anticipated results, a discussion of major problems (technical or other), and lessons learned and recommendations.

For consideration to continue through the remaining two years of the project, Part 2 of the report should provide a plan for remaining activities. Part 2 should articulate the approach to implement the application, the baseline users' approach to the decision to be affected, updated assessments of the potential impact of the application, any changes to the composition of the team, preliminary transition approach, key milestones and final expected ARL, and key challenges to address.

Year 2 and 3 reports summarize progress, results, transition, and illustrations of regional hub and user engagements.

6. Reference Information

6.1 SERVIR Global Network

SERVIR operates through regional hubs or consortia within existing regional institutions that have a unique set of characteristics, including political buy-in from member countries; technical capabilities in remote sensing, geographic information systems, and database management; and relationships with users in some of the following service areas: food security, water and water related disasters, land use and ecosystems, and weather and climate.

SERVIR's network of regional hubs and consortia includes the Regional Center for Mapping of Resources for Development (RCMRD) in Nairobi, Kenya, serving the Eastern and Southern Africa regions; the International Center for Integrated Mountain Development (ICIMOD) in Kathmandu, Nepal, serving the Hindu-Kush Himalayan region; and the Asian Disaster Preparedness Center (ADPC) in Bangkok, Thailand, serving the Lower Mekong region, and in 2016, a SERVIR West Africa partner. Additional partners in the program include U.S. government agencies, national space agencies, Non-Governmental Organizations, universities, private sector companies, international organizations, and development agencies.

6.1.1 NASA's Role

The SERVIR Coordination Office, based at the NASA Marshall Space Flight Center in Huntsville, Alabama, provides technical support to SERVIR regional hubs/consortia related to data access, science, technology, and geospatial information technology management and policy, in line with NASA's assets and capabilities in these areas. NASA funds an Applied Sciences Team of U.S.-based researchers to provide opportunities for collaborative research with regional hubs, partners, and local experts to solve regional and local development challenges.

6.1.2 USAID's Role

USAID funds and manages agreements with regional hubs/consortia to implement SERVIR activities through its regional field offices. USAID facilitates connections to USAID-funded programs and partners that may be interested in connecting with SERVIR regional hub/consortia institutions and partners to benefit from their data, tools, trainings, or other services. USAID manages the SERVIR Support Team to assist regional hubs (see below).

6.1.3 The SERVIR Support Team's Role

A SERVIR Support Team, led by a contractor, provides technical support for SERVIR regional hubs/consortia related to monitoring and evaluation, communications and outreach, sustainability planning, knowledge management, and program planning and management. This helps to ensure consistent quality and recognition of SERVIR's efforts, as well as sustainability of SERVIR within regional organizations.

6.1.4 What is a SERVIR Regional Hub or Consortium?

USAID and NASA have identified seven capabilities of a successful SERVIR regional hub or consortium:

- Political mandate to convene and advise member states that will allow its services to influence decision makers;
- Technical ability to work with remote sensing information, models, GIS, and offer training;
- Engagement/Outreach ability to reach and communicate effectively with users;
- Organizational/Financial ability to manage and finance operations;
- Infrastructure, including the availability of hardware, software, and reliable Internet;
- Network of partners, including an ability to connect with others both generating and consuming data, products, and tools; and
- Sector expertise in food security, water and related disasters, land use and ecosystems, and weather/climate.

SERVIR has operated through two different models in other regions to access these capabilities: as a single regional institution or "regional hub" (e.g., Hindu-Kush Himalaya), and as a consortium of institutions (e.g., Mekong). In the Mekong region, Spatial Informatics Group (SIG), Deltares, and the Stockholm Environment Institute (SEI) join ADPC in a consortium.

6.2 Application Readiness Levels (ARLs)

The Applied Sciences Program developed a nine-step Application Readiness Level (ARL) index to track the development of applications and integration of Earth observations into partner organizations' decisionmaking activities. The ARL index is an adaptation of the Technology Readiness Level (TRL) scale used in NASA to assess technical maturity in sensors and hardware development. The ARL index provides a scale for the expected advancement along a continuum, starting with a concept and progressing through levels of development and transition to operational use. (Compared with the technology-based TRL, the operational decisionmaking activity of the practitioner organization is the applications analog to space.)

The ARL reflects three main tiers in application development. In general, ARLs 1-3 encompass application discovery and feasibility; ARLs 4-6 address application development, test, and validation; and, ARLs 7-9 focus on application demonstration in partners' system and transition.

The nine ARLs defined as follows:

1. Basic Research – Basic principles and phenomenology observed and reported. Scientific research produces results that could begin to be translated into applied research and development.
2. Application Concept – Application invention and formulation begins. Once basic principles are observed and products produced and validated, practical applications can be invented. Initial understanding and characterization of the decisionmaking activity.
3. Proof of Application Concept - Feasibility studies to assess the potential viability of the application. More complete characterization of the decisionmaking process, including baseline performance and mechanisms. Analytical and experimental studies to set the Earth science products into the decision support context.
4. Initial Integration and Verification (in laboratory environment) - Basic components of Earth science products and decisionmaking activity (decision support system, tool, etc.) are integrated together to establish that they will work together.
5. Validation in Relevant Environment – Basic components are integrated with reasonably realistic supporting elements to application can be tested in a simulated decisionmaking environment.
6. Demonstration in Relevant Environment – Major increase in the application's demonstrated readiness. Prototype system demonstration in a relevant environment or simulated operational decisionmaking environment.
7. Application Prototype in Partners' Decisionmaking – Prototype near or at planned operational system. A major advance from ARL 6, requiring prototype system demonstration of an actual system prototype in an operational environment, such as partners' decisionmaking activity.
8. Application Completed and Qualified – Actual system completed and "qualified" through test and demonstration for partners' decisionmaking activity. Application has been proven to work in its final form and under expected conditions.
9. Approved, Operational Deployment and Use in Decision Making – Actual operational, successful use of application by users in decisionmaking activities.

7. Summary of Key Information

Expected program budget for first year of new awards	~ $2.5M
Number of new awards pending adequate proposals of merit	12; 3 for each SERVIR region
Award duration	3 years
Proposers' Telecon	October 15, 2015, more information at https://www.servirglobal.net/AST-Telecon
Due date for mandatory Step-1 proposals	November 16, 2015
Notifications of Step-1 selections	January 29, 2016
Due date for invited Step-2 Proposals	April 29, 2016
Planning date for start of investigation	July 1, 2016
Page limit for the central Science-Technical-Management section of proposal	Step-1 proposals: 5 pp; Step-2 proposals: 15 pp; and an additional 2 pp for Regional Hub Alignment, see Section 4.
Relevance to NASA	This program is relevant to the Earth science strategic questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-SERVIR
NASA points of contact concerning this program	Programmatic point of contact: Nancy Searby Applied Sciences Program Earth Science Division Science Mission Directorate

	NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0395 E-mail: Nancy.D.Searby@nasa.gov Technical point of contact: Ashutosh Limaye Project Scientist, SERVIR Coordination Office NASA Marshall Space Flight Center 320 Sparkman Dr. Huntsville, AL 35805 Telephone: (256) 961-7903 E-mail: Ashutosh.Limaye@nasa.gov

A.45 EARTH SCIENCE APPLICATIONS: SOCIOECONOMIC BENEFITS

NOTICE: Amended on December 7, 2015. This amendment presents the final text for this Program Element. Notices of Intent to propose are requested by January 22, 2016. Proposals are due March 24, 2016.

1. Overview

The NASA Earth Science Division Applied Sciences Program solicits proposals to develop, implement, and manage a program of activities for the articulation of socioeconomic benefits of Earth science applications.

Key objectives of this solicitation are to develop, advance, and exercise socioeconomic impact analysis techniques and methodologies applied to Earth observations and decision-support applications; expand case study examples and literature base; encourage cross-disciplinary awareness and collaboration; and build capacity in the Earth science community regarding socioeconomic impacts analysis and concepts. This solicitation includes innovative communications work as part of the activities and articulation of benefits.

The solicitation encompasses two elements: Impact Assessments and Community Outreach. Proposal teams may submit to one of the elements or to both elements. The Applied Sciences Program strongly encourages that proposals to this solicitation involve a multidisciplinary, multisectoral team of organizations as a consortium to achieve the objectives. NASA plans to pursue a Cooperative Agreement funding vehicle for this solicitation.

2. Program Information

2.1 Applied Sciences Program

The Applied Sciences Program (hereinafter, the Program) promotes efforts to discover and demonstrate innovative, practical, and beneficial uses of Earth observations. The Program supports applied science research and applications projects to enable near-term uses of Earth observations that inform organizations'[1] decisions and resulting actions, that identify and promote societal benefits from Earth observations[2], and that build key capabilities in the Earth science community and broader workforce. The projects are carried out in partnership with private and public-sector organizations to achieve sustained uses of and sustained benefits from the Earth observations. For more information, visit the Applied Sciences Program website at http://AppliedSciences.NASA.gov/.

[1] Examples include Government agencies, companies, regional associations, international organizations, multinational financial institutions, philanthropic institutions, tribal organizations, not-for-profit organizations.
[2] The Program considers that Earth observations broadly include a range of products and capabilities, including Earth-observing satellite measurements (NASA, other U.S. agencies, foreign, and commercial), outputs and predictive capabilities from Earth science models, algorithms, visualizations, knowledge about the Earth system, and other geospatial products.

The Applied Sciences Program has three primary lines of business: Applications, Capacity Building, and Satellite Mission Planning. The Applications themes include four of the eight societal benefit areas (SBA) of the international Group on Earth Observations (GEO): Health (including Air Quality), Disasters, Ecological Forecasting, and Water Resources.[3] In addition, there is a cross-cutting Wildfires theme and an initiative on Food Security. The Program includes the impacts from a changing climate within each of these topics.

The Capacity Building program improves the ability of individuals and institutions in the United States and abroad, especially in developing countries, to access and apply Earth observations. The program includes three components: ARSET training sessions for professionals; DEVELOP for workforce development and short-term applications projects; and SERVIR for applications in developing countries (joint with the United States Agency for International Development).

Note: This solicitation is for proposals addressing methods and capabilities specifically related to socioeconomic impacts assessments. Proposals that aim to conduct applications projects or fundamental Earth science research will be considered noncompliant. For such pursuits, the reader is referred to other ROSES-2015 Earth Science appendices.

2.2 Socioeconomic Benefits

National and international organizations are placing greater emphasis on the societal and economic benefits that can be derived from applications of Earth observations. The determination of the specific societal and economic impacts, especially quantitatively, can be challenging, yet these determinations are critical to the value proposition of Earth observations. For new knowledge and as a strategic pursuit, NASA's Earth Science Division (ESD) considers it important to substantiate the benefits of Earth science applications in socially and economically meaningful terms, and to communicate those benefits to audiences beyond the Earth science community. Having enabled many successful examples of Earth science applications, the Applied Sciences Program is pursuing this solicitation with these goals in mind.

Historically, it has been challenging to substantiate fully such benefits and to communicate them to a wide audience for a number of reasons, such as a lack of familiarity with socioeconomic terms and concepts within the Earth science community, few connections to experts in social and economic sciences, and limited opportunities for interdisciplinary collaborations on the topic. Yet, the audience for such valuations is potentially sizable and includes NASA stakeholders, Government officials, private companies, non-Governmental organizations, the public, and the Earth science community itself. Overall, it is strategically important for the Earth science community to build skills, networks, examples, and capabilities to determine and document socioeconomic benefits from the use of Earth science in informing organizations' analyses, decisions, and actions.

[3] The eight GEO SBAs are: Agriculture, Ecosystems/Biodiversity, Disasters, Energy/Minerals, Health, Infrastructure/Transportation, Urban Development, and Water Resources.

There are some articles on the value of Earth science data in the wide scholarly literature, yet the number is limited; the number of case studies and methodological examples across the range of societal benefit areas is equally limited. There have been some recent advances that have improved the understanding of the economic value of information, resources, health, and ecosystems, among others. Tools and techniques for ascribing value to such public goods and services are advancing, providing potential means to complement and solidify the link between Earth observations and economic and societal value.

The Applied Sciences Program has sought to advance socioeconomic assessments of Earth science, both to expand knowledge and to induce broader interest in Earth observations applications. Since 2010, the Program has sponsored a series of annual workshops, supported a limited number of project impact assessments, and developed a primer entitled *Measuring Socioeconomic Impacts of Earth Observations*[4] for the Earth science community. However, these efforts have largely been *ad hoc* and incremental. The Program is now interested in a more formal, deliberate, and comprehensive approach to advance socioeconomic impact valuation.

3. Solicitation Information

This section provides information on the intent of this solicitation. Section 3.1 describes the purpose and objectives. Section 3.2 conveys the two elements of the solicitation. Section 3.3 describes the scope of the solicitation. Section 3.4 provides suggestions for proposal teams to consider in preparing a proposal.

3.1 Purpose

NASA solicits proposals for a program of activities for the articulation of socioeconomic impacts of Earth science applications. The program of activities encompasses two major elements: Impact Assessments and Community Outreach. Applied Sciences will select 1-2 proposals to lead, develop, implement, and manage the program and its two elements. As described below, proposers can propose to focus on one element or both elements. Applied Sciences expects a considerable level of postaward interaction and cooperation with the awardee(s), and thus it plans to pursue a cooperative agreement as the award instrument.

Overall, Applied Sciences seeks to advance the state of practice in socioeconomic impact assessments, with a particular emphasis on quantitative analysis of the use of Earth observations in management, business, and policy decisions and activities. The Program seeks to increase capabilities to produce high-quality impact assessments, which can demonstrate the benefits of Earth science and observations and can induce greater use and uptake of Earth science applications.

Key objectives to achieve through the program of activities include:

- Advances and refinements in assessment methodologies and analytic techniques, addressing any unique aspects of Earth science data and applications;

[4] Primer is available at: http://appliedsciences.nasa.gov/system/files/docs/SocioeconomicImpacts.pdf

- Advances in knowledge and body of literature on impact assessments concerning the explicit use of Earth observations in decision support;
- Greater number of applications of assessment methodologies across themes, sectors, decision types, and other meaningful factors;
- Greater effectiveness and use of impact assessments for Earth observations and geospatial information;
- Advances in familiarity, skills, and capacity within the Earth science community with socioeconomic impacts analysis, concepts, and methods;
- Greater awareness about Earth science data and information within the social, economic, and decision sciences communities;
- Improved networking across and substantive collaborations between the Earth science community and the social, economic, and decision sciences communities;
- Advances in communications approaches and innovation for the expression of Earth science impacts.

As a result of this solicitation, NASA and the Earth science community hope to better articulate the import of, and return on investment from, NASA Earth science. Successful activities can expand the depth and breadth of understanding of the value of Earth science applications within the broader space community, public and private sectors, and the public at large.

3.2 Solicitation Elements

The solicitation encompasses two elements: Impact Assessments and Community Outreach.

- Impact Assessments
  This element includes advancing impact assessment methodologies and analytic techniques as well as exercising existing ones, especially to determine which are most effective for particular themes, types of decisions, audiences, etc. This element also includes the refinement of current methods and the development of new methods and analytic techniques, if appropriate. Proposals can involve methods across the spectrum from traditional approaches to innovative, nontraditional ones. Envisioned activities include collaborations between the Earth science community and social, economic, and decision science communities as well as innovative approaches to communicate impacts. Overall, this element should increase the quality, quantity, and breadth of Earth observations impact analyses and examples, helping advance knowledge and build the body of literature.

- Community Outreach
  This element addresses engagement with the Earth science community to build awareness, capacity, and familiarity with impact assessments terms, concepts, methods, and analytic techniques. Proposals can include engagement and capacity building approaches from traditional to innovative, nontraditional, and experimental ones. This element addresses engagement with the social, economic, and decision sciences communities about Earth science data, capabilities, applications, and assets. This element involves creating connections and enabling networking between the Earth science community and the social, economic, and decision science communities as well as innovative approaches to communicate impacts and build awareness. Overall, this element should increase the

knowledge within the Earth science community about socioeconomic impact assessments and about potential people and organizations with whom they can consult and collaborate.

Proposals must identify which element(s) is the focus of their activity. Teams may propose to focus on one of the elements or on both. Teams interested in both elements may submit either one proposal encompassing both elements, or a separate proposal for each element. See Section 5.4 for information on proposal content and page limits.

3.3 Scope

This section describes items that are encompassed in the general scope of the solicitation as well as items that are specific to each element.

The scope includes the assessment of value and benefits at microeconomic and macroeconomic scales. The Program strongly prefers and encourages a greater focus on the former. The emphasis of the solicitation is on quantitative assessment and analysis, although this does not necessarily imply monetization of impacts. Nonmarket valuation is allowed.

The activities involve work with the Earth science community, work with communities external to Earth science (e.g., decision science, economics, social science), and cross-disciplinary work spanning the communities.[5] Both elements involve networking between the Earth science and other communities, including connections on both practitioner and scholarly pursuits.

There is a rich array of decision types (and resultant actions) that Earth observations can support, such as planning, early warnings, and resource allocation, among many others. The solicitation encompasses the full range of decision types. Proposal teams may wish to present a framework by which they propose to conduct their activities across the range of decision types.

The adoption of new data, information, and techniques by organizations and decision makers can be affected by their sense of the value and benefits. Thus, the scope involves efforts to understand organizational contexts and issues that affect the willingness to accept impact analyses and socioeconomic valuations. Relatedly, it includes efforts to understand the kinds of methods, analytic techniques, approaches to communicate results that are most accepted by particular types of organizations. This information can help ESD and the Applied Sciences Program design activities and interventions to lower organizational barriers to consider, adopt, and use Earth observations.

The Program is interested in assessing and tracking advances in knowledge of and capacity with socioeconomic impacts terms, concepts and techniques. The scope includes the development, testing, application, and refinement of indicators to evaluate and communicate progress toward the objectives through the proposed program of activities.

[5] While both elements involve this work, the nature of the specific work will likely be different for each element.

3.3.1 Impact Assessments

In the application of methodologies and analytic techniques, there may be issues associated with unique aspects of Earth science data and applications that warrant special attention. These issues may need to be addressed to better understand the economic and societal impacts of Earth observations and geospatial information. The scope includes the identification of and attention to issues presented by satellite data in the context of the methods; the scope includes efforts to determine the kinds of information that are most important to assess the impacts of particular methods.

Substantial impact assessment work has already been performed on weather applications and use of meteorological observations. The scope of this solicitation includes broad types of Earth observations, and the scope and intent are purposefully broader than weather applications. For the purposes of this solicitation, while weather applications and meteorological observations can be included, a proposal that is solely or primarily focused on these will be downgraded.

3.3.2 Community Outreach

Significant effort will likely be required to engage the Earth science community in building familiarity and capacity with impact assessments, terms, concepts, and methods. The Earth science community is broad and contains numerous disciplines, all of which are included in the solicitation's scope. Proposal teams may choose to focus on specific disciplines at different stages of their project. NASA encourages teams to present a framework by which they propose to conduct their engagement and develop awareness, capacity, and familiarity across the broad community.

Social scientists, decision scientists, and the communities involved with economic valuation activities on the environment, natural resources, health, disasters, and other topics may have low or limited awareness of the Earth science community, including Earth system science, concepts, observations, data and information products, modeling capabilities, etc. Significant effort is expected to engage (or enable engagement) with highly relevant portions of the social sciences community, such as economic and decision sciences, and other relevant communities about Earth science. As part of the overall engagement and networking, the scope includes efforts to inform them about Earth science capabilities, contacts, and assets for their ongoing endeavors.

3.4 Specific Suggestions and Considerations

Proposals to this solicitation should involve a multidisciplinary, multisectoral team of organizations in a consortium arrangement to achieve the desired objectives. The Program encourages a consortium as a way to have a breadth of experience and the flexibility and agility to respond to needs as the work unfolds; such an arrangement will require an effective management structure. The solicitation allows for private sector entities to be involved in a consortium and/or to submit proposals.

Applied Sciences is interested in showcasing the value and benefits across the range of Earth satellite missions and observations. While the Program recognizes that some missions and

observations are used more than others in applications, the Program strongly encourages that proposed work show breadth in the satellite missions and observations covered. Teams can consider impacts from data products from non-NASA satellites, including foreign satellites, if used in conjunction with some NASA observations, models, or capabilities.

Applied Sciences recognizes that the scope of this solicitation includes multiple aspects. The Program suggests that teams offer, where appropriate, a conceptual framework(s) that outlines the intended foci, dimensionality, or stages of their proposed work. If offered, proposals should articulate the rationale underlying the framework(s).

The Program encourages involvement with personnel knowledgeable about NASA Earth science, data, and disciplines during proposal development and throughout the project itself. However, people in leadership roles with the Applied Sciences Program at NASA Centers should not be part of a proposal submission[6].

The solicitation includes communications work as part of the activities and articulation of benefits. For both elements of the solicitation, the Program encourages teams to consider innovative and creative methods, visualizations, scenarios, graphic design, and other approaches as part of their efforts to convey value, impacts, concepts, methods, or techniques.

It is important for the awardee(s) to interact with NASA Earth mission science teams[7]. The Program expects proposers to plan to attend and participate in at least two mission science team meetings per year, and proposal teams should budget accordingly.

As a standard practice, Applied Sciences Program personnel participate in conferences that practitioners and end users attend, which supports two-way dialogue. The Program expects the awardee(s) to follow similar practices, especially to learn which valuation metrics resonate with particular applications communities and their types of decisions. Similar practices could occur with community meetings related to social, economic, and decision sciences. The Program expects proposers to plan to attend and participate in at least two community meetings per year, and proposal teams should budget accordingly.

The awardee(s) will be expected to produce annual work plans. The Program expects significant coordination through teleconferences and virtual means. The Program expects at least one in-person meeting with the awardee(s) each fiscal year to discuss progress and plans. Proposal teams should budget for one trip for its primary personnel to the Washington, DC area per year.[8] See also Section 5.5 for reporting information.

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[6] The Applied Sciences Program has an Applied Remote Sensing Training project, ARSET. Proposal teams can consult with ARSET and can include activities that align with, make use of, or supplement that project. However, the ARSET project and staff should not be part of a proposal submission.

[7] These are competitively-selected teams associated with Earth science missions, sensors, or measurements. Examples include the Aura Science Team, MODIS Science Team, and Sea Surface Temperature Science Team.

[8] In reality, this meeting may occur in conjunction with other events and conferences. For budget purposes, teams should plan for one such meeting.

There are professional organizations and associations focused on decision sciences and economic topics which may be beneficial to proposal teams. The Program suggests that proposal teams (and awardee(s)) consider them in the context of this solicitation, in areas such as partnering, networking and brokering. Examples include but are not limited to:

- Association of Environmental Resource Economists, http://aere.org/
- Decision Science Institute, http://www.decisionsciences.org/
- American Evaluators Association, http://www.eval.org/
- World Bank Institute, http://wbi.worldbank.org/wbi/
- American Geophysical Union Societal Impacts and Policy Sciences Focus Group, http://sites.agu.org/leadership/sections-focus-groups/sips/

3.4.1 Community Outreach

In the Earth science community, baseline knowledge of and skill with socioeconomic terms and impact assessment methodologies is limited. Applied Sciences encourages proposal teams to consider producing a range of introductory materials for this audience, such as briefings, case study examples, and tutorials. The Program suggests that proposal teams consider publishing articles on the state of practice and review of the literature near the beginning and the end of their work.

Applied Sciences suggests that proposal teams consider both physical and virtual means of community outreach. Innovative, experimental approaches are encouraged along with traditional approaches to engagement. Proposals may include capability-building activities, such as summer schools and community workshops, among others. The Program encourages proposal teams to include skilled, professional communications experts as part of their team and consortium.

4. Solicitation Information

Maximum Period of Performance	5 years
Type of Award	Cooperative Agreement
Expected Project Start Date	August 1, 2016
Total Amount of NASA Funding (FY16-20)	$3.5M total
Anticipated Number of Awards	1-2 awards
Expected Level of Awards	$700K per year total Impact Assessments: $400K-500K Community Outreach: $200K-300K
Contributions from Other Organizations	See Sections 5.3 and 5.5. Note: Contributed funding is in addition to NASA funding; it does not count toward funding level guidelines.

5. Amendments and Clarifications to the *Summary of Solicitation*

The following information provides clarifications of or amendments to the *Summary of Solicitation* of this NRA. The information below supersedes direction provided in the respective sections of the *Summary of Solicitation*. Potential participants in projects involving private sector

organizations and/or proprietary products and services are strongly encouraged to read the definition of cooperative agreement in Section D.1.2 of the *Guidebook for Proposers* and NASA guidelines on cooperative agreements in the *Grant and Cooperative Agreement Manual*.

5.1 Funding and Award Policies: Changes to Section II(a) of the *Summary of Solicitation*

The Applied Sciences Program plans to pursue a cooperative agreement funding instrument, given the substantial level of interaction and cooperation expected to achieve the desired objectives. As such, a proposal should describe the relationship it envisions with NASA.

The Program may augment the award(s) for certain activities based on results of coordination and interaction in the cooperative agreement.

5.2 Award Period of Performance: Changes to Section II(b) of the *Summary of Solicitation*

The total period of performance is five years. In accordance with the *NASA Guidebook for Proposers* and *NASA Grants and Cooperative Agreement Handbook*, the Program will conduct a full peer evaluation of all awards after the first three years in order to qualify for continued funding.

5.3 Cost Sharing: Changes to Section III(d) of the *Summary of Solicitation*

Cost sharing, contributions from proposing institutions, and external resource contributions to a venture are encouraged, though not required nor part of the evaluation criteria (see Setion 5.5). The Program accepts explicit financial contributions and in-kind contributions during the course of the venture as cost sharing. Relevant past work, prior results, or previous support and accomplishments may be described, but the Program does not consider these as cost sharing or in-kind contributions for proposals to this solicitation. Ventures involving commercial organizations are encouraged to read Section D, §1274.204, "Costs and Payments" of the NASA grant and cooperative agreement manual.

5.4 Proposal Format and Contents: Changes to Section IV(b)(ii) of *the Summary of Solicitation*

Proposals should provide sufficient detail to allow reviewers to assess the viability and potential success. Section 2.3 of the *NASA Guidebook for Proposers* provides information on the proposal content. The following items modify Section 2.3.

In the proposal summary, teams should identify which element(s) – Impact Assessments and/or Community Outreach – the proposal addresses. Overall, teams should tailor the information in their proposal to that element(s).

5.4.1 Scientific-Technical-Management

For Section 2.3.5, proposals should include the following additional items in the content for the Scientific/Technical/Management section:

- Characterization of the current state of practice;

- Comprehension of the topic and how the proposed work will augment the current state;
- A program of activities and how it relates to the purpose, objectives, and scope in Section 3;
- Description of the breadth, depth, or focus of the program of activities, including any framework(s) offered;
- The mechanisms and approaches to be used to conduct the program of activities;
- Description of the consortium and how the consortium will address the proposed work; description of the consortium's expertise across Earth science, social/economic/decisions sciences, engagement activities, communications, and other key topics and factors described within;
- Descriptions of the challenges and risks affecting success of the venture, and the approaches to address the challenges and risks.

For proposals to one element of the solicitation, the page limit for this Scientific-Technical-Management section is 15 pages. For proposals to both elements of the solicitation, the page limit for this section is 22 pages. NASA encourages proposal teams to be succinct.

In addition, proposals should have the following discrete subsections in the Scientific-Technical-Management section[9]:

Indicators
This subsection describes the indicators and/or indicator framework proposed to assess and communicate progress toward the objectives.

Anticipated Results/Improvements
This subsection describes the expected outputs, results, and outcomes from the program of activities and proposed work offered in the proposal. The subsection can include metrics for performance.

Consortium Management
This subsection describes the approach used to manage the proposed work and program of activities. Topics might include consortium structure, management arrangements, roles and responsibilities, governance, and other aspects describing how the proposal team plans to organize, coordinate, conduct, review, and adjust its work.

5.4.2 Schedule and Milestones

Proposals should include and describe a schedule for the proposed work and program of activities, including milestones for key elements in the proposed program. The page limit for this section is two pages.

5.4.3 Letters of Reference

As a modification to Section 2.3.9 of the *NASA Guidebook for Proposers,* proposals may, in addition to guidelines in that section, include up to four, one-page letters of reference from

[9] There are no guidelines for page limits for these subsections; proposal teams can determine the space to allocate to these within the page totals for the Scientific/Technical/Management section.

organizations about the proposal team or about the writer's interest in the results. The letters may include input from the community and beneficiaries served by the organizations. All statements or letters must be delivered to the Principal Investigator (PI) and included in the proposal. Letters sent to NASA Applied Sciences (or delivered after the deadline) will not be considered in the review process.

5.5 Evaluation Criteria: Factors for Section VI(a) of the Summary of Solicitation and Section C.2 of the *NASA Guidebook for Proposers*

In addition to the Key objectives given in Section 3.1, the evaluation criterion "relevance" specifically includes the following factors:

- Intent, scope, and plan to advance the articulation of the value and benefits of Earth observations and their application in decision making and associated actions;
- Intent, scope, and plan to include an array of Earth observations, themes, and decision types;
- Intent, scope, and plan to advance cross-disciplinary connections and collaborations;
- Impact Assessment element: Intent, scope, and plan to advance impact assessments, methodologies, and analytic techniques (especially quantitative ones);
- Community Outreach element: Intent, scope, and plan to build Earth science community awareness, capacity, and familiarity with impact analysis concepts and techniques.

In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion "intrinsic merit" specifically includes the following factors:

- Likelihood for potential, demonstrable impact to the state of practice and community capabilities;
- Quality, creativity, and adequacy of the proposed work and the program of activities;
- Quality and adequacy of proposed approaches and mechanisms to conduct the program of activities;
- Quality and adequacy of the proposed breadth, depth, or focus of the program of activities;
- Quality and adequacy of consortium expertise, structure, and arrangements.

In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion "cost realism and reasonableness" specifically includes the following factors:

- Overall approach to manage the project and to achieve stated objectives, and
- Appropriate level of effort to meet the offered objectives cost-effectively.

Cost-sharing and external resource contributions to a consortium are not part of the evaluation criteria and are not included in the peer review scores. However, at the time of project selection, NASA may consider these contributions as one of the factors when deciding between proposals of otherwise equal merit.

NASA may use separate peer review panels for the two elements of the solicitation. NASA will assign proposals to a panel based on the element specified by the proposing team and NASA's assessment of the proposal content. For proposals encompassing both elements, NASA may

assign such proposals to both panels or hold a separate panel. While NASA expects to select a proposal in each element, NASA reserves the right to select proposals in none, one, or both elements depending on the nature and distribution of proposals received and the outcome of the peer review process. NASA will notify all proposers of the outcome of the evaluation process.

5.6 Award Reporting Requirements: Changes to Section VII(c) of *the Summary of Solicitation*

If a team of organizations or subcontractors exist, consolidated project reports, including financial records, must be submitted and are the responsibility of the lead organization. The proposed budget should provide for these reporting requirements.

The awardee(s) will be responsible for timely maintenance (via an online system) of information, status updates, highlights, and milestone achievements. NASA will coordinate with the PI at the time of the award to provide the necessary information for the online system.

During award negotiation, NASA representatives will discuss methods, including electronic reporting, to transmit the reports and presentation packages. The NASA Shared Services Center (NSSC) will also solicit and archive the annual progress reports and final report.

The following reports are required of the awardee(s). The specific reporting requirements will be laid out in the cooperative agreement.

- Quarterly Summary

The awardee(s) will produce brief written reports on a quarterly basis. These brief reports should provide a summary of activities from the past quarter; key highlights and achievements; progress or adjustments to milestones; major activities, events, and milestones in the next two quarters; and issues, problems, risks, and plans of action to address them. Key members of the team may have a quarterly telecon with an Applied Sciences Program representative to discuss the quarterly report and any actions to be taken.

- Annual Progress Report

The awardee(s) will produce an annual written summary of its activities, using information from the quarterly summaries and additional materials to highlight achievements for the year and changes in plans. The Applied Sciences Program will post a version on its website and will incorporate information into its own Annual Report. (Note: This item satisfies the requirement for Annual Progress Reports in Appendix D of the *Guidebook for Proposers*) The Program may request a virtual presentation of the annual summary.

- NASA Outreach and Inreach

Periodically, the Applied Sciences Program and Earth Science Division request information about projects, achievements, and key events to support communications and outreach both internal and external to NASA. The awardee(s) is expected to support such requests and should budget for these accordingly.

- Engagement Materials and Publications (Community Outreach)

As the scope includes significant engagement, capacity building, and communications activities, these activities may require and involve specialized materials, examples, briefings, articles, and other items. The team is expected to produce articles for popular, grey, or scholarly/refereed/peer literature. By the end of each calendar year, the team will provide an annotated timeline of activities, a set of materials, and a compiled list of publications directly associated with the award from the prior year.

- Literature Review and Publications (Impact Assessment)

On a semiannual basis, the awardee(s) will produce an annotated bibliography of all relevant publications (scholarly, grey, popular literature) from the previous half year.

The team is expected to produce articles for scholarly, grey, and popular literature. By the end of each calendar year, the team will provide a compiled list of the publications directly associated with the award from the prior year.

- Applied Sciences Program Reviews

Applied Sciences conducts program-wide reviews six times a year to review status, progress, achievements, and financial situations within the applications areas, capacity building, and selected projects. The awardee(s) is expected to provide information on request to support the program reviews where this venture is covered, which is planned to occur twice a year. If desired, a representative from the team can participate (physically or virtually) in the program reviews.

- Annual Results Event

Awardee representative(s) should plan to travel and participate in one Program-sponsored results workshop/conference per year. The Applied Sciences Program will coordinate this activity with the awardee(s) during the course of the project; the proposal teams should budget accordingly to attend these annual events. (While the location will likely rotate, teams can use Washington, D.C., as a domestic location for budgetary purposes.)

- Final Report

The Final Report summarizes the overall activities of the award, including achievements, progress, impacts, smart practices, findings and conclusions, remaining issues to address, and other information to provide an appropriate documentation of the award. The report should also explain any variations in the anticipated results and a discussion of major problems (technical or other). The report should describe the state-of-practice at the end of the venture, and it should include lessons learned and recommendations. (Note: This final report, with the additions mentioned, is the same item referred to in Appendix D of the Guidebook for proposers) The Program may request a presentation of the report, findings, recommendations, and achievements.

6. Summary of Key Information

Expected program budget	See Section 4
Number of new awards pending adequate proposals of merit	1-2

Maximum duration of awards	5 years (3 years plus 2-year extension option)
Due date for Notice of Intent to propose (NOI)	January 22, 2016.
Due date for proposals	March 24, 2016.
Planning date for start of investigation	August 1, 2016
Page limit for the central Science-Technical-Management section of proposal	15-22 pp; see Section 5.4 of this document
Relevance to NASA	This program is relevant to the Earth science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-SEB
NASA point of contact concerning this activity	Lawrence Friedl Applied Sciences Program Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-7200 E-mail: kathryn.a.carroll@nasa.gov Submit all e-mail inquiries with "ROSES SEB Inquiry" in the subject line and cc LFriedl@nasa.gov.

A.46 HEALTH AND AIR QUALITY APPLIED SCIENCES TEAM

NOTICE: Amended on December 11, 2015. This amendment releases a new opportunity in this Program Element. Notices of Intent (NOIs) to propose are requested by January 14, 2016 and proposals are due March 11, 2016.

Overview

The NASA Earth Science Division (ESD) Applied Sciences Program seeks proposals to form a Health and Air Quality Applied Sciences Team (H-AQAST). This team will apply Earth observations to improve and develop decision-making activities and enable transition and adoption by public- and/or private-sector organization(s) for sustained use in decision making and services to end users in the areas of public health and air quality.

This team will focus on specific applications and demonstrations required to advance the health and air quality management communities' uses of Earth science observations and models in decision making. An emphasis of the team is on responsiveness to managerial and end user needs, as well as pursuit of multiple applications of varied durations. Awardees will receive baseline funding to be a team member; a separate amount, representing a significant portion of funds overall, will be allocated to team members for "tiger team" projects during the course of the H-AQAST.

1. Scope of Program

1.1 Applied Sciences Program Objectives

The ESD Applied Sciences Program promotes efforts to discover and demonstrate innovative and practical uses of Earth observations. The Program funds applied science research and applications projects to enable near-term uses of Earth observations, formulate new applications, integrate Earth observations and related products in practitioners' decision-making, and transition the applications. The projects are carried out in partnership with public- and private-sector organizations to achieve sustained uses of and sustained benefits from the Earth observations[1]. For more information visit the Applied Sciences Program website at http://AppliedSciences.NASA.gov/.

The Program supports projects that develop and demonstrate improvements to decision-making from the use of an array of Earth observations and related products. The Program considers that Earth observations broadly include a range of products and capabilities, including Earth-observing satellite measurements (NASA in-orbit and planned satellites, as well as foreign, commercial, and other U.S. Government satellites), outputs and predictive capabilities from Earth science models, algorithms, visualizations, knowledge about the Earth system, and other geospatial products. Hereinafter, this set is referred to collectively as "Earth observations."

[1] Examples include companies, humanitarian organizations, regional associations, international organizations, Government agencies, multinational financial institutions, philanthropic institutions, tribal organizations, and not-for-profit organizations.

The Applied Sciences Program has three primary lines of business: Applications, Capacity Building, and Satellite Mission Planning. The Applications themes include four of the nine societal benefit areas (SBA) of the international Group on Earth Observations (GEO): Health (including Air Quality), Disasters, Ecological Forecasting, and Water Resources.[2] In addition, there is a cross-cutting Wildfires theme and an initiative on Food Security. The Program includes the impacts from a changing climate within each of these topics.

The Capacity Building program improves the ability of individuals and institutions in the United States and abroad, especially in developing countries, to access and apply Earth observations. The program includes three elements: ARSET training sessions for professionals; DEVELOP for workforce development and short-term applications projects; and SERVIR for applications in developing countries (joint with the United States Agency for International Development).

1.2 Health and Air Quality Applications Area

The Health and Air Quality applications area is managing this solicitation. This application area supports the use of Earth observations in air quality management and public health, particularly regarding infectious disease and environmental health issues. The area addresses issues of toxic and pathogenic exposure and health-related hazards and their effects for risk characterization and mitigation. The area promotes uses of Earth observing data and models regarding implementation of air quality standards, policy, and regulations for economic and human welfare. The Health and Air Quality Applications area also addresses effects of climate change on public health and air quality to support managers and policy makers in their planning and preparations.

The Health and Air Quality applications area website is available at http://appliedsciences.nasa.gov/programs/health-air-quality-program.

2. Purpose and Scope of Solicitation

The objective of this solicitation is to select a Health and Air Quality Applied Sciences Team (H-AQAST). The Health and Air Quality area supports the formation of this team to execute projects on specific applied topics and demonstrations required to advance the health and air quality management communities' sustained use and application of Earth science observations and models in decision making.

This solicitation is a partial follow-on to the Air Quality Applied Sciences Team (AQAST) competed in ROSES 2009. The vast majority of AQAST grants expire in summer 2016 and will not be re-competed. H-AQAST will build on the lessons and successes of AQAST. While many elements of H-AQAST will be similar to AQAST, specific topics will differ. H-AQAST will address topics at the intersection of the health and air quality communities, but will also address issues unique to each community.

[2] The nine GEO SBAs are: Agriculture, Biodiversity, Climate, Disasters, Ecosystems, Energy, Health, Water, and Weather.

2.1 Team Purpose

The H-AQAST will be expected to connect Earth observations and related products with health and air quality management issues, challenges, and decision-making through 1) active partnerships with health and air quality managers with deliverables/outcomes; 2) self-organization of team members to respond quickly to end user needs; and 3) flexibility in how the team allocates resources. Overall, the team will use multiple satellite observations, especially multisensor fusion products, to better connect research knowledge and results with health and air quality activities of Government agencies, businesses, and other organizations.

Objectives of the H-AQAST team include:

- Broaden and deepen the awareness, familiarity, and use of Earth observations by the health and air quality communities;
- Deliver applications and test proofs-of-concept for possible applications;
- Deliver prototypes, activities, demonstrations, etc. that support and complete the transition of applications to operational and end-user organizations;
- Provide technical feedback on Earth observations (especially NASA products) from applications-oriented perspectives and end users in health and air quality communities;
- Identify and/or develop new data products with strong applications and applied research potential;
- Integrate expertise on natural sciences, engineering, data systems, social sciences, and human factors to enable applications to organizational decision making;
- Showcase innovative uses of Earth observations to improve decision-making and environmental health outcomes; and
- Articulate specific applied needs and actual or possible societal benefits stemming from research and applications.

2.2 Team Scope and Composition

This team will focus on specific applied topics required to advance the health and air quality management communities' use and application of Earth observations decision making. The H-AQAST team will conduct new, focused applied science activities on emerging and urgent needs in the health and air quality communities.

The team-generated applications can use all relevant NASA satellite mission observations and can include data products from non-NASA satellites, including foreign satellites. The team will coordinate with other, competitively-selected projects within the Health and Air Quality area's portfolio. The team will likely interact with appropriate mission science teams and with the ESD Research and Analysis Program's science focus areas, such as the Atmospheric Composition science focus area.

The collective composition of the H-AQAST team is expected to include to Earth science researchers, modelers, and applications specialists as well as representative experts of the environmental health and air quality communities, such as epidemiologists, statisticians, social

scientists, public health officers, atmospheric modelers, air quality forecasters, and air quality policy and regulatory managers. The team will be led by a single Team Leader (see Section 3.3).

Members are expected to have a high level of scientific and technical capability in an applicable area and/or have significant expertise on environmental health and/or air quality management and policy topics. Suggested areas and topics include:

- Regional atmospheric chemical and transport modeling capability as applied to environmental health and air quality issues, including air quality forecasting;
- Emissions and emissions inventory evaluation and improvement;
- Technical aspects of national and international environmental health and air quality policy, including long range transport; air quality management approaches in the U.S. and other countries; evolving policy needs arising from interactions among air pollution, health, and climate change; and the national and international organizations that address these issues;
- Assessment of the information content of satellite observations by comparisons with data from other satellite sensors, calibration/validation activities, and well-calibrated existing ground-based sensors;
- Environmental health and air quality trends, regulatory compliance, policy analysis, policy efficacy, and accountability;
- Issues of toxic exposure and health-related hazards and their effects for risk characterization and mitigation;
- Urban heat islands and their impact on air quality and health;
- Epidemiology;
- Other environmental health issues, policies, and impacts (e.g., particulate matter, ozone, wildfires, controlled burns, etc.).

Note: The Health and Air Quality applications area portfolio includes projects on vector-borne and infectious diseases, as well as on water quality; however, the H-AQAST is not expected to address these topics.

2.3 Team Structure

The structure of the H-AQAST will be composed of team members and "tiger teams," which are made up of groups of team members. The tiger teams will conduct ad hoc projects of mixed duration and size to address the priority needs identified through H-AQAST engagement with end users. The intent is to provide for agile, rapid, short-term action on emerging needs. These tiger team projects provide flexibility for coordinated efforts to advance systematic, sustained use of Earth observations in the health and air quality communities.

The members of the team will be funded at a baseline level, with additional, supplemental funds available for the tiger team activities (see Section 3.2). Tiger team proposals will be reviewed by members of the health and air quality communities and other subject matter experts. A slate of tiger teams will be recommended by the Team Leader to the Health and Air Quality area Program Manager. The Program Manager will review these inputs and then present his recommendations to the ESD Steering Committee for final approval. Team members, especially

through the tiger teams, will work in collaboration with end users and managers from the health and/or air quality communities.

3. Programmatic Information

This Section provides information about the expectations of team members (3.1), budget and eligibility (3.2), team leadership (3.3), content to include in a proposal (3.4), as well as other suggestions (3.5).

3.1 H-AQAST Team Members

The H-AQAST team is expected to consist of 13 to 15 members whose expertise collectively spans aspects addressed in Section 2.2. The Principal Investigator (PI) of each selected project will serve as sole official member of H-AQAST; however, the PI is welcome to include other individuals (e.g., Co-Investigators (Co-Is), collaborators, graduate students, postdoctoral students) in his/her proposal to support the PI's roles, duties, and contributions to the H-AQAST. Team membership is for a period of three (3) years.

Team members will be expected to:

- Work with managers in the health and air quality communities to assess priority needs and issues;
- Translate and interpret research knowledge to managers and end users to assist in applications and developing solutions to current and future challenges;
- Maintain knowledge of research progress by the Earth science community related to the team's activities;
- Maintain knowledge on emerging and continuing management and policy issues in health and air quality for possible opportunities for applied research and applications;
- Provide information to NASA on a variety of technical matters associated with health and air quality measurements, instruments, algorithms, data products, etc.; and
- Participate in technical interchange meetings, Health and Air Quality Applied Sciences Team meetings (planned semiannually), relevant science team meetings, and more frequent teleconference calls (proposers should budget for ~four domestic trips per year for meetings);

It is expected that the participation at all H-AQAST team meetings and NASA-supported reviews will be by the team member or a named Co-Investigator.

3.2 Budget and Eligibility

Awardees will receive annual baseline funding for their membership on the team; this baseline funding enables the core activities of the team membership. NASA will provide additional, supplemental funds for the "tiger teams." The distribution of tiger team funds is decided postaward. The allocation is based on the nature of the needs, tiger team project focus, required expertise from within the team, and other relevant factors. Individual team members will not necessarily receive equal allocations of the supplemental funds.

The expected annual program baseline budget for awards is approximately $1.75 million. Proposers are strongly encouraged to keep the total cost per investigation to approximately $100,000 - $125,000 per year, depending on the complexity of the proposed effort.[3]

Cost sharing is allowed and encouraged; however, cost sharing is not part of the evaluation criteria. Cost sharing may become a factor at the time of selection when deciding between proposals of otherwise equal overall merit.

The Team will be self-organizing under the direction of the H-AQAST Team Leader (see Section 3.3). The Team will create a prioritized list of additional activities to address needs within the health and air quality community that the Team is qualified to address through the tiger teams. Next, an expert review of tiger team proposals will occur, followed by a recommendation of a slate of teams and topics by the Team Leader, and a review of these inputs by the Health and Air Quality area Program Manager. The Program Manager will then present his recommendations for tiger team topics for final approval of the ESD Steering Committee.

Additionally, the ESD Steering Committee will review the members of each tiger team and the associated budget per team member for final approval. After these actions, the tiger team activities will access additional funding per tiger team per member. It is expected that approximately $1.5 million will be available for these tiger teams in FY 2017; however, these potential funds should not be reflected or addressed in the proposal.

All interested people and organizational sectors are eligible to apply, including academia, private, Government, and nonprofit sectors. Representatives of foreign entities are eligible to propose members on a no exchange of funds basis. Representatives from commercial organizations are eligible and should refer to terms in Section III(a) of the *Summary of Solicitation.*

Representatives from interested Federal Government agencies are expected to be sponsored by their agencies.

3.3 H-AQAST Team Leadership

The H-AQAST team will be led by a Team Leader, who will be selected by NASA from awarded proposers. The Team Leader will organize the Team, track progress by team members and tiger teams, plan and organize and lead the Team meetings, coordinate development of annual Team work plans (coordinated with the Health and Air Quality area program leadership), and report on achievements of the Team's work. The Team Leader will perform in close

[3] This includes NASA civil servant salaries and indirect costs, despite the fact that these costs may not be included in the proposal. (For more information on this, see Section I c of the ROSES Summary of Solicitation and the SARA website at http://science.nasa.gov/researchers/sara/how-to-guide/nspires-CSlabor/). Thus, any NASA civil servant Co-Investigators on proposals submitted by other organizations must share their total costs, including salaries and indirects, with the submitting organization.

association with the NASA Health and Air Quality area program leadership and relevant R&A program scientists.

Proposers may request consideration for selection as the Team Leader, who will receive additional funds for this leadership role. Interested proposers should articulate their qualifications to be Team Leader and their approach to managing the team. The team leader will receive approximately $200,000 - $225,000 per year (baseline plus leadership funds).

3.4 Mandatory Proposal Information

Because of the novel nature of this Applied Sciences team, care should be taken to document the PI's qualifications for membership and additional expertise of his/her proposed group. Investigators will have two main roles on the Team: 1) to pursue baseline activities facilitated through core funding and, 2) to participate in tiger team activities appropriate to their background and expertise.

The proposer should provide evidence of expertise and knowledge in areas highly relevant to the primary scientific goals and related applications activities of the Team. The types of expertise and knowledge desired were listed in Section 2.2; however, appropriate expertise is not limited to the examples given there. All proposers must explain the knowledge and skills they have to offer and why they are important for H-AQAST activities. Proposals should include a section on which aspects of H-AQAST the investigator would be able to help develop and why (i.e., what activities the investigator would pursue with baseline funding). Proposers should articulate their experience with and skill in engaging end-users and managers to identify and successfully address needs. Proposers should include information illustrating their experience, skill, and success with working in team settings.

Proposals should contain a list of references to scientific or technical papers the investigator has published and/or positions held and work conducted that establish her/him as a leader in their area(s) of expertise.

Respondents must also include an additional two-page section titled "Societal Impact," which will be used to clearly identify how the proposed work will complement and improve decision-making activities in the health and air quality communities. The societal impact of the proposed work and planned approaches to qualify or quantify the work's impacts on decision-making should be illustrated.

Proposal budgets must allow for a minimum of two H-AQAST meetings per year, travel to approximately two conferences or symposia per year, particularly ones organized by community end users and any proposed additional travel to meet with end users and managers to address applications and project progress.

3.5 Other Suggestions and Considerations

Within the H-AQAST and the tiger team projects, NASA will strongly encourage the use of visualizations and visualization techniques to illustrate alternative scenarios and support

decision-making activities, so proposers may wish to highlight their ideas and experience with these items. NASA strongly encourages the use of Earth system science models and coupled models (e.g., physical-biological-ecological models) in team activities. Additionally, NASA will encourage the team to consider and use products from recently launched NASA missions, as well as commercial sources, if they meet project requirements.

The public health and air quality communities have developed networks and websites to share information. Proposals are encouraged to utilize these resources to gather information, make contacts to community representatives, understand key needs and issues, understand existing decision support tools, etc. Examples include:

- CDC Environmental Public Health Tracking Network, http://www.cdc.gov/nceh/tracking/;
- American Public Health Association, http://www.apha.org/;
- American Thoracic Society, http://www.thoracic.org/;
- Air and Waste Management Association, http://www.awma.org/Public/;
- Central States Air Resource Agencies, http://www.censara.org/;
- California Air Resources Board, http://www.arb.ca.gov/homepage.htm;
- Western States Air Resources Council, http://www.westar.org/;
- World Health Organization, http://www.who.int/en/;
- Grand Challenges in Global Health, http://www.grandchallenges.org/Pages/Default.aspx;
- Pan American Health Organization, http://www.paho.org/usa/;
- EPA AirNow, http://airnow.gov/.

In addition, the remote sensing and Earth science communities have developed numerous resources to support the application of Earth observations to health and air quality issues. Proposals are encouraged to utilize these resources, as appropriate. Examples include:

- USGCRP Metadata Access Tool for Climate and Health, http://match.globalchange.gov;
- Group on Earth Observations (GEO) Health and Environment Community of Practice, http://www.earthobservations.org/cop_he_henv.shtml;
- American Meteorological Society (AMS) Board on Environment and Health, http://www2.ametsoc.org/stac/index.cfm/boards/board-on-environment-and-health/;
- Interagency Cross Cutting Group on Climate Change and Human Health (part of the US Global Climate Research Program (USGCRP)), http://www.globalchange.gov/what-we-do/climate-change-health;
- NASA Air Quality Applied Sciences Team, http://aqast.org;
- CDC WONDER, http://wonder.cdc.gov/.

4. Proposal Format and Evaluation

All proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the ROSES *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those proposals that violate the rules may be rejected without review.

Proposals will be evaluated by a peer-review panel based on the proposal's relevance, intrinsic merit, and cost. The criteria are given in Section VI of the ROSES *Summary of Solicitation* with the following additions.

In addition to the factors given in Section 1, the evaluation criterion "Relevance" includes the following factors:

- Intent to demonstrate the applicability of Earth observations to address a topic of importance;
- Intent to determine the utility of Earth observations for potentially substantive improvements to health and air quality challenges and decision-making activities;
- Intent to work in a team setting;
- Intent to work with managers and end users to deliver solutions enabled by Earth observations; and,
- Potential societal impact of the project.

In addition to the factors given in the NASA Guidebook for Proposers, the evaluation criterion "Intrinsic Merit" specifically includes the following factors:

- Ability to develop, test, demonstrate, and achieve results in a team setting;
- Ability to apply Earth observations and related products;
- Ability to characterize decision-making activities and needs for improvement; and,
- Ability of teaming across appropriate sectors and areas of expertise with appropriate end user organization(s).

In addition to the factors given in the NASA Guidebook for Proposers, the evaluation criterion "Cost Realism" specifically includes the following factors:

- Overall approach, ability, and level of effort to manage the project and achieve stated objectives; and,
- Overall feasibility of the proposed work to cost effectively meet identified needs.

5. Award Reporting Requirements

Each awarded project will be responsible for periodic maintenance of team activities, status updates, highlights, and milestone achievements. NASA will coordinate with each principal investigator at award to provide the necessary information for the online reporting system.

The following reports in Sections 5.1 and 5.2 will be required of awardees. In cases where teams of organizations or subcontractors exist, consolidated project reports, including financial records, must be submitted by and are the responsibility of the Principal Investigator. The proposed budget should provide for these reporting requirements.

5.1 Tiger Team Reports

A one-page tiger team "quad chart" (format provided after award) with Purpose and Objectives, Approach, a Figure, and Key Milestones will be required at the beginning and end of each tiger team. Additional charts may be requested to summarize progress. Progress is also verbally reported at Health and Air Quality Applied Sciences Team meetings.

5.2 Annual and Final Reports

Annual reports should thoroughly discuss milestones and achievements met in the past year and look forward to project plans and milestones for the coming year, including “tiger team” activities. Annuals should also address any risks to schedule and intended milestones and include information on financial status.

A Final Project Report is required prior to the conclusion of the project. The Final Report should describe how the grant activities met the solicitation requirements and demonstrated an impact on decision-making activities using Earth observations. The report should describe all the tiger team and core activities undertaken by the Principal Investigator over the course of the grant. The report should also include lessons learned and recommendations. The Program may request a presentation of the project report, results, and findings.

NASA, ESD, and the Applied Sciences Program may periodically request information to support outreach efforts, website content, etc. PIs are expected to publish results from their work in peer-reviewed/refereed, trade, and popular literature.

6. Summary of Key Information

Expected program budget for first year of new awards	~ $1.75M; $100-$125K per award per annum
Number of new awards pending adequate proposals of merit	13 to 15 expected
Award duration	3 years
Notices of Intent are requested by	January 14, 2016
Due date for Proposals	March 11, 2016
Planning date for start of investigation	July 1, 2016
Page limit for the central Science-Technical-Management section of proposal	8 pp plus an additional 2pp for "Societal Impact" (see section 3.4)
Relevance to NASA	This program is relevant to the Earth science strategic questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposals via	http://nspires.nasaprs.com/ (help desk available at

NSPIRES	nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-HAQST
NASA point of contact concerning this program	John Haynes Applied Sciences Program Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-4665 E-mail: jhaynes@nasa.gov

A.47 SUSTAINABLE LAND IMAGING-TECHNOLOGY (SLI-T)

NOTICE: This amendment presents a new opportunity in Program Element A.47. Two subelement areas are being solicited: 1) Advanced Technology Demonstrations (ATD) and 2) Technology Investments (TI) activities. Proposers must clearly state if they are proposing to the ATD or TI subelement area. Notices of Intent to propose are requested by January 22, 2016, and proposals are due March 30, 2016. An online question form will be posted and questions and responses will be posted, see Section 2.2. Proposers to this program do not need to submit a data management plan via the NSPIRES cover pages.

1. Scope of Program

1.1 Introduction

Since 1972, Landsat satellites and associated U.S. Government ground processing, distribution, and archiving systems have acquired and made available global, moderate-resolution (15-100m), multispectral measurements of land and coastal regions, providing humankind's longest, consistently processed record of Earth's land areas from space. NASA and the U.S. Geological Survey (USGS) of the Department of the Interior (DOI) fully recognize that this information is a national asset, representing an important and unique capability that benefits many communities, including Federal, state, and local governments; global change researchers; academia; and the private sector. Landsat data provide a consistent and reliable foundation for research on land use change, forest health, carbon inventories, and changes to the Earth's environment, climate, and natural resources – to name but a few. Until recently, however, there has been no enduring, robust, U.S. plan that would assure seamless and continuous acquisition of Landsat-like measurements in future decades.

In 2013, the NRC released a report entitled *Landsat and Beyond: Sustaining and Enhancing the Nation's Land Imaging Program*, which can be accessed on the web at http://www.nap.edu/catalog/18420.html. This report included a number of recommendations regarding the need for establishing a Sustained and Enhanced Land Imaging Program (SELIP).

The July 2014 *National Plan for Civil Earth Observations* states that the nation should "maintain a sustained, space-based, land-imaging program, while ensuring the continuity of 42 years of multispectral information and 36 years of thermal-infrared land-surface information from space, which are unique sources of terrestrial data for understanding land cover change."

In the President's FY 2016 budget request submitted to Congress in February 2015, the Administration detailed a multicomponent "Sustainable Land Imaging" (SLI) program to enable continuity in the acquisition of Landsat-like measurements for at least the next two decades. Components of the SLI program included immediate development of Landsat-9 as a near-copy of Landsat-8, to launch no later than 2023 and possibly as early as 2021; design and implementation of Landsat-10 with mission architecture decisions to be made in 2019-2020 and an expected launch in 2028-2030; and a continuing investment in land imaging-focused technology development. Of particular relevance to this program element, the technology

development program will ensure the timely maturation, evaluation, and eventual infusion of new measurement and processing approaches throughout the multidecadal duration of SLI. NASA has thus initiated a Sustainable Land Imaging – Technology (SLI-T) program to support innovative technology development activities leading to new Landsat-like instruments, sensors, components, and measurement concepts.

1.2 Goals of the Sustainable Land Imaging – Technology (SLI-T) Program

The goals of the SLI-T program are to research, develop, and demonstrate new measurement technologies that improve upon the Nation's current land imaging capabilities while at the same time reducing the overall program cost for future SLI measurements. The SLI-T program seeks to:

- Reduce the risk, cost, size, volume, mass, and development time for the next generation SLI instruments, while still meeting or exceeding the current land imaging program capabilities;
- Improve the temporal, spatial, and spectral resolution of SLI measurements; and
- Enable new SLI measurements that can improve the program's operational efficiency and reduce the overall costs of the Nation's land imaging capabilities.

As discussed in more detail in Section 1.4 below, this program element requests proposals for technology development activities aimed specifically at: (1) demonstrating improved, innovative, full-instrument concepts for potential infusion into the architecture and design of Landsat-10; and (2) development and technical maturation at the component and/or breadboard-level of technologies that have long-term potential to significantly improve future land imaging instruments and systems through substantial architecture changes.

1.3 SLI-T Reference Mission Architecture (RMA)

In this Section, we define a baseline SLI-T Reference Mission Architecture, principally to guide the nearer-term innovative instrument technology developments that represent a major (but not exclusive) part of this program element. The baseline SLI-T reference mission consists of a single spacecraft. The orbit is based upon the current Landsat 8 orbit and assumes a repetitive, circular, Sun-synchronous, and near polar orbit at a nominal altitude of 705 km (438 miles) at the Equator. The system provides a nadir-pointing imaging opportunity for all the 185 km x 180 km scenes identified in the Landsat Worldwide Reference System-2 (WRS-2) grid at least once every 16 days. A description of the Worldwide Reference System-2 (WRS-2) is provided in more detail in the Landsat Data Continuity Mission Landsat Worldwide Reference System-2 (WRS-2) Definition document (# GSFC 427-02-07Revision –Code 427) and is available at http://esto.nasa.gov/files/SLIT2015/WRS2Definition.pdf.

Key performance drivers for the SLI-T RMA include continuation of Landsat data heritage in terms of image quality and compatibility, radiometric accuracies of the data, the spectral and spatial stability of the measurements over time, and the reproducibility of data. The reference mission bands are defined below in Table 1.

Key imaging performance parameters for the SLI-T RMA includes the imaging bands, the spectral, spatial, radiometric, geometric precision, geo-location and cartographic registration

performance. RMA key parameters can be found at:
http://esto.nasa.gov/files/SLIT2015/RMAKeyParameters.pdf.

Table 1: Baseline SLI-T Reference Mission Architecture Bands

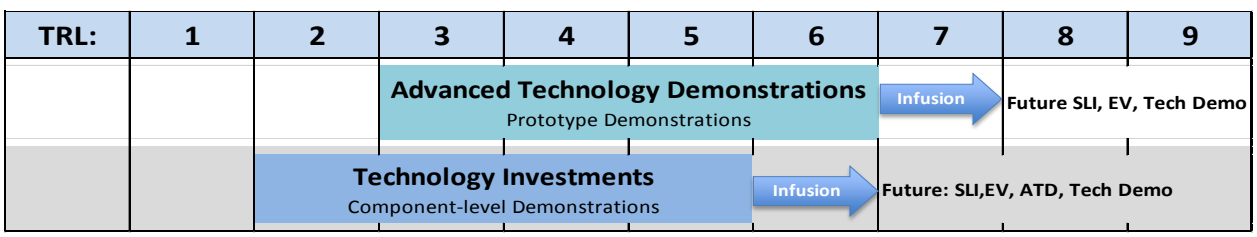
Band Number	Band	Resolution	Wavelengths (nm)
1	Coastal Aerosol	30 m	433 – 453
2	Blue	30 m	450 – 515
3	Green	30 m	525 – 600
4	Red	30 m	630 – 680
5	NIR	30 m	845– 885
6	SWIR 1	30 m	1560 – 1660
7	SWIR2	30 m	2100 – 2300
8	Panchromatic	15 m	500 – 680
9	Cirrus	30 m	1360 – 1390
10	Thermal 1	60 m	10300 -11300
11	Thermal 2	60 m	11500 – 12500

1.4 Proposal Research Topics

Proposals are sought that advance the goals and objectives of Sustainable Land Imaging through technology developments in two subelement topic areas:

1) Nearer-term Advanced Technology Demonstrations (ATD)
2) Longer-term Technology Investments (TI) activities

Table 2: ATD and TI Technology Readiness Level (TRL) Range



1.4.1 *Advanced Technology Demonstrations (ATD)*

The ATD subelement area seeks prototypes or engineering model demonstrations of innovative instrument concepts that meet the objectives of the SLI-T program.

The proposed ATD activities should have an entry Technology Readiness Level (TRL) of 3-6 and result in the development of a prototype and/or engineering model that adequately addresses all critical scaling issues and should be demonstrated in a relevant environment.

1.4.2 *Technology Investments (TI)*

The TI subelement seeks components and/or breadboard demonstrations of instrument technologies that can be infused into future SLI measurement techniques.

Rapid advances in Earth science instrument technology are enabling considerably smaller instruments that may be able to meet many land imaging needs in the future. Rapid evolution of smaller satellites, when combined with increased launch opportunities, opens the possibility for many new approaches to land imaging mission implementation.

The proposed TI activities should have an entry TRL of 2 or higher and result in the validation of a component and/or breadboard in a relevant environment.

2. Preproposal Information

This section provides additional details regarding the activities prior to the proposal due date.

2.1 Notice of Intent to Propose

A Notice of Intent (NOI) to propose is encouraged, but not required, for the submission of proposals to this program element. The information contained in the NOI is used to help expedite the proposal review activities. NOIs shall be submitted electronically via NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) by the due date given in Tables 2 and 3 in the *ROSES Summary of Solicitation*. Late NOIs, as well as indications of intent NOT to propose on an earlier NOI submission, may be submitted by E-mail to the point of contact for this program element, given in Section 7.

2.2 Virtual Q&A Session

An online question form is available online at http://esto.nasa.gov/SLI2015_VBC/ from December 28, 2015 – January 11, 2016. Proposers may submit their questions regarding this solicitation at any point during that window using the online form. Responses will be posted to that website and on the NSPIRES page for this program element under "other documents" by January 15, 2016. Please continue to check these websites periodically in case there are additional questions and answers posted. If there are additional questions and answers posted, a notice to this effect will appear on the NSPIRES page for this program element.

3. Proposal Content

This section provides additional details that govern the proposed activities. The requirements have been tailored to the specific call and supplement the general guidelines announced in the NASA *Guidebook for Proposers Responding to a NASA research Announcement (NRA) or Cooperative Agreement (CAN)* and are incorporated by reference into the ROSES solicitation. This document is hereafter referred to as the *Guidebook for Proposers*. The most recent editions of the *Guidebook for Proposers* may be accessed on the web at www.hq.nasa.gov/office/procurement/nraguidebook/.

The required proposal content follows the format prescribed in the *Guidebook for Proposers*, Section 2.3 except in the case where additional information is needed to supplement this solicitation. Supplemental requirements are noted below (Applicable to both ATD and TI proposals).

3.1 Proposal Summary

NSPIRES requires a proposal summary and enforces our 4000-character limit on the length. The proposal summary includes: (a) objectives and benefits; (b) an outline of the proposed work and methodology; (c) the period of performance; and (d) entry and planned exit TRL.

3.2 Scientific/Technical/Management Section

This section must include the following content information in subsections that use the same titles. Failure to provide any of this material may be cause for the proposal being judged as noncompliant and returned without further review. The Project Description is limited to 20 nonreduced, single-spaced typewritten pages. Standard proposal style formats shall be in accordance with Table 1 of ROSES and Section 2.2 of the *Guidebook for Proposers*. Proposals that exceed the 20-page limit or in any way add extra text by violating formatting rules may be rejected without review.

The Project Description Section includes:

1. Description of Proposed Technology – Provide a description of the proposed new technology. Describe the technical approach and include an operational concept for the proposed technology that shows how it addresses future SLI needs. Discuss any deviations or exceptions to the SLI-T reference mission architecture and mission performance.
2. Applicability to SLI Measurements – Describe the benefits to future SLI missions that utilize the proposed technology and include a one-page relevancy scenario showing how the proposed technology contributes to one or more SLI measurements.
3. Comparative Technology Assessment – Describe the anticipated advantages of this technology compared to those currently in use - e.g., reduction of size, mass, power, volume or cost, improved performance, or enabling of a new capability not previously possible. Reference the current state of the art and relate it to the proposed work.
4. TRL Assessment – Define the starting point for the instrument technology or measurement technique and the exit or success criteria for the proposed activity. If proposed activity duration is for multiple years, advancement of one TRL per year is desirable. TRL definitions can be found at http://esto.nasa.gov/files/TRL.doc. The proposer must substantiate the entry TRL and identify the planned exit TRL in their proposal. Please refer to Table 2 to see the TRL ranges of the ATD and TI sub-elements.
5. Research Management Plan – Proposer must provide a statement of work that concisely describes each task and milestone to be accomplished in the course of the research and development. Define the success criteria associated with each task or milestone. Also include a schedule chart that identifies critical milestones. At least two milestones per twelve-month period must be defined. Subcontracting portions of the research project is acceptable, but overall management and reporting are the responsibility of the proposing organization.
6. Facilities and Equipment – Describe significant facilities and equipment required to complete the work. Before requesting funding to purchase a major item of capital equipment, the proposer should determine if sharing or loan of equipment already available within the proposing organization is a feasible alternative.

7. Special Matters – Proposers should include a brief description of the organization, its facilities, and previous work experience relevant to the proposal.
8. Quad Chart – Provide a Quad Chart as described in section 7.1. This quad chart is not included in 20-page limit for the Project Description Section.

4. Evaluation Criteria

The three basic evaluation criteria are given in the ROSES summary of Solicitation Section VI (a) and Section C.2 of the *NASA Guidebook for Proposers* and they are Relevance, Merit, and Cost. Additional requirements specific and clarifications to SLI-T are listed below.

4.1 Relevance

The basic definition of relevance is the degree to which the proposed investigation specifically supports the objectives of SLI-T program. This includes:

- The potential for the sensor or instrument technology development to reduce cost, size, and development time of future SLI instruments or to enable new SLI measurements. Potential cost reductions should be clearly stated and substantiated to the extent possible, with supporting analysis that indicates scalability;
- The potential of the sensor or instrument technology to be integrated, once matured, into future SLI missions;
- The potential for the sensor or instrument technology development to have commercial benefits.

4.2 Intrinsic Merit

- Feasibility and merit of the proposed technical approach to achieve the technology development objectives;
- Degree of innovation of the proposed technology development concepts and approach;
- Past performance and related experience in the proposed area of technology development;
- Qualifications of key personnel and adequacy of facilities, staff, and equipment to support the proposed activity with a team that has strong technology development and instrument development skills, as well as any leveraging/teaming, such as with recent SBIR awards/awardees;
- Substantiated justification and appropriateness of the entry and exit TRL;
- Feasibility of obtaining the potential reduction in risk, cost, size, and development time, or making the newly enabled measurement, with the proposed sensor or instrument;
- Feasibility of making a demonstrable TRL increase. The TRL must advance at least one level over the duration of the project.

4.3 Cost Realism and Reasonableness

- Adequacy and realism of proposed milestones and associated success criteria;
- Realism and reasonableness of the proposed cost and comparison of costs to available funds;
- Adherence to sound and consistent management practices appropriate to the TRL of the proposed task;

- Commitment of the organization's management to the proposed technology development (evidenced by prior teaming arrangements, etc.). Proposers should identify any previous investment by the organization/program and provide supporting documentation.
- Cost sharing is not part of the cost criteria, but cost sharing may become a factor at the time of selection when deciding between proposals of otherwise equal scientific and technical merit.

5. Award Information

5.1 Funding

The Government's obligation to make award(s) is contingent upon both the availability of appropriated funds from which payment can be made and the receipt of proposals that NASA determines are acceptable for award under this solicitation. No additional funds beyond the negotiated award value will be available. NASA does not allow for payment of profit to commercial firms under grant awards, and few fees are permitted, see http://science.nasa.gov/researchers/sara/faqs/#16 for more information.

If a cost sharing arrangement is proposed, appropriate data rights that recognize the proposer's contributions, as well as the Government's rights to access, will be negotiated prior to award.

5.1.1 *Advanced Technology Demonstration Funding*

The total funding available for the Advanced Technology Demonstration subelement of the solicitation will limit the number and magnitude of the proposals awarded. It is anticipated that a total of three to four proposals will be selected with the value of each to be approximately $1.2 - $1.6 million per year.

5.1.2 *Technology Investment Funding*

The total funding available for the Technology Investment subelement of the solicitation will limit the number and magnitude of the proposals awarded. It is expected that a total of three to four proposals will be selected with the value of each to be approximately $300,000 per year.

5.2 Period of Performance

5.2.1 *Advanced Technology Demonstration Period of Performance*

The period of performance is one year, with options for a second, third, fourth, and fifth year. Proposals must provide clear, measurable milestones for each year of performance in order to warrant continuation in the second, third, fourth, and fifth years.

5.2.2 *Technology Investment Period of Performance*

The minimum period of performance is one year with options for a second and third year. Proposals must provide clear, measurable milestones for each year of performance in order to warrant continuation in the second and third years.

6. Technical Reporting Requirements

The Earth Science Technology Office (ESTO) will provide assistance in managing performance of the awards made under this solicitation. Once awarded, all status information, presentation material, and report deliverables applicable to this solicitation will be submitted to the web-based ESTO Reporting System (ERS). A user account on the ESTO ERS will be provided to the PI upon award. Due to NASA IT security requirements, all PIs must register with Identity Management and Account Exchange (IdMAX) system before a user account on ERS will be established. To create an IdMAX account, some personal information will be required.

The following deliverables are required of awarded proposals. In cases where subcontract arrangements exist, consolidated project reports are the responsibility of the PI. The proposed budget should provide for these reporting requirements. In this context, "Annual" refers to a twelve-month task effort that commences at award.

6.1 Initial Plans and Reports

Within 15 days of award, provide an updated Project Plan, initial Quad Chart, and initial TRL assessment. Provide a monthly obligation and cost phasing plan for the entire period of performance. These documents shall be uploaded to the appropriate locations in the ESTO ERS for this solicitation.

The project plan shall identify all technical, schedule, and resource activities for the proposed life of the project.

The Quad Chart shall contain the following information:

- Upper Left Quadrant: "Objectives"
- Lower Left Quadrant: "Approach" and "Co-Is (Co-Investigators)/Partners"
- Upper Right Quadrant: A visual, graphic, or other pertinent information
- Lower Right Quadrant: "Milestone Schedule" and "Entry TRL."

Proposers are required to update the Quad Chart at least annually and more often, if appropriate. A template is available in the ESTO ERS under "Information" and "File Templates" or the template and example of the quad chart can be downloaded from http://esto.nasa.gov/files/EntryQuad_instructions_template.ppt.

Proposers will provide an initial TRL assessment, and the basis for that assessment, within the critical technology developments of the activity. Proposers are required to update the TRL assessment at least annually, or more often, if appropriate.

6.2 Bimonthly Technical Reports

The bimonthly technical report will focus on the preceding two month's efforts. Each report should address:

1. Technical status: Summarize accomplishments for the preceding two months, including technical accomplishments (trade study results, requirements analysis, design, etc.), technology development results, and results of tests and/or demonstrations.

2. Schedule status: Address the status of major tasks and the variance from planned versus actual schedule, including tasks completed, tasks in process, tasks expected to complete later than planned, and tasks that are delayed in starting, with rationale for each and recovery plans as appropriate.

Proposers should upload their Bimonthly Technical Reports to the appropriate location in the ESTO ERS at two-month intervals, starting on the second-month anniversary date of the start date specified in the award vehicle. In months for which the PI is providing interim or annual review, the requirement for a bimonthly report is superseded by the interim or annual review requirements discussed in the next two sections.

Reports may be submitted in PDF, Microsoft Word, or Microsoft PowerPoint compatible file formats by the required due date, or by close of business of the first workday following the due date if the due date falls on a weekend or a holiday. A teleconference or brief meeting may be conducted between the ESTO and the PI to review and discuss each report.

6.3 Interim Reviews

An Interim Review occurs at the end of the first six-month calendar period commencing from the date of award and at twelve-month intervals thereafter. The PI must provide a presentation summarizing the work accomplished and results leading up to this Interim Review and must:

1. Describe the primary findings, technology development results, and technical status, e.g., status of design, construction of breadboards or prototype implementations, results of tests and/or proof-of-concept demonstrations, and other relevant progress.
2. Describe the work planned for the remainder of the project and critical issues that need to be resolved to successfully complete the remaining planned work;
3. Summarize the cost and schedule status of the project, including any schedule slippage/acceleration. A schedule milestone chart of all major task activities shall be created and maintained and shown at all reviews. A cost data sheet shall be created and maintained, showing total project costs obligated and costed, along with a graphical representation of the project cost profile to completion;
4. Provide a summary of anticipated results at the end of the task; and
5. At the second review and subsequent reviews, address the comments and recommendations prepared by the reviewers participating in the most recent review.

The Interim Review will be conducted via teleconference and uploaded to the appropriate location in the ESTO ERS at least three (3) working days prior to the review. Following the review, the presentation, updated in accordance with comments and discussion resulting from the review, will constitute the Interim Report and be uploaded to the appropriate location in the ESTO ERS within ten days after the review.

6.4 Annual Review

An Annual Review occurs at the end of each twelve-month calendar period commencing from the date of award. The Annual Reviews are similar to the Interim Reviews and include all of the products required at an Interim Review with the following exceptions:

1. The review is held at the PI's facility or a mutually agreed to location.
2. An independent technical reviewer from an organization separately funded by ESTO may participate in the review.
3. The PI may provide a laboratory demonstration, if appropriate, to show technical results and status.
4. Report any educational and outreach components of the project, e.g., graduate degrees, educational activities; technology infusion or patents applied for or granted; journal or conference publications; presentations at professional conferences, seminars and symposia; demonstrations; media exposure; and, other activities that contributed to the overall success of the research project.
5. The Annual Review should be comprehensive, and should cover the progress over the previous twelve months.

The review package will be uploaded to the appropriate location in the ESTO ERS at least three (3) working days prior to the review. The presentation, updated in accordance with comments and discussion resulting from the review will constitute the Annual Report deliverable and be uploaded to the appropriate location in the ESTO ERS within ten days after the review.

6.5 Final Review and Final Report

The Final Review occurs at the completion of the activity. The Final Review is similar to the Annual Reviews and includes all of the products required at an Annual Review. In addition, the Final Review must provide conclusions of the work performed and make recommendations for follow-on activities that should be pursued, with estimates of the cost and schedule to advance the TRL to the next level.

The written Final Report will include the following:

1. Background of the project, including the SLI-related rationale for conducting this technology development;
2. Results of all analyses, element, subsystem, or system designs, breadboards and/or prototyping implementations and designs;
3. Performance analysis results of tests and/or demonstrations; estimation of reduction(s) in size, mass, power, volume and/or cost; improved performance; description of newly enabled capability; and documentation of technology dependencies;
4. Tables, graphs, diagrams, curves, sketches, photographs, and drawings in sufficient detail to comprehensively explain the results achieved;
5. An updated TRL assessment, including a rough order of magnitude cost and a description and estimate of the duration of the follow-on activities necessary to advance the TRL to next level;
6. Updated Quad Chart; and
7. At the end of the period of performance, the PI will provide an Accomplishments Chart which contains the following information (a template is available in the ERS):
   - Upper Left: "Objectives."
   - Upper Right: A visual, graphic, or other pertinent information.
   - Middle: "Accomplishments."
   - Bottom: "Co-Is" (name and affiliation), "Entry TRL" and "Exit TRL."

Please note that the Accomplishments Chart differs somewhat from the Quad Chart required within the proposal content.

The Final Report, updated Quad Chart or Accomplishments Chart, and updated TRL assessment will all be uploaded with the updated Final Review presentation to the appropriate locations in the ESTO ERS within thirty days of the final review.

6.6 Earth Science Technology Forum and Workshops

The awardee is encouraged to participate in the Earth Science Technology Forum (ESTF) if held. The ESTF is an opportunity for NASA planners, managers, technologists and scientists to review the research funded by ESTO. It is also an opportunity for researchers from NASA, academia and industry to meet with their peers and to better understand NASA Earth science requirements.

7. Summary of Key Information

Expected program budget for first year of new awards	ATD: Up to ~$4.8M TI: Up to ~$1.2M
Number of new awards pending adequate proposals of merit	ATD: 3-4 awards TI: 3-4 awards
Duration of awards	ATD: Minimum 1-year / Maximum 5-year awards TI: Minimum 1-year / Maximum 3-year awards
Due Date for Notice of Intent to Propose (NOI)	January 22, 2016. See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for delivery of proposals	March 30, 2016. See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Page length for the central Science-Technical-Management section of proposal	20 pp; see also Chapter 2 of the *NASA Guidebook for Proposers* and Section 3.2 of this solicitation.
Relevance	This program is relevant to the Earth Science questions and goals in the NASA Science Plan; see Table 1 of ROSES and the reference therein. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guideline for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)

Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-SLIT
NASA point of contact concerning this program	Robert Connerton Science Mission Directorate Earth Science Technology Office Telephone: (301) 286-3404 E-mail: Robert.m.connerton@nasa.gov

A.48 UNDERSTANDING CHANGES IN HIGH MOUNTAIN ASIA

NOTICE: Amended on January 7, 2016. This amendment presents a new opportunity in Program Element A.48 Understanding Changes in High Mountain Asia. Because data management plans are part of the main body of the proposal (see Section 3.4) they will not be collected on the NSPIRES cover pages. Notices of Intent to propose are requested by March 7, 2016, and proposals are due April 15, 2016.

1. Introduction

High Mountain Asia (HMA), extending from the Hindu Kush and Tien Shan in the west to the Eastern Himalaya, is the world's largest reservoir of perennial glaciers and snow outside of the Earth's polar ice sheets. The region is home to a range of unique landforms, ecosystems, hazards, and cultures; and HMA supplies water to more than a billion people. Changes in the region's glaciers, snow, permafrost, and precipitation patterns have altered this water supply, while also transforming regional ecology, land utilization practices, and the hazards associated with landslides and glacial-lake-outburst floods.

Satellite remote sensing observations offer the possibility to characterize these changes; gain insight into the Earth system processes that control them; and inform decisions, management actions, and policy development.

2. Scope of Program

This solicitation funds investigations into HMA's glaciers, snow, permafrost, and precipitation to improve our understanding of regional changes, water resources, and induced impacts, while furthering NASA's strategic goals in Earth system science and societal applications. Through expanded knowledge of the processes controlling change in HMA, the program intends to improve regional forecasts and address vulnerabilities in human and biogeophysical systems.

2.1 Requirements

The program has the following requirements of all investigations:

1) Investigations must be based on satellite remote sensing observations, but should, as appropriate, be integrated with *in situ* measurements and models.
2) Every investigation must be framed to contribute to the development or refinement of tools to foster interdisciplinary research, forecast change in the region, and/or support policy development and related work. Tools should be interoperable and will be linked as possible to form a Glacial Melt Toolbox (GMELT).
3) GMELT development and utilization for science, forecasts, and assessments will be enabled by NASA's High Mountain Asia Team (HiMAT). Key investigators associated with each project selected under this solicitation will receive support to participate as members of HiMAT.
4) Understanding and forecasting change in HMA requires the coordinated efforts of a diverse group of scientists. Beyond HiMAT, this solicitation encourages integrative, interdisciplinary proposals from groups of scientists of up to $1M per year.

2.2 Specific investigations

Specific investigations to be supported under this solicitation include, but are not limited to, the following elements:

Earth Science, including:

- Satellite remote sensing studies aimed at better characterizing and understanding the processes controlling change of snow, glaciers, permafrost, precipitation, and ecosystems.
- Modeling of these processes to support Earth science research and regional forecasts.
- Obtaining and developing data sets to understand the underlying causality of change through determination of the specific processes involved, as well as to validate and support process and modeling studies.
- Optimizing high-resolution meteorological models for HMA, preferably spanning the time period from 1980 to the present, aimed at understanding the drivers of change in the glaciers, snow, permafrost, and precipitation of the region.

Improved forecasts, preferably through the development and/or utilization of GMELT tools, to support:

- Hazard mitigation studies for the HMA region, especially:
  a) Improvements to assessments of hazards from melting of snow and ice and permafrost thaw; such as landslides, debris flows, ecosystem and infrastructure impacts, and integrated assessments of cascading hazards.
  b) Improvements to forecasting and predictive tools, including early warnings for glacial outburst floods.
- Policy support studies for the HMA region, especially:
  a) Construction of decision support tools to forecast regional change in water resources over the next 1-100 years.
  b) Application of hazard assessments to support regional planning.

3. Proposal Details and Review information

Proposed research investigations must meet the following criteria, and each of these should be specifically addressed in the proposal:

- Proposals must address at least one of the areas listed—Earth Science, Hazard Mitigation, or Policy Support—and must identify clearly which area or areas are being addressed.
- Proposals must be based on satellite observations, but should include suborbital sensors and *in situ* information, as appropriate.
- Earth science proposals must go beyond creation or correlation of data sets and seek to understand the underlying causality of change through determination of the specific processes involved.
- Hazards and policy proposals must address the targeted end user(s), including their needs, use of the tools, and policies to be impacted.
- Proposals must explain how the research will be integrated into and/or benefit from GMELT tools, and how the tool will be documented to enable use by the broader community.

- Proposals must discuss how the Principal and Co-Investigators (PIs and Co-Is) will work with the HiMAT team for regional forecasts, interdisciplinary research, and integrated development of GMELT.
- Studies that require a focus on small spatial scales, such as specific events or geographic regions, must describe how the results will be made scalable and extensible to the broadest possible areas, timescales, and forecasts.

3.1 GMELT contributions and development

It is expected that all proposals will contribute to or utilize GMELT, which will be comprised of individual tools to assess and forecast change in the water, ice, snow, hazards, and related phenomena in HMA. Tools will be linked as appropriate, but may stand alone.

Proposals for Earth science research should be framed to either develop or contribute to the development or refinement of GMELT, either through quantification of processes to improve models or production of regional data sets and assessments that can be used for tool validation.

Proposers that strictly intend to use tools for hazard mitigation or policy support must develop collaborative relationships with proposers planning to develop tools, but may submit independent proposals.

GMELT will require development and documentation such that all tools can be used independently by the broader community. All investigations that will develop and/or refine GMELT tools must include explicit development and documentation plans in the proposal, including delivery of all relevant codes, algorithms, and documentation to a to-be-selected NASA DAAC, in compliance with NASA standards (https://earthdata.nasa.gov).

3.2 Team Participation, Meetings, and Leadership

PIs and Co-Is on selected proposals will become members of HiMAT. The team will have a range of responsibilities and goals, including:

- Facilitating the collaborative development of GMELT.
- Fostering interdisciplinary Earth system science.
- Utilizing GMELT for improved forecasts of HMA.
- Improving hazard assessments and identification of policy options for HMA.

Proposals must discuss their approach to collaboration within HiMAT, including details on their contributions to GMELT.

All proposals should include in their budget support to attend two meetings of HiMAT each year, one in the continental U.S. and another in Asia (e.g., Kathmandu, Nepal).

3.3 Team Leader

HiMAT will be led by a Team Leader who will facilitate the integration of the team's work; organize, plan, and chair HiMAT meetings; foster regional forecasts; and be responsible for producing a yearly team report. Proposers wishing to serve as Team Leader should state so in their proposal, and are allowed up to two (2) additional pages to describe their qualifications,

interests, and approach to leadership. Team Leader activities should not be included in the proposal budget. Team leaders will receive an additional $80,000 per year to support their leader activities, and the successful proposer will revise their budget during final award negotiations.

3.4 Data Policy

Proposals developing significant datasets must include a data management plan, including delivery to a to-be-selected NASA DAAC in compliance with NASA data standards (https://earthdata.nasa.gov). For investigations that collect new data, proposals must clearly state when the data will be fully released. There will be no period of exclusive use and it is expected that all data collected under this program will be released publicly as soon as possible.

3.5 Fieldwork

This solicitation is intended to support work based on available remote sensing observations and is not intended to support large field deployments to collect new observations. Small field programs to specifically improve the utility of remote sensing observations and/or provide calibration and validation data for models are appropriate, but must be fully justified. Please consider the estimated budget in Section 4. Summary of Key Information in developing work plans, and note that only proposals for up to a $1M per year are encouraged.

Investigators proposing activities involving aircraft must contact Mr. Bruce Tagg, the NASA Airborne Science Program Manager, at Bruce.Tagg@nasa.gov during proposal preparation to discuss aircraft selection and budgeting, to ensure that NASA requirements for airworthiness are met, regardless of whether it is proposed to use NASA-, commercially-, or partner-supplied aircraft. Proposals must include the cost of the flight time for the specified field program for these aircraft in their budget.

3.6 Collaborations and Co-Investigators

Given the broad scope of work required under this solicitation and the unique challenges of HMA, the solicitation is open to collaborative proposals with budgets that are larger than those traditionally supported for a solicitation at this funding level. However, proposers are reminded that the role and necessity for each Co-I must be specifically justified and integrated into the work plan.

3.7 International Collaboration

International collaborations are encouraged, but, as required by law, proposals to this solicitation may not involve collaboration with institutions in China. This includes development, design, planning, promulgation, implementation, or execution in bilateral collaboration with Chinese entities, including participation in the NASA HiMAT team as PIs, Co-Is, or otherwise. However, it is NASA's intention that the progress and results from awards will be presented to parties working on similar issues, including those from the Chinese Academy of Sciences, at periodic meetings held in international locations, such as Kathmandu, Nepal.

3.8 Review Details

NASA may have separate peer review processes and panels for each element in Section 2.2, and proposals will be assigned to one or more panels based on NASA's assessment of proposal content. While NASA expects to select proposals in each of these elements, NASA reserves the right to select proposals in none, some, or all of these depending on the nature, quality, and distribution of proposals received.

4. Summary of Key Information

Expected program budget for first year of new awards	~ $3.5M per year
Number of new awards pending adequate proposals of merit	~12
Maximum duration of awards	3 years
Due Date for Notice of Intent to Propose (NOI)	March 7, 2016
Due date for delivery of proposals	April 15, 2016
Planning date for start of investigation	August 1, 2016
Page length for the Science-Technical-Management section of proposal	15 pages; see also Chapter 2 of the *NASA Guidebook for Proposers*. Note: Proposals with a team leader section are allowed an additional two pages
Relevance to NASA	This program is relevant to the Earth science strategic goals and sub-goals in NASA's *Strategic Plan*; see ROSES Table 1 and the references therein. Proposals that are relevant to this program are, by definition, relevant to
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguide book/.
Submission medium	Electronic proposal submission is required; no hardcopy is required or permitted. See also Section IV of the *ROSES Summary of*
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-HMA

Main NASA point of contact concerning this program	Thomas Wagner Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-4682 E-mail: thomas.wagner@nasa.gov

General questions about the Program should be directed to the point of contact above by email. Questions about specific sub-elements should be directed to those listed below by email.

NAME	PROGRAM RESPONSIBILITY	TELEPHONE	E-MAIL
Nancy Searby	Policy Support	(202) 358-0245	nancy.d.searby@nasa.gov
David Green	Hazard Mitigation	(202) 358-4682	david.s.green@nasa.gov
Jared Entin	Earth Science, Hydrology and Snow	(202) 358-0275	jared.k.entin@nasa.gov
Thomas Wagner	Earth Science, Glaciers	(202) 358-4682	thomas.wagner@nasa.gov

APPENDIX B. HELIOPHYSICS RESEARCH PROGRAM

B.1 HELIOPHYSICS RESEARCH PROGRAM OVERVIEW

1. Overview

NASA's heliophysics strategic objective is to understand the Sun and its interactions with the Earth and the solar system, including space weather. The Heliophysics Research Program is focused on achieving the goals as defined in the *NASA Science Plan* (available at http://nasascience.nasa.gov/about-us/science-strategy) and the 2013 Heliophysics Decadal survey (Solar and Space Physics: A Science for a Technological Society www.nap.edu/catalog.php?record_id=13060). Heliophysics research addresses these recommendations by implementing a program to achieve three overarching science goals:

- Explore the physical processes in the space environment from the Sun to the Earth and throughout the solar system
- Advance our understanding of the connections that link the Sun, the Earth, planetary space environments, and the outer reaches of our solar system
- Develop the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth

The program supports investigations in all subdisciplines of Heliophysics and also supports investigations that span the subdisciplines and address a systems approach — emphasizing the understanding of fundamental processes and interconnections across the traditional science disciplines. The program seeks to characterize these phenomena on a broad range of spatial and temporal scales, to understand the fundamental processes that drive them, to understand how these processes combine to create space weather events, and to enable a capability for predicting future space weather events. In concert with the other NASA science divisions (Planetary Science, Astrophysics, and Earth Science), the Program shares responsibility for learning about the Earth, our solar system, the universe, and their interrelationships.

The program supports investigations of the Sun, including processes taking place throughout the solar interior and atmosphere and the evolution and cyclic activity of the Sun. It supports investigations of the origin and behavior of the solar wind, energetic particles, and magnetic fields in the heliosphere and their interaction with the Earth and other planets, as well as with the interstellar medium. The program supports investigations of the physics of magnetospheres, including fundamental interactions of plasmas and particles with fields and waves, and coupling to the solar wind and ionosphere. It supports the physics of the terrestrial mesosphere, thermosphere, ionosphere, and auroras, including the coupling of these phenomena to the lower atmosphere and magnetosphere.

The program elements are as follows:

- B.2 Heliophysics Supporting Research (H-SR)
- B.3 Heliophysics Technology and Instrument Development for Science (H-TIDeS)
- B.4 Heliophysics Guest Investigators (H-GI)
- B.5 Heliophysics Grand Challenges Research (H-GCR)
- B.6 Heliophysics Living With a Star Science (H-LWS)

- B.7 Heliophysics Infrastructure and Data Environment Enhancements (H-IDEE)

It is the overall objective of each of the program elements to contribute as effectively and directly as possible to the achievement of NASA Heliophysics strategic goals. Priority for selection is given to those proposals that most clearly demonstrate the potential for such contributions.

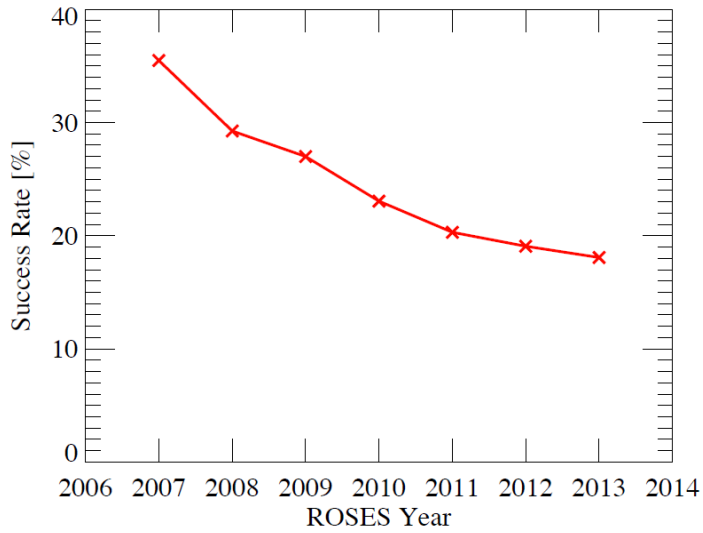
All proposals to Appendix B will have to address data management. For all programs but B.7 H-IDEE proposers must present a data management plan (DMP) or an explanation of why one is not necessary given the nature of the work proposed by responding to the compulsory NSPIRES cover page question about the DMP. The kinds of proposals that require a data management plan on the cover pages are described in the NASA Plan for increasing access to results of Federally funded research and in the SARA FAQs for ROSES. For proposers to B.7 H-IDEE the minimum DMP requirement is superseded by instructions in the program element that place more detailed descriptions into the body of the Scientific/Technical/Management section of proposals. See, Sections 2.2 and 2.3 of B.7 H-IDEE.

Proposal submission to all elements in Heliophysics will continue using a two-step process, in which the Notice of Intent is replaced by a required Step-1 proposal. The title and investigators cannot be changed between the Step-1 and Step-2 proposals. All Heliophysics programs will continue reviewing Step-1 and/or Step-2 proposals for compliance. Step-1 proposals for H-TIDeS, H-IDEE, and H-LWS will continue to require a description that is limited to one page of science goals and objectives and of the proposed methodology. All compliant proposals submitted to these calls will be invited to submit a Step-2 proposal. H-GI and H-SR require submission of Step-1 proposals that are up to three pages in length. Proposers to H-GI and H-SR are limited to one Step-1 proposal per Principal Investigator (PI) per program element, i.e., they can submit one and only one proposal as PI to each. The H-GI and H-SR Step-1 proposals will be reviewed for the importance of the science, feasibility of the methodology, and likelihood of success by a combination of unconflicted mail-in reviewers from the science community and NASA Headquarters personnel, and will result in encouragement or discouragement to submit a full proposal.

1.1 Recent Trends in Proposal Selection Rates

The Heliophysics research budget that is competed through ROSES continues to experience high demand through increased numbers of proposals submitted by the community. At the same time, funding for Heliophysics research has not kept up with inflation. ROSES-2014 proposal submission, however, is down by ~26% as compared to ROSES-2013, a possible combined result of sustained low success rates in recent years, expanded use of the encourage/discourage review process in Step 1, and one less solicited program overall (H-GCR) in ROSES-2014, which was fully subscribed. The number of active missions of the Heliophysics System Observatory (HSO) has increased through recent successful launches and the longevity and ongoing high productivity of the missions in extended operations phase. As a result, the success rate of proposals submitted to the ROSES portfolio that Heliophysics offers has seen near-constant decline.

Figure 1, at right, shows the decrease of proposal selection rates over the ROSES years 2007-2013 (FY 2008-2014). Only full proposals (as compared to Step-1 proposals) are included in the selection rate.



2. Program Elements

A brief description of each program element offered in the Heliophysics Research Program is given below. Note that the program elements underwent major restructuring between ROSES-2012 and ROSES-2013. The ROSES-2013 structure is generally maintained in ROSES-2015, but there are minor changes. The intent of these summaries is to give the prospective proposer some insight into the element's purpose within the context of the overall program structure. Detailed descriptions of each element are to be found in Program Elements B.2 through B.7.

Heliophysics Supporting Research (H-SR):

Heliophysics SR awards are small focused individual research investigations that employ a variety of techniques, including theory, numerical simulation, modeling, analysis, and interpretation of space data. The investigations that will be of highest priority to the Heliophysics SR program will be those that use data from current or historical NASA spacecraft, together with theory and/or numerical simulation to address one of the four Heliophysics Decadal Survey goals. Heliophysics SR supports investigations of the solar interior, solar photosphere, solar chromosphere, transition region, and corona; particle acceleration, transport, modulation in the heliosphere, heliospheric plasma processes, turbulence, waves, composition, and outer heliosphere and the interstellar boundary investigations; solar wind – magnetosphere coupling, dayside outer magnetosphere, inner magnetosphere, magnetosphere-ionosphere coupling and magnetotail; ionosphere – atmosphere coupling, neutral atmosphere and solar output-ionosphere/atmosphere coupling; and other planetary magnetospheres. The Heliophysics Supporting Research program is described in Program Element B.2.

Heliophysics Technology and Instrument Development for Science (H-TIDeS):

The H-TIDeS program solicits proposals for technology and instrument development investigations that are relevant to NASA's programs in Heliophysics. The H-TIDeS program seeks to investigate key Heliophysics science questions by addressing the best possible (i) science and/or technology investigations that can be carried out with instruments flown on suborbital sounding rockets, stratospheric balloons, International Space Station (ISS), CubeSats,

or other platforms; (ii) state-of-the-art instrument technology development for instruments that may be proposed as candidate experiments for future space flight opportunities; and (iii) laboratory research.

The H-TIDeS program element has three components:

Low Cost Access to Space (LCAS) investigations may be science investigations in and of themselves or proof-of-concept experiments for techniques/detectors that enable new Heliophysics science. LCAS includes rides on research balloons, sounding rockets, the ISS, commercial reusable suborbital rockets, and CubeSats. LCAS investigations that launch into space in order to return scientific data are expected to make direct contributions to the science of Heliophysics.

Instrument and Technology Development (ITD) investigations have as their objective the development of instrument technologies that show promise for use in scientific investigations on future Heliophysics science missions, including the development of laboratory instrument prototypes, but not of flight hardware. Instrument development proposals are not necessarily expected to apply the results of their efforts to science questions within the time period of the proposed effort. They must, however, demonstrate that there are specific scientific problem(s), for which the development is a necessary precursor.

The Laboratory Nuclear, Atomic, and Plasma Physics (LNAPP) subelement supports studies that probe fundamental plasma physical processes and produce chemical, spectroscopic, and nuclear measurements that support spacecraft measurements and atmospheric models.

The Heliophysics Technology and Instrument Development for Science program with subelements Low-Cost Access to Space (LCAS), Instrument and Technology Development (ITD), and Laboratory Nuclear, Atomic and Plasma Physics (LNAPP) are described in Program Element B.3.

Heliophysics Guest Investigators (H-GI):

The Heliophysics Guest Investigators (H-GI) program, which was strongly endorsed by the 2013 Decadal Survey, is offered for investigations that draw extensively upon the data sets from the missions of the Heliophysics System Observatory. The focus of the solicited research continuously evolves to ensure that the most important questions identified for recently launched Heliophysics missions are addressed and that high-value data products of currently operating missions of the HSO are created to enable significant advances in Heliophysics science. The Heliophysics Guest Investigators program is described in Program Element B.4.

Heliophysics Grand Challenges Research (H-GCR):

The Heliophysics Grand Challenges Research (H-GCR) program serves as a placeholder for future larger research efforts or Heliophysics science centers as recommended in the 2013 Decadal Survey. All Heliophysics Theory, Modeling, and Simulations (H-TMS) funds have been competed in ROSES-2013, so there is no H-GCR solicitation in ROSES-2015. Program Element B.4 is a placeholder for future H-GCR solicitations.

Heliophysics LWS Science (H-LWS):

The goal of NASA's Living With a Star (LWS) Program is to develop the scientific understanding needed to effectively address those aspects of Heliophysics science that affect life and society. To ensure this, the Heliophysics LWS Science program solicits proposals for Focus Teams which coordinate large-scale investigations that cross discipline and technique boundaries leading to an understanding of the system linking the Sun to the Solar System both directly and via the heliosphere, planetary magnetospheres, and ionospheres.

A primary goal of NASA's LWS Program is the development of first-principles-based models for the coupled Sun-Earth and Sun-Solar System, similar in spirit to the first-principles models for the lower terrestrial atmosphere. Such models can act as tools for science investigations, as prototypes and test beds for prediction and specification capabilities, as frameworks for linking disparate data sets at vantage points throughout the Sun-Solar System, and as strategic planning aids to enable exploration of outer space and testing new mission concepts. Strategic Capabilities are the development and integration of such models for all the various components of this system. The LWS Science - Strategic Capability subelement will not be competed in ROSES-2015. The Heliophysics LWS Science program is described in Program Element B.6.

Heliophysics Infrastructure and Data Environment Enhancements (H-IDEE):

Progress in space science is sparked by the synthesis of ground- and space-based observations and open data access. It is essential that observations be properly recorded, analyzed, released to the general public, documented, and rapidly turned into scientific results. Heliophysics Infrastructure and Data Enhancement investigations support ground-based observational facilities that openly provide observations in support of Heliophysics space missions, and they extend data services necessary for the conduct of Heliophysics research. This program has two main subelements: Data Environment Enhancements and Infrastructure. However, the Infrastructure element is not being competed in ROSES-2015. Proposers should take into account the special needs driven by the increasing complexity of missions, the associated increasing complexity and volume of data, and the need for innovative and enabling technologies. For proposers to B.7 H-IDEE there will be no NSPIRES cover page question about a data management plan. This is superseded by instructions in the program element that place more detailed descriptions into the body of the Scientific/Technical/Management section of proposals. See, Sections 2.2 and 2.3 of B.7 H-IDEE. The Heliophysics Infrastructure and Data Environment Enhancement program is described in Program Element B.7.

B.2 HELIOPHYSICS SUPPORTING RESEARCH

NOTICE: Amended on May 7, 2015. This amendment delays the due date for Step-1 proposals for this program element. Step-1 proposals are now due by May 29, 2015. Step-2 proposals are still due on September 11, 2015.

Proposals to this program will continue to be taken by the two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an Authorized Organizational Representative. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. Step-1 proposals will be reviewed. Some proposers may be discouraged from submitting a Step-2 proposal, while others will be encouraged to submit a Step-2 proposal. See Section 3 for details.

1. Scope of Program

Heliophysics SR awards are focused individual research investigations that employ a variety of techniques, including theory, numerical simulation, modeling, analysis, and interpretation of space data. The Heliophysics Supporting Research program is a component of the Heliophysics Research Program and proposers interested in this program element are encouraged to see the overview of the Heliophysics Research Program in Appendix B.1 of this ROSES NASA Research Announcement.

1.1 Overview

The goal of the Heliophysics Supporting Research (SR) program combines the scientific objectives previously supported in the Supporting Research elements of the Geospace Science program and the Solar and Heliospheric Science program. Heliophysics SR replaces the former supporting research sections entirely.

Laboratory Research, Instrument and Technology Development, and Low Cost Access to Space proposals are not solicited with Heliophysics Supporting Research, but instead under ROSES Program element B.3: Heliophysics Technology and Instrument Development for Science (H-TIDeS).

Science investigations are solicited with this Heliophysics SR program. The investigations that will be of highest priority to the program will be those that a) use data from current or historical NASA spacecraft b) together, with theory and/or numerical simulation to address, c) one of the four Heliophysics Decadal Survey goals (listed below). Investigations that address some but not all (a-c) of the aspects of the highest priority investigations are also solicited and will be supported as resources allow. Examples of investigations in this second category include, but are not limited to, (1) use of numerical simulations alone to address one of the Decadal Survey goals, and (2) use of NASA data and theory to address a science goal outside the Decadal Survey goals. Use of non-NASA data as ancillary data supporting the investigation is allowed but the proposed investigation should not be focused on such data.

The four high level science goals from the Heliophysics Decadal survey (*Solar and Space Physics: A Science for a Technological Society* www.nap.edu/catalog.php?record_id=13060) are:

1. Determine the origins of the Sun's activity and predict the variations in the space environment;
2. Determine the dynamics and coupling of Earth's magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs;
3. Determine the interaction of the Sun with the solar system and the interstellar medium;
4. Discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe.

1.2 Organizing Science Areas

The Heliophysics Supporting Research program has established four broad categories and 13 science areas for the purpose of organizing the evaluation and peer review. The four categories mirroring the four sub-disciplines are Solar, Heliosphere, Magnetosphere, and Ionosphere-Thermosphere-Mesosphere (ITM). The 13 science areas are listed below; some of these science areas fit within more than one broad category. Each proposal must choose one of the four broad categories and one of the 13 science areas.

1. Solar Interior;
2. Solar Transient events;
3. Solar Atmosphere;
4. Particle Acceleration, Transport, Modulation in the Heliosphere
5. Heliospheric Plasma Processes, Turbulence, Waves, Composition
6. Outer Heliosphere and the Interstellar Boundary
7. Solar Wind – Magnetosphere coupling / Dayside Outer Magnetosphere
8. Inner Magnetosphere
9. Magnetosphere – Ionosphere Coupling / Magnetotail
10. Ionosphere – Atmosphere Coupling
11. Neutral Atmosphere
12. Solar Output – Ionosphere/Atmosphere Coupling
13. Planetary Magnetospheres (not Earth)

System science proposals that touch on more than one of these science areas are encouraged; for the purpose of organizing the review, choose the one that is most relevant. The Heliophysics SR program is open to innovative, new investigations within the realm of Heliophysics, as long as they fit within the scope described above.

2. Submission and Evaluation Process

2.1 General Considerations

Each Principal Investigator (PI) is allowed to submit one and only one Step-1 proposal to this program element. In that proposal the Principal Investigator must invest a substantial portion of his/her time, of the order of 10-20%, to the investigation. Co-Investigators (Co-Is) must each have a specific and defined task in the project, and the task must be essential to the completion of

the project. Use of Collaborators is discouraged. Proposals may be declared noncompliant based on either the Step-1 or Step-2 proposal if they are outside the scope of the H-SR program (see Section 2.2 below) or if they fail to meet submission guidelines specified below (Section 3).

2.2 Limitations and Scope

Proposals outside the scope of Heliophysics Supporting Research include the following:

- Proposals already submitted in whole or major part to other programs in Heliophysics or across the Science Mission Directorate (SMD);
- Proposals whose intent or purpose is to duplicate existing investigations (1) already funded under other Heliophysics or SMD research programs or (2) already funded for approved space flight missions. Currently funded PIs must show how their new proposed effort is different and not duplicative with current awards;
- Model or tool development and/or new data analysis techniques, where this effort constitutes more than one year of a three-year effort;
- The routine, long-term gathering of observational data and investigations with the main purpose of supporting ground-based infrastructure and facilities;
- Proposals requiring the use of Magnetospheric Multiscale (MMS) data are not solicited

3 The Two-Step Submission Process

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process. The overall description of a two-step process can be found in *Section IV. (b) vii* of the ROSES *Summary of Solicitation*.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Tables 2 and 3 in the *ROSES Summary of Solicitation*). The Step-1 proposal must be submitted by the organization Authorized Organizational Representative (AOR). No budget or other elements are required. Only proposers who submit a Step-1 proposal are eligible to submit a full proposal. Full (Step-2) proposals must contain the same scientific goals proposed in the Step-1 proposal. The Step-1 proposal title, Principal Investigator, and all Co-Investigators, Collaborators, Consultants, and Other Professionals cannot be adjusted between the Step-1 and Step-2 proposals. The expected format and evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal later.

3.1 Step-1 Proposal Content

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Step-1 proposal is restricted to three pages in length (references and any other supporting material are not required, but if included must fit within the 3 page limit). The Step-1 proposal must include the following information:

- A description of the science goals and objectives to be addressed by the proposal. The description should include the importance and scientific priority of the proposed investigation's science goals and objectives; the unique value of the investigation to make scientific progress in the context of current understanding in the field, and the importance of carrying out the investigation now.

- A brief description of the methodology to be used to address the science goals and objectives. The description should include the appropriateness of the selected data, models, and analysis for completing the investigation and the feasibility of the methodology for ensuring scientific success.
- A brief work plan that includes major steps to be employed to carry out the work.
- The relevance of the problem to one or more of the four Decadal Survey goals.

The NSPIRES system for proposal submission requires a very brief summary to be entered into the "Proposal Summary" field and it requires a PDF "Proposal Attachment", which should be the Step-1 proposal, as described above.

3.2 Step-1 Evaluation Criteria

Step-1 proposals may be declared noncompliant if they fail to meet submission guidelines specified in Section 3 or if they are outside the scope of the HSR program, as discussed in Section 1. PIs of noncompliant proposals will not be eligible to submit the associated Step-2 proposal and will receive a letter to this effect.

Compliant Step-1 proposals may be reviewed by a combination of un-conflicted mail-in reviewers from the science community and NASA Headquarters personnel looking at the importance of the science, feasibility of the methodology, likelihood of success, and relevance to the program. Given that the number of proposals submitted will likely be far in excess of what can be supported, a portion of the proposers will likely receive a letter discouraging them from submitting a Step-2 proposal. The rest of the proposers will receive a letter encouraging them to submit a Step-2 proposal. Evaluation details will not be provided in either case.

3.3 Step-2 Proposals

A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the *ROSES Summary of Solicitation*). The Step-2 proposal must be submitted via NSPIRES or Grants.gov by the organization Authorized Organizational Representative (AOR). A budget and other specified information is required. The Step-2 proposal title, Principal Investigator, and all Co-Investigators, Collaborators, and Consultants must be the same as those in the Step-1 proposal. Step-2 proposals must contain the same scientific goals proposed in the Step-1 proposal.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. Proposers that received a noncompliant letter are not eligible to submit a Step-2 proposal.

Proposers are strongly encouraged to provide names and contact information of five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is. This information can be supplied via the SARA web page at http://science.nasa.gov/researchers/suggested-reviewers/.

Proposers are expected to provide mail-in reviews for one to three proposals in this competition. Much of the science expertise lies in the PI/Co-I community, because increasingly, nearly the

entire Heliophysics community proposes. In order to maintain a high caliber review process, it is important to get the additional mail-in reviews to cover all proposals fairly.

3.4 Step-2 Proposal Format

Proposers should refer to the PDF entitled "How to submit a Step-2 proposal" that will appear under "Other Documents" on the NSPIRES page for this program after the Step-1 proposal due date. The process for preparation and submission of the Step-2 (full) proposals is that for any other ROSES proposal. Guidelines for content and formatting Step-2 full proposals are specified in the *NASA Guidebook for Proposers* and the *ROSES Summary of Solicitation*.

Proposals should include the following within their Scientific/Technical/Management section: clear descriptions of (1) a specific scientific problem, (2) the importance of the problem, (3) a method of attack on this problem. PIs have the privilege of choosing the science question(s) they wish to address. However, having done so, they are then expected to detail a methodology/science plan that clearly and specifically addresses the chosen question(s). Historically, proposals that are focused on a specific science question have been more successful at constructing methodologies that clearly address a single target question than those that propose to address a large number of science questions or that are directed at a broad science topic, rather than a specific question.

3.5 Step-2 Evaluation Criteria

Step-2 proposals that are not compliant with format requirements may be rejected without review. See Section IV (b) ii of the *ROSES Summary of Solicitation* and the *NASA Guidebook for Proposers* for details. Proposals that have changed the scientific scope from that of their Step-1 proposal may be declared noncompliant.

Compliant proposals will be evaluated according to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*. These criteria are intrinsic scientific and technical merit, relevance to NASA's objectives, and cost realism/reasonableness.

Proposals will be evaluated for scientific and technical merit based on the following:

- Compelling nature and scientific priority of the proposed investigation's science goals and objectives, including the importance of the problem within the broad field of Heliophysics; the unique value of the investigation to make scientific progress in the context of current understanding in the field, and the importance of carrying out the investigation now.
- Appropriateness and feasibility of the methodology, including the appropriateness of the selected data, models, and analysis for completing the investigation and the feasibility of the methodology for ensuring scientific success.

Based on these two factors, the evaluation will consider the overall potential science impact and probable success of the investigation.

Relevance to and priority within the H-SR program will be assessed based on criteria discussed in Section 1. Each proposal must demonstrate that the investigation is relevant and of high priority.

Cost realism/reasonableness includes assessing the amount of work to be accomplished versus the amount of time proposed. Open-ended proposals or those with a large number of science questions to be addressed typically do not fare well in this evaluation. Only necessary Co-Investigators and Collaborators should be included, and their specific tasks and roles in the investigation must be clearly laid out.

4. Available Funds

It is expected that there will be approximately ~$4M available in Fiscal Year (FY) 2016 to support new Heliophysics SR investigations selected through this program element. Annual funding in past programs has averaged ~$125K per investigation, however due to the complexity of these coupled data/modeling/theory investigations, we are encouraging an increase in the proposed level of effort.

5. Award Types

As begun in 2013, the Heliophysics SR program will primarily award funds through three vehicles: (1) grants, (2) interagency transfers, and (3) awards to NASA Centers. The Heliophysics SR program will no longer award contracts. An institution that has received a contract previously can receive funds as a grant by not charging a fee.

6. Summary of Key Information

Expected program budget for first year of new awards	~$4M
Number of new awards pending adequate proposals of merit	~27
Maximum duration of awards	3 years
Due date for Step-1 proposal	**May 29, 2015 [Amended May 7, 2015]**
Due date for full proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after full proposal due date.
Page limit for the central Science-Technical-Management section of full proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Heliophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.

Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Step 1 and Step 2 proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step 1 and Step-2 proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-HSR
NASA point of contact concerning this program for Sun and Heliosphere	Arik Posner Heliophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358 0727 E-mail: arik.posner@nasa.gov
NASA point of contact concerning this program for Magnetospheres and ITM	Elsayed Talaat Heliophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358 3804 E-mail: elsayed.r.talaat@nasa.gov

B.3 HELIOPHYSICS TECHNOLOGY AND INSTRUMENT DEVELOPMENT FOR SCIENCE

NOTICE: Amended June 11, 2015. This amendment makes two changes to this program element: First, it delays the due dates for proposals for this program element. Step-1 proposals are now due June 26, 2015, and Step-2 proposals are now due August 28, 2015. Second, this amendment excludes the EM-1 launch opportunity for CubeSats. The ROSES-2015 Summary of Solicitation states (Section (V)(b)(v), page 29) that "CubeSats are typically launched as secondary payloads to low-Earth orbit or from the International Space Station, but submissions to ROSES-2015 may also propose to launch on Exploration Mission 1 (EM-1) to achieve Earth-escape." Last year in ROSES-2014 the Exploration Mission 1 (EM-1) opportunity was part of the LCAS subset of H-TIDeS. Therefore, no additional proposals targeting the EM-1 launch opportunity are solicited.

Proposal submission to all calls in Heliophysics will be performed by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an Authorized Organizational Representative (AOR). Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. The title, main goals, and investigators cannot be changed between the Step-1 and Step-2 proposals. See Section 3.2 for details.

1. Scope of Program

The Heliophysics Technology and Instrument Development for Science (H-TIDeS) program is a component of the Heliophysics Research Program and proposers interested in this program element are encouraged to see the overview of the Heliophysics Research Program in Appendix B.1 of this ROSES-2015 NASA Research Announcement.

1.1 Overview

The H-TIDeS program combines technology elements previously separated within the old Solar, Heliosphere, and Geospace (Magnetosphere –Ionosphere-Thermosphere-Mesosphere Mag-ITM) Science Supporting Research and Technology programs.

Supporting Research studies are found under ROSES-2015 Program Element B.2 Heliophysics Supporting Research (H-SR). Guest Investigator studies are found under ROSES Program Element B.4 Heliophysics Guest Investigators.

H-TIDeS seeks to investigate key Heliophysics science questions through three separate subelements. These subelements are also established for the purpose of organizing the evaluation and peer review process.

- Low-Cost Access to Space (LCAS): science and/or technology investigations that can be carried out with instruments flown on suborbital sounding rockets, stratospheric balloons, CubeSats, suborbital reusable launch vehicles, or other platforms, collectively referred to as Low-Cost Access to Space (see Section 1.2 below)

- Instrument and Technology Development (ITD): state-of-the-art instrument technology development for instruments that may be proposed as candidate experiments for future space flight opportunities, called Instrument and Technology Development which may be carried out in the laboratory and/or observatory (see Section 1.3 below)
- Laboratory Nuclear, Atomic, and Plasma Physics (LNAPP): laboratory research designated as enabling Laboratory Nuclear, Atomic, and Plasma Physics studies (see Section 1.4 below).

Advancement in Heliophysics science requires the development and application of new technologies that will yield the next generation of innovative instruments. Laboratory research can be a relevant supplement to instrumentation and to the science of Heliophysics. The ability to achieve significant progress toward the scientific and technical challenges in Heliophysics in the coming years is greatly enhanced through the H-TIDeS program.

These studies are carried out in support of NASA's Heliophysics strategic objective "to understand the Sun and its interactions with Earth and the solar system, including space weather." from the *Science Mission Directorate Science Plan for 2014* (http://nasascience.nasa.gov/about-us/science-strategy). The recommended priorities of the Heliophysics community are also discussed in the National Research Council Decadal Strategy for Solar and Space Physics report, *Solar and Space Physics: A Science for a Technological Society* (http://www.nap.edu/catalog.php?record_id=13060).

1.2 Low-Cost Access to Space

The Low-Cost Access to Space (LCAS) component supports science investigations or instrument development that must be completed through suborbital or orbital flights. The LCAS program is expected to continue to lead the way in the development of a large fraction of the instrument concepts for future solar, heliospheric, and magnetosphere-ionosphere-thermosphere-mesosphere (Mag-ITM) missions. Suborbital launch vehicle services include those provided by the NASA Sounding Rocket Program Office (SRPO), the NASA Balloon Program Office (BPO), and commercial suborbital reusable launch vehicle (sRLV) services through the Flight Opportunities Office of the Space Technology Mission Directorate. The Science Mission Directorate also provides for CubeSats and International Space Station payloads.

Proposals for the LCAS program must be for a complete science investigation, including clearly defined scientific goals appropriate for (future) Heliophysics missions, payload construction, launch phase, data analysis, and publication of results. A discussion of the plans for management and for reduction and analysis of the data should be given.

LCAS-class investigations provide unique opportunities not only for executing intrinsically meritorious science investigations, but also for advancing the technology readiness levels of future space flight detectors and supporting technologies and for preparing future leaders of NASA space flight missions, such as junior researchers and graduate students. For LCAS-class proposals, specific factors that will be considered when evaluating a proposal's intrinsic merit are: the scientific merit, the degree to which it advances the technology readiness level of a detector or supporting technology, and the degree to which it advances the readiness of junior researchers or graduate students to assume roles on future NASA space flight missions.

Proposals to the LCAS program must supply the following information that is needed in order to generate an estimate of the costs associated with the operational requirements for the proposed investigation: the envisioned vehicle type and quantity, payload mass, trajectory requirements, launch site, telemetry requirements, attitude control or pointing requirements, and any plans for payload recovery and reuse. For the purpose of estimating feasibility and costs associated with operational requirements, LCAS-class proposals requiring durable orbits (CubeSats) must supply the following information in the body of the proposal: a science traceability matrix and a table specifying the expected mass/size, power, and telemetry budgets, including reserves, the orbit characteristics (perigee, apogee, inclination), and access-to-space methodology. Some of this information will also be requested on LCAS proposal cover pages, and cost estimates based on these data will be used in proposal selection. Proposers planning to utilize CubeSats should refer to the Guidelines for CubeSat Proposers document that can be downloaded from the NSPIRES web page for this Program Element and the ROSES-2015 *Summary of Solicitation* Section V. *Suborbital-Class Investigations* Subsections (a), (b), and (c). **However, the EM-1 launch opportunity is not available for CubeSats in this program element this year. [Amended June 11, 2015].**

When appropriate, the funding for science support elements, such as science radars, lidars, ionosondes, optical sites, and the associated logistics, must be included in science proposal budgets.

It is strongly encouraged that data returned from LCAS investigations be deposited in a NASA, publicly accessible repository, such as the Solar Data Analysis Center (SDAC) or Space Physics Data Facility (SPDF).

Balloon projects needing unique engineering and/or technical support services and/or vehicles and/or the Wallops Arc-Second Pointing System (WASP) should contact the Balloon Program Office directly for an estimate of the Government Furnished Equipment (GFE) cost of the desired support.

Budgets are expected to cover complete investigations, including payload development and construction, instrument calibration, launch, and data analysis. The number of investigations that can be supported is limited and heavily dependent on the funds available to this program. Note that NASA does not carry reserves to accommodate any cost overrun incurred by a particular investigation, including the loss of the payload owing to a rocket or balloon system failure. Therefore, failure to achieve the proposed goals within the proposed time and budget could require either descoping the initially proposed investigation, delaying it, canceling a particular launch date opportunity, or canceling the investigation altogether.

1.2.1 LCAS Page Limit

Owing to the larger scope of LCAS proposals, the page limit for the Science/Technical/ Management section given in the *NASA Guidebook for Proposers* is revised from the default standard of 15 pages to 20 pages. A science traceability matrix is required for all LCAS proposals and should be included in the Scientific/Technical/Management section of the proposal. Three additional pages (up to 23 total) are permitted for CubeSat proposals, given the added necessity of describing the CubeSat spacecraft systems (e.g., attitude control, telemetry,

power, space environment survivability, etc.). The three additional pages must be in a clearly labeled section that describes only the CubeSat spacecraft systems. The table specifying the expected mass/size, power, and telemetry budgets, including reserves, should be included in this section.

1.2.2 Export Control Laws

Export licenses are required for all foreign nationals accessing sounding rocket-class hardware. LCAS program Principal Investigators (PIs) should contact the Sounding Rocket Program Office regarding PI responsibilities in this arena. Procuring the required State Department licenses can take some time, and PIs are urged to begin the process well before team members need access to the actual flight hardware. Questions concerning U.S. Export Control Laws and Regulations for sounding rocket-class missions may be addressed to Philip.J.Eberspeaker@nasa.gov of the Sounding Rocket Program Office.

1.2.3 Launch vehicle services

Detailed information, including suborbital and orbital specifications and points of contact, is found in the *ROSES Summary of Solicitation, Section V, Suborbital-Class Investigations.*

1.2.4 LCAS Proposals from Multiple Institutions

The LCAS program no longer makes separate awards to the Principal Investigator (PI) and Co-Investigators (Co-Is) of the same investigation at different institutions, except in those cases where a Co-Investigator is affiliated with a U.S. Government Laboratory (see the NASA Guidebook for Proposers, Section 2.3.10(c)), in which case NASA separately funds that Co-Investigator through a direct transfer of funds. In all other cases, the PI institution is expected to fund participating Co-I(s).

No separate Co-I cost proposals will be accepted.

1.3 Instrument and Technology Development (ITD)

The ITD program supports the development of instrument or detector concepts that show promise for use in scientific investigations on, or give rise to future Heliophysics missions, including the development of laboratory instrument prototypes, detectors, instrument components, etc., but not of major space flight hardware. Proposals for ITD must demonstrate relevance to the Heliophysics program, including clearly defined scientific goals appropriate for future Heliophysics missions. The goal of the program is to define and develop scientific instruments and/or components of such instruments to the point where complete instruments may be proposed in response to future Announcements of Opportunity without significant additional technology development.

Either new measurement concepts or methods to improve the performance of existing instruments or detectors may be proposed, provided they would be candidates for use in space. Among the characteristics typically desirable in space-quality detection systems are high sensitivity to relevant signals, low mass, low vulnerability to particle radiation effects, low power

consumption, compactness, ability to operate in a vacuum (such that high-voltage arcing is minimized), vibration tolerance, ease and robustness of integration with instrumentation, and ease of remote operation, including reduced transient effects and ease of calibration.

Proposals to the ITD must demonstrate that the proposed development is a necessary precursor to solving specific scientific problems. However, the proposers are not necessarily expected to apply the results of their efforts to the science problems within the time period of the proposed effort.

1.4 Laboratory Nuclear, Atomic, and Plasma Physics (LNAPP)

The LNAPP program supports studies that probe fundamental nuclear, atomic, and plasma physical processes and produce chemical and spectroscopic measurements that support spacecraft observations and atmospheric models. They provide benchmarks for integrating theory and modeling with observation in solar and space physics. Laboratory experiments allow the use of a controlled environment to perform reproducible measurements that shed light on key processes with the Heliophysics environment. These experiments are directed toward understanding basic processes. Additionally, there are also important experiments that are directly used to facilitate the interpretation of spacecraft observations, e.g., spectroscopic or cosmic ray measurements. As such, LNAPP encompasses measurements of fundamental atomic parameters, e.g., cross sections associated with various processes.

Proposals for LNAPP must demonstrate relevance to the Heliophysics program, including clearly defined scientific goals appropriate for current and/or future Heliophysics missions. Proposals to LNAPP must demonstrate that the proposed work is a necessary precursor to solving specific scientific problems. The proposers are not necessarily expected to apply the results of their efforts to the science problem(s) within the time period of the proposed effort. Proposals for projects that aim to produce data products for wide use across the heliophysics community should explain how those products would be made available to the intended users in a stable fashion.

2. Relevance Criterion

The H-TIDeS program encompasses the scientific, technology and instrument development needs throughout Heliophysics, including Solar, Heliospheric, and Mag-ITM Sciences. Especially welcome are proposals that seek to explore and demonstrate concepts for new instruments for future suborbital or orbital flight opportunities, such as those identified in the 2013 National Research Council decadal survey for space physics, *Solar and Space Physics: A Science for a Technological Society,* including those in Appendix B.

As part of a mission-oriented agency, the Heliophysics Research Program seeks to fund those efforts that directly impact NASA missions or interpretation of their data. Therefore, investigations that are judged to be more appropriate for submission to other Federal agencies, even if of considerable merit, will not be given high priority for funding through this solicitation.

3. Submission and Evaluation Process

3.1 General Considerations

Each Principal Investigator is allowed to submit one and only one Step-1proposal to each subelement (LCAS, ITD, LNAPP) of this solicitation. In that proposal, the Principal Investigator must invest a substantial portion of his/her time, at least of order 10-20%, to the investigation. Co-investigators must each have a specific and defined task in the project, and the task must be essential to completion of the project. Use of Collaborators is discouraged. Proposals may be declared noncompliant based on either the Step-1 or Step-2 proposal if they are outside the scope of the H-TIDeS program or if they fail to meet submission guidelines specified below (3.2 and 3.3).

3.2 Step-1 Proposals

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process. The overall description of a two-step process can be found in *Section IV. (b) vii* of the ROSES-2015 *Summary of Solicitation*.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Tables 2 and 3 in the *ROSES-2015 Summary of Solicitation*). Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Step-1 proposal must be submitted by an Authorized Organizational Representative (AOR) from the PI's institution. No budget is required, see below. Only proposers who submit a Step-1 proposal are eligible to submit a full proposal. Full (Step-2) proposals must have the same scientific goals proposed in the Step-1 proposal. The Step-1 proposal title; Principal Investigator; and all Co-Investigators, Collaborators, and Consultants cannot be adjusted between in the Step-1 and Step-2 proposals. The expected format and compliance evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal later. Each Principal Investigator is allowed to submit one and only one Step-1 proposal for each subelement.

3.2.1 Step-1 Proposal Format

The Step-1 proposal is restricted to one page in length. It should include the following information:

- A description of the science goals and objectives to be addressed by the proposal.
- A brief description of the methodology to be used to address the science goals and objectives.

The NSPIRES system for proposal submission requires a very brief summary to be entered into the "Proposal Summary" field and it requires a PDF "Proposal Attachment," which should be the Step-1 proposal, as described above.

3.2.2 Step-1 Evaluation Criteria

Step-1 proposals will be declared noncompliant if the proposed work is outside the scope of the H-TIDeS program, as described in Section 1. PIs of noncompliant proposals will not be eligible to submit the associated Step-2 proposal and will receive a letter to this effect. All who submit a compliant Step-1 proposal will be invited to submit a corresponding Step-2 proposal.

3.2.3 Request for Reviewer Names

Proposers are strongly encouraged to provide names and contact information of five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is. This information can be supplied confidentially by the PI through the NASA Science URL http://science.nasa.gov/researchers/suggested-reviewers when submitting a Step-1 proposal.

3.3 Step-2 Proposals

A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the *ROSES-2015 Summary of Solicitation*). The Step-2 proposal must be submitted by an Authorized Organizational Representative (AOR) from the institution of the PI. A budget and other specified information is required. The Step-2 proposal title, Principal Investigator, and all Co-Investigators, Collaborators, and Consultants must be the same as those in the Step-1 proposal. Step-2 proposals must contain the same scientific goals proposed in the Step-1 proposal. Each Principal Investigator is allowed to submit one and only one proposal for each subelement.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. A Step-2 proposal cannot be submitted if the corresponding Step-1 proposal was deemed noncompliant.

Proposers are expected to provide mail-in reviews for one to three proposals in this competition. Much of the science expertise lies in the PIs and Co-Is, since nearly the entire Heliophysics community proposes. In order to maintain a high-caliber review process, it is important to get these mail-in reviews to cover all proposals fairly.

3.3.1 Step-2 Proposal Format

Proposers should refer to the PDF entitled "How to submit a Step-2 proposal" that will appear under "Other Documents" on the NSPIRES page for this program after the Step-1 proposal due date. The process for preparation and submission of the Step-2 (full) proposals is that for any other ROSES proposal. Guidelines for content and formatting of Step-2 full proposals are specified in the *NASA Guidebook for Proposers* and the *ROSES Summary of Solicitation*.

Proposals should include the following within their Scientific/Technical/Management section: clear descriptions of (1) a specific scientific problem, (2) the importance of the problem, and (3) a method of attack on this problem. Principal Investigators (PIs) have the privilege of choosing

the science question(s) they wish to address. However, having done so, they are then expected to detail a methodology/science plan that clearly and specifically addresses the chosen question(s). Historically, proposals focused on a specific science question have been more successful at constructing methodologies that clearly address a single target question than those that propose to address a large number of science questions or that are directed at a broad science topic, rather than a specific question.

3.3.2 Step-2 Evaluation Criteria

Step-2 proposals that are not compliant with format requirements may be rejected without review. See Section IV (b) ii of the *ROSES Summary of Solicitation* and the *NASA Guidebook for Proposers* for details. Proposers must select the subelement that is appropriate for their proposal. Proposals that have changed the scientific scope from that of their Step-1 proposal may be declared noncompliant.

Compliant proposals will be evaluated according to the criteria specified in section C.2 of the *NASA Guidebook for Proposers*. These criteria are intrinsic scientific and technical merit, relevance to NASA's objectives, and cost realism/reasonableness.

Proposals will be evaluated for scientific and technical merit based on the following:

- Compelling nature and scientific priority of the proposed investigation's science goals and objectives, including the importance of the problem within the broad field of Heliophysics; the unique value of the investigation to make scientific or technological progress in the context of current understanding in the field, and the importance of carrying out the investigation now.
- Appropriateness and feasibility of the methodology, including the appropriateness of the selected data, models, facilities, instrumentation, and flight systems for ensuring scientific success.

Based on these two factors, the evaluation will consider the overall potential science impact and probable success of the investigation.

Suborbital and suborbital-class investigations provide unique opportunities for executing intrinsically meritorious science investigations, advancing the technology readiness levels of future space flight detectors and supporting technologies, and preparing future leaders of NASA space flight missions, such as junior researchers and graduate students. For these proposals, the science must be meritorious (as described above), but full closure during the flight is not required. The proposed experiment should demonstrate the viability of achieving the science goals through subsequent flights and/or future orbital missions relying on the proposed technologies. The evaluation of technical merit will include the degree to which it advances the technology readiness level of a detector or supporting technology.

Additionally, though not required, the degree to which the proposed effort advances the readiness of junior researchers or graduate students to assume leadership roles on future NASA space flight missions will be considered.

Relevance to NASA objectives is dependent on the particular program subelement. Each proposal must demonstrate that the investigation is appropriate for the specific program selected. See Section 2. Relevance Criterion.

Cost realism/reasonableness includes assessing the amount of work to be accomplished versus the amount of time proposed. Open-ended proposals or those with a large number of science questions to be addressed typically do not fare well in this evaluation. In addition, it is advisable that PIs contact the SRPO or BPO before submitting proposals requesting large amounts of resources (e.g., high number of rocket flights) to determine if the proposed investigation is realistic. Only necessary Co-Investigators and Collaborators should be included, and their specific roles in the investigation must be clearly laid out. Use of Collaborators whose only role is advisory is discouraged.

4. Available Funds

A total of about $4.5M-5.0M program funds next fiscal year will allow the selection of about 12 new awards. ITD and LNAPP proposals of exceptional scientific merit will be considered for funding, within the constraints of the budget.

It is anticipated that approximately $3.5M in next fiscal year funds will be available to support three to eight new selections for LCAS.

It is anticipated that approximately $0.8M in next fiscal year funds will be available to support two to five new selections for ITD.

It is anticipated that approximately $0.4M in next fiscal year funds will be available to support one to three new selections for LNAPP.

5. Maximum Duration of Awards

The maximum duration of ITD and LNAPP awards is three years. Although most LCAS awards are also three years in duration, a four-year proposal may be accepted to develop a completely new, highly meritorious investigation through its first flight.

6. Summary of Key Information

Expected program budget for first year of new awards	~$4.5M-5.0M Total, $3.5M LCAS, $0.8M ITD, $0.4M LNAPP
Number of new awards pending adequate proposals of merit	~12 for LCAS, ITD, LNAPP combined
Maximum duration of awards	LCAS – 4 Years; ITD, LNAPP – 3 years.
Due date for Step-1 Proposal	See Tables 2 and 3 in the *ROSES Summary of Solicitation*. **June 26, 2015 [Amended June 11, 2015]**
Due date for Step-2 (full) proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*. **August 28, 2015 [Amended June 11, 2015]**

Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp. except for LCAS where the page limit is 20 pp. and CubeSat where the page limit is 23 pp.; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	See Section 2, Relevance Criteria. This program is relevant to the Heliophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-HTIDS
NASA points of contact concerning this program all of whom share the following mailing address: Heliophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001	Elsayed Talaat Telephone: (202) 358-3804 E-mail: elsayed.r.talaat@nasa.gov Jeff Morrill Telephone: (202) 358-3744 E-mail: jeff.s.morrill@nasa.gov Arik Posner Telephone: (202) 358-0727 E-mail: arik.posner@nasa.gov

B.4 HELIOPHYSICS GUEST INVESTIGATORS

NOTICE: Amended on June 1, 2015. The due date for Step-2 proposals to this program element has been delayed to July 31, 2015.

Proposals to this program will continue to be taken by a two-step process, in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an Authorized Organizational Representative (AOR). Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. Step-1 proposals will be reviewed. Some proposers may be discouraged from submitting a Step-2 proposal, while others will be encouraged to submit a Step-2 proposal. See Section 3 of this call for details.

1. Scope of Program

The Heliophysics Guest Investigator (H-GI) program is intended to maximize the scientific return from operating Heliophysics missions by providing support for research that is beyond the scope of work of the mission science teams. It also allows scientists who are not associated with a mission team to participate in the mission science. In ROSES-2015, it is offered with a single Open program element. Proposers interested in this program element are encouraged to see the overview of the Heliophysics Research Program in Appendix B.1 of the ROSES-2015 NASA Research Announcement and additional references cited therein.

1.1 H-GI Open: Objectives and Requirements

The H-GI Open program is for investigations whose primary emphasis is the analysis of data from currently-operating missions of the Heliophysics System Observatory (HSO). It provides support for analysis of observations from both extended missions and from missions in their prime phase (Phase E). Investigations using data from multiple spacecraft, as appropriate, and those addressing global system problems are encouraged. Proposals must address one or more of the four high-level science goals from the most recent Heliophysics Decadal survey (*Solar and Space Physics: A Science for a Technological Society* www.nap.edu/catalog.php?record_id=13060):

1. Determine the origins of the Sun's activity and predict the variations in the space environment;
2. Determine the dynamics and coupling of Earth's magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs;
3. Determine the interaction of the Sun with the solar system and the interstellar medium;
4. Discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe.

In support of any H-GI proposal, investigations may employ theory, models, and data from other sources, as needed, to interpret and analyze NASA's HSO data, but only as a secondary emphasis, However, in any such instance, the proposal must clearly demonstrate that the theory, models, and/or data in question are necessary for interpretation of the HSO data, and are not themselves the primary object of the investigation. Development of new models and theories is not solicited.

The list of operating HSO missions is found at:
http://science.nasa.gov/heliophysics/missions/operating/

Proposers should be aware that for many of these missions, the mission science teams and others have already accomplished a substantial amount of research. Proposals must demonstrate that the proposed research will extend the frontier of existing knowledge in a fundamental and important manner.

Additionally, prospective investigators must demonstrate that the proposed effort can be accomplished using data that will be available during the period of the award. Most Heliophysics data may be found in one or more of the NASA active archives and Virtual Observatories (VOs).

Archive		**URL**
Solar Data Analysis Center	SDAC	http://umbra.nascom.nasa.gov
Space Physics Data Facility	SPDF	http://spdf.gsfc.nasa.gov
Virtual Solar Observatory	VSO	http://sdac.virtualsolar.org/
Heliophysics Data Portal	formerly VSPO	http://vspo.gsfc.nasa.gov/websearch/dispatcher
Virtual Magnetospheric Observatory	VMO	http://vmo.nasa.gov
Virtual Heliospheric Observatory	VHO	http://vho.nasa.gov
Virtual Radiation Belt Observatory	ViRBO	http://virbo.org
Virtual Ionosphere Thermosphere Mesosphere Observatory	VITMO	http://vitmo.jhuapl.edu
Virtual Wave Observatory	VWO	http://vwo.gsfc.nasa.gov

1.2 Avoidance of Duplicate Investigations

Proposals to duplicate or directly supplement existing investigations already funded for approved space flight missions or other Heliophysics research programs are not appropriate for the H-GI program. Investigators who are members of the science teams of ongoing missions and who propose to use data from those missions must clearly demonstrate that the research proposed is distinct from and beyond the scope of existing mission-related science-team research efforts. A Principal Investigator (PI) or a Co-Investigator (Co-I) on a qualifying Heliophysics mission may also propose as a PI or Co-I to the H-GI program. However, such Heliophysics mission personnel must include in their proposal a description of their mission duties and clearly distinguish the proposed new activity from their existing responsibilities for mission operations and data analysis.

2. Submission and Evaluation Process

2.1 General Considerations

Each Principal Investigator (PI) is allowed to submit one and *only* one proposal to this solicitation. In that proposal, the Principal Investigator must invest a substantial portion of his/her time, of the order of 10-20%, to the investigation. Co-investigators (Co-Is) must each have a specific and defined task in the project, and the task must be essential to completion of the project. Use of collaborators is discouraged. NASA may determine proposals to be noncompliant based on either the Step-1 or Step-2 proposal if they are outside the scope of the H-GI program or if they fail to meet submission guidelines.

2.2 Limitations and Scope

Proposals outside the scope of H-GI that may be declared noncompliant based on either the Step-1 or Step-2 proposal, include the following:

- Proposals that do not focus on analysis of data from currently-operating HSO missions;
- Proposals addressing the most recent Heliophysics LWS Science (H-LWS) Focus Topics (see ROSES-2015 Appendix B.6);
- Proposals for model or theory development;
- The routine, long-term gathering of observational data;
- Investigations with the main purpose of supporting ground-based infrastructure or facilities;
- Proposals already submitted in whole or major part to this or other programs in Heliophysics or across the Science Mission Directorate (SMD);
- Proposals to duplicate or supplement existing investigations (1) already funded under other Heliophysics or SMD research programs or (2) already funded for approved space flight missions. Currently funded PIs must show that their new proposed effort does not duplicate work promised in connection with other awards;
- Proposals requiring the use of Magnetospheric Multiscale (MMS) data are not solicited.

3 The Two-Step Submission Process

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process. The overall description of a two-step process can be found in *Section IV. (b) vii* of the ROSES *Summary of Solicitation*.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Tables 2 and 3 in the *ROSES Summary of Solicitation*). The Step-1 proposal must be submitted by the organization Authorized Organizational Representative (AOR). No budget or other elements are required. Only proposers who submit a Step-1 proposal are eligible to submit a full proposal. Full (Step-2) proposals must contain the same scientific goals proposed in the Step-1 proposal. The Step-1 proposal title; Principal Investigator; and all Co-Investigators, Collaborators, Consultants, and Other Professionals cannot be adjusted between the Step-1 and Step-2 proposals. The expected format and evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal later.

3.1 Step-1 Proposal Content

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Step-1 proposal is restricted to three pages in length (references and any other supporting material are not required, but, if included, must fit within the three page limit). The Step-1 proposal must include the following information:

- A description of the science goals and objectives to be addressed by the proposal. The description should include the importance and scientific priority of the proposed investigation's science goals and objectives; the unique value of the investigation to make scientific progress in the context of current understanding in the field, and the importance of carrying out the investigation now.
- A brief description of the methodology to be used to address the science goals and objectives. The description should include the appropriateness of the selected data, models, and analysis for completing the investigation and the feasibility of the methodology for ensuring scientific success.
- A brief work plan that includes major steps to be employed to carry out the work.
- The relevance of the problem to one or more of the four Decadal Survey goals.

The NSPIRES system for proposal submission requires a very brief summary to be entered into the "Proposal Summary" field and it requires a PDF "Proposal Attachment", which should be the Step-1 proposal, as described above.

3.2 Step-1 Evaluation Criteria

Step-1 proposals may be declared noncompliant if they fail to meet submission guidelines specified in Section 3 or if they are outside the scope of the H-GI program, as discussed in Section 1. PIs of noncompliant proposals will not be eligible to submit the associated Step-2 proposal and will receive a letter to this effect.

Compliant Step-1 proposals may be reviewed by a combination of unconflicted mail-in reviewers from the science community and NASA Headquarters personnel looking at the importance of the science, feasibility of the methodology, likelihood of success, and relevance to the program. Given that the number of proposals submitted will likely be far in excess of what can be supported, a portion of the proposers will likely receive a letter discouraging them from submitting a Step-2 proposal. The rest of the proposers will receive a letter encouraging them to submit a Step-2 proposal. Evaluation details will not be provided in either case.

3.3 Step-2 Proposals

A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the *ROSES Summary of Solicitation*). The Step-2 proposal must be submitted via NSPIRES or Grants.gov by the organization Authorized Organizational Representative (AOR). A budget and other specified information is required. The Step-2 proposal title; Principal Investigator; and all Co-Investigators, Collaborators, and Consultants must be the same as those

in the Step-1 proposal. Step-2 proposals must contain the same scientific goals proposed in the Step-1 proposal.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. Proposers that received a noncompliant letter are not eligible to submit a Step-2 proposal.

Proposers are strongly encouraged to provide names and contact information of five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is. This information can be supplied via the SARA web page at http://science.nasa.gov/researchers/suggested-reviewers/.

Proposers are expected to provide mail-in reviews for one to three proposals in this competition. Much of the science expertise lies in the PI/Co-I community, because increasingly, nearly the entire Heliophysics community proposes. In order to maintain a high caliber review process, it is important to get the additional mail-in reviews to cover all proposals fairly.

3.4 Step-2 Proposal Format

Proposers should refer to the PDF entitled "How to submit a Step-2 proposal" that will appear under "Other Documents" on the NSPIRES page for this program after the Step-1 proposal due date. The process for preparation and submission of the Step-2 (full) proposals is that for any other ROSES proposal. Guidelines for content and formatting Step-2 full proposals are specified in the *NASA Guidebook for Proposers* and the *ROSES Summary of Solicitation*.

Proposals should include the following within their Scientific/Technical/Management section: clear descriptions of (1) a specific scientific problem, (2) the importance of the problem, and (3) a method of attack on this problem. PIs have the privilege of choosing the science question(s) they wish to address. However, having done so, they are then expected to detail a methodology/science plan that clearly and specifically addresses the chosen question(s). Historically, proposals that are focused on a specific science question have been more successful at constructing methodologies that clearly address a single target question than those that propose to address a large number of science questions or that are directed at a broad science topic, rather than a specific question.

3.5 Step-2 Evaluation Criteria

Step-2 proposals that are not compliant with format requirements may be rejected without review. See Section IV (b) ii of the *ROSES Summary of Solicitation* and the *NASA Guidebook for Proposers* for details. Proposals that have changed the scientific scope from that of their Step-1 proposal may be declared noncompliant.

Compliant proposals will be evaluated according to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*. These criteria are intrinsic scientific and technical merit, relevance to NASA's objectives, and cost realism/reasonableness.

Proposals will be evaluated for scientific and technical merit based on the following:

- Compelling nature and scientific priority of the proposed investigation's science goals and objectives, including the importance of the problem within the broad field of Heliophysics, the unique value of the investigation to make scientific progress in the context of current understanding in the field, and the importance of carrying out the investigation now.
- Appropriateness and feasibility of the methodology, including the appropriateness of the selected data, models, and analysis for completing the investigation and the feasibility of the methodology for ensuring scientific success.

Based on these two factors, the evaluation will consider the overall potential science impact and probable success of the investigation.

Relevance to and priority within the H-GI program will be assessed based on criteria discussed in Section 1. Each proposal must demonstrate that the investigation is relevant and of high priority.

Cost realism/reasonableness includes assessing the amount of work to be accomplished versus the amount of time proposed. Open-ended proposals or those with a large number of science questions to be addressed typically do not fare well in this evaluation. Only necessary Co-Investigators and Collaborators should be included, and their specific tasks and roles in the investigation must be clearly laid out.

4. Available Funds

It is expected that there will be approximately ~$4M available in Fiscal Year (FY) 2016 to support new Heliophysics GI investigations selected through this solicitation. Annual funding in past programs has averaged ~$125K per investigation per year.

5. Award Types

As begun in 2013, the H-GI program will primarily award funds through three vehicles: (1) grants, (2) interagency transfers, and (3) awards to NASA Centers. The H-GI program will not award contracts. An institution that has received a contract previously can receive funds as a grant by not charging a fee.

6. Summary of Key Information

Expected annual program budget for first year of new awards	~$4M
Number of new awards pending adequate proposals of merit	~32
Maximum duration of awards	3 years; shorter-term proposals are encouraged.
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Step-2 proposals	**July 31, 2015 [Amended June 1, 2015]**
Page limit for the central Science-Technical-Management section of	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*

Step-2 proposals	
Planning date for start of investigation	6 months after proposal due date.
Relevance	This program is relevant to the Heliophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV in the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Step 1 and Step 2 proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-HGI
NASA point of contact concerning this program	William R. Paterson Heliophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358 0991 E-mail: william.r.paterson@nasa.gov

B.5 HELIOPHYSICS GRAND CHALLENGES RESEARCH

NOTICE: The Heliophysics Grand Challenges Research Program is not being offered this year. All existing Fiscal Year 2015 and Fiscal Year 2016 program funds have been competed in ROSES-2013.

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B.6 HELIOPHYSICS LIVING WITH A STAR SCIENCE

NOTICE: There are four major changes to LWS this year:
(1) The Strategic Capabilities element will not be competed in ROSES-2015.
(2) Large Targeted Science Team proposals, whereby a single large investigation covers the entire breadth of a Focus Science Topic will not be permitted in ROSES-2015. Instead, this call will focus on Focused Science Topics proposals lead by individual Principal Investigators, see Section 3.1.
(3) The Sun-Climate Theme has been subsumed into Section 3.2.1.2
(4) The Cross-Disciplinary proposals that include infrastructure-building elements are solicited, see Section 4.

Proposal submission to all calls in Heliophysics will be done by a two-step process, in which a Notice of Intent is replaced by a required Step-1 proposal. The Title and investigators cannot be changed between the Step-1 and Step-2 proposals. See Section 5 for details.

1. Scope of Program

The goal of NASA's Living With a Star (LWS) Program is to develop the scientific understanding needed for the U.S. to effectively address those aspects of Heliophysics science that may affect life and society. LWS Science solicits proposals for fundamental science that will lead to a physics-based understanding of the integral system linking the Sun to the Solar System, including the impact on the heliosphere, planetary magnetospheres, and ionospheres.

Achieving an understanding of those aspects of the Sun-Solar System that have direct impact on life and society behooves the LWS program to tackle strategic large-scale problems that cross (traditionally separate) discipline and technique boundaries (e.g., data analysis, theory, modeling, etc.).

LWS Science is a crosscutting initiative that addresses the following LWS strategic goals (in no priority order):

1. To deliver the understanding and modeling required for useful prediction of the variable solar particulate and radiative environment at the Earth, Moon, Mars, and throughout the solar system;
2. To deliver the understanding of how and to what degree variations in the solar radiative and particulate output contribute to changes in global and regional climate over a wide range of time scales;
3. To deliver the understanding and modeling required for effective forecasting/specification of magnetospheric radiation and plasma environments; and
4. To deliver understanding and predictive models of upper atmospheric and ionospheric responses to changes in solar electromagnetic radiation and to coupling above and below.

These strategic goals, which are expounded on further at the LWS website (http://lwstrt.gsfc.nasa.gov/), provide the basis for the selection of topics for this solicitation. The

primary goal of the LWS Program is to make progress in understanding the complex Heliophysics system, focusing on the fundamental science of the most critical interconnections.

As a result of its defining studies and recommendations, the LWS Science program has defined a strategy with three parts, namely, Strategic Capabilities, Targeted Investigations, and Cross-Disciplinary Infrastructure Building programs.

Further background material concerning relevant research objectives can be found on the LWS website, and in the following documents:

- The latest *TR&T Steering Committee Team Report* (http://lwstrt.gsfc.nasa.gov/trt_steeringcom.htm);
- The National Research Council Decadal Survey Report *Solar and Space Physics: A Science for a Technological Society* (http://www.nap.edu/openbook.php?record_id=13060).

2. Strategic Capabilities

NOTICE: The Strategic Capabilities element will not be competed this year. In its previous guise as "Living With a Star Targeted Research and Technology: NASA/NSF Partnership for Collaborative Space Weather Modeling," it is fully subscribed this year with awards from ROSES-2011 and will not be recompeted until ROSES-2016, at the earliest.

3. Targeted Investigations

The stated goal of LWS, that of achieving an understanding of those aspects of the Sun-Solar System that have direct impact on life and society, poses two great challenges for the LWS program. First, the program must tackle large-scale problems that cross discipline and technique boundaries (e.g., data analysis, theory, modeling, etc.); and second, the program must identify how this new understanding will have a direct impact on life and society.

The Targeted Investigations element this year consists of two Focused Science Topics (FSTs).

3.1. Focused Science Topics

The Focused Science Topics (FST) permitted as the objectives for proposals to this LWS Science solicitation are as follows:

1) Space Weather at Terrestrial Planets: Comparative Climatology
2) The Solar-Stellar Connection

NASA desires a balance of research investigation techniques for each Topic, including theory, modeling, data analysis, observations, and simulations. In 2013 and 2014, proposals could be individual proposals that would form part of a team, or Targeted Science Teams (TSTs), that form prior to selection under a single PI and submit a single TST proposal that attacks the entire

breadth of the Focus Science Topic. However, such TSTs will not be permitted in ROSES-2015. Instead, LWS Science will adopt one of the recommendations in Chapter 10 of the 2013 Heliophysics Decadal Survey that NASA "work toward doubling the size of Individual-Principal-Investigator grants." Given the strategic nature of LWS, and the fact that strategically feasible tasks require sufficient investment, it is anticipated that FST proposals will be in the range of $250K – $300K. (This includes fully encumbered Civil Servant labor, where appropriate.) It is left to individual Principal Investigators (PIs) to decide whether a strategically feasible award size could be achieved by increased collaborative efforts, greater full-time equivalent (FTE) of investigators, or a mix of the two. PIs should be cognizant, however, that given the submission of proposals of adequate number and merit and investigative techniques, up to *four* selections will be made for each Focused Science Topic.

Once selected, these investigators will form a team in order to coordinate their research programs. Due to the collaborations that will arise from coordination of the team research efforts the expected duration of FST awards is four years. One of the PIs will serve as the Team Leader for the Focused Science Topic for which he/she proposed, and will receive supplemental funding, as necessary, to support costs associated with these duties after the selection process is completed. Proposers are encouraged to propose to act as a Team Leader and, if they do so, should include a brief section in their proposal describing how they would lead the team effort. Up to one extra page in the proposal is allowed for this proposed effort. All proposers for Focused Science Topics should include sufficient travel funds in their proposed budgets to cover two team meetings per year to be held on the U.S. coast furthest from their home institutions. See Instructions for LWS Focus Team Members and Leaders at (http://lwstrt.gsfc.nasa.gov/trt_focusteams.htm) for full details of responsibilities.

3.1.1 Space Weather at the Inner Planets

NASA and other space agencies have begun to expand their research into the solar system. Probes are now orbiting or en route to Mercury, Venus, Mars, the outer planets and other bodies in the solar system. With the recent availability of comprehensive solar spectral measurements at X-ray and ultraviolet (XUV) wavelengths, together with development and advancements in first-principles modeling of planetary atmospheres, quantification of the many ranges of solar effects on neutral and ion composition and dynamics of planetary atmospheres is now possible.

The goal of this Focused Science Topic is to develop understanding of the complex response of various planets (excluding Earth) to solar forcing at various time-scales to understand the relative importance of solar driving of these planetary atmospheres and of the implications for the historical and future evolution of the planetary climates. We presently have unprecedented observations of solar spectral variability and of terrestrial planetary atmospheres, which respond to the highly variable solar irradiance and interplanetary CME (ICME) impact. Observations of planetary atmospheres for different phases of the solar cycle and for sporadic events are available through various NASA missions, as well as from ground-based observatories. We also now have modeling capabilities to explore the complex interactions and responses throughout the affected portions of atmospheres to the inputs. Additionally, the long-term variation of these drivers could address planetary atmosphere response on climatological and evolutionary timescales.

3.1.1.1 Goals and Measures of Success

The primary goals of this focused science topic are to improve modeling and characterization of response of various terrestrial planetary environments to varying solar output. Successful investigations will improve quantitative understanding of the complex response of terrestrial planetary atmospheres to solar irradiance temporal and spectral variation. Progress will also be made in understanding what other factors might control the response to solar forcing, such as prior conditioning of the atmosphere. Additionally, a major goal is the use of current observations to validate and calibrate models and allow these models to explore historical and climatological trends.

3.1.1.2 Types of Investigations

The group will consist of modelers of solar irradiance and particulate output, solar and planetary observers, and theorists. Substantial progress on this Focused Science Topic is envisioned with the following (non-exhaustive) investigations:

- New observations and characterization of the solar irradiance environment at a terrestrial planet, in the atmosphere, and/or at the planet surface.
- Numerical models of terrestrial upper atmospheric and surface responses to a full range of solar irradiance inputs.
- Integration of observations of actual impulsive inputs and atmospheric models, combined with models, to establish the complex response function and its sensitivity to input and boundary parameters.
- Coordinated studies of interplanetary modeling of solar irradiance observations.
- Complementary studies of modeling ICME impact on terrestrial planets and their atmospheres.
- Validated models to explore and to quantify whether longer-term variations in these rapid-timescale phenomena contribute to climate variability.

3.1.2 The Solar-Stellar Connection

Solar dynamo forecasting, even for a single cycle, is of practical significance, because it yields predictions of average space weather similar to seasonal forecasts of terrestrial weather. Equally important, solar cycle predictions yield forecasts for Total Solar Irradiance (TSI), a crucial, although not the dominant driver in global climate simulations. Solar dynamo models have grown very sophisticated in recent years, but despite that different simulations have led to very different predictions for the upcoming solar cycle. Hence, we have to look at ways to improve our predictive capability.

A fundamental limitation of current dynamo models is that they are calibrated versus just a single star, the Sun. A dynamo code that captures the essential physics of the dynamo mechanism should be able to reproduce the cyclic activity of other Sun-like stars. The calibration of such simulation codes versus cycle observations of other cool stars is now possible, since we have decades worth of data on the cycle duration and amplitude of these stars from Mount

Wilson and Lowell Observatory, as well as on their starspot coverage and surface differential rotation, and also their flares and CME-like eruptions from other sources.

The calibration of dynamo codes versus stellar data requires basic input data from these stars, such as radius, rotation rate, depth of convection zone, and any information that can be obtained regarding differential rotation. Most of this information is available and more is becoming available right now through from two current asteroseismology missions, CoRoT and Kepler. With this information stellar dynamo codes will produce a prediction for magnetic flux and its distribution over latitude as a function of time, in particular cycle length and amplitude.

It is well known that the Sun through its history has gone through many low activity periods like the Maunder minimum, yet current dynamo models have great difficulty reproducing such global minima, let alone predicting them. A small class of very inactive low variability stars has been identified as possible Maunder minimum candidates. Finding more of these, and detailed studies of their properties, will shed light on the physical underpinnings of global minima and help dynamo modelers incorporate their basic physics and simulate them.

This cross-disciplinary activity is not new, but new investment is timely. Results from Kepler and other experiments have revealed accurate critical parameters for many Sun-like stars. Spectroscopy and photometry reflecting magnetically induced variations now span several decades for the Sun and several well-observed stars. Continued and expanded observation programs will have broader impacts in stellar rotational evolution, the solar-terrestrial connection, space weather, and astrobiology, providing important constraints for diverse theoretical models.

3.1.2.1 Goals and Measures of Success

The overall goal is acquiring a better understanding of the basic physical ingredients of the solar dynamo, including those that cause global activity minima in order to improve the predictive capabilities of current dynamo models. The criteria for success of this focus group are a) progress in the physical understanding of the dynamos of solar-type stars, and b) in the predictive capabilities of the codes that simulate them. Success would be demonstrated by achieving one or both of the following objectives:

- From comparative dynamo simulations for other solar-type stars show how key characteristics of the dynamo cycle depend on basic stellar parameters.
- Find whether a trigger for solar global minima exists, and if so, what it is.

Note that this proposed solar-stellar connection focus completely reverses the current paradigm of solar-stellar research. Here we do not use information from the Sun to understand better other cool stars, but instead we will use information gleaned from other Sun-like stars to obtain a better understanding of the magnetic activity of the Sun -- which is a focus of the LWS program is about.

3.1.2.2 Types of Investigations

The group will consist of dynamo modelers, data miners, solar and stellar observers, and theorists. Substantial progress on this Focused Science Topic is envisioned with the following (nonexhaustive) investigations:

- Dynamo simulations for solar-type stars, calibrated by available observations on cycle periods and amplitudes, starspot evolution and differential rotation, latitude distribution of activity, asteroseismic properties, stellar flare and CME activity.
- Observational studies to determine basic parameters for activity cycles of Sun-like stars from archival data and currently operating missions.
- Studies of Maunder-like minima in stars and in the Sun, both through dynamo modeling and analysis of pertinent stellar and solar data.
- Establish the path of solar evolution, including its activity. Did the Sun have 'superflares' like some early Sun-like stars, and if so, what were their space environment consequences, including analogs of current-day solar winds, CMEs, and solar energetic particles?
- Development of new diagnostics for solar-stellar activity comparisons, especially for early "Suns".
- Studies of cyclical variation of Sun-like stars, through chromospheric proxies or flaring, to study many realizations of "the solar experiment" under conditions of varying age, mass, metallicity, convection zone, and rotational properties.
- Theoretical investigations or numerical models explaining the difference between the dynamos of stars on the "I" and "A" branches of the Böhm-Vitense diagram, and why the Sun appears to (anomalously) lie alone between the branches.
- Development of a (new) homogeneous database of solar-stellar observations – a "VSSO," so to speak, so that the community at large may continue to study the solar-stellar connection after the conclusion of this four-year FST.

3.2. <u>LWS Support for SCOSTEP/ VarSITI International Program</u>

The Scientific Committee on Solar Terrestrial Physics (SCOSTEP) has launched its new scientific program (Variability of the Sun and Its Terrestrial Impact 2014-2018 (VarSITI)) which is an international interdisciplinary research initiative. The international collaboration is the key element in these projects and can significantly enhance NASA/LWS scientific return by bringing in ongoing international effort and expertise to US investigations. The following are four major themes being pursued by VarSITI:

- Solar Evolution and Extrema (SEE);
- International Study of Earth-Affecting Solar Transients (ISEST)/ MiniMax24;
- Specification and Prediction of the Coupled Inner-Magnetospheric Environment (SPeCIMEN); and
- Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate (ROSMIC).

Many of the research themes of VarSITI are already being addressed by the ongoing efforts in the LWS TR&T program. Based on the needs of the LWS TR&T program and other ongoing efforts in LWS, we will support three of the themes (1, 3 & 4) of VarSITI in ROSES-15:

3.2.1 Types of Investigations

3.2.1.1 Solar Evolution and Extrema (SEE)

Solar variability underpins all of the LWS strategic goals

- What is the expectation for cycle 25? Are we at the verge of a new grand minimum?
- Does our current best understanding of the evolution of solar irradiance and mass loss resolve the “Faint Young Sun” problem?
- For the next few decades, what can we expect in terms of extreme solar flares and storms, and also absence of activity?

So that the user/operational communities can directly benefit from LWS scientific developments, upon selection, the LWS Program Officer will contact relevant modeling centers to identify liaisons to appropriate user/operational communities with respect to development of Cycle 25 (and beyond) predictions.

3.2.1.2 Specification and Prediction of the Coupled Inner-Magnetospheric Environment (SPeCIMEN)

SPeCIMEN’s desire for "quantitative prediction and specification of the Earth’s inner magnetospheric environment based on Sun/solar wind driving inputs" meshes well with the LWS strategic goal to "deliver the understanding and modeling required for effective forecasting/specification of magnetospheric radiation and plasma environments." As such, particular emphasis will be placed upon proposals that:

- Understand how the inner magnetosphere responds as a coupled system to Sun/solar-wind driving;
- Improve predictive models and further develop theoretical models, with a view to integration;
- Couple related models that quantitatively predict the dynamical evolution of the inner magnetospheric state (radiation belts, ring current, cold plasma distribution, plasmasheet, convection electric field, etc.); and
- Couple or fuse predictive and physical models

Proposals that anticipate relying on data from NASA’s upcoming Magnetospheric Multiscale Mission (MMS) will not be considered compliant under this theme. The appropriate venue for such ideas is the expected MMS-specific Guest Investigator opportunity in future ROSES. Similarly, purely model development efforts are more appropriate for the Grand Challenge Research call.

3.2.1.3 Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate (ROSMIC)/ LWS Sun-Climate Theme

The LWS Sun-Climate strategic objective to "deliver the understanding of how and to what degree variations in the solar radiative and particulate output contribute to changes in global and regional climate over a wide range of time scales" directly supports the above VarSITI theme and, therefore, is subsumed under this topic. Particular emphasis will be placed upon:

- Coupling of the upper and lower atmosphere and the processes responsible for transmitting solar variations to the Earth's surface where they can affect *regional climate.*
- Atmospheric responses on time scales of seasons to millennia and relative importance of solar irradiance versus energetic particles are of primary interest.

Only investigations of Sun-climate issues will be considered compliant under this theme; climate investigations that are not directly relevant to solar forcing are not being solicited.

The VarSITI elements are not Focused Science Topics; there is no expected FST team contribution for awards, and the maximum duration of awards resulting from this element are for three years only (also in keeping with the 2014-2018 timeframe of VarSITI). However, proposals will be judged for compliance based on their (demonstrated) relevance to the SEE, SPeCIMEN or ROSMIC themes. It is nevertheless anticipated that selected PIs will collaborate and share their models and results with each other and the international VarSITI project leaders.

4. Cross-Discipline Infrastructure Building Programs

One of the major challenges facing the LWS Program is to foster an interdisciplinary research community that can cut across traditional discipline boundaries to solve system science problems that are central to understanding and modeling the Sun-Solar System connection. The LWS program is soliciting proposals for one or more investigations to help NASA meet this challenge by promoting interdisciplinary research and development of skills to foster it. It is the expectation of LWS that the resulting award(s) will enhance and facilitate a Heliophysics community composed of diverse sub-disciplines. In order to address this challenge, proposals to this LWS program element may include infrastructure-building elements (e.g, see Final Report of the LWS TR&T Science Definition Team), such as but not limited to, summer schools, postdoctoral fellowships, community workshops implementing the proposed investigation consistent with LWS research goals and objectives. LWS envisions that any award(s) that include such methods and approaches to facilitate the community working together would be guided by a steering committee composed of both community and NASA scientists in the LWS area.

5. Submission and Evaluation Process

5.1 Step-1 Proposals

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process (see the overall description of a two-step process in the *Summary of Solicitation Section IV. (b) vii*). Proposers should refer to the "Instructions for

Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Tables 2 and 3 in the *ROSES Summary of Solicitation*). The Step-1 proposal must be submitted by an Authorized Organizational Representative (AOR) of the PI's institution. No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a full Step-2 proposal. Full proposals must contain the same scientific goals proposed in the Step-1 proposal. The Step-1 proposal title, Principal Investigator, and all Co-investigators, collaborators, and consultants cannot be adjusted between the Step-1 and Step-2 proposals. The expected format is described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal later, but all who submit a compliant Step-1 proposal will be invited to submit a corresponding Step-2 proposal.

5.1.1 Step-1 Proposal Format

The Step-1 proposal is restricted to one page in length. It should include the following information:

- A description of the goals and objectives to be addressed by the proposal.
- A brief description of the methodology to be used to address the goals and objectives.
- A brief description of "Proposed Contributions to the Focus Team Effort" (or relevance to LWS Cross-Discipline Infrastructure Building goals and elements of VarSITI themes).

The NSPIRES system for proposal submission requires a very brief summary to be entered into the "Proposal Summary" field and it requires a PDF "Proposal Attachment", which should be the Step-1 proposal. Proposals will be checked to ensure that the text is compliant with the program element indicated (i.e., relevant to only the specified topics, with "Proposed Contributions" addressed).

5.2. Step-2 Proposals

A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the *ROSES Summary of Solicitation*). The Step-2 proposal must be submitted via NSPIRES by the organization Authorized Organizational Representative (AOR). A budget and other specified information is required. The Step-2 proposal title, Principal Investigator, and all team members must be the same as those in the Step-1 proposal. Step-2 proposals must contain the same goals proposed in the Step-1 proposal.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. Proposers that have received a noncompliant letter are not eligible to submit a Step-2 proposal.

5.2.1 Step-2 Proposal Format

Guidelines for submitting Step-2 full proposals are specified in the *NASA Guidebook for Proposers*. The criterion for relevance includes relevance to one of the two Focused Science

Topics (Sections 3.1.1–3.1.2) as an essential requirement for selection. As such, NASA has instituted a compliance check as follows:

In order to be compliant to this ROSES element, each FST Step-2 proposal submitted must contain a section, which must be entitled “Proposed Contributions to the Focus Team Effort” and be identified in the proposal's table of contents. Failure to include this section will result in the proposal being judged noncompliant, and the proposal will be returned. This section must include the following three items:

- The relevance of the proposal to the scientific objectives of the Focused Topic.
- The potential contributions (e.g., data sets, simulation results, understanding of physical mechanisms, etc.) from the proposed effort to the Focused Science Team's effort.
- Metrics and milestones for determining the successful progress and outcome of the proposed research.

The *NASA Guidebook for Proposers* states, “NASA strongly encourages PIs to specify only the most critically important personnel to aid in the execution of their proposals.”

5.2.2 Step-2 Evaluation Criteria

Step-2 proposals that are not compliant with format requirements in Section IV (b) *ii* of the *ROSES Summary of Solicitation* and the *NASA Guidebook for Proposers* may be rejected without review.

Compliant proposals will be evaluated according to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*. These criteria are intrinsic scientific and technical merit, relevance to the NASA’s objectives and those of the FST, which includes cost realism/reasonableness.

For Focus Science Topics described in section 3.1, in addition to the factors given in the *NASA Guidebook for Proposers* each proposal submitted must contain a section, entitled "Proposed Contributions to the Focus Team Effort" and it must be identified in the proposal's table of contents. Failure to include this section will result in the proposal being judged noncompliant, and the proposal will not be reviewed.

Relevance is dependent on the particular Focus Science Topic. Each proposal must demonstrate that the investigation is appropriate for the FST selected. This criterion will be strictly enforced. The appropriate scale of the effort in terms of manpower will also be considered in considering the relevance of FST proposals.

NASA will establish one review panel per element. Named Co-Investigators (who are not PIs on other proposals in the same element) should expect to be called on to provide external ("mail-in") reviews for two to four proposals for that element. External reviews provide review panels with access to vital in-depth expertise and they are critical to the integrity of the review process. Simply being an investigator on a proposal submitted to the H-LWS program solicitation does not automatically constitute a conflict of interest and relief of obligation. (A proposal that is

mistakenly sent to review that does include a PI/Co-Is from the same organization would, however, be an inappropriate conflict of interest).

6. Award Types

The Heliophysics LWS Science program will primarily award funds through three vehicles: (1) grants, (2) interagency transfers, and (3) awards to NASA centers. This call will not award contracts, as it is not appropriate for the nature of the work. Please also see the *ROSES Summary of Solicitation,* Section II (a).

7. Summary of Key Information

Expected annual program budget for new awards	$3.5 M. See also Section 3.1
Number of new awards pending adequate proposals of merit	~20
Maximum duration of awards	Focused Science Topics: 4 years SCOSTEP/VarSITI : 3 years Infrastructure: 5 years
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Step-2 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Date for start of investigation	No earlier than October 1, 2015.
Page limit for the central Science-Technical-Management section of proposal	15 pp; one extra page permitted for proposals to be Team Leader of a Focused Science Topic, two extra pages are permitted for Cross-Discipline Infrastructure Building proposals; see also Chapter 2 of the *NASA Guidebook for Proposers*
File size limit for the proposal	10MB
Relevance	This program is relevant to the Heliophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. See Section 5.2.2
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Section 3.3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)

Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-LWS
NASA points of contact concerning this program	Madhulika Guhathakurta Heliophysics Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1992 E-mail: lws.trt@nasa.gov Robert Leamon Heliophysics Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1546 E-mail: lws.trt@nasa.gov

B.7 HELIOPHYSICS INFRASTRUCTURE AND DATA ENVIRONMENT ENHANCEMENTS

Notice: Proposal submission to all calls in Heliophysics will be by a two-step process, in which a Notice of Intent is replaced by a required Step-1 proposal. The Title and investigators cannot be changed between the Step-1 and Step-2 proposals. See section 4 for details. The Heliophysics Infrastructure element of H-IDEE will not be competed in ROSES-2015.

1. Introduction

The Heliophysics Infrastructure and Data Environment Enhancements (H-IDEE) program is a component of the Heliophysics Research Program and proposers interested in this program element are encouraged to see the overview of the Heliophysics Research Program in B.1 of this ROSES NRA.

The goal of the H-IDEE program is to enable breakthrough research in Heliophysics by providing both a state of the art data environment and necessary supporting infrastructure to maximize the scientific return of the NASA missions.

This program has two main research thrusts, Data Environment Enhancements (H-DEE see Section 2 below) and Infrastructure (H-I see Section 3 below). The Infrastructure element will not be competed in ROSES-2015.

These studies are carried out in support of the Heliophysics strategic goals and subgoals in NASA's 2014 *Strategic Plan* and Chapter 4.1 of the NASA *2014 Science Plan* (http://nasascience.nasa.gov/about-us/science-strategy). The recommended priorities of the Heliophysics community are also discussed in the National Research Council Decadal Strategy for Solar and Space Physics report, *Solar and Space Physics: A Science for a Technological Society* (http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_056864).

The H-IDEE program encompasses the data environment and infrastructure needs throughout Heliophysics, including Solar, Heliospheric, and Geospace Sciences. When competed in future years, especially welcome (for H-I) are proposals that seek to explore and demonstrate key components of our infrastructure, such as those identified in the National Research Council decadal survey for space physics, *Solar and Space Physics: A Science for a Technological Society,* including those in Appendix B and C.

As part of a mission-oriented agency, the Heliophysics Research Program seeks to fund those efforts that directly impact NASA missions or interpretation of their data. Therefore, investigations that are judged to be more appropriate for submission to other Federal agencies, even if of considerable merit, will not be given high priority for funding through this solicitation.

2. Heliophysics Data Environment Enhancements (H-DEE)

The basic building blocks of the NASA Heliophysics data environment are well-documented, carefully calibrated, and easily used data products, typically the result of the reduction of numbers from spacecraft telemetry to the physical quantities that enter the equations we use to

model space plasmas. Many such datasets were produced before the era of standard formats and cheap storage devices, and others have been served by recent missions in a variety of ways from specialized web sites. This call solicits proposals to upgrade older datasets that are of continuing value (Data Upgrades) and to support the continued serving of data from recent missions in the context of groups that understand the data and can help with its use (Resident Archives). As NASA mission data become better documented and formatted in standard ways, the need for Resident Archives continues to decrease, although in cases where data use is still demonstrably high and the products are complex, there may still be utility in supporting these intermediate archives for some time before the data transition to a Final Archive.

As detailed in the Heliophysics Scientific Data Management Policy (found at http://hpde.gsfc.nasa.gov), which gives further information about the Heliophysics Data Environment (HPDE), the Final Archive for Space Physics data, where the data will be preserved and served for the long-term, is the NASA Space Physics Data Facility. Solar data are handled by NASA's Solar Data Analysis Center (SDAC), although the specific archiving arrangements are currently being dealt with on a case-by-case basis. Proposers working with solar data should expect to work with SDAC, the Heliophysics (HP) Data and Model Consortium (HDMC), and NASA Headquarters on a long-term plan. (The HDMC oversees work under the H-DEE grants.)

In recent years, NASA HP has developed standard ways of registering, and thereby enabling, searches for HP data. Ultimately, we aim to have all HP data products described in terms of the Space Physics Archive Search and Extract (SPASE) Data Model (see http://www.spase-group.org/ for information on SPASE and http://heliophysicsdata.gsfc.nasa.gov for a "public face" to the registry) that provides a uniform terminology and an associated registry service. Registration of data products can be done directly by the data provider, but the HP Virtual Observatories (VOs) should be able to provide descriptions as needed. Thus, people undertaking data projects under this call should identify a VO to help them with the required SPASE descriptions, if needed. (See http://hpde.gsfc.nasa.gov/hpde_data_access.html for descriptions of and links to the VOs.)

A frequent problem with past data is that it has been stored in a wide variety of idiosyncratic formats for various reasons. A major goal of Data Upgrade proposals will be to put data in uniform, sustainable formats. For solar physics data, this should be Flexible Image Transport System (FITS), and for space physics data Common Data Format (CDF) is generally the format of choice. Some Ionosphere, Thermosphere, Mesosphere (ITM) data are closely allied to Earth Sciences, and thus, NetCDF is appropriate. ASCII is acceptable as a "format," as long as the files are well described, but the self-documenting formats are to be preferred. Resident Archives should work toward these formats as well, and some portion of their budget may be devoted to this.

In summary, one aspect of this program solicits proposals designed to upgrade existing Heliophysics data products to improve the quality, utility, and accessibility of datasets relevant to Heliophysics research. Possible upgrades could include (but are not limited to) placing datasets online, translating datasets into more readily accessible hardware and/or software formats, improving the data quality, providing data access and interpretation tools, and improving metadata. Note that the term "dataset" can apply not only to data products derived directly from

NASA-funded instruments or other instrumentation, but also to higher-level datasets derived from the results of data analyses, data assimilation, and modeling.

Also solicited are proposals to continue existing data services, which would typically have a period of award no longer than two (2) years, featuring data from Heliophysics missions that have terminated or will soon terminate; such Data Service Continuation proposals will result in Resident Archives (RAs). These are intended to continue access to data with expert help until the data are sufficiently documented for independent use and are moved to a Final Archive. When RA access is no longer deemed necessary, the final legacy data files will be served from one of the Final Archives, namely the Space Physics Data Facility (SPDF) and the Solar Data Analysis Center (SDAC—see above). The increasingly common practice of entering mission data into HP final archives in standard formats before the mission is over has reduced the need for RAs, which were primarily intended to avoid the loss of access to data that had often occurred when past HP missions terminated. Arguments for the need for RAs should be framed in this context.

2.1 Programmatic Considerations

Proposals must discuss the relationship of the proposed effort to the present, as well as anticipated, state of knowledge in the field, to the anticipated readiness of needed technologies, to the relevant datasets that should be available from any related planned missions, and to any related NASA community research efforts.

All proposals to this call should address two general areas:

I. Science Rationale. The science rationale includes:
- a. Key objectives and their scientific importance;
- b. Relationship to NASA strategic plans and the HP data policy; and
- c. Uniqueness or scientific advantages of the proposed approach compared to alternatives.

II. Architecture and Implementation Approach. The architecture and implementation approach includes:
- a. Technical approach and its requirements and feasibility;
- b. Data products or other resources supported or enhanced;
- c. Metadata and documentation of products and required ancillary data or services;
- d. Infrastructure and constraints assumed in place at the time of implementation; and
- e. Compatibility with the Space Physics Archive Search and Extract (SPASE) Data Model.

All proposals are expected to result in significant services and products within the grant period. The total funding available for awards will be approximately $500K, with no *a priori* division amongst the type of awards. It is expected that Data Upgrades will be for up to $50K for one year and Resident Archives up to $50K per year for two years. Proposals requesting higher levels of funding and/or longer periods of performance must show sufficient justification for such requests. It should be noted that although the allotment for RAs is up to $50K, it will not be practical to support each instrument on all the NASA HP missions as they retire at this level; efforts should be made to use economies of scale (e.g., combining with existing or other proposed RAs), the resources of the Final Archives, and other means to contain costs.

Submitting a proposal to this solicitation implies that if an award is made, a copy of any data product will be made public, preferably via one of the two discipline archives: the Space Physics Data Facility (SPDF), or the Solar Data Analysis Center (SDAC). Any proposal that would create a data product should include a brief data sharing plan regarding how it would be publicly archived. Proposers that include a plan to archive data should allocate suitable time for this task.

Proposers to this program element are not required to provide a data management plan via the NSPIRES cover page question. Instead, that is superseded by instructions in the sections below that place more detailed descriptions into the body of the Scientific/Technical/Management section of proposals. See Sections 2.2 and 2.3, below.

2.2 Data Services Upgrades Proposals

Funding in this area is intended to support small, short-term (typically one year) awards to improve the quality, utility, and accessibility of datasets relevant to Heliophysics research. Priority will be given to those proposals from data providers of NASA-sponsored datasets, but other data relevant to HP research will be considered.

A proposal for a Data Services Upgrade must include explicit subheadings with a discussion of each of the following points (explicitly note if not applicable):

- Products to be Produced: A clear description of the products to be produced, including the time span covered; the physical quantities to be included with their temporal and/or spatial resolution; and the format(s), coordinate system(s), and processing level(s) (e.g., calibrated in physical units or not, the former being far preferable).
- Scientific Utility: An argument for why the datasets involved were scientifically useful in the past and for how the proposed upgrade will make them more useful in the future. Specific research projects should be mentioned, along with an assessment of whether these will bring qualitatively new insights. This should be supported by, e.g., refereed publications or other citations and uses by people outside the original PI team.
- Demonstration of Improvement: A demonstration that the proposed upgrade represents a significant improvement in the quality and/or utility of the data, its format, and/or its accessibility. "Before and after" graphs are especially helpful, and the validation of techniques and results must be discussed.
- Current Data Status: The current status of the data and a demonstration that the data can still be retrieved from their current storage medium.
- Data Description: A statement of the current data volume, the expected data volume after processing, and the fraction of the data expected to be recovered.
- Metadata Plan: A plan for providing required metadata and ancillary data and descriptions needed for independent scientific usability. A plan for providing SPASE descriptions of products, usually in conjunction with a VO or data center, should be included.
- Archive and Dissemination Plan: A clear discussion of how the resource will be placed in an HP Data Center for general access or otherwise made easily available.

- Need for Resources: A discussion that demonstrates that the requested resources are necessary and sufficient for success in achieving the proposed upgrade. If the product is ongoing, the plan for supporting the continuation should be stated.

The discussion of each of these points may be brief, but each point must be clearly addressed. The titles of proposals submitted to this portion of the solicitation must contain the words "Data Services Upgrade." The Scientific/Technical/Management section (including figures) of proposals submitted to this portion of the solicitation shall be no more than five pages.

2.3 Data Services Continuation Proposals

Funding will support modest awards, typically for up to two years, to continue existing data services, in "resident archives." A Resident Archive (RA) will be created to continue to serve mission data or a subset of a mission's data (e.g., data products for a single instrument) after the mission has ended. This arrangement is intended to keep those most familiar with the data and its caveats involved such that a user will have access to expert assistance in using the data for research. There is no restriction (other than those for this solicitation) on who can apply for an RA for a particular set of products or on possible arrangements with other RAs or data centers.

A Data Services Continuation proposal must include:

- A statement of the scope of the RA, including the data products and services to be included.
- Arguments for why the data should still be served by the Principal Investigator (PI) team or a closely associated team knowledgeable about the data, rather than directly deposited in a Final Archive. These should demonstrate the science value of the data to qualitatively significant ongoing or future investigations as indicated, e.g., by refereed publications, specific research project suggestions, and the use of the data by researchers outside the proposing team.
- A description of how the RA will ensure that the mission data are served to the general community in an efficient and scientifically useful manner consistent with the community data environment guidelines. While level zero data plus on-the-fly processing may be used for serving, it is expected that a set of "legacy products" in physical units and accessible formats will also be available and served.
- A plan to maintain the integrity of the data by safeguarding against data loss; this could be achieved by a number of approaches, including the use of mirror sites, backup storage at the HP Data Centers or elsewhere, as well as with such tools as checksums. (See the criteria for a good archive in the HP Data Policy, Appendix F, Section F.4.)
- A statement of the relationship of the RA to one or more of the VOs or HP Final Archives and of the related plan to produce SPASE descriptions of products.
- A statement of the type and amount of expert assistance with data issues to be provided.
- An inventory of documentation to be provided for data, calibration, and validation methods; and for the mission, observatory, and instrument(s), along with a demonstration that these are adequate to assure the data will be independently usable.
- Considerations of potential cost-savings and increased utility through collaboration with others, including other investigator teams, existing or proposed RAs, NASA Data Centers, or other data centers.
- A plan to obtain community input to ensure success and make improvements.

- A plan for transitioning the data to a Final Archive.
- A demonstration that the resources requested will be necessary and sufficient to perform the RA functions. Proposals are expected to make use of economies of scale, when appropriate, by combining related serving functions across related data products (related by, e.g., mission, data type, institution, personnel, etc.).

Activities that are not to be proposed for a Resident Archive would be the generation of significant upgrades to the datasets, reprocessing data, upgrading data processing algorithms, or providing new data products derived from the resident data. These types of postmission data activities need to be funded from other sources (in some cases, this could be through a separate Data Services Upgrade). However, the functions of a Resident Archive could include "loading" newly derived data products into the archive with appropriate changes to metadata, documentation, web interfaces, etc.

The proposal should maintain reserves such that, if the Data Services Continuation award is not renewed or is subsumed under another RA structure, the RA would transfer the data to the other RA or a Final Archive. The RA proposal shall include a plan for such transfer to a Final Archive in a manner that will still allow data access to at least the basic legacy data files.

The titles of proposals submitted to this portion of the solicitation must contain the words Data Services Continuation. The Scientific/Technical/Management section (including figures) of proposals submitted to this portion of the solicitation should be no more than ten pages.

3. Heliophysics Infrastructure

The Heliophysics Infrastructure element of H-IDEE will not be competed in ROSES-2015.

Advancement in Heliophysics research goals not only requires a robust research program and new observations by NASA missions, but it requires a coordinated set of observations and facilities. The Heliophysics Infrastructure (H-I) program element supports ground-based facilities that are crucial to fulfilling the scientific potential of the NASA missions. Specific examples of Infrastructure facilities fall into three categories: 1) ground-based observations directly related to the scientific return of NASA mission data and 2) ground-based facilities crucial to the development and calibration of NASA flight instruments, and 3) ground-based instrumentation that directly supports NASA suborbital flights.

When competed in future years, proposals for H-I must demonstrate relevance to the Heliophysics program, including clearly defined scientific goals appropriate for future Heliophysics missions. Proposals to the H-I must demonstrate that there are specific scientific problem(s) for which the facility is necessary. The proposals are not necessarily expected to apply the results of their efforts to the science problem(s) within the time period of the proposed effort.

4. Submission and Evaluation Process

4.1 Step-1 Proposals

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process. The overall description of a two-step process can be found in Section IV. (b) vii of the ROSES *Summary of Solicitation*.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Tables 2 and 3 in the *ROSES Summary of Solicitation*). Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Step-1 proposal must be submitted by the organization Authorized Organizational Representative (AOR). No budget or other elements are required. Only proposers who submit a Step-1 proposal are eligible to submit a full proposal. Full (Step-2) proposals must contain the same scientific goals proposed in the Step-1 proposal. The Step-1 proposal title, Principal Investigator (PI), and all Co-Investigators (Co-Is), Collaborators, and Consultants cannot be adjusted in between the Step-1 and Step-2 proposals. The expected format and compliance evaluation criteria are described below. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal later.

4.1.1 Step-1 Proposal Format

The Step-1 proposal is restricted to one page in length. It should include the following information:

- A description of the science goals this proposal is enabling and that are appropriate for Heliophysics investigations.
- A brief description of the methodology to be used to address the science goals and objectives.

The NSPIRES system for proposal submission requires a very brief summary to be entered into the "Proposal Summary" field and it requires a PDF "Proposal Attachment", which should be the Step-1 proposal.

4.1.2 Step-1 Evaluation Criteria

NASA may determine Step-1 proposals to be noncompliant based on the compliance requirements listed in Section 1. PIs of noncompliant proposals will not be eligible to submit the associated Step-2 proposal, and will receive a letter to this effect. All who submit a compliant Step-1 proposal will be invited to submit a corresponding Step-2 proposal.

4.1.3 Request for reviewer names

Proposers are strongly encouraged to provide names and contact information of up to five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is or stand to benefit financially from the selection (or otherwise) of the proposal. This information can be supplied via the SARA web page at http://science.nasa.gov/researchers/suggested-reviewers/.

4.2 Step-2 Proposals

A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the *ROSES Summary of Solicitation*). The Step-2 proposal must be submitted by the organization Authorized Organizational Representative (AOR). A budget and other specified information is required. The Step-2 proposal title, Principal Investigator, and all Co-Investigators, Collaborators, and Consultants must be the same as those in the Step-1 proposal. Step-2 proposals must contain the same scientific goals proposed in the Step-1 proposal.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. Proposers that have received a noncompliant letter are not eligible to submit a Step-2 proposal.

Proposers may be asked to provide mail-in reviews for one to three proposals in this competition. Much of the science expertise lies in the PI/Co-I community, because increasingly, much of the Heliophysics community proposes. In order to maintain a high caliber review process it is important to get the additional mail-in reviews to cover all proposals fairly.

4.2.1 Step-2 Proposal Format

Proposers should refer to the PDF entitled "How to submit a Step-2 proposal" that will appear under "Other Documents" on the NSPIRES page for this program after the Step-1 proposal due date. The process for preparation and submission of the Step-2 (full) proposals is that for any other ROSES proposal. Guidelines for content and formatting of Step-2 full proposals are specified in the *NASA Guidebook for Proposers* and the *ROSES Summary of Solicitation*.

Proposals should include the following within their Scientific/Technical/Management section: clear descriptions of (1) specific Heliophysics scientific problems that could be addressed with the ground-based data, upgraded data, or archived data in conjunction with other HSO resources (2) the importance of the problems, and (3) the details of the technical approach to providing the promised data or archival services. Proposals should be clear on how data will be made to conform to the Heliophysics Data Policy.

4.2.2 Step-2 Evaluation Criteria

Step-2 proposals that are not complaint with format requirements may be rejected without review. See Section IV (b) ii of the *ROSES Summary of Solicitation* and the *NASA Guidebook for Proposers* for details. (1) If applicable for this solicitation, proposers must select the subelement that is appropriate for their intended proposal; proposals that are not appropriate for the chosen subelement may be declared noncompliant. (2) Proposals outside the scope of this solicitation may be declared noncompliant.

Compliant proposals will be evaluated according to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*. These criteria are intrinsic scientific and technical merit, relevance to NASA's objectives, and cost realism/reasonableness.

The evaluation of scientific and technical merit will include:

- Compelling nature and scientific priority of science goals enabled by and appropriate for future investigations, including the importance of the problem within the broad field of Heliophysics; the unique value of the investigation to make scientific progress in the context of current understanding in the field, and the importance of carrying out the investigation now.
- Appropriateness and feasibility of the methodology, including the appropriateness of the selected data, models, and analysis for completing the investigation and the feasibility of the methodology for ensuring scientific success.

Based on these two factors, the evaluation will consider the overall potential science impact and probable success of the investigation.

Relevance to NASA objectives is dependent on the particular program element. Each proposal must demonstrate that the investigation is appropriate for the specific program selected.

Cost realism/reasonableness will include assessing the amount of work to be accomplished versus the amount of time proposed. Open-ended proposals or those with a large number of science questions to be addressed typically do not fare well in this evaluation. Only necessary Co-Investigators and Collaborators should be included, and their specific roles in the investigation must be clearly laid out. Use of Collaborators whose only role is advisory is discouraged.

5. Available Funds

It is anticipated that approximately $500K will be made available to support new selections for Data Environment Enhancements. It is expected that about 10-12 new selections will be made with funds of the next fiscal year.

6. Summary of Key Information

Expected program budget for first year of new awards	$500K H-DEE
Number of new awards pending adequate proposals of merit	~10-12
Maximum duration of awards	H-DEE: see Section 1.2; H-I: Not solicited this year
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for full proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after step-2 proposal due date.
Page limit for the central Science-Technical-Management section of proposal	H-DEE: See Section 2. H-I: Not solicited this year; see also Chapter 2 of the *NASA Guidebook for Proposers*

Relevance	This program is relevant to the Heliophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Step 1 and Step 2 proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-HIDEE
NASA points of contact concerning H-DEE Call	Jeffrey Hayes Heliophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0353 E-mail: jhayes@nasa.gov and D. Aaron Roberts Heliophysics Science Division Code 672 Goddard Space Flight Center Greenbelt MD 20771 Telephone: (301) 286-5606 E-mail: aaron.roberts@nasa.gov

APPENDIX C. PLANETARY SCIENCE RESEARCH PROGRAM

C.1 PLANETARY SCIENCE RESEARCH PROGRAM OVERVIEW

NOTICE: Amended March 13, 2015. This amendment adds a requirement that investigators that would publish a geologic map through the U.S. Geological Survey (USGS) would include in their Step-2 (full) proposals a letter of technical specifications from the USGS Map Coordinator (Section 4.4.1) and adds text describing how to determine to what program element a proposal that includes the publication of a geologic map should be submitted (Section 4.4.2). The requirement of the letter of technical specifications does not alter the requirements for the 15-page main body of the proposal to adequately explain and justify the work proposed. This Amendment does not alter the deadlines for any program element.

1. Introduction

The Planetary Science Research Program supports investigations of all classes of objects in the Solar System, except those focused on the Earth and Sun, consistent with the strategy for Solar System Exploration embodied in the *Solar System Roadmap 2006* (available at http://solarsystem.nasa.gov/multimedia/downloads.cfm). A proposal submitted to any of the following programs in this section must present, within its Scientific/Technical/Management section, a clear description of a specific scientific problem, a description of how the attack on this problem will be carried out, and a discussion of the relevance of the proposed research to NASA's current and/or future programs. Proposals whose intent or purpose is to extend or directly supplement investigations already selected for approved space flight missions are not appropriate for this NRA. Investigators who are members of science teams of ongoing missions must delineate clearly between their mission responsibilities and any research efforts proposed through this NRA.

Proposals that include analysis of data from Planetary Science Division (PSD) space flight missions must use publicly available data released through the Planetary Data System (PDS) at http://pds.jpl.nasa.gov/. Proposals that utilize any data from Planetary Science Division space flight missions, in any amount, that is not yet publicly available on the PDS, will not be considered. Requirements for depositing derived data products in the Planetary Data System have been revised to require that all products be PDS4 conformant. This applies to such programs as Lunar Data Analysis (C.8), Mars Data Analysis (C.9), Cassini Data Analysis and Participating Scientists (C.10), and Discovery Data Analysis (C.11). Guidelines for planning data in this format are available at http://pds.nasa.gov/pds4.

The standard award duration is three years, and it is anticipated that most proposals will seek three years of funding. Proposals for less than three years are encouraged for projects that can be completed on shorter timescales. For those program elements that permit longer awards, funding for more years than three is contingent upon the need for the longer duration as sufficiently well justified in the proposal.

1.1 Changes from Last Year

Although Appendix C continues to use the Two-Step Proposal Submission Process, an uploaded PDF document is no longer required, merely text typed into the mandatory (4000-character) Proposal Summary box in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web interface, see Section 2, below.

The Planetary Science Division will not accept or evaluate duplicate Step-2 submissions for the same or essentially the same work, see Section 3.1 for details.

With the a few exceptions, proposers to Appendix C must provide a data management plan (DMP) or an explanation of why one is not necessary given the nature of the work proposed. See Section 4.3, below, and the SARA Frequently Asked Questions (FAQs) for ROSES.

Some program elements in Appendix C (e.g., C.3-C.5 and C.10) require an explicit relevance statement, which will be collected in a mandatory (4000-character) text box on the cover pages via the NSPIRES web interface. See section 5, below.

2. The Two Step Proposal Submission Process

To facilitate the early recruitment of a conflict-free review panel, and to ensure proposals are submitted to the appropriate program, most calls in Appendix C will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact identified in the summary table of key information and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

2.1 Step-1 Proposal

The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be performed on Step-1 proposals. Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for the program of interest.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

2.2 Step-2 Proposal

Proposers should refer to the PDF entitled "Instructions for Submitting a Step-2 Proposal" that will appear under "Other Documents" on the NSPIRES page for the program of interest. All proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages, unless otherwise specified
- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that proposers use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single spaced.
- Figure captions: Must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

3. Planetary Division Research Program Organization

The Planetary Science Division reorganized its calls for proposals in ROSES-2014 and that structure remains in place. Although some calls, such as, Mars Data Analysis (C.9), Cassini Data Analysis (C.10), and Discovery Data Analysis (C.11) remain, core research programs from past years, such as Planetary Astronomy, Planetary Atmospheres, and Planetary Geology and Geophysics have been recast into five new "Core" research calls that map to the five Planetary Science Division goals. In addition, two "Strategic" calls, narrower in scope and meeting strategic needs, and two "Focused" calls, narrow in scope and limited in the time, have been added. A cross-divisional call, Exoplanets (E.3) shared with the Astrophysics Division, has replaced the previous Origins of Solar Systems program.

1. The new "Core" research calls are:
   Emerging Worlds, C.2
   Solar System Workings, C.3
   Habitable Worlds, C.4
   Exobiology, C.5
   Solar System Observations, C.6

2. The new "Strategic" calls are:
   Planetary Data Archiving, Restoration, and Tools, C.7
   Planetary Science and Technology from Analog Research, C.14

3. The new "Focused" calls are:
   Lunar Data Analysis, C. 8
   Hayabusa2 Participating Scientist Program, C.19

The new "Core" calls are organized by the themes of the science investigations. For some calls, this means a direct mapping from the old program elements to the new program elements. For a few of the old program elements, however, the proposals that would have gone into one program element together are now directed to separate programs (for instance, some proposals from Mars Fundamental Research Program will go to Solar System Workings, while others will go to Habitable Worlds). In addition, for other reasons, there may be regions of ambiguity in whether a proposal is appropriate for submittal to one program or to another.

PSD solicits proposals whose work efforts are primarily analysis of planetary mission data through the Data Analysis Programs. If a proposal would analyze data within the scope of more than one of the data analysis programs, in order to perform comparative studies across the Solar System, but is not appropriate to any one data analysis program, then submission to a Core Research Program is encouraged. If a proposal is not appropriate for one of the Data Analysis programs but does fit within the bounds of a Core Research Program (i.e., Solar System Workings or Emerging Worlds), it should be submitted to that Core Program.

3.1 Duplicate Proposals

If it is unclear to which program a proposal should be submitted, proposers should contact either the technical officer of the current award or the point of contact for the program element most likely to be appropriate for the proposal.

Proposers may not simply submit Step-2 proposals for the same project or investigation to more than one program element. The Planetary Science Division will not accept or evaluate duplicate Step-2 submissions for the same or essentially the same work more than once in a ROSES year. The first proposal will be evaluated, but any subsequent proposal submitted to Planetary Science via ROSES-2015 for the same work will not be evaluated or considered.

Substantive changes to a proposed project or investigation that would result in it no longer being the same, include aspects of the proposal that are covered by the merit evaluation, e.g.,

- The proposing institution
- Funded investigators and unfunded Co-Investigators (Co-Is) who are performing a significant portion of the work
- Concepts, ideas, goals and objectives
- Implementation (methods, approaches, instrumentation)
- Target (i.e., of measurements, observations, modeling)

Changes to a proposed project or investigation that would not be considered substantive and thus would not result it being eligible for submission again in the same year, include aspects of the proposal that are not covered by the merit evaluation, e.g.,

- The Current and Pending Support Section

- Relevance statement
- Budget Section
- Minor changes, even to the prior list of aspects covered by the merit evaluation (Team, Concepts, Implementation, Target, etc.) will not necessarily be considered substantive.

This applies to all proposals being considered by the Planetary Science Division in response to program elements in Appendix C and also program element E.3. Proposals that are no longer under consideration, either because they were rejected or withdrawn, are not duplicates for the purpose of this rule.

4. Resources: Information, Data, and Facilities

4.1 Limits on Use of Mission Data

For proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply, must demonstrate clearly how the proposed research does not overlap and is not redundant with data analysis, duties, or responsibilities already funded by their respective mission(s).

4.2 Facilities and Data Sources Available to Proposers

The following facilities and data sources are available to supported investigators. If their use is anticipated, this must be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment).

Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

- The Planetary Data System (PDS)

The Planetary Data System (PDS) archives and distributes scientific data from NASA planetary missions, astronomical observations, and laboratory measurements. The archives can be found through the PDS home page at http://pds.nasa.gov/. PDS is supported by six Science Discipline Nodes (Atmospheres, Geosciences, Imaging, Planetary Plasma Interactions, Rings, and Small Bodies) distributed around the U.S. Each Node serves data from NASA's planetary missions and documentation sufficient to use those data. Data searches and requests can be initiated from the PDS home page or at any of the Science Discipline Node pages accessible there. Guides and tools for using data, preparing an archive, and archiving data can be found at http://pds.nasa.gov/tools/. Contact the PDS Operator (pds_operator@jpl.nasa.gov) or the appropriate Node's point-of-contact for assistance.

- General Lunar and Planetary Information

The Lunar and Planetary Institute (LPI) provides one of the most concentrated and easily-accessible collections of data and other information in lunar and planetary science, including extensive digital map and imagery collections, computational tools for the lunar community, and a vast collection of educational products and resources. These resources, along with an extensive range of electronic tools to enhance science activities and effective communication within the planetary science community, can be found on the LPI's website at http://www.lpi.usra.edu.

- Data from Completed NASA Flight Programs

The National Space Science Data Center (NSSDC) archives digital and other data from historic and completed flight missions, and its archives are complementary to those of the PDS. Such data include lunar and planetary photographs, digital planetary images, tabular and experiment data from numerous flight missions, and cartographic products. Investigators are responsible for acquiring the data needed for their proposal. Modest requests for data are free of charge, while charges will be incurred for large-volume requests. Requests from U.S. investigators for data products and information may be made through the Coordinated Request and User Support Office at the NSSDC (nssdc-request@lists.nasa.gov). For more information, see http://nssdc.gsfc.nasa.gov/nssdc/obtaining_data.html.

- Regional Planetary Image Facilities

Regional Planetary Image Facilities (RPIFs) contain nearly half a million images of the planets and their satellites taken both from Earth and manned and unmanned spacecraft, as well as topographic and geologic maps produced from these images. The RPIFs, located at institutions worldwide, are intended for use by individuals and groups who use photographic and cartographic materials of the planets and satellites in their research programs. These programs include geologic, photometric, colorimetric, photogrammetric, and atmospheric dynamical studies.

In addition to the local scientists and their associates who use these data on a daily basis, investigators throughout the world are encouraged to use the RPIFs. Send inquiries to the nearest facility in care of the Director, Regional Planetary Image Facility. Note that, while these centers may be used for onsite study and selection of planetary and satellite images, they are not facilities for the production of photographs for users. Instead, such materials may be obtained from the NSSDC at the NASA Goddard Space Flight Center at http://nssdc.gsfc.nasa.gov/nssdc/obtaining_data.html. Additional information, including a listing of RPIF locations worldwide, can be found on the RPIF home page at http://www.lpi.usra.edu/library/RPIF

- Planetary Cartographic Products

NASA has a long-term contract with the U.S. Geological Survey (USGS) to provide a variety of cartographic support functions for NASA researchers through the Planetary Cartography Program. This support includes:

- the Integrated Software for Imagers and Spectrometers (ISIS, http://isis.astrogeology.usgs.gov/);
- the management, review, and publication of geologic maps (Planetary Geologic Mapping Program, http://planetarymapping.wr.usgs.gov/);

- a search capability for raw planetary image data (PILOT, http://pilot.wr.usgs.gov);
- on demand production of higher level data products (Projection On the Web and Map and Planet, http://www.mapaplanet.org/);
- coordination of IAU approval of nomenclature http://planetarynames.wr.usgs.gov/;
- training in planetary GIS methods (MRCTR GIS Lab, http://astrogeology.usgs.gov/facilities/mrctr);
- training in the generation of topographic data from stereo images (Photogrammetry Guest Facility, http://astrogeology.usgs.gov/facilities/photogrammetry-guest-facility);
- and free hardcopies of USGS planetary geologic maps and a wide variety of historical information through the USGS node of the Regional Planetary Information Facility (RPIF, http://astrogeology.usgs.gov/rpif) Network.

For cartography support beyond what is provided by the Planetary Cartography Program, the USGS is willing to join proposal teams to produce or assist in the production of specific cartographic tools or products. However, the USGS is required to recoup the full cost of such activities in the proposal budget. Visit http://astrogeology.usgs.gov/ or E-mail laz@usgs.gov for further information.

- Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM)

An important goal of the Planetary Science Research Program is to facilitate access to extraterrestrial sample material for scientific purposes, including NASA-supported research projects. NASA's Johnson Space Center is responsible for the security of and access to all NASA-returned extraterrestrial samples (Apollo, Genesis, and Stardust), a subset of particles returned by The Japan Aerospace Exploration Agency's (JAXA's) Hayabusa mission, interplanetary dust particles collected by high-altitude aircraft, and meteorites collected in Antarctica by U.S. field parties. Peer review of sample requests is provided by the Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM). For information on how to obtain any of the specimens in these collections, see http://curator.jsc.nasa.gov/ or contact:

Office of the Curator
Code KT
Johnson Space Center
National Aeronautics and Space Administration
Houston, TX 77058-3696

- NASA-provided High-End Computational (HEC) Facilities

Those investigators whose research requires high-performance computing should refer to the *Summary of Solicitation*, Section I(d), "NASA-provided High-End Computing Resources." This section describes the opportunity for successful proposers to ROSES to apply for computing time on either of two NASA computing facilities at the NASA Goddard Space Flight Center's (GSFC's) Computational and Information Sciences and Technology Office or at the NASA Ames Research Center's (ARC's) Advanced Supercomputing Division. Proposers needing access to these facilities should include estimates of needed resources in the Budget Narrative section of their proposal. Further information on computing capabilities may be found at the NASA High-End Computing website, http://hec.nasa.gov/

- Planetary Aeolian Facility (PAL)

The Planetary Aeolian Facility at the NASA Ames Research Center consists of wind tunnels to simulate atmosphere-surface interactions on Earth, Mars and Titan. For more information, contact David Williams at David.Williams@asu.edu or find the PAL Guidebook for Proposers at: http://rpif.asu.edu/pal/

- Reflectance Experiment Laboratory (RELAB)

The RELAB facility at Brown University provides a mechanism for researchers to obtain high quality laboratory spectra of natural or synthetic materials for use in compositional, geologic, and remote sensing applications. RELAB is partially supported by NASA as a multiuser spectroscopy facility, and researchers are invited, but not required, to visit the laboratory in person during sample measurements. Laboratory time and most sample measurements are made available at no charge to investigators funded by NASA. If research proposed to NASA sponsored programs through the ROSES announcement requires acquisition of new spectra in the VIS/NIR or mid-IR, then the scope and justification must be provided in the submitted proposal. Data acquired as part of NASA-funded research are made available to the investigator immediately after measurement and are made publicly available three years after measurement. Additional information about this facility, a RELAB User's Manual, sample submittal forms, and access to RELAB spectroscopy data can be found at http://www.planetary.brown.edu/relab/. For further information, contact the Science Manager of RELAB, Dr. Ralph Milliken (Ralph_Milliken@brown.edu) or the Operations Manager, Dr. Takahiro Hiroi (Takahiro_Hiroi@brown.edu).

- NASA Ames Vertical Gun Range (AVGR)

The NASA AVGR is a national facility funded by the NASA Science Mission Directorate to enable investigations of impact phenomena and processes. Exploratory or proof-of-concept programs requiring a limited number of experiments can be accommodated at no cost. More extensive programs are subject to review in order to assess feasibility and cost effectiveness. Any need for extensive use of the AVGR should be explicitly described in the proposal. The proposal budget should include an estimate of usage costs. A letter of support from the AVGR is required.

For more information, potential users of the AVGR should contact:
Dr. John S. Karcz
Planetary Systems Branch
NASA Ames Research Center
Moffett Field, CA 94035-1000
Telephone: (650) 604-5174
Email: john.s.karcz@nasa.gov

- NASA Venus *In situ* Chamber (VICI)

The Venus *In situ* Chamber Investigations (VICI) is a NASA pressure chamber that enables testing of components and small instruments under temperatures and pressures that simulate Venus surface conditions. Lower temperatures and pressures can also be accommodated. Exploratory or proof-of-concept programs requiring a limited number of experiments/tests can be accommodated for minimal cost. Extensive use of the chamber should be described in the proposal and is subject to review by VICI personnel to assess feasibility and cost effectiveness.

Any use of the chamber and its corresponding costs should be included in the proposal budget. A letter of support from the VICI facility is required. For additional information, please contact natasha.m.johnson@nasa.gov.

- NASA Glenn Extreme Environment Rig (GEER)

The Glenn Extreme Environment Rig (GEER) is a simulation rig designed to provide the scientific and engineering communities an asset to perform laboratory experiments and/or technology developments or instrument/hardware qualification in extreme environments. When fully operational, GEER can accurately simulate the temperatures, pressures, and chemistry of the atmospheres of planetary bodies, including the conditions found on the surface of Venus. The chamber is of cylindrical shape with interior dimensions of three feet in diameter and four feet long. The chamber is rated for pressures up to 1518 psi at 1000 °F and eight individually controllable gas streams are available. Interested parties should contact Dan Vento (Daniel.M.Vento@nasa.gov) or Tibor Kremic (Tibor.Kremic@nasa.gov) for questions regarding status, availability, and any proposal related intentions. Some additional information on the GEER is available at http://microgravity.grc.nasa.gov/SSPO/SS/Extreme/.

4.3 Data Management Plans and Archiving

Proposals submitted to ROSES-2015 are required to include a data management plan (DMP), unless explicitly noted by the specific program element. The instrument development and Planetary Major Equipment calls (C.12, C.13, and C.17) do not require DMPs. Unless otherwise explicitly stated, DMPs must be submitted using the text box provided via the NSPIRES web interface. The DMP has an 8000-character limit, which will be automatically enforced by the NSPIRES web interface. Those who submit via Grants.gov will be held to the same requirements and length restriction. The DMP question is answered in a Grants.gov application by completing and attaching the relevant PSD.pdf form provided in the opportunity instructions document. NSPIRES will automatically incorporate the DMP into the proposal cover pages. Individual program elements may provide instructions that supersede and/or amplify the requirements described here. For example, the Planetary Data Archiving, Restoration and Tools (PDART, C.7) program element includes the data management discussion in the body of the proposal itself, rather than via the cover pages.

For more information on DMPs please see the SARA FAQ on data management plans in ROSES-2015.

For purposes of the DMP, the term "data" includes scientific and technical information, associated calibration data, and metadata or other documentation necessary to use the data. "Data" does not include physical objects.

The DMP must cover any data needed to validate the scientific conclusions of peer-reviewed publications, particularly data underlying figures, maps, and tables. The DMP should also cover any other data that would enable replication/reproduction of published results or future research. However, the DMP need not cover preliminary and other unpublished data, data in prepublication documents, private communications, or certain other types of information that have been specifically exempted (see the SARA FAQ on data management plans in ROSES).

Proposers should apply their own professional knowledge and experience in determining what data are scientifically appropriate for preservation and sharing, according to the standards of the relevant research communities.

In the case of a project that would produce no scientifically appropriate data, or only data specifically exempted, the DMP should simply state that no data preservation or data sharing is needed, but must also explain why. In a case where no appropriate archive exists for a particular data set, the DMP should explain why the data cannot be archived in another way.

The DMP should contain the following elements, as appropriate to the project, in adequate detail for review.

1. A description of data types, volume, formats, and (where relevant) standards.
2. A description of the schedule for data archiving and sharing.
3. A description of the intended repositories for archived data, including mechanisms for public access and distribution.
4. A discussion of how the plan enables long-term preservation of data.
5. A discussion of roles and responsibilities of team members in accomplishing the DMP. (If funds are required for data management activities, these should be covered in the normal budget and budget justification sections of the proposal.)

Typical DMPs will describe plans for the publication of data in scientific papers, in online supplemental material to scientific papers, in the Planetary Data System (PDS) or equivalent public archives, or on websites that serve as accepted community repositories for specific types of data.

DMPs will be reviewed as part of the overall NASA research proposal review process. NASA reserves the right to require the revision of the DMP prior to selection or funding. Funded researchers, research institutions, and NASA centers are responsible for ensuring and demonstrating compliance with the DMPs approved as part of their awards. Awardees who do not fulfill the intent of their DMPs may have continuing funds withheld and this may be considered in the evaluation of future proposals.

Proposers intending to make use of the PDS in their DMPs should refer to the most recent version of the following documents for information on PDS compliance:

Document	Hyperlink
Proposer's Archive Guide	http://pds.nasa.gov/pds4/propose/proposing.shtml
Standards Reference	http://pds.nasa.gov/pds4/doc/sr/

Proposers should communicate with the PDS Discipline Node responsible for curating similar data (links to the PDS Discipline Nodes are at http://pds.nasa.gov/) to discuss procedures and requirements prior to proposing to a Planetary Science Division ROSES program element. Proposers intending to archive data or products in the PDS should obtain and include

confirmation from the appropriate Discipline Node that the PDS is willing to accept their submission. It is the proposer's responsibility to conform to PDS standards.

4.4 Publication of Geologic Maps

Proposed science investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Investigators who choose to produce a geologic map as a USGS product will be required to follow current guidelines for the production and submission of digital products, including the generation of maps that are compatible with Geographic Information System (GIS) software packages for review, edit, and publication. To support this requirement, the USGS will provide a GIS project that contains the projected, geographically rectified, and scaled mapping base or mosaic, as well as other relevant global- or regional-scale data sets (if available and needed). Investigators selected to publish USGS geologic maps will be expected to (1) provide peer reviews for two geologic maps generated by other planetary mappers, and (2) attend the annual Planetary Geologic Mappers Meeting to present map status to the mapping community and receive updates on current guidelines. ~~Proposers are required to contact James Skinner at USGS (jskinner@usgs.gov) in order to obtain further information pertaining to the production of USGS geologic maps (e.g., map bases, scales, extents, formats, guidelines), or visit http://planetarymapping.wr.usgs.gov/.~~ **Further information pertaining to the production of USGS geologic maps (e.g. map bases, scales, extents, formats, guidelines) are available at http://planetarymapping.wr.usgs.gov/ or by contacting James Skinner at the USGS (jskinner@usgs.gov).**

4.4.1 *Required Letter from USGS Map Coordinator*

Investigators that intend to produce a USGS geologic map are required to include in their Step-2 (full) proposal a confirmation of technical specifications document obtained from the USGS Map Coordinator. This document will identify (1) latitude/longitude boundaries of the map region, (2) scale of the proposed map, (3) required base map, (4) projection of the base map, and (5) key supplemental data. This document is only a confirmation and does not fulfill any requirement that the mapping effort be described and justified within the 15-page main body of a proposal. Selection of a proposal for funding is contingent upon the inclusion of this document, and investigators are encouraged to contact the USGS early in the proposal preparation process. For the USGS Map Coordinator's contact information, please refer to http://planetarymapping.wr.usgs.gov/Page/view/Contacts.

4.4.2 *Program Elements Supporting Geologic Mapping*

Geologic mapping is an investigative process designed to go beyond standard image analyses to identify the geologic history of a local region, a large area, or a whole planetary object. Thus, geologic maps are tools to aid in identification of this geologic history. Below are some guidelines about where to propose geologic mapping investigations:

If the geologic map is being created as part of a science investigation (i.e., to address specific scientific objectives or questions about a local region, larger area, or planetary object) and uses imaging data from planetary missions identified in a Data Analysis Program (DAP), then the mapping proposals should be submitted to the appropriate DAP:

a) MESSENGER-based Mercury maps: Discovery DAP
b) Lunar maps: Lunar DAP
c) Mars maps: Mars DAP
d) Vesta or Ceres maps: Discovery DAP
e) Saturnian satellite maps: Cassini DAP

If the geologic map is being created as part of a science investigation using imaging data from missions not covered by a current DAP, or a comparative planetology science investigation, then the mapping proposals should be submitted to the Solar System Workings Program. Examples:

a) Venus maps
b) Jupiter Galilean satellite maps
c) Uranian or Neptunian satellite maps

If the geologic map is being created as a higher-order data product that does not have an accompanying science investigation, then the mapping proposals should be submitted to the Planetary Data Archiving, Restoration, and Tools (PDART) program.

Remember: Imaging data for all mapping projects must be available in the Planetary Data System 30 days prior to the proposal deadline. If you have questions about where to submit a mapping proposal, please contact Geologic Mapping Subcommittee Chair David Williams at David.Williams@asu.edu. [Section 4.4 was updated on March 13, 2015.]

5. Relevance

Although ROSES-2015 in general doesn't demand it (see Section VI (a) of the Summary of Solicitation) some program elements in Appendix C (e.g., C.3-C.5 and C.10) require an explicit relevance statement, which will be collected in a mandatory (4000-character) text box on the cover pages via the NSPIRES web interface. For those program elements that require it, this required relevance text is outside of the 15-page Scientific/Technical/Management Section and the relocation of the relevance discussion does not decrease that 15-page limit. This requirement supersedes the default in the *NASA Guidebook for Proposers* and the ROSES *Summary of Solicitation*. For these calls, the omission of a relevance statement on the cover pages is sufficient reason for a proposal to be returned without review. See the individual program elements.

As always, the argument for relevance must be made to the individual program element to which the proposal has been submitted. General statements of relevance to higher-level NASA or SMD goals and objectives may fail to convince NASA and or the peer reviewers.

6. Program Elements

A brief description of each program element offered in the Planetary Science Research Program is given below. The intent of these summary statements is to give the prospective proposer a brief overview. A detailed description of the types of research supported by each program element can be found in the Scope of Program section of the respective program element description.

Research in the area of Emerging Worlds (EW) aims to understand the formation and early evolution of the Solar System. The central goal of the program element is to understand how the Sun's family of planets, satellites, and minor bodies (including small bodies and rings) form and evolve. NASA is particularly interested in proposals for research projects that closely support its mission for exploring the Solar System, contribute to the development of future missions, or involve major interdisciplinary efforts to solve key questions. A wide range of investigations will be covered, including theoretical studies, analytical and numerical modeling, sample-based studies of extraterrestrial materials, laboratory studies, data synthesis, and observational studies of objects outside of our Solar System relevant to the formation of planetary systems. (C.2)

The Solar System Workings (SSW) program supports research into atmospheric, climatological, dynamical, geologic, geophysical, and geochemical processes occurring on planetary bodies, satellites, and other minor bodies (including rings) in the Solar System. This call seeks to address the physical and chemical processes that affect the surfaces, interiors, atmospheres, exospheres, and magnetospheres of planetary bodies. A wide range of investigations will be covered, including theoretical studies, analytical and numerical modeling, sample-based studies of extraterrestrial materials, laboratory studies, and data synthesis relevant to the physical and chemical processes affecting planetary systems. (C.3)

Research supported in Habitable Worlds (HW) seeks to use knowledge of the history of the Earth and the life upon it to determine the processes that create and maintain habitable environments, search for ancient and contemporary habitable environments, and explore the possibility of extant life beyond the Earth. (C.4)

The goal of research in Exobiology is to understand the origin, evolution, and distribution of life on Earth. Research is centered on the origin and early evolution of life on Earth and the potential of life to adapt to different terrestrial environments. This research is conducted in the context of NASA's ongoing exploration of our stellar neighborhood and the identification of biosignatures for *in situ* and remote sensing applications. (C.5)

Solar System Observations (SSO) supports both ground-based astronomical observations and suborbital investigations of our Solar System involving sounding rockets and balloons. Proposals are solicited for observations over the entire range of wavelengths, from the ultraviolet to radio, that contribute to the understanding of the Solar System. Additionally, Solar System Observations support NASA's commitment to discover and inventory potentially hazardous near Earth objects with sizes down to ~100 meters and to characterize that population through determination of their orbital elements. This program element will also consider proposals that

characterize a representative sample of these objects by measuring their sizes, shapes, and compositions. (C.6)

Recognizing that data access is important for the community, proposals addressing data archiving, restoration, and tools will be considered separately under a new strategic program. Planetary Data Archiving, Restoration, and Tools (PDART) is a program that will solicit research handling higher order data products, archiving and restoration of data, reference databases (i.e., Spectral libraries), digitization of nondigitized data, and tools. (C.7)

In order to take full advantage of the wealth of lunar data from recent and ongoing missions, the Lunar Data Analysis program (LDAP) will support data analysis of specific lunar missions. These include: LRO, GRAIL, LADEE, ARTEMIS, LCROSS, and Chandrayaan-1/M[3]. Data analysis from missions by other space agencies may by considered as well. (C.8)

The objective of the Mars Data Analysis Program (MDAP) is to enhance the scientific return from the Mars Atmosphere and Volatile EvolutioN, Mars Science Laboratory, Mars Pathfinder, Mars Global Surveyor, Mars Odyssey, Mars Exploration Rovers, Mars Express, Mars Reconnaissance Orbiter, and Phoenix missions by broadening scientific participation in the analysis of their respective data sets and to fund high-priority areas of research that support planning for future Mars missions. (C.9)

The objective of the Cassini Data Analysis and Participating Scientists (CDAPS) Program is to enhance the scientific return of the Cassini mission by broadening the scientific participation in the analysis and interpretation of the data returned by the mission. (C.10)

The objective of the Discovery Data Analysis Program (DDAP) is to enhance the scientific return of Discovery missions by broadening the scientific participation in the analysis of data collected by those missions. DDAP is intended to complement and not to overlap other active data analysis programs, e.g., Mars Data Analysis Program (MDAP), Cassini Data Analysis Program (CDAPS), and Lunar Data Analysis Program (LDAP).

The Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) Program supports the development of spacecraft-based instrument systems that show promise for use in future planetary missions. The goal of the program is to conduct planetary and astrobiology science instrument feasibility studies, concept formation, proof of concept instruments, and advanced component technology development to the point where they may be proposed in response to the Maturation of Instruments for Solar System Exploration (MatISSE) Program, C.13 – see below. (C.12)

The Maturation of Instruments for Solar System Exploration (MatISSE) Program supports the advanced development of spacecraft-based instruments that show promise for use in future planetary missions. The goal of the program is to develop and demonstrate planetary and astrobiology science instruments to the point where they may be proposed in response to future announcements of flight opportunity without additional extensive technology development (approximately technology readiness level (TRL) 6). The proposed instrument must address specific scientific objectives of likely future planetary science missions. This program is solicited

every other year; it was solicited in ROSES-2014 so it will not appear in ROSES-2015 and will next appear in ROSES-2016. (C.13)

The Planetary Science and Technology from Analog Research (PSTAR) program addresses the need for integrated interdisciplinary field experiments as an integral part of preparation for planned human and robotic missions. Furthermore, the program solicits proposals for investigations focused on exploring the Earth's extreme environments in order to develop a sound technical and scientific basis to conduct astrobiological research on other solar system bodies. The focus of this program element is on providing high-fidelity scientific investigations, scientific input, and science operations constraints in the context of planetary field campaigns. Funding provided in this program element is intended to enable researchers to conduct scientific investigations and integrate their instruments, projects, and/or protocols into field activities designed to help NASA plan for future exploration. The PSTAR solicitation is a consolidation of two previous calls: Astrobiology Science and Technology for Exploring Planets (ASTEP) and Moon Mars Analogue and Mission Activities (MMAMA). (C.14)

Planetary Protection Research (PPR) is aimed at the numerous areas of research in exobiology that have implications for the prevention of contamination of extraterrestrial environments by terrestrial organisms carried by spacecraft launched from Earth and, conversely, for understanding the potential hazards associated with possible extraterrestrial organisms that could be brought to Earth by sample-return missions. Research is required to allow NASA to understand the potential for both forward and backward contamination, as well as to set standards in these areas for spacecraft preparation and operating procedures and for returned-sample analysis. (C.15)

The Early Career Fellowships (ECF C.16) were established to facilitate the integration of early career planetary science researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced position. The ECF program is currently on hiatus pending revision. Participation is limited to proposers to the following Planetary Science Division science research programs offered in this solicitation:

- Emerging Worlds (C.2);
- Solar System Workings (C.3);
- Habitable Worlds (C.4);
- Exobiology (C.5);
- Solar System Observations (C.6);
- Lunar Data Analysis (C.8);
- Mars Data Analysis (C.9);
- Cassini Data Analysis and Participating Scientists (C.10);
- Discovery Data Analysis (C.11);
- Planetary Instrument Concepts for the Advancement of Solar System Observations (C.12);
- Maturation of Instruments for Solar System Exploration (C.13);
- Planetary Science and Technology from Analog Research (C.14);
- Laboratory Analysis of Returned Samples (C.18); and
- Exoplanets (E.3).

The Planetary Major Equipment (PME) program allows proposals for upgrading the analytical, computational, telescopic, and other instrumentation required by investigations sponsored by the following Planetary Science Division science research programs offered in this solicitation:

- Emerging Worlds (C.2);
- Solar System Workings (C.3);
- Habitable Worlds (C.4);
- Exobiology (C.5);
- Solar System Observations (C.6);
- Planetary Science and Technology from Analog Research (C.14);
- Planetary Protection Research (C.15);
- Laboratory Analysis of Returned Samples (C.18); and
- Exoplanets (E.3).

New instrumentation may also be proposed. Planetary Major Equipment proposals may be submitted only in conjunction with new science research proposals to this solicitation or as an augmentation to planetary science multiple year awards. Stand-alone proposals must be explicitly affiliated with an existing "parent" Planetary Science Division award. If the program that provided the "parent" award still exists then the PME should be submitted to that program. If the "parent" award is from a program that no longer exists (e.g., because of reorganization) then a PME may be submitted to a new program. Such a stand-alone PME request must explain the relevance of the parent award to the new program to which it is being submitted. (C.17).

The goal of the Laboratory Analysis of Returned Samples (LARS) program is to maximize the scientific return from extraterrestrial samples from NASA missions and to develop laboratory instrumentation and advanced analytical techniques. (C.18)

The Hayabusa2 mission will investigate the asteroid 1993 JU3 (C-type) and return a sample for analysis. The spacecraft will carry remote sensing instruments, as well as an impactor, small rovers, and a small lander. This Hayabusa2 Participating Scientist program will seek eight to nine scientists as Co-Investigators (Co-Is) to carry out research on the asteroid and analyze the sample after Earth return, planned for 2020. (C.19)

The Exoplanets Research program solicits basic research proposals to advance our knowledge and understanding of exoplanetary systems. This program is shared between the Planetary Science Division and the Astrophysics Division. Its objectives are the detection and characterization of planets and planetary systems outside of our Solar System, including the determination of their compositions, dynamics, energetics, and chemical behaviors. Research supported by this calls may include observational work, theoretical studies, and modeling work. (E.3)

C.2 EMERGING WORLDS

NOTICE: On March 5, 2015, the first paragraph of this program element was updated to better align with the 2014 Science Plan, and the text in Section 2.3 was updated and clarified in a number of ways. The due dates remain unchanged.

NOTICE: Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 4 for details.

Research in the area of "Emerging Worlds" aims to **answer the fundamental science question of how the Solar System formed and evolved, which** may be addressed through studies of our Solar System, as well as planetary systems in general. **It helps to advance the strategic science goal to "explore and observe the objects in the Solar System to understand how they formed and evolve" through basic research that supports planetary exploration, aids in the development of missions and provides context for the interpretation of all Solar System observations that are relevant to its formation and evolution. Major interdisciplinary efforts to solve key questions are particularly valued.**

~~understand the formation and early evolution of the Solar System. The strategic science question of the program is: "How did the Sun's family of planets, satellites, and minor bodies form and evolve?" This may be addressed through studies of our Solar System, as well as planetary systems in general. NASA is particularly interested in proposals for research projects that closely support its mission of exploring the Solar System, contribute to the development of future missions, or involve major interdisciplinary efforts to solve key questions.~~
[Changed March 5, 2015]

A wide range of investigations will be covered, including, but not limited to, theoretical studies, analytical and numerical modeling, sample-based studies of extraterrestrial materials, laboratory studies, and synthesis of previous work.

1. Scope of Program

The Emerging Worlds program solicits research proposals to conduct scientific investigations related to understanding the formation and early evolution of our Solar System. It covers the physics and chemistry of events and materials that are relevant to the formation of planets, satellites, and minor bodies, including dust, and to the early history of these bodies.

For the purposes of this solicitation, formation encompasses events and processes that result in a significant change to the physical or chemical structure of the Solar System, the inventory of

bodies in the Solar System (planets, satellites, minor bodies, rings, and dust), or the distribution of bodies in the Solar System. This includes, but is not limited to:

- Protoplanetary disk formation and evolution;
- Nebular transport mechanisms;
- Large-scale chemical and isotopic fractionation processes;
- Chemical and physical processing of gas, dust, and ice;
- Formation of organic molecules in space;
- Formation, accretion, and stability of Solar System bodies;
- The bulk properties of Solar System bodies;
- The chemical and physical properties of ancient materials (including asteroids and comets);
- The origins of meteorites and meteorite groups.

Early evolution includes, but is not limited to:

- Dynamical evolution of the Solar System;
- Early thermal and chemical processes occurring on small bodies regardless of whether or when they differentiated;
- Global differentiation — processes that result in the separation of bodies into compositionally distinct layers (including their atmospheres, cryospheres, and hydrospheres);
- Processes that occur on Solar-System bodies during the period of global differentiation;
- Planetary-scale events that affect global differentiation.

Also covered is the delivery of organic molecules and volatiles to planetary surfaces, including their abundances and preservation in accreting matter, and their survival through the accretion process.

The types of studies that may be supported include:

- Theoretical investigations;
- Modeling investigations;
- Laboratory studies;
- Studies of chemical and isotopic properties of planetary materials;
- Studies of radiometric ages, magnetism, or radiation exposure effects;
- Mineralogical and petrologic studies of planetary materials;
- Studies of the bulk chemical and physical properties of small bodies.

2. Programmatic Information

2.1 Exclusions

Proposers are advised to read each of the calls listed below prior to submitting proposals and to contact the appropriate Points of Contact with any questions.

2.1.1 Studies of Exoplanets: Investigations to develop the theory of planets or planetary systems as they relate directly to our Solar System should be submitted to the Emerging Worlds

program element. Basic research proposals to conduct scientific investigations related to the research and analysis of exoplanetary systems should be submitted to the Exoplanets call (Program Element E.3). Research aimed at investigating the habitability of a planet should be submitted to the Habitable Worlds program element (Program Element C.4).

2.1.2 Earth Science Studies: Emerging Worlds does not, in general, support Earth science investigations, including research on terrestrial analog samples, unless relevance to the formation and evolution of other planetary bodies or planetary science in general can be firmly established. Terrestrial research should address: key geochemical processes in early planetary evolution; terrestrial history in terms of general Solar System processes; or the reasons for differences in evolution among the various planetary bodies; including Earth, the Moon, and parent bodies of meteorites. Proposals to analyze terrestrial samples should clearly explain the nature of the planetary connection, since this will be a key factor in ascertaining the relevance of such proposals for selection in this program.

2.1.3 Data Analysis: Through the Data Analysis Programs, listed below, NASA solicits proposals whose work efforts are primarily analysis of planetary mission data. The Emerging Worlds program element does not accept proposals that are eligible for submission to one of these program elements. The solicitations for these programs should be consulted prior to any proposal with major data analysis components being submitted to Emerging Worlds.

- *Lunar*: Proposals using recent lunar missions (including, but not limited to LRO, GRAIL, LADEE, ARTEMIS, LCROSS, and Chandrayaan-1/M^3) may be appropriate for the Lunar Data Analysis Program (see Program Element C.8).
- *Mars*: Proposals using Mars missions (including, but not limited to Mars Atmosphere and Volatile EvolutioN, Mars Science Laboratory, Mars Pathfinder, Mars Global Surveyor, Mars Odyssey, Mars Exploration Rovers, Mars Express, Mars Reconnaissance Orbiter, and Phoenix) may be appropriate for the Mars Data Analysis Program (see C.9).
- *Cassini*: Proposals using the Cassini mission (including from the Jupiter flyby) may be appropriate for the Cassini Data Analysis Program (see Program Element C.10).
- *Discovery*: Proposals that use Discovery mission data not covered by the above programs may be appropriate for the Discovery Data Analysis Program (see Program Element C.11).

2.1.4 Observations: This program element does not fund proposals whose work effort is primarily to acquire new ground- or space-based observations or surveys; proposals to acquire observations in our Solar System should be submitted to the Solar System Observations program (see Program Element C.6); proposals to acquire observations outside of our Solar System should be submitted to the Exoplanets program (see Program Element E.3). However, proposals that include analysis and interpretation of existing observations in order to understand the formation and early evolution of our Solar System are encouraged to apply to this program

2.1.5 Solar System Workings: Investigations into processes that occur late in the history of small bodies and after global differentiation on other bodies should be submitted to Solar System Workings (Program Element C.3).

2.2 Interdisciplinary Work

The Emerging Worlds program values the potential of interdisciplinary efforts to solve key scientific question. To achieve this goal, proposals involving joint research efforts by investigators from different scientific communities are encouraged. Note, for interdisciplinary proposals involving observational studies of planetary systems outside our Solar System, tasks for those observations must only be a minor component of the proposed work; otherwise, such proposals should be submitted to Exoplanets (Program Element E.3).

2.3 Duration and Size of Awards

It is anticipated that most proposals will seek three years of funding. Proposals for less than three years are encouraged for projects that can be completed on shorter timescales. Funding for the proposed fourth year may be provided if the need for the longer duration is sufficiently well justified, **i.e., only to allow the completion of individual tasks that require more than three years. The proposal must contain an explicit discussion of why it is impractical or impossible to complete such tasks within three years. A fourth year of funding will not be provided to accommodate multiple tasks which, if proposed alone, could be completed in fewer years**. In all cases, proposals should present a well-conceived plan outlining the work to be done in each year of the request.

~~Awards made in the past from the two main predecessor programs (Cosmochemistry and Origins of Solar Systems) averaged ~ $140,000 per year, but with a wide range, depending on the nature of the work proposed. When the 2014 Emerging Worlds selections are made that data will be~~

Awards made in Emerging Worlds in the first year of its existence (selections made from ROSES-2014 proposals) averaged $150,000 per year, but with a wide range, depending on the nature of the work proposed. The 2014 Emerging Worlds selections will be included in the spreadsheet on the SARA grant stats web page. Proposers are encouraged to refer to the FAQ for this program to view a histogram of award sizes for prior years. Proposers are encouraged to request what they actually need to conduct the research proposed.

Since this is a **relatively** new program with a new scope, the budget and expected number of new awards is somewhat uncertain, and it may depend on the distribution of topics proposed and the number of proposals submitted to each ~~new~~ program. Of course, the number of new awards will also depend on the available budget. Awards resulting from proposals submitted to this program will be funded with Fiscal Year (FY) 2016 dollars.
[Section 2.3 was updated on March 5, 2015]

2.4 Additional Funding for Relevant Instrumentation Construction or Upgrade

The Planetary Major Equipment (PME) program element described in C.17 of this NRA allows proposals for upgrading the analytical, computational, telescopic, and other instrumentation required by investigations for certain programs sponsored by the Planetary Science Division (PSD) Research and Analysis Program, including this one. All new analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $40,000,

must be requested according to the PME guidelines in C.17. Two types of instrumentation requests are permitted. (1) A PME request to PSD may be made as a special section that is appended to a new research proposal to this program. This appendix is to be titled "Planetary Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal, and (2) A stand-alone PME proposal may be prepared and submitted to this program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" PSD award and should explain the relevance of the parent award to this program. See C.17 for details on how to prepare both types of PME requests.

2.5 Topical Workshops

Proposals for topical conferences, workshops, or symposia related to the Emerging Worlds program are not solicited by this program element. Instead, such proposals may now be submitted in response to Program Element E.2, "Topical Workshops, Symposia, and Conferences," of this NRA. Proposers should specifically identify the Emerging Worlds program as the relevant SMD program element and refer to the goals and objectives of the Emerging Worlds program in demonstrating relevance.

2.6 Planetary Science Division Early Career Fellowship Program

The purpose of the Early Career Fellowships (ECF) program (see Program Element C.16) is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the PI's future research contributions and the potential for leadership within the scientific community. Please see Program Element C.16 of ROSES-2015 for more information on the two-step process for the ECF program and the criteria for evaluating candidates.

3. Resources: Information, Data, and Facilities

For proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply must demonstrate clearly how the proposed research does not overlap and is not redundant with data analysis, duties, or responsibilities already funded by their respective mission(s). Please see C.1, The Planetary Science Division Research Program Overview, for more information.

3.1 Facilities and Data Sources Available to Proposers

Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for information on facilities that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

3.2 Data Archiving and Map Publication

Selected investigations may result in data products that are of broad use to the science community, including maps, data with improved calibrations, etc. NASA strongly encourages that such data be archived in the Planetary Data System (http://pds.nasa.gov/), or equivalent public archive, by the end of the award period. Proposers are strongly advised to read C.1, The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for the USGS' information on and requirements for map production and publication.

4. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, and to ensure proposals are submitted to the appropriate program, this program will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

4.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System

(NSPIRES) webpage for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be performed on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

4.2 Step-2 Proposal

This is a reminder that all proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that you use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). You may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Do not adjust line-spacing settings for your selected font below single-spaced.
- Figure captions: Must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

5. Summary of Key Information

Expected program budget for first year of new awards	~$4.5M
Number of new awards pending adequate proposals of merit	~28, see section 2.3
Maximum duration of awards	4 years; shorter-term proposals (1-3 years) are typical; fourth year must be well justified. **See Section 2.3**
Due date for Step-1 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Due date for Step-2 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Planning date for start of investigation	~6 months after Step-2 proposal due date

Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required. See also Section IV in the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-EW
NASA point of contacts concerning this program	Jeff Grossman Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1218 Email: jeffrey.n.grossman@mail.nasa.gov

C.3 SOLAR SYSTEM WORKINGS

NOTICE: This Program Element requires an explicit statement of relevance, which will be collected in a mandatory (4000-character) text box on the cover pages via the NSPIRES web interface. See section 2.6, below.

Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal.

This program will have two Step-2 proposal deadlines. See Section 3.3 for details.

The Solar System Workings (SSW) program element supports research into atmospheric, climatological, dynamical, geologic, geophysical, and geochemical processes occurring on planetary bodies, satellites, and other minor bodies (including rings) in the Solar System. This call seeks to address the physical and chemical processes that affect the surfaces, interiors, atmospheres, exospheres, and magnetospheres of planetary bodies. A wide range of investigations will be covered, including theoretical studies, analytical and numerical modeling, sample-based studies of extraterrestrial materials, field work, laboratory studies, and data synthesis relevant to the physical and chemical processes affecting planetary systems.

1. Scope of Program

The Solar System Workings program solicits proposals for innovative scientific research related to understanding the atmospheric, climatological, dynamical, geologic, physical, and chemical processes occurring within the Solar System. This program is open to investigations relevant to surfaces and interiors of planetary bodies, planetary atmospheres, rings, orbital dynamics, and exospheres and magnetospheres. The Solar System Workings program values the potential of interdisciplinary efforts to solve key scientific questions. The program also values research in comparative planetology. Research supported by this call may include data synthesis, laboratory studies that examine physical or chemical properties and processes, studies of sample or analog materials of other Solar System bodies, field studies of terrestrial analogs of planetary environments, or theoretical and numerical modeling of physical or chemical processes.

This program seeks to understand processes that occur throughout the Solar System, as well as those which are specific to individual objects and systems, but inform our understanding of the fundamental processes at work. A nonexhaustive list of areas of research called for in this solicitation follows. For conciseness in this list, the term ‘planetary’ refers to Solar System objects other than the Sun (ranging in size from small objects, like comets and asteroids, through natural satellites, and up to planets) and structures (such as atmospheres, ionospheres, and ring systems).

- Surfaces and Interiors
  - *Interior structure*. Determine the internal structure, chemistry, and dynamics of Solar System objects and identify and understand the physical and chemical processes that occur within these structures.
  - *Planetary magnetism*. Determine the configuration of planetary magnetic fields and understand how and why they are formed and vary through time. Catalog remnant magnetic fields in order to probe the history of planetary dynamos as well as core-mantle structures and dynamics.
  - *Mantle Evolution.* Understand the chemical evolution and physical structure of mantles and how they change over time.
  - *Lithospheres*. Identify objects with evidence of active or ancient tectonics and understand the processes and inputs that cause tectonic activity to start or stop. Understand the role that regional and global stress fields play in the formation of large-scale surface features and how those features inform studies of the global structure and dynamics.
  - *Volcanism.* Identify the physical and chemical variations in volcanic activity throughout the Solar System. Investigate how volcanic activity can provide insight into interior processes. Understand how volcanic activity can modify planetary surfaces and atmospheres.
  - *Evolution and modification of surfaces.* Characterize and understand the chemical, mineralogical, and physical features of planetary surfaces (such as geologic formations and impact craters) and fluid inventories that interact with the surface (including hydrospheres, cryospheres, atmospheres, and other volatile reservoirs). Develop theoretical and experimental bases for understanding these features in the context of the varying conditions through time after formation.
- Planetary atmospheres
  - *Composition and evolution*. Characterize the chemical composition (including isotope and trace species) of planetary atmospheres and of atmospheric structures (such as haze layers). Understand the vertical mixing, convective profiles, and chemical processes that control the stability of, the losses from, and the evolution of planetary atmospheres. Determine where atmospheric composition deviates from that expected from solar-nebula material and understand alternative sources and their implications for atmospheric evolution.
  - *Dynamics and thermal structure*. Identify and investigate varied features of Solar System atmospheres, such as Venus' greenhouse effect and Martian dust storms. Accurately describe wind patterns and cloud features; determine their temporal variability, their role in heat and momentum transfer, and other atmospheric processes. Characterize vertical structure and the transport of mass and heat at all scales, including the effects of coupling with planetary surfaces and with the environment above the atmosphere.
  - *Climate change*. Characterize planetary climates over short and long time scales by reconstructing the history of atmospheric volatile inventories and understanding the chemical processes that affect them. Resolve the role that atmospheric circulation, dynamics, surface (e.g., volcanic activity) and external (e.g., solar radiation) conditions, and disruptive events play in providing stability for, cyclic modulation of, or

perturbations in the global climate. Compare climates and atmospheres among different planetary bodies at present and over time.

- Rings
  - *Composition and structure*. Determine the three-dimensional structure of ring systems and the effects that moons and moonlets have on them. Characterize the chemical and size composition of ring system particles, including transient, diffuse, and dust rings.
  - *Processes and evolution*. Understand the physical and chemical processes active in ring systems and the interactions these systems have with planetary atmospheres, magnetospheres, and planetary bodies. Model the effects these interactions have in order to identify temporal changes of the rings on short and long time scales.
- Orbital dynamics
  - *Orbital characteristics and evolution.* Understand the gravitational interactions among groups of planetary bodies (e.g., satellites of a planet, an asteroid family, planets and other Sun-orbiting objects) and how they affect orbital characteristics and stability. Characterize the nongravitational forces acting on objects and understand their effect on orbital characteristics. Identify and characterize dust populations from planetary sources, and understand their dynamics within in the Solar System.
  - *Orbital relationships.* Characterize the creation, and understand the evolution, of asteroid families. Understand the effects of orbital relationships (such as orbital resonances between satellites) on planetary interiors, surfaces (including liquids and ices), and atmospheres.
- Plasma environments
  - *Fundamental plasma processes.* Understand the role that localized plasma waves and plasma processes (including reconnection and instabilities) have in regulating large-scale dynamics; characterize the energy that is produced and carried by these phenomena and how they couple distant regions.
  - *Sources and sinks of mass and energy*. Characterize the neutral and plasma sources in planetary magnetospheres (including induced magnetospheres), considering the contribution of internal sources (such as moons or rings), the solar wind, and planetary atmospheres (including cometary outgassing). Understand the relative importance of sources of charged and neutral particle energization. Characterize and understand the mass and energy exchange with other objects or structures (such as the planet, the solar wind, or rings) and the loss from the system.
  - *Magnetospheric processes and dynamics*. Characterize magnetospheric processes and dynamics; determine how they cause mass and energy to flow through the system and couple these processes to the ionosphere and solar wind. Identify similarities and differences in magnetospheric processes and dynamics between the planets. Determine the relative importance of dynamics driven by internal and external energy sources across the magnetospheres, and understand how the different planetary magnetic field configurations affect these dynamics. Refine and exploit our understanding of electromagnetic radiation (e.g., auroral emissions and planetary radio signals) and particle emissions (e.g., dust streams and energetic charged and neutral particles) in order to remotely study dynamics and processes.
  - *Plasma interactions with structures and bodies*. Determine mass and energy exchange with atmospheres and surfaces; understand the physical and chemical processes that this coupling may drive. Describe the interactions between the magnetospheric plasma and

planetary objects, dust, and gas populations; characterize the energy flow and chemical processes within these coupled systems. Characterize the processes associated with space weathering and its effects on optical, spectroscopic, physical and mechanical properties.

Due to the broad nature of this program's mandate, it is open to a wide range of targets of interest and methods of investigation, but only accepts scientific investigations. Each proposal must present a scientific investigation to be conducted, what data and resources will be used, the investigation's methodology, and how the investigation will achieve closure of the proposal's goals. Although this program encourages the utilization of data from planetary missions and studies that produce data products (e.g., cartographic products, calibration data, moments calculations) to inform science investigations, it does not accept proposals eligible for funding by the Data Analysis Programs or the Planetary Data Archiving, Restoration, and Tools Program (see Section 2.1).

2. Programmatic Information

2.1 Exclusions

Proposers are advised to read each of the calls listed below prior to submitting proposals and to contact the appropriate Points of Contact with any questions.

Proposals to conduct research to understand the formation and early evolution of the Solar System should be submitted to the Emerging Worlds program element (see C.2). The scope of Solar System Workings covers processes that occur after this period. For evolved bodies, Solar System Workings focuses on processes occurring after the end of global planetary differentiation; for primitive bodies, the focus is on processes that were not mainly active in the early Solar System. Processes that occur on regional or local scales on planetary bodies (such as impact cratering) are generally covered by Solar System Workings, even if they resulted in localized magmatism and/or differentiation.

Proposals to investigate the physical and chemical processes present in the Solar System in order to understand habitability and the conditions that may support life should be submitted to the Habitable Worlds program element (see C.4).

Proposals to provide the fundamental research and analysis necessary to detect and characterize exoplanets should submit their proposals to the Exoplanets program element (see E.3).

Comparative studies of planetary bodies that apply investigations such as those listed above to two or more planets (including the Earth) are appropriate for the Solar System Workings program element. However, investigations that focus primarily on the Earth are not; research opportunities supporting the Earth Science Research Program may be found in Appendix A of this solicitation.

Through the Data Analysis Programs, listed below, NASA solicits proposals whose work efforts are primarily analysis of planetary mission data. The Solar System Workings program element

does not accept proposals that are eligible for submittal to one of these program elements; the solicitations for these programs should be consulted prior to any proposal with major data analysis components being submitted to Solar System Workings. If the proposal is not appropriate to these programs and does fit within the bounds of Solar System Workings, submittal is encouraged. If the proposal analyzes data within the scope of more than one of the below programs in order to perform comparative studies across the Solar System, but is not appropriate to any one data analysis program, then submittal to Solar System Workings is encouraged.

- *Lunar*: Proposals using recent lunar missions (including, but not limited to LCROSS, LRO, Chandrayaan-1/M^3, GRAIL, LADEE, and ARTEMIS) may be appropriate for the Lunar Data Analysis Program (see C.8).
- *Mars*: Proposals using Mars missions (including, but not limited to Mars Atmosphere and Volatile EvolutioN, Mars Science Laboratory, Mars Pathfinder, Mars Global Surveyor, Mars Odyssey, Mars Exploration Rovers, Mars Express, Mars Reconnaissance Orbiter, and Phoenix) may be appropriate for the Mars Data Analysis Program (see C.9).
- *Cassini*: Proposals using the Cassini mission (including from the Jupiter flyby) may be appropriate for the Cassini Data Analysis Program (see C.10).
- *Discovery*: Proposals that use Discovery mission data may be appropriate for the Discovery Data Analysis Program (see C.11).

Proposals to Solar System Workings must include a science investigation. Proposals to produce a higher order data product that enhances the science return from one or more missions, but does not include a science investigation, should be submitted to the Planetary Data Archiving, Restoration, and Tools (PDART) Program (see C.7).

This program element does not fund proposals whose work effort is primarily to acquire new ground- or space-based observations or surveys; such proposals should be submitted to the Solar System Observations program (see C.6). However, proposals that include analysis and interpretation of existing observations of Solar System objects are encouraged to apply to this program.

Proposals for topical conferences, workshops, or symposia related to the Solar System Workings program may not be proposed through this solicitation. Proposers are encouraged to pursue such submissions through ROSES-2015 E.2, Topical Workshops, Symposia, and Conferences.

2.2 Duration of Awards

NASA anticipates that most proposals will seek three years of funding. Proposals for less than three years are encouraged for projects that can be completed on shorter timescales. In rare cases, funding for the proposed fourth year may be provided if the need for the longer duration is sufficiently well justified.

2.3 Pilot Studies

Proposals for one to two year pilot studies to demonstrate or develop a new technique or a new application of an established technique will be considered.

2.4 Additional Funding for Relevant Instrumentation Construction or Upgrade

The Planetary Major Equipment (PME) program element described in C.17 of this NRA allows proposals for upgrading the analytical, computational, telescopic, and other instrumentation required by investigations for certain programs sponsored by the Planetary Science Division (PSD) Research and Analysis Program, including this one. All new analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $40,000, must be requested according to the PME guidelines in C.17. Two types of instrumentation requests are permitted. (1) A PME request to PSD may be made as a special section that is appended to a new research proposal to this program. This appendix is to be titled "Planetary Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal, and (2) A stand-alone PME proposal may be prepared and submitted to this program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" PSD award and should explain the relevance of the parent award to this program. See C.17 for details on how to prepare both types of PME requests.

2.5 Planetary Science Division Early Career Fellowship Program

The purpose of the Early Career Fellowship (ECF) program (see C.16) is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the Principal Investigator's (PIs) future research contributions and the potential for leadership within the scientific community. See C.16 of ROSES-2015 for more information on the two-step process for the ECF program and the criteria for evaluating candidates.

2.6 Relevance Statement Requirement

Proposals to this program must discuss relevance in a (4000-character max) text box on the cover pages via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web interface for this program element. This section is outside of the 15-page Scientific/Technical/Management Section and the relocation of the relevance discussion does not decrease that 15-page limit. This requirement supersedes Section 2.3.5 of the *NASA Guidebook for Proposers* and the *ROSES Summary of Solicitation*, and the omission of this section is sufficient reason for a proposal to be returned without review.

The relevance discussion must explicitly refer to this program element and the section of the solicitation to which the proposal is responsive. If the proposed work is close in scope to research covered by any other program element, this discussion must also justify why it is more relevant to this program element than that other program element. This discussion may not be used to address the proposal's intrinsic merit, budget justification, or any other factor that remains in the 15-page main body, or any other section, of the proposal.

3. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, and to ensure proposals are submitted to the appropriate program, this program will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.)

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted between the Step-1 and Step-2. Proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Unless proposers hear otherwise from NASA, they should proceed with the change in team. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

3.1 Step-1 Proposal

The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be done on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to create Step-2 proposals.

3.2 Step-2 Proposal

All proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those submissions that violate the rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages

- Margins: 1 inch on all sides, with a standard page size of 8.5 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that proposers use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line-spacing settings for a selected font below single-spaced.
- Figure captions: Must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

3.3 Step-2 Submission and Review

As part of the Step-1 review process, regardless of the decision itself, all proposals will be directed to one of two Step-2 deadlines (see Tables 2 and 3 in the *Summary of Solicitation* of this NRA for the exact dates, which are referred to as "Step 2.1" and "Step 2.2"). Submitting a Step-1 proposal does not obligate a PI to submit a Step-2 proposal and a discouraged Step-1 does not prevent a PI from submitting a Step-2 proposal. However, the assignment of a proposer to one of the two Step-2 deadlines is binding; no Step-2 proposal will be accepted after the deadline to which it was assigned.

Proposals will be reviewed with others submitted to the same Step-2 deadline and separately from those submitted to the other Step-2 deadline. There will be two separate and equitable selections, corresponding to the two Step-2 deadlines. If funds remain, after the second batch of selections is announced, PSD reserves the right to identify additional selections from either batch.

4. Resources: Information, Data, and Facilities

4.1 Limits on Use of Mission Data

For proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply must clearly demonstrate how the proposed research does not overlap and is not redundant with data analysis, duties, or responsibilities already funded by their respective mission(s). Please see C.1, The Planetary Science Division Research Program Overview, for more information.

4.2 Facilities and Data Sources Available to Proposers

Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

4.3 Data Archiving and Map Publication

Selected investigations may result in data products that are of broad use to the science community, including maps, data with improved calibrations, etc. NASA strongly encourages that such data products be archived in the Planetary Data System (http://pds.nasa.gov/), or equivalent public archive, by the end of the award period. Proposers are strongly advised to read C.1, The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for the USGS' information on and requirements for map production and publication.

4.4 Access to the Antarctic

The National Science Foundation (NSF) manages the U.S. Antarctic Program. NASA, therefore, collaborates with the NSF in evaluating the logistics needs of research programs that request access to Antarctic field sites. To that end:

1. Proposals requesting access to Antarctic field sites must justify their request on the grounds that Antarctica is the best or only location for their research.
2. Proposals must include, as an appendix, a Logistical Requirements and Field Plan, which will be subject to peer review, outlining the PI's logistical requests associated with the proposed field work. Proposals with fieldwork that lack this Plan are subject to return without review. The Logistical Requirements and Field Plan must include the elements listed below and should be limited to one page of text and one page of figures (if needed). These pages are in addition to the 15 page limit for the Science/Technical/Management section of the proposal.
   a. Brief statement of research objectives.
   b. List of field sites and the geographic region where they are located. For remote sites, investigators should consider providing a map of proposed field sites.
   c. Description of proposed field activities, including major logistical resources required (i.e., fixed-wing aircraft, vessels, helicopter support).
   d. Description and justification of the desired deployment schedule.
   e. Projected numbers of deploying personnel.

f. Description of any needs for facility construction, alteration, or instrument installation. Further information on the U.S. Antarctic Program may be found at http://www.nsf.gov/geo/plr/ant/index.jsp.

Due to the scheduling of NASA and NSF review cycles, proposals requesting access to Antarctica should expect that their first field season would start six to twelve months after award. Proposals requiring Antarctic access in their first performance year may suggest a start date commensurate with this schedule.

5. Summary of Key Information

Expected program budget for first year of new awards	$9-10M
Number of new awards pending adequate proposals of merit	50-70
Maximum duration of awards	4 years; shorter-term proposals (1-3 years) are typical; fourth year must be explicitly and well justified.
Due date for Step-1 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Due date for Step-2 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA. Also see Section 3.3 of this solicitation for a description of the multiple Step-2 deadlines.
Planning date for start of investigation	~1 year after proposal due date
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the planetary science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA. See Section 2.6 of this solicitation for special relevance requirements.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required. See also Section IV in the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)

Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-SSW
NASA points of contacts concerning this program, all of whom share the following postal address: Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001	Mary Voytek Telephone: (202) 358-1577 E-mail: mvoytek@hq.nasa.gov Mitchell Schulte Telephone: (202) 358-2127 E-mail: mitchell.d.schulte@nasa.gov Sarah Noble Telephone: (202) 358-2492 E-mail: sarah.noble-1@nasa.gov Jared Leisner Telephone: (202) 358-2016 E-mail: jared.s.leisner@nasa.gov

C.4 HABITABLE WORLDS

NOTICE: This Program Element requires an explicit statement of relevance, which will be collected in a mandatory (4000-character) text box on the cover pages via the NSPIRES web interface. See Section 2.1, below.

Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 2.6 for details.

1. Scope of Program

The goal of the Habitable Worlds program is to use knowledge of the history of the Earth and the life upon it as a guide for determining the processes and conditions that create and maintain habitable environments and to search for ancient and contemporary habitable environments and explore the possibility of extant life beyond the Earth.

NASA's Habitable Worlds Program includes elements of the Astrobiology Program, the Mars Exploration Program, and the Outer Planets Program. A common goal of these programs is to identify the characteristics and the distribution of potentially habitable environments in the Solar System and beyond. This research is conducted in the context of NASA's ongoing exploration of our stellar neighborhood and the identification of biosignatures for *in situ* and remote sensing applications. For further information on the science scope of Astrobiology, please refer to the Astrobiology roadmap, which can be found on the Astrobiology web page http://astrobiology.nasa.gov/. Information on the habitability-related goals of the Mars Exploration Program can be found in the "Mars Science Goals, Objectives, Investigations and Priorties: 2010" document, available on the Mars Exploration Program Analysis Group web page (http://mepag.jpl.nasa.gov). For the Outer Planets Program, refer to the document "Scientific Goals and Pathways for Exploration of the Outer Solar System," found on the Outer Planets Assessment Group web site (http://www.lpi.usra.edu/opag).

Theoretical and experimental studies will be considered, as well as quantitative terrestrial field experiments that improve scientific understanding of how *in situ* measurements at analog sites can or will improve our understanding of the potential for the environment to support life. Research areas include, but are not limited to, the presence of water and/or exotic solvents, sources of energy for life, presence of organics and their reactivity, and water body physics and chemistry as they pertain to habitability and habitability over time. The target bodies for this program element include, but are not limited to:

- Mars - the astrobiological potential of past or present environments on or in the Martian surface or subsurface.

• Icy Worlds - the astrobiological potential of icy worlds in the outer solar system, including Europa, Ganymede, Enceladus, and Titan.

• Habitable Exoplanets and/or their moons - A potentially habitable exoplanet implies a planet with conditions roughly comparable to those of Earth (i.e., an Earth analog) and thus potentially favorable to the presence of life.

2. Programmatic Information

Proposals are sought for new projects within the scope of the Habitable Worlds. Proposals submitted in response to this NRA should be for new work that is not currently supported by the program or for investigations that would extend to their next logical phase those tasks that have been funded in the Astrobiology, Mars Fundamental Research, and Outer Planets (or other) programs, but whose periods of performance expired last year or are expiring in the first half of this year.

2.1 Relevance Statement Requirement

Proposals to this program element must discuss relevance in a (4000-character maximum) text box on the cover pages via the NSPIRES web interface for this program element. This section is outside of the 15-page Scientific/Technical/Management Section and the relocation of the relevance discussion does not decrease that 15-page limit. This requirement supersedes Section 2.3.5 of the *NASA Guidebook for Proposers* and the *ROSES Summary of Solicitation*, and the omission of this section is sufficient reason for a proposal to be returned without review.

The relevance discussion must explicitly refer to this program element and the section of the solicitation to which the proposal is responsive. If the proposed work is close in scope to research covered by any other program element, this discussion must also justify why it is more relevant to this program element than that other program element. This discussion may not be used to address the proposal's intrinsic merit, budget justification, or any other factor that remains in the 15-page main body, or any other section, of the proposal.

2.2 Program Exclusions

Proposals focused on the formation and stability of habitable planets, and the formation of complex organic molecules in space and their delivery to planetary surfaces, should be submitted to C.2 Emerging Worlds.

Biosignature studies of samples from sites thought to be analogs of other planetary environments that might potentially harbor life should be directed to C.5 Exobiology. Models of early environments on Earth in which organic chemical synthesis could occur and the forms in which prebiotic organic matter has been preserved in planetary materials should be directed to C.5 Exobiology. Work to understand the phylogeny, physiology and adaptations of extant terrestrial organisms to extreme environments should be directed to C.5 Exobiology.

Field-based investigations focused on exploring the relevant environments on Earth in order to develop a sound technical and scientific basis to conduct planetary research on other Solar System bodies should be directed to C.14 PSTAR (Planetary Science and Technology from Analog Research) program.

Through its data analysis programs, C.8 Lunar Data Analysis Program (LDAP), C.9 Mars Data Analysis Program (MDAP), C.10 Cassini Data Analysis and Participating Scientists (CDAPS), C.11 Discovery Data Analysis Program (DDAP), the Planetary Science Division solicits proposals for work that are primarily analysis of planetary mission data. This program element does not accept proposals that are eligible for submission to one of those data analysis programs. If a proposal is not appropriate for one of the data analysis programs, but does fit within the bounds of this program then it should be submitted to this program.

2.3 Pilot Studies

Proposals for one to two year pilot studies to demonstrate or develop a new technique or a new application of an established technique will be considered. Such proposals may also include the demonstration of a technique new to the proposer but not new to the field in general.

2.4 Instrumentation: Construction or Upgrade

The Planetary Major Equipment (PME) program element described in C.17 of this NRA allows proposals for upgrading the analytical, computational, telescopic, and other instrumentation required by investigations for certain programs sponsored by the Planetary Science Division (PSD) Research and Analysis Program, including this one. All new analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $40,000, must be requested according to the PME guidelines in C.17. Two types of instrumentation requests are permitted. (1) A PME request to PSD may be made as a special section that is appended to a new research proposal to this program. This appendix is to be titled "Planetary Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal, and (2) A stand-alone PME proposal may be prepared and submitted to this program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" PSD award and should explain the relevance of the parent award to this program. See C.17 for details on how to prepare both types of PME requests.

2.5 Development of Instruments

This solicitation does not request proposals for the development of advanced instrument concepts and technologies as precursors to astrobiology flight instruments. Such proposals should be submitted to C.12 the Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) Program (for technology readiness levels (TRLs 1-3)) or C.13 the Maturation of Instruments for Solar System Exploration (MatISSE) Program (for TRLs 4-6). Proposals for science-driven field campaigns that are expected to produce new science results, as well as new operational or technological capabilities, should be submitted to the C.14, Planetary Science and Technology Analogs Research (PSTAR) program.

2.6. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, given the nature of the new calls, and to ensure proposals are submitted to the appropriate program, this program uses a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

2.6.1 *Step-1 Proposal*

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal has been submitted to the appropriate program element. No evaluation of intrinsic merit will be performed on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

2.6.2 *Step-2 Proposal*

This is a reminder that all proposals submitted to ROSES must strictly conform to the formatting rules in Chapter IV of this announcement and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the formatting of the Scientific/Technical/Management section proposals have been noted. Please pay particular attention to:

- Length: 15 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that proposers use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.

- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Do not adjust line-spacing settings for your selected font below single-spaced.
- Figure captions: must follow the same font and spacing rules as the main text.
- Figures and tables: for text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

2.7 Duration and Size of Awards

NASA anticipates that most proposals will seek three years of funding. Proposals for less than three years are encouraged for projects that can be completed on shorter timescales. In rare cases, funding for the proposed fourth year may be provided, if the need for the longer duration is sufficiently well justified. The appropriateness of the proposed funding period will be reviewed, and adjustments may be requested. Programmatic balance may limit the opportunities for funding in some areas.

Since this is a new program with a new scope, the budget and expected number of new awards is somewhat uncertain, as it will depend on the distribution of topics proposed and the number of proposals submitted to each new program. Based on our experience with predecessor awards on related topics, we estimate that the average award size will be ~$150 K per year per award, but with a wide range, depending on the nature of the work proposed. When the 2014 Habitable Worlds selections are made, that data will be included as a spreadsheet on the SARA grant stats web page and summarized here. Proposers are encouraged to request what they actually need to conduct the research proposed.

2.8 Early Career Researchers

The purpose of the Early Career Fellowship (ECF) program (see C.16) is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the Principal Investigator's (PIs) future research contributions and the potential for leadership within the scientific community. See C.16 of ROSES-2015 for more information on the two-step process for the ECF program and the criteria for evaluating candidates.

2.9 Access to the Antarctic

The National Science Foundation (NSF) manages the U.S. Antarctic Program. NASA, therefore, collaborates with the NSF in evaluating the logistics needs of research programs that request access to Antarctic field sites. To that end:

1. Proposals requesting access to Antarctic field sites must justify their request on the grounds that Antarctica is the best or only location for their research.
2. Proposals must include, as an appendix a Logistical Requirements and Field Plan, which will be subject to peer review, outlining the PI's logistical requests associated with the proposed field work. Proposals with fieldwork that lack this Plan are subject to return without review. The Logistical Requirements and Field Plan must include the elements listed below and should be limited to one page of text and one page of figures (if needed). These pages are in addition to the 15 page limit for the Science/Technical/Management section of the proposal.
   a. Brief statement of research objectives
   b. List of field sites and the geographic region where they are located. For remote sites, investigators should consider providing a map of proposed field sites.
   c. Description of proposed field activities including major logistical resources required (i.e. fixed-wing aircraft, vessels, helicopter support).
   d. Description and justification of the desired deployment schedule.
   e. Projected numbers of deploying personnel.
   f. Description of any needs for facility construction, alteration, or instrument installation.

Further information on the U.S. Antarctic Program may be found at http://www.nsf.gov/geo/plr/ant/index.jsp.

Due to the scheduling of NASA and NSF review cycles, proposals requesting access to Antarctica should expect that their first field season would start six to twelve months after award. Proposals requiring Antarctic access in their first performance year may suggest a start date commensurate with this schedule.

2.10 Resources: Information, Data, and Facilities

For proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply must demonstrate clearly how the proposed research does not overlap and is not redundant with data analysis, duties, or responsibilities already funded by their respective mission(s). Please see C.1, The Planetary Science Division Research Program Overview, for more information.

2.10.1 Facilities and Data Sources Available to Proposers

Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

2.10.2 Data Archiving and Map Publication

Selected investigations may result in data products that are of broad use to the science community, including maps, data with improved calibrations, etc. NASA strongly encourages that such data products be archived in the Planetary Data System (http://pds.nasa.gov/), or equivalent public archive, by the end of the award period. Proposers are strongly advised to read C.1, The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for the USGS' information on and requirements for map production and publication.

2.11 NASA Postdoctoral Program Fellows

Grantees in the program are eligible to serve as mentors to NASA Postdoctoral Program (NPP) Fellows. The tenure of a Fellow must begin before the end of the award, but may extend beyond it. Proposals from potential Fellows must be submitted through the standard NPP process. This Program expects to select no more than two Fellows this year. More information about the NASA Postdoctoral Program may be found at http://nasa.orau.org/postdoc/ and a list of current opportunities may be found at https://www3.orau.gov/NPDoc/Catalog.

3. Summary of Key Information

Expected program budget for first year of new awards	~$2M
Number of new awards pending adequate proposals of merit	See section 2.7
Maximum duration of awards	4 years; shorter-term proposals (1-3 years) are typical; fourth year must be explicitly and scientifically justified.
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Step-2 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*

Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-HW
NASA point of contact concerning this program	Mitch Schulte Planetary Science Division NASA Headquarters Washington, DC 20546 Telephone: (202) 358-2127 E-mail: mitchell.d.schulte@nasa.gov

C.5 EXOBIOLOGY

NOTICE: Amended on April 6, 2015. This amendment delays the due dates for Program Element C.5 Exobiology. The new Step-1 due date is May 22, 2015, and the new Step-2 due date is July 24, 2015.

This Program Element requires an explicit statement of relevance, which will be collected in a mandatory (4000-character) text box on the cover pages via the NSPIRES web interface. See Section 2.1, below.

Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 2.6 for details.

1. Scope of Program

The goal of NASA's Exobiology is to understand the origin, evolution, distribution, and future of life in the Universe. Research is centered on the origin and early evolution of life, the potential of life to adapt to different environments, and the implications for life elsewhere. This research is conducted in the context of NASA's ongoing exploration of our stellar neighborhood and the identification of biosignatures for *in situ* and remote sensing applications. For further information on the science scope of Astrobiology — within which exobiology is located— please refer to the Astrobiology roadmap, which can be found on the Astrobiology web page http://astrobiology.nasa.gov/roadmap.

The areas of research emphases in this solicitation are as follows:

- *Prebiotic Evolution*

Research in the area of prebiotic evolution seeks to understand the planetary and molecular processes that set the physical and chemical conditions within which living systems may have arisen. A major objective is determining what chemical systems could have served as precursors of metabolic and replicating systems on Earth and elsewhere, including alternatives to the current DNA-RNA-protein basis for life. This would also include models of early environments on the Earth in which organic chemical synthesis could occur. Laboratory and theoretical, as well as related data-analysis, studies will be considered.

Topics *not* included are the formation and stability of habitable planets, the formation of complex organic molecules in space and their delivery to planetary surfaces. Proposals on these topics should be submitted to C.2 Emerging Worlds.

- *Early Evolution of Life and the Biosphere*

The goal of research into the early evolution of life and the biosphere is to determine the nature of the most primitive organisms and the environment in which they evolved. The opportunity is taken to investigate two natural repositories of evolutionary history available on Earth: the molecular record in living organisms and the geological record. These paired records are used to: (i) determine when and in what setting life first appeared and the characteristics of the first successful living organisms; (ii) understand the phylogeny and physiology of microorganisms, including extremophiles, whose characteristics may reflect the nature of primitive environments; (iii) determine the original nature of biological energy transduction, membrane function, and information processing, including the construction of artificial chemical systems to test hypotheses regarding the original nature of key biological processes; iv) investigate the development of key biological processes and their environmental impact; v) investigate the evolution of genes, pathways, and microbial species subject to long-term environmental change relevant to the origin of life on Earth and the search for life elsewhere; and vi) study the coevolution of microbial communities, and the interactions within such communities, that drive major geochemical cycles, including the processes through which new species are added to extant communities.

In addition to the above, the Exobiology Program is particularly interested in research that has the potential to significantly advance our ability to utilize Earth's sulfur isotope record to improve our understanding of the history of Earth's atmosphere. NASA's Astrobiology Program co-organized with the National Science Foundation (NSF) a 2011 workshop that highlighted promising areas for future research along these lines; a document summarizing the findings of that workshop can be found at http://is.gd/s_mif.

- *Evolution of Advanced Life*

Research associated with the study of the evolution of advanced life seeks to determine the biological and environmental factors leading to the origin of eukaryotes and the development of multicellularity on Earth and the potential distribution of complex life in the Universe. This research includes studies of the processes associated with endosymbiosis and the origin and early evolution of those biological factors that are essential to multicellular life, such as developmental programs, intercellular signaling, programmed cell death, the cytoskeleton, cellular adhesion control and differentiation, in the context of the origin of advanced life.

Proposals aimed at identification and characterization of signals and/or properties of extrasolar planets that may harbor intelligent life are *not* solicited at this time.

- *Large scale environmental change and Macro-evolution*

Research associated with the study of the macro-evolution of life on Earth includes an evaluation of environmental factors, such as the influence of latitudinal differences or extraterrestrial (e.g., bolide impacts, orbital and solar variations, gamma-ray bursts, etc.) and planetary processes ("Snowball Earth" events, rapid climate change, etc.) on the large-scale evolution of life on Earth. Of particular interest are mass extinction events.

- *Biosignatures and Life Elsewhere*

Research in this area focuses on relating what is known about the origin of life on Earth to the potential for the origin and establishment of life under conditions prevailing on other planetary bodies and basic research on the formation and retention of biosignatures under non-Earth conditions (e.g., Mars, Europa). This includes studies that constrain or extend concepts of possible chemical evolution relevant to the origin, evolution, and distribution of life. As part of the focus on biosignatures, this area includes research on the forms in which prebiotic organic matter formed on planetary surfaces has been preserved and the range of planetary environments amenable to life.

Biosignature studies of samples from Earth sites thought to be analogues of other planetary environments that might potentially harbor life will be considered as part of NASA's broader interest in the search for life in the Universe.

Efforts to assess the potential habitability of planetary environments other than those found on the Earth should be submitted to C.4 Habitable Worlds

2. Programmatic Information

Proposals are sought for new projects within the scope of Astrobiology. Proposals submitted in response to this NASA Research Announcement (NRA) should be for new work that is not currently supported by the program or for investigations that would extend to their next logical phase those tasks that have been funded in the Astrobiology program, but whose periods of performance expired in the last year or are expiring in the first half of this year.

2.1 Relevance Statement Requirement

Proposals to this program element must discuss relevance in a (4000-character maximum) text box on the cover pages via the NSPIRES web interface for this program element. This section is outside of the 15-page Scientific/Technical/Management Section and the relocation of the relevance discussion does not decrease that 15-page limit. This requirement supersedes Section 2.3.5 of the *NASA Guidebook for Proposers* and the ROSES Summary of Solicitation, and the omission of this section is sufficient reason for a proposal to be returned without review.

The relevance discussion must explicitly refer to this program element and the section of the solicitation to which the proposal is responsive. If the proposed work is close in scope to research covered by any other program element, this discussion must also justify why it is more relevant to this program element than that other program element. This discussion may not be used to address the proposal's intrinsic merit, budget justification, or any other factor that remains in the 15-page main body, or any other section, of the proposal.

2.2 Program Exclusions

Proposals focused on the formation and stability of habitable planets and the formation of complex organic molecules in space and their delivery to planetary surfaces should be submitted to C.2 Emerging Worlds.

Proposals aimed at identification and characterization of signals and/or properties of extrasolar planets that may harbor intelligent life are not solicited at this time.

Efforts to assess the potential habitability of planetary environments other than those found on the Earth should be submitted to C.4 Habitable Worlds.

2.3 Pilot Studies

Proposals for one to two year pilot studies to demonstrate or develop a new technique or a new application of an established technique are encouraged. Such proposals may also include the demonstration of a technique new to the proposer, but not new to the field in general.

2.4 Instrumentation: Construction or Upgrade

The Planetary Major Equipment (PME) program element described in C.17 of this NRA allows proposals for upgrading the analytical, computational, telescopic, and other instrumentation required by investigations for certain programs sponsored by the Planetary Science Division (PSD) Research and Analysis Program, including this one. All new analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $40,000, must be requested according to the PME guidelines in C.17. Two types of instrumentation requests are permitted. (1) A PME request to PSD may be made as a special section that is appended to a new research proposal to this program. This appendix is to be titled "Planetary Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal, and (2) A stand-alone PME proposal may be prepared and submitted to this program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" PSD award and should explain the relevance of the parent award to this program. See C.17 for details on how to prepare both types of PME requests.

2.5 Development of Astrobiology Instruments

This solicitation does not request proposals for the development of advanced instrument concepts and technologies as precursors to astrobiology flight instruments. Such proposals should be submitted to the Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) Program (for technology readiness levels [TRLs] 1-3+) or the Maturation of Instruments for Solar System Exploration (MatISSE) Program (for TRLs 4-6). Proposals for science-driven field campaigns that are expected to produce new science results, as well as new operational or technological capabilities, should be submitted to the Planetary

Science and Technology from Analog Research (PSTAR) program (see C.14 and potential amendments thereto).

2.6 The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, and to ensure proposals are submitted to the appropriate program, this program will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

2.6.1 *Step-1 Proposal*

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be done on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

2.6.2 *Step-2 Proposal*

All proposals submitted to ROSES-2015 must strictly conform to the formatting rules in Chapter IV of the *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages.
- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that you use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). You may not adjust the character spacing or otherwise condense a font from its default appearance.

- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Do not adjust line-spacing settings for your selected font below single-spaced.
- Figure captions: must follow the same font and spacing rules as the main text.
- Figures and tables: for text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

2.7 Duration of Awards

The standard award duration is three years. It is anticipated that most proposals will seek three years of funding. However, proposals of less than three years are highly encouraged for projects that can be completed on shorter timescales. In rare cases, four-year projects may be considered, but appropriate justification must be provided. The appropriateness of the proposed funding period will be reviewed and adjustments may be requested. Programmatic balance may limit the opportunities for funding in some areas.

2.8 Topical Workshops, Symposia, and Conferences

Exobiology accepts proposals for the support of relevant workshops, symposia, and conferences. It is expected that, except for rare circumstances, NASA will not be the sole support of the workshop, symposium, or conference. Proposals for workshops, symposia, and conferences should include a detailed statement of the relevance of the event to the Astrobiology Program.

2.9 Early Career Fellowship Program

Early career researchers are encouraged to apply for the Early Career Fellowships (ECF) Program. The purpose of the ECF program (see C.16) is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the Principal Investigator's (PI's) future research contributions and the potential for leadership within the scientific community. Please see C.16 of ROSES-2015 for more information on the two-step process for the ECF program and the criteria for evaluating candidates

2.10 NASA Postdoctoral Program Fellows

Grantees in the program are eligible to serve as mentors to NASA Postdoctoral Program (NPP) Fellows. The tenure of a Fellow must begin before the end of the Exobiology award but may extend beyond it. Proposals from potential Fellows must be submitted through the standard NPP process. The Astrobiology Program expects to select no more than three Fellows associated with

Exobiology research in 2015. More information about the NASA Postdoctoral Program may be found at http://nasa.orau.org/postdoc/ and a list of current opportunities may be found at https://www3.orau.gov/NPDoc/Catalog.

2.11 Access to the Antarctic

The National Science Foundation (NSF) manages the U.S. Antarctic Program. NASA, therefore, collaborates with the NSF in evaluating the logistics needs of research programs that request access to Antarctic field sites. To that end:

1. Proposals requesting access to Antarctic field sites must justify their request on the grounds that Antarctica is the best or only location for their research.
2. Proposals must include, as an appendix, a Logistical Requirements and Field Plan, which will be subject to peer review, outlining the PI's logistical requests associated with the proposed field work. Proposals with fieldwork that lack this Plan are subject to return without review. The Logistical Requirements and Field Plan must include the elements listed below and should be limited to one page of text and one page of figures (if needed). These pages are in addition to the 15 page limit for the Science/Technical/Management section of the proposal.
    a. Brief statement of research objectives.
    b. List of field sites and the geographic region where they are located. For remote sites, investigators should consider providing a map of proposed field sites.
    c. Description of proposed field activities including major logistical resources required (i.e. fixed-wing aircraft, vessels, helicopter support).
    d. Description and justification of the desired deployment schedule.
    e. Projected numbers of deploying personnel.
    f. Description of any needs for facility construction, alteration, or instrument installation.

Further information on the U.S. Antarctic Program may be found at http://www.nsf.gov/geo/plr/ant/index.jsp.

Due to the scheduling of NASA and NSF review cycles, proposals requesting access to Antarctica should expect that their first field season would start six to twelve months after award. Proposals requiring Antarctic access in their first performance year may suggest a start date commensurate with this schedule.

3. Resources: Information, Data, and Facilities

3.1 Limits on Use of Mission Data

For proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties

will be overcome. Investigators funded by spacecraft missions who wish to apply must demonstrate clearly how the proposed research does not overlap and is not redundant with data analysis, duties, or responsibilities already funded by their respective mission(s). Please see C.1, The Planetary Science Division Research Program Overview, for more information.

3.2 Facilities and Data Sources Available to Proposers

Proposers are advised to read C.1 The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

3.3 Data Archiving and Map Publication

Selected investigations may result in data products that are of broad use to the science community, including maps, data with improved calibrations, etc. NASA strongly encourages that such data products be archived in the Planetary Data System (http://pds.nasa.gov/), or equivalent public archive, by the end of the award period. Proposers are strongly advised to read C.1 The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Proposers are advised to read C.1 The Planetary Science Division Research Program Overview, for the USGS' information on and requirements for map production and publication.

4. Summary of Key Information

Expected program budget for first year of new awards	~$3M
Number of new awards pending adequate proposals of merit	~20
Maximum duration of awards	4 years; shorter term proposals (1-3 years) are typical; fourth year must be explicitly and scientifically justified.
Due date for Step-1 proposals	**May 22, 2015.** See Tables 2 and 3 in the *ROSES Summary of Solicitation*. **[Amended April 6, 2015]**
Due date for Step-2 proposals	**July 24, 2015.** See Tables 2 and 3 in the *ROSES Summary of Solicitation*. **[Amended April 6, 2015]**
Planning date for start of investigation	6 months after proposal due date.

Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Step-1 and Step-2 proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step-1 and Step-2 proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-EXO
NASA point of contact concerning this program	Michael H. New Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1766 E-mail: michael.h.new@nasa.gov

C.6 SOLAR SYSTEM OBSERVATIONS

NOTICE: Suborbital investigations and the Near Earth Object Observations component are not being solicited in this program element under ROSES-2015. However, It is expected that suborbital investigations will be solicited under ROSES-2016.

Proposals to this program will be taken by a two-step process, in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 4 for details.

1. Scope of Program

Solar System Observations supports both ground- and space-based astronomical observations and suborbital investigations of our Solar System involving sounding rockets and balloons. Proposals are solicited for observations over the entire range of wavelengths, from the ultraviolet to radio, that contribute to the understanding of the nature and evolution of the Solar System and its individual constituents. Additionally, Solar System Observations supports NASA's commitment to discover and inventory potentially hazardous near Earth objects with sizes down to at least ~100 meters and to characterize that population through determination of their orbital elements. This program element will also consider proposals that characterize a representative sample of these objects by measuring their sizes, shapes, and compositions.

Suborbital investigations are not being solicited in this program element under ROSES-2015. It is expected that suborbital investigations will be solicited under ROSES-2016.

Solar System Observations contains two primary components: Planetary Astronomy and Near Earth Object Observations. The Near Earth Object Observations component is not being solicited under ROSES-2015. It is expected that the Near Earth Object Observations component will be solicited under ROSES-2016.

1.1 Planetary Astronomy

Planetary Astronomy investigations must contain a primary element of new Solar System observation and must support those NASA Solar System program objectives that cannot be met by current spacecraft missions or that directly support specific flight missions. The proposal must also include scientific analysis and publication. Ground-based observations that supplement NASA missions returning significant amounts of data within the next three years are especially encouraged. Such observations may be made at any currently operating ground-based facility, public or private, including those supported by NASA. Support for investigations proposing to use existing space-based assets is only permitted if those missions do not already provide a funded observer program.

Proposals to utilize data to be obtained from large surveys, or other sources where the data is obtained in a routine manner for general use, should include a member of the data collection team as a Co-Investigator (Co-I) or as a Collaborator in order to meet the requirement for an element of new observation.

1.2 Near Earth Object Observations

Near Earth Objects (NEOs) are defined as asteroids or comet nuclei whose perihelia are less than 1.3 AU. This subelement covers NEO survey and characterization and impactor characterization and mitigation, and is not being solicited under ROSES-2015. Solicitation of this subelement is expected under ROSES-2016. Details on this subelement as previously solicited under ROSES 2014 can be found in ROSES-2014 C.6 Solar System Observations.

Investigations of NEOs may be proposed to Solar System Observations under ROSES-2015 provided they meet the scope and science requirements covered under the Planetary Astronomy subelement above.

1.3 Suborbital Flight Investigations

Solar System Observations supports science investigations and technology development utilizing payloads flown on sounding rockets, balloons, or reusable suborbital vehicles. Suborbital flight investigations are not being solicited under ROSES-2015. It is expected that suborbital investigations will be solicited under ROSES-2016.

2. Programmatic Considerations

2.1 Instrumentation: Construction or Upgrade

The Planetary Major Equipment (PME) program element described in C.17 of this NRA allows proposals for upgrading the analytical, computational, telescopic, and other instrumentation required by investigations for certain programs sponsored by the Planetary Science Division (PSD) Research and Analysis Program, including this one. All new analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $40,000, must be requested according to the PME guidelines in C.17. Two types of instrumentation requests are permitted. (1) A PME request to PSD may be made as a special section that is appended to a new research proposal to this program. This appendix is to be titled "Planetary Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal, and (2) A stand-alone PME proposal may be prepared and submitted to this program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" PSD award and should explain the relevance of the parent award to this program. See C.17 for details on how to prepare both types of PME requests.

2.2 Proposals Utilizing Goldstone Planetary Radar

Proposals intending to use the planetary radar capabilities of the Deep Space Network Goldstone complex must contact the JPL Goldstone Solar System Radar (GSSR) Task Manager listed below for information on costs associated with using the Goldstone radar, which must be included in the proposal.

GSSR Task Manager:
Martin Slade
M/S 238-420
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109
Telephone: (818) 354-2765
Email: Martin.A.Slade@jpl.nasa.gov

2.3 Early Career Fellowship Program

Early career researchers are encouraged to apply for the Early Career Fellowships (ECF) Program. The purpose of the ECF program (see C.16) is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more. In the case of the NEOO Program, the ECF award is named for Dr Stephen J. Ostro, a pioneer in NEO observation research using planetary radar techniques.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the Principal Investigator's (PI's) future research contributions and the potential for leadership within the scientific community. Please see C.16 of ROSES for more information on the two-step process for the ECF program and the criteria for evaluating candidates.

3. Resources: Information, Data, and Facilities

3.1 Limits on Use of Mission Data

For proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply must demonstrate clearly how the proposed research does not overlap and is not redundant with data

analysis, duties, or responsibilities already funded by their respective mission(s). Please see Appendix C.1, The Planetary Science Division Research Program Overview, for more information.

3.2 Facilities and Data Sources Available to Proposers

Proposers are advised to read Appendix C.1, The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

3.3 Data Management Plans and Map Publication

Selected investigations may result in data products that are of broad use to the science community, including maps, data with improved calibrations, etc. Proposers are strongly advised to read C.1, The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Proposers are advised to read Appendix C.1, The Planetary Science Division Research Program Overview, for the USGS' information on and requirements for map production and publication.

4. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, and to ensure proposals are submitted to the appropriate program, this program will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

4.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be done on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

4.2 Step-2 Proposal

All proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages normally, but 20 pages for Suborbital investigations, when solicited.
- Margins: 1 inch on all sides, with a standard page size of 8.5 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that proposers use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single spaced.
- Figure captions: must follow the same font and spacing rules as the main text.
- Figures and tables: for text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

5. Summary of Key Information

Expected program budget for first year of new awards	~$2M
Number of new awards pending adequate proposals of merit	10-12
Maximum duration of awards	Typically 3 years. Up to 5 years permitted.
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.

Due date for Step-2 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	~7 months after Step-2 proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp.
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Step-1 and Step-2 proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step-1 and Step-2 proposals via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-SSO
NASA point of contact concerning this program	Kelly E. Fast Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0768 E-mail: kelly.e.fast@nasa.gov

C.7 PLANETARY DATA ARCHIVING, RESTORATION, AND TOOLS

NOTICE: Amended March 27, 2015. Throughout this program element, the text has been modified to strengthen the requirements on proposers to make data products available. For example, in Section 1.1, data products "must" be made available, Section 1.7 now requires that software tools be archived at Github, and Section 4.3 requires rather than encourages that certain data products be archived. In addition, PDART specific evaluation criteria are presented in Section 2.1, the definition of an equivalent archive is given in Section 2.2, and updated average award sizes are presented in Section 2.4. New text is in bold, deleted text is struck through. The due dates remain unchanged.

Proposals to this program will be submitted by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 3 for details. Proposers to this program do not need to submit a data management plan via the NSPIRES cover pages.

1. Scope of Program

1.1 Programmatic Overview

The Planetary Data Archiving, Restoration, and Tools (PDART) **program** solicits proposals to generate higher-order data products, archive and restore data sets or products, create or consolidate reference databases, generate new reference information, digitize data, and develop or validate software tools.

The objective of this program element is to increase the amount and quality of digital information and data products available for planetary science research and exploration, and to produce tools that would enable or enhance future scientific investigations. Although it is expected that a small amount of data analysis, interpretation, or modeling may be performed to validate any generated products, this program element does not accept proposals in which the main focus is hypothesis-based science.

For all types of proposals, ~~it is expected~~ - the products of selected proposals ~~will~~ **must** be made available to the scientific community. Data products must be archived in the NASA Planetary Data System (PDS) or an equivalent archive **(see Section 2.2 for a definition of an equivalent archive)**. All proposals will be evaluated on the perceived impact of the new products, datasets, or tools on future planetary science research and exploration.

Proposers to this program element will not provide a data management plan via the NSPIRES cover pages. Instead, that is superseded by instructions in the sections below that place more detailed descriptions into the body of the Scientific/Technical/Management section of proposals.

1.2 Data Product Generation

Proposals to generate higher-order data products than those that currently exist are encouraged. Source data may be derived from NASA or other spaceflight missions, astronomical observations, sample analyses, or other sources. The new data products may include, but are not limited to, cartographic products and calibrated or corrected datasets.

1.3 Data Set Restoration and Archiving

Proposals to archive complete datasets and/or to restore and archive incomplete datasets (e.g., to reextract, rereduce, and/or recalibrate data to fill in fragmentary datasets) will be considered. Such proposals ~~should~~ **must** include: 1) an archiving plan (see Section 4.3); 2) a description of how the data will be obtained; 3) a detailed plan for how the data will be restored, if relevant; and 4) a description of documentation, calibration data, and related software necessary to read and interpret the original and new datasets.

1.4 Reference Database Creation

Proposals that create or consolidate reference databases useful for planetary science research will be considered. These databases may include, but are not limited to, spectral libraries, chemical and physical properties of materials, and photographic catalogs. The burden is on the proposer to demonstrate the demand for a proposed database and its likelihood of advancing the current state of knowledge or resolving a significant planetary question or problem.

1.5 Generation of New Reference Information

Proposals to make laboratory measurements, conduct experiments, or otherwise generate new reference information that is intended for general use in planetary science will be considered. Examples may include, but are by no means limited to, spectral data, phase diagrams and equations of state, physical laws, optical constants, partition coefficients, and thermodynamic properties of materials. Where the main product of the proposal is a reference dataset, the proposal must include a plan to deposit the data in the NASA PDS or an equivalent archive. The burden is on the proposer to demonstrate the demand for a proposed reference product and its likelihood of advancing the current state of knowledge or resolving a significant planetary question or problem.

1.6 Data Digitization

This program element encourages proposals to recover datasets that currently are available only on media not readable by modern computing equipment, or to digitize data that are only available in analog form (e.g., printed matter, photographs, and manuscripts). PDART will consider proposals that include the rental of specialty equipment and/or the hiring of independent

expertise to accomplish those tasks. Regardless of the method, the proposal must demonstrate the capability and provide a plan to recover or digitize the data. **The burden is on the proposer to demonstrate the demand for the digitized product and its likelihood of advancing the current state of knowledge or resolving a significant planetary question or problem.**

1.7 Software Tool Development and Validation

This program element supports the development and dissemination of software tools that facilitate the use of existing datasets or that would enable or enhance future science investigations of interest to the Planetary Science Division. PDART does not support extensive application of these tools, but it is expected that the validity of the tools will be demonstrated during the course of the proposed work. Proposals are expected to include a plan to disseminate the tools for use by the planetary community. **In addition to any other dissemination mechanisms, investigators developing software tools are required to archive the source code, and all relevant documentation, at NASA's Github site (https://github.com/nasa).** ~~Investigators are encouraged, but not required, to distribute the source code for software tools.~~ It is expected that user interfaces and/or executables will be made publically available at no cost.

This program element does accept proposals to fund the development or enhancement of numerical models, with the expectation that the funded model will be made publicly available. In these instances, the proposal will be judged on 1) how the enhancement would result in an improvement in the results previously produced by this or similar models, and 2) how the enhancement would enable scientific investigations not currently possible with, or improve investigations relative to, models currently in use.

Proposals to develop tools that would enhance the usability of, and access to, the PDS4 file format are particularly encouraged. Of special interest are tools for converting PDS4-formated files into other popular file formats (*e.g.*, FITS, CDF).

2. Programmatic Information

2.1 Merit Evaluation Criterion

As PDART's goals differ from other programs, the review of proposals submitted to this program element will include Merit factors not listed in the *NASA Guidebook for Proposers* (Appendix C). In addition to the *Guidebook* criteria, all submitted proposals will be evaluated on the following PDART-specific merit factors:

1. **The perceived impact of the new products, datasets, or tools on future planetary science research and exploration. This factor includes an evaluation of the proposal's end products against the state-of-the-art.**
2. **The uniqueness and/or time criticality of the proposed new products, datasets, or tools. For this factor, historical significance may also be considered.**
3. **The credibility of the proposed plan for dissemination and archiving. This factor includes both the format that the data products/tools would be in and how they would be made available for the scientific community. For those proposals that**

would use an archive other than NASA's PDS or Github site, this factor includes an evaluation of whether the repository is a PDS-equivalent archive (Section 2.2).

4. **Any applicable work-specific factors described in Sections 1.2-1.7.**

2.2 <u>Definition of a PDS-equivalent archive</u>

Equivalence of an archive to the NASA PDS is defined by a number of factors that cover accessibility, reliability, usability, and other qualities.

Proposed archives are required to have the following features:

1. **The Archive shall be managed by someone other than the data provider. (Independence)**
2. **The Archive shall be managed for the long-term (25 years at least). (Sustainability)**
3. **The Archive shall be accessible to the public (lay and scientific) without preapproval. (Open Accessibility)**
4. **The Archive shall ensure that data are searchable. (Searchability)**
5. **The Archive shall ensure that data are citable. (Citability)**
6. **The Archive shall be considered by its user community as the "standard" archive for the subfield. (Preeminence)**
7. **The Archive shall require that data products be submitted in standardized formats and file types. (Standardization)**

Proposed archives are preferred to have the following features:

1. **Archive should conduct independent peer reviews of data to assess usability and completeness of data packages. (Peer Review)**
2. **Archive should include documentation for it's holding such as user guides, calibration descriptions, etc. (Documentation).**

2.3 <u>Exclusions</u>

PDART does not support scientific investigations whose primary emphasis is data analysis, fundamental theoretical research, or instrument development. Proposers are encouraged to consult C.1 Planetary Science Research Program Overview for the appropriate program element to which they should submit.

Proposals whose primary focus is on data to be used in investigations solicited by the Astrophysics, Heliophysics, or Earth Science Divisions are encouraged to consult Appendices A, B, and D for information on the appropriate program elements to which they should be submitted.

The PDART element does not fund proposals whose work effort is primarily to acquire new ground- or space-based observations or surveys; such proposals should be submitted to the Solar System Observations program (see C.6).

Proposals for topical conferences, workshops, or symposia related to this program element may not be proposed through this solicitation. Proposers are encouraged to pursue such submissions through ROSES-2015 E.2, Topical Workshops, Symposia, and Conferences.

2.4 Duration and Size of Awards

The maximum duration of awards from C.7 is three years (not including no cost extensions). Proposals for funding of less than three years are highly encouraged for projects that can be completed on shorter timescales. The appropriateness of the proposed funding period will be reviewed and adjustments may be requested.

Since this is a new program with a new scope, the budget and expected number of new awards is somewhat uncertain, as it may depend on the distribution of topics proposed and the number of proposals submitted. As always, the number of new awards will also depend on the available Fiscal Year (FY) 2016 budget.

NASA does not have historical data to rely on, but the 2014 PDART selections have been made and those data have been added to the spreadsheet on the SARA grant stats web page. The average year-one award size in 2014 was ~$120K, but the award sizes spanned a very wide range, depending on the nature of the work proposed. Proposers are encouraged to request what is actually needed to conduct the proposed work.

~~Since this is a new program with a new scope we don't have historical data to rely on, but when the 2014 PDART selections are made that data will be spreadsheet on the SARA grant stats web page and summarized here. We do know that the average year one award size in the past made from the Planetary Mission Data Analysis Program (PMDAP) was ~$90K per year in FY 2013, but ~$135K per year in FY 2014 and each year the award sizes spanned a wide range, depending on the nature of the work proposed. Proposers are encouraged to request what is actually needed to conduct the proposed research.~~

3. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, and to ensure proposals are submitted to the appropriate program, this program will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES Summary of Solicitation.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

3.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be performed on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

3.2 Step-2 Proposal

All proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: Section 2 of the *NASA Guidebook for Proposers* requires easily read fonts having, on average, no more than 15 characters per inch (e.g., 12-point Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line-spacing settings for a selected font below single-spaced.
- Figure captions: Must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

4. Resources: Information, Data, and Facilities

4.1 Limits on Use of Data

For proposals that generate higher-order data products or otherwise use data in the development or testing of software, the data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues

that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply must clearly demonstrate how the proposed research does not overlap and is not redundant with duties or responsibilities already funded by their respective mission(s). Please see Appendix C.1, The Planetary Science Division Research Program Overview, for more information.

Proposals to digitize and/or archive data not currently available in a public archive must demonstrate that the data to be used are available (such as a letter of support, if they are owned by a private entity, or a detailed plan to locate and obtain the data from a known repository), in a format suitable for the proposed work, and of sufficient quality to achieve the goals set forth in the proposal. The proposal should further demonstrate a familiarity with the data and an understanding of the work required to prepare the data for future analysis and/or delivery to an appropriate public archive.

4.2 Facilities and Data Sources Available to Proposers

Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

4.3 Data Archiving and Map Publication

Selected investigations **are expected to** result in data products that are of broad use to the science community, including maps, data with improved calibrations, etc. ~~NASA strongly encourages~~ **PDART requires** that such data be archived in the Planetary Data System (http://pds.nasa.gov/), or **an** equivalent public archive, by the end of the award period. Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for information on including an archiving plan in the proposal. **Proposers are highly encouraged to contact the appropriate PDS discipline node during the initial phases of the proposal process to help with discerning the most efficient way to archive your proposed data.**

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. ~~The scientific goal of such a geologic map product should be clearly explained and justified.~~ Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for the USGS' information on and requirements for map production and publication.

5. Summary of Key Information

Expected program budget for first year of new awards	~$2-2.4M
Number of new awards pending adequate proposals of merit	See Section 2.2
Maximum duration of awards	3 years
Due date for Step-1 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Due date for Step-2 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Planning date for start of investigation	~8 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-PDART

Points of contact concerning this program all of whom share the following postal address: Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001	Sarah Noble – Lead Discipline Scientist Telephone: (202) 358-2492 E-mail: sarah.noble-1@nasa.gov Michael New – Discipline Scientist Telephone: (202) 358-1766 E-mail: michael.h.new@nasa.gov Jared Leisner – Discipline Scientist Telephone: (202) 358-2016 E-mail: jared.s.leisner@nasa.gov ~~Christina Richey – Adjunct Discipline Scientist~~ ~~Telephone: (202) 358-2206~~ ~~Email: christina.r.richey@NASA.gov~~

C.8 LUNAR DATA ANALYSIS PROGRAM

NOTICE: Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 2.3 for details.

1. Scope of Program

1.1 Program Overview

The Lunar Data Analysis Program (LDAP) program funds research on the analysis of recent lunar missions in order to enhance their scientific return. LDAP broadens scientific participation in the analysis of mission data sets and funds high-priority areas of research that support planning for future lunar missions.

LDAP supports scientific investigations of the Moon using publicly available (released) data. These include the following missions:

Lunar Crater Observation and Sensing Satellite (LCROSS),
Moon Mineralogy Mapper (M3),
Lunar Reconnaissance Orbiter (LRO)
Gravity Recovery and Interior Laboratory (GRAIL),
Acceleration, Reconnection, Turbulence, and Electrodynamics of the Moon's Interaction with the Sun (ARTEMIS),
Lunar Atmosphere and Dust Environment Explorer (LADEE),
Non-U.S. missions: Kaguya, Chang'e 1, Chang'e 2, Chandrayaan-1, Chang'e 3.

Any proposal may incorporate the investigation of data from more than one mission.

An investigator may propose a study (e.g., scientific, landing site science, cartographic, topographic, geodetic research, etc.) based on analysis of lunar data collected by spacecraft at the Moon (listed above). Proposals may incorporate the analysis of data from more than one mission. Moreover, data analyses that require the use of older mission data sets (e.g., Apollo, Clementine) are allowable in the context of enhancing the analysis and understanding of the data from the missions listed above. The use of older data sets as complementary/supplementary data sets to the missions listed above for the purpose of creating a needed data product (e.g., maps) for analysis is allowable. Additional information about NASA and other lunar missions can be found at NASA's National Space Science Data Center (NSSDC) at: http://nssdc.gsfc.nasa.gov/planetary/planets/moonpage.html.

Investigations are welcome in the following high priority areas of lunar research:

- Identification and/or characterization of potential landing sites of high lunar science return (e.g., geomorphology, regolith, radiation, and compositional properties);
- Modeling of the lunar gravitational field, global topography, and global lunar figure;
- Enhancement of the lunar geodetic network to enable precision lunar landing;
- Identification, distribution, transport, and characterization of volatiles in and on the Moon;
- Determination of the size and state of the lunar core;
- Determination of lunar lithospheric thickness;
- Lunar "change detection" (i.e., detection of surface or atmospheric changes as a function of time);
- Characterization of the global variability and structure of the lunar exosphere and/or dust environment;
- Identification/characterization of lunar mineralogy as a function of location and depth.

A description of science research priorities for lunar exploration can be found in the documents: *The Scientific Context for Exploration of the Moon (2007),* obtained at http://books.nap.edu/catalog.php?record_id=11954, and *Vision and Voyages for Planetary Science in the Decade 2013-2022 (2011),* obtained at http://www.nap.edu/catalog.php?record_id=13117. Both documents are published by the Space Studies Board of the National Research Council.

LDAP will consider requests for support of new ground-based observations and field/laboratory measurements provided that the requests are clearly described and that the observations or measurements are essential to the success of the work proposed. Requests to support such tasks are only allowable in the context of enhancing the analysis and understanding of the data from the missions listed above. Requests to perform new ground-based observations or field/laboratory measurements will be considered only if their cost (including full-time equivalents [FTEs], travel, etc.) does not exceed 20% of the proposal's total effort.

Investigators interested in proposing mostly theoretical, modeling, laboratory, or field studies that do not directly use spacecraft data, or proposals whose data analysis components are only a small portion of the total work effort proposed, are advised that such studies are not appropriate for LDAP, but may be suitable for submission to the C.2 Emerging Worlds or C.3 Solar System Workings Programs.

1.2 Sources of Information and Data

The LDAP program supports research investigations relevant to the scientific interpretation of lunar mission data that are now in the public domain. LDAP supports investigations that use only publicly available and released data. Data to be used in proposed investigations must be available in the Planetary Data System (PDS) (http://pds.nasa.gov) or other publicly accessible archive at least 30 days prior to the submission due date for LDAP proposals. Spacecraft data that have not been placed in the public domain may not be proposed for use in LDAP investigations. (Once a proposal has been awarded, investigators are free to augment the proposed dataset under analysis

with data deposited in the PDS (or other publically available archive) subsequent to 30 days prior to the LDAP submission date.)

Whether from the PDS or another source, if the data to be analyzed are not certified or otherwise have issues that might represent an obstacle to analysis, the obligation is on the proposer to clearly demonstrate that such potential difficulties can be overcome. Likewise, this requirement applies to proposals that make use of planetary data from international missions that do not have their data deposited in the PDS.

In all cases, it is the responsibility of the LDAP investigator to acquire any necessary data; therefore, before submitting a proposal, proposers must demonstrate in their proposal that the necessary data are available. Proposers who wish to use photographic and cartographic materials may access such data through the nearest Regional Planetary Image Facility (RPIF). RPIF locations are listed on the RPIF home page at http://www.lpi.usra.edu/library/RPIF.

1.2.1 Flight Team Member Requirements

Members of current spacecraft flight teams who wish to apply to the LDAP program must clearly demonstrate that their proposed investigation will use only released and publicly available data. Flight team members must scrupulously comply with the 30 days prior to submission rule (above). Additionally, proposals from current flight team members must rigorously demonstrate how the proposed LDAP research does not overlap – and is not redundant with – data analysis duties/responsibilities already funded within their respective mission. This requirement applies to all members of the proposal team.

1.3 Data Products and Data Archiving and Map Publication

Investigators may propose to produce data products (e.g., cartographic products, such as geologic, topographic, or mineral maps, and/or calibration data). Such investigations must have associated scientific tasks. Proposers interested in producing data products that do not have associated scientific tasks are directed to the Planetary Data Archiving Restoration and Tools Program (C.7, PDART). A plan for archiving and making products readily available must be included in any proposed investigation that will result in the production of data products. NASA reserves the option to require the archiving in the Planetary Data System (http://pds.nasa.gov/) of any data products resulting from LDAP selected proposals. Proposers are strongly advised to read C.1, The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans. Proposed investigations that will result in a geologic map suitable for publication by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the *Proposal Summary*, as well as in the text of the proposal.

Proposers should refer to the most recent versions of the following documents for information on PDS compliance:

Document	Hyperlink
Proposer's Archive Guide	http://pds.nasa.gov/documents/pag/index.html
Standards Reference	http://pds.nasa.gov/documents/sr/index.html

Additional information on the PDS may be obtained from the following individuals:

Contact	Title	E-mail
William Knopf	Program Executive	william.knopf@nasa.gov
Edwin Grayzeck	Program Manager	edwin.j.grayzeck@nasa.gov

2. Programmatic Information

2.1 Early Career Fellowship Program

Early career researchers are encouraged to apply for the Early Career Fellowships (ECF) Program. The purpose of the ECF program (see C.16) is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the Principal Investigator's (PI's) future research contributions and the potential for leadership within the scientific community. Please see Appendix C.16 of ROSES for more information on the two-step process for the ECF program and the criteria for evaluating candidates.

2.2 NASA Provided High-End Computational (HEC) Facilities

Those investigators whose research requires high-performance computing should refer to the *ROSES Summary of Solicitation*, Section I(d), "NASA-provided High-End Computing Resources." This section describes the opportunity for successful proposers to this program to apply for computing time on either of two NASA computing facilities at the Goddard Space Flight Center's Computational and Information Sciences and Technology Office or at the Ames Research Center's Advanced Supercomputing Division.

2.3. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, and to ensure proposals are submitted to the appropriate program, this program will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain

the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

2.3.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be performed on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

2.3.2 Step-2 Proposal

All proposals submitted to ROSES must strictly conform to the formatting rules in Chapter IV of the *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages.
- Margins: 1 inch on all sides, with a standard page size of 8.5 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that you use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). You may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Do not adjust line-spacing settings for your selected font below single-spaced.
- Figure captions: must follow the same font and spacing rules as the main text.
- Figures and tables: for text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

2.4 Duration and Size of Awards

The maximum duration of awards from C.8 is four years (not including no cost extensions). It is anticipated that most proposals will seek funding for up to three years. Proposals for funding of less than three years are highly encouraged for projects that can be completed on shorter

timescales. The appropriateness of the proposed funding period will be reviewed and adjustments may be requested.

Since this is a new program with a new scope, the budget and expected number of new awards is somewhat uncertain, as it may depend on the distribution of topics proposed and the number of proposals submitted. As always, the number of new awards will also depend on the available budget for next Fiscal Year.

When the 2014 LDAP selections are made that data will be spreadsheet on the SARA grant stats web page and summarized here. We do know that awards made in the past from the Lunar Advanced Science and Exploration Research program averaged ~$120-130 K per year, but with a wide range, depending on the nature of the work proposed. Proposers are encouraged to request specifically what is needed to conduct the proposed research.

3. Summary of Key Information

Expected program budget for first year of new awards	~$1M
Number of new awards pending adequate proposals of merit	See Section 2.4
Maximum duration of awards	Four years, but see also Section 2.4
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Step-2 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after the Step-2 proposal due date
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions, and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)

Web site for submission of proposals via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-LDAP
NASA points of contact concerning this program	Robert A. Fogel Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-2289 E-mail: rfogel@nasa.gov

C.9 MARS DATA ANALYSIS

NOTICE: Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 3 for details.

1. Scope of Program

The objective of the Mars Data Analysis Program (MDAP) is to enhance the scientific return from missions to Mars conducted by NASA and other space agencies. These include, but are not limited to, the following missions: Mars Pathfinder (MPF), Mars Global Surveyor (MGS), Mars Odyssey (MO), Mars Exploration Rovers (MERs), Mars Express (MEX), Mars Reconnaissance Orbiter (MRO), Phoenix (PHX), the Mars Science Laboratory (MSL) and Mars Atmosphere and Volatile EvolutioN (MAVEN). MDAP broadens scientific participation in the analysis of mission data sets and funds high-priority areas of research that support planning for future Mars missions. MDAP supports scientific investigations of Mars using publicly available (released) data. Where justified to support planning for future Mars missions, investigations that use data derived from other sources (e.g., ground-based radar, Hubble) will also be considered.

An investigator may propose a study based on analysis of Mars data collected by spacecraft at Mars, including MPF, MGS, MO, MERs, MEX, MRO, PHX and MSL. Any proposal may incorporate the investigation of data from more than one mission. Additional information about these missions, as well as references containing preliminary science results, can be found on the Mars Exploration Program (MEP) homepage at: http://mars.jpl.nasa.gov/. Investigations submitted to this program must demonstrate how the research to be undertaken will directly improve our understanding of open science questions at Mars relevant to current hypotheses.

MDAP also supports correlative studies that use Mars data from another source, in addition to flight mission data, to further the understanding of some aspect of Mars science. Funds awarded for correlative studies may be used to cover data analysis and expenses involved in collaboration with other Mars investigators, but may not be used for taking new observations (whether astronomical, field, or laboratory studies) or for support of observing or laboratory facilities.

An investigator may also propose in the following high-priority areas of Mars research that support planning for future Mars missions:

- Improved atmospheric models that further the understanding and forecasting of Mars atmospheric conditions that affect the orbital trajectories of spacecraft and/or the safe passage of spacecraft through the atmosphere, including aerobraking and aerocapture.

- Characterization of potential landing sites for future Mars exploration missions (e.g., geomorphology, distribution and size of rocks, pits, sand dunes, regional and local slopes, surface composition, and texture variability).
- Improved models for the Mars gravity field and global topography and planetary figure.
- Improvement of the geodetic network of Mars for precision landing.
- Analysis and comparison of Mars orbital and surface data to increase the predictive accuracy of surface characteristics of Mars from orbit.

For more information about the type of research supported by the MDAP, please refer to the abstracts of currently funded investigations that are available online at: http://nspires.nasaprs.com/.

Investigators interested in proposing mostly theoretical, modeling, laboratory, or field studies that do not directly use spacecraft data, or proposals whose data analysis components are only a small portion of the total work effort proposed, are advised that such studies are not appropriate for MDAP, but may be suitable for submission to the Solar System Workings or Habitable Worlds Program described in C.3 and C.4, respectively, of this NRA.

Investigators who wish to propose to produce data products (e.g., cartographic products, such as geologic, topographic or mineral maps, and/or calibration data) are directed to C.7, Planetary Data Archiving, Restoration and Tools (PDART).

2. Resources: Information, Data, and Facilities

2.1 Limits on Use of Mission Data

For proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply must demonstrate clearly how the proposed research does not overlap and is not redundant with data analysis, duties, or responsibilities already funded by their respective mission(s). Please see C.1, The Planetary Science Division Research Program Overview, for more information.

2.2 Facilities and Data Sources Available to Proposers

Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and

Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

Documents that describe the research priorities for Mars exploration include:

- Mars Exploration Program Analysis Group (MEPAG) reports (http://mepag.jpl.nasa.gov/), including *Mars Scientific Goals, Objectives, Investigations, and Priorities* [2010 and subsequent updates]

and

- The recommendations of the Committee on the Planetary Science Decadal Survey of the National Research Council, as described in the Space Studies Board report *Visions and Voyages for Planetary Science in the Decade 2013-2022* [2011], available at http://www.nap.edu/catalog.php?record_id=13117
- *An Astrobiology Strategy for the Exploration of Mars* [2007], by the Space Studies Board (SSB) of the National Research Council (NRC) (http://www.nap.edu/catalog.php?record_id=11937).

Additional information is available on the MEP web site at: http://mars.jpl.nasa.gov/.

2.3 Data Archiving and Map Publication

Selected investigations may result in data products that are of broad use to the science community, including maps, data with improved calibrations, etc. NASA strongly encourages that such data be archived in the Planetary Data System (http://pds.nasa.gov/), or equivalent public archive, by the end of the award period. Proposers are strongly advised to read C.1, The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for the USGS' information on and requirements for map production and publication.

3. Programmatic Information

3.1 The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, given the nature of the new calls, and to ensure proposals are submitted to the appropriate program, many programs will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The Principal Investigator (PI) cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

3.2 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be done on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

3.3 Step-2 Proposal

All proposals submitted to ROSES must strictly conform to the formatting rules in Chapter IV of the *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that proposers use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single-spaced.
- Figure captions: must follow the same font and spacing rules as the main text.
- Figures and tables: for text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

3.4 Early Career Fellowship Program

Early career researchers are encouraged to apply for the Early Career Fellowships (ECF) Program. The purpose of the ECF program (see C.16) is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the Principal Investigator's (PI's) future research contributions and the potential for leadership within the scientific community. Please see Program Element C.16 of ROSES for more information on the two-step process for the ECF program and the criteria for evaluating candidates.

4. Summary of Key Information

Expected program budget for first year of new awards	~ $3.5M
Number of new awards pending adequate proposals of merit	~ 30-35
Maximum duration of awards	4 years
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Step-2 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.

Web site for submission of Step-1 and Step-2 proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step-1 and Step-2 proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-MDAP
NASA point of contact concerning this program	Mitchell Schulte Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-2127 E-mail: mitchell.d.schulte@nasa.gov

C.10 CASSINI DATA ANALYSIS AND PARTICIPATING SCIENTISTS

NOTICE: Clarified June 23, 2015. This clarification explicitly states that the evaluation of Intrinsic Merit will not hold proposals responsible for end-of-mission trajectory/orientation specifics that are not publicly available. This evaluation will be handled separately in the review process. Proposals are still responsible for demonstrating that utilized instruments, assuming adequate pointing and mode, are capable of making the necessary observations. This clarification does not change the proposal due date.

Amended April 21, 2015. This amendment presents a major revision to this program element and thus the prior text is replaced in its entirety. The major changes are:
1) The Participating Scientist proposal is now separate from a parent Data Analysis proposal. Step-2 Participating Scientist submissions now require their own fifteen-page proposal that is accompanied by a five-page appendix on the Relevance to the Cassini Participating Scientist Program. See Sections 2.2 and 2.3.
2) Only those Participating Scientist proposals that demonstrate the need for future mission data for achieving successful closure of the scientific objectives are eligible for selection. That is, this year's Participating Scientist program focuses on and solicits proposals that would address the science goals and objectives for the Cassini Solstice Mission or Grand Finale. However, proposals that would require and would use future mission data to address other science questions are eligible for consideration. See Section 2 for details on and requirements for the Participating Scientist proposals.

This is the final year that the Cassini Participating Scientist program will be offered, although the Cassini Data Analysis Program will continue.

As in prior years, proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. However, this year no PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 5 for details.

1. Scope of Program

The objective of the Cassini Data Analysis and Participating Scientists (CDAPS) Program is to enhance the scientific return of the Cassini mission by broadening the scientific participation in the analysis and interpretation of the data returned by the mission. Proposals may also be directed to the Cassini Participating Scientist program, which will further broaden participation in the mission by augmenting the existing science team, by following the directions in Section 2.

This program solicits research proposals to conduct scientific investigations utilizing data obtained by the Cassini and Huygens spacecraft. Proposers are encouraged to read the abstracts of investigations that were selected from previous competitions, which are available online at http://science.nasa.gov/researchers/sara/grant-stats/ (select the relevant ROSES year and the awards abstracts PDF beneath "Cassini Data Analysis"). All proposals to CDAPS should identify and address a clear objective with science research that will be a significant, not incremental, advance in our understanding of the Saturn system.

In order to be considered, data analysis proposals must use data that are in the public domain 30 days before the CDAPS Step-2 proposal due date, and they must make clear to the peer reviewers that the data are publicly available. Proposals that do not comply with this rule may be declared noncompliant and declined without evaluation. It is understood, however, that once the grant is awarded, succeeding years of work may address data that have subsequently come into the archive, as long as those data are not necessary for the successful completion of the proposed work.

NASA's organization for archiving and distributing Cassini data is the Planetary Data System (PDS). In accordance with the approved mission data-archiving plan, Cassini data is archived in the PDS in three-month increments, nine to twelve months after it is received on Earth. PDS archived Cassini data can be found at http://pds-atmospheres.nmsu.edu/data_and_services/atmospheres_data/Cassini/Cassini.html. Data that are otherwise in the public domain via open-literature publications and other freely available sources are also eligible, but proposers are cautioned that it may not be calibrated and validated. To the extent that lack of calibration and validation may affect the scientific quality and value of the end product of the investigation, the peer reviewers may note this as a weakness. Whether from the PDS or another source, if the data to be analyzed are not certified or otherwise have issues that might represent an obstacle to analysis, the proposers must clearly demonstrate that such potential difficulties can be overcome.

Proposals should be focused on the Saturn system and make significant use of (or greatly enhance the use of) data returned by Cassini instruments. Additionally, data from the Cassini Jupiter flyby in 2000 is eligible. Proposals to work with Cassini data and also use ground-based or other data are acceptable, provided that the success of the proposal, as written, is dependent upon the Cassini data. If this is not the case, the proposal should be submitted to another ROSES element, as appropriate; see Appendix C of this ROSES NRA.

Investigations that incorporate theory, modeling, laboratory studies, correlative analyses, and/or other research that would greatly increase the use of, or significantly facilitate the interpretation of, data from the mission are also eligible for CDAPS. Such proposals that don't directly analyze data, but are intended to amplify its interpretation, will be judged upon the perceived impact of the proposed work on the interpretation of Cassini data. Proposers are encouraged to seek collaborations with Cassini scientists and to utilize data from more than one instrument, if appropriate, in order to produce the most useful contributions to understanding the Saturn system.

Proposed data products for delivery to the PDS should be clearly described, and the proposer should consult with the manager of the appropriate PDS data node to insure that they will be PDS compliant and constructed as efficiently as possible. For additional information, refer to the PDS Proposer's Archiving guide at http://pds.nasa.gov/documents/pag/index.html. Data products, including maps, improved calibrations, etc., should be submitted to the PDS by the end of the funded research period, unless the investigator explicitly makes a case in the proposal for a later date. Each research proposal must constitute a stand-alone scientific investigation, with stated lines of inquiry, and result in one or more peer-reviewed publications.

2. Participating Scientists

2.1 Background

As stated in the original Cassini Announcement of Opportunity (AO), Participating Scientist investigations are carried out by scientists who wish to participate only in the data collection and analysis phases of the mission. These investigations can either be instrument-specific or multidisciplinary. Proposers interested in becoming a Participating Scientist should propose a science investigation that addresses one or more of the Cassini science objectives listed below. These investigations, and the expertise of the proposer, should complement or extend the existing investigations and expertise of the science team. Selected Participating Scientists will become independent members of the Cassini science team for the duration of their CDAPS grant and be encouraged to work in a collaborative manner with other Cassini science team members after selection. Participating Scientists may be attached to existing groups or teams, if appropriate. All science team members will be bound by the Cassini Project "Rules of the Road" document that describes the data access rights, data-sharing responsibilities, and data release policies of the Cassini science team. This rules of the road document is downloadable as a PDF file from the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program element. After selection, Participating Scientists will also need to negotiate and abide by secondary agreements with specific instrument teams, as necessary. For more information about these secondary agreements, please contact Curt Niebur, the NASA Cassini Program Scientist (curt.niebur@nasa.gov, (202) 358-0390) or Nicolas Altobelli, ESA Cassini-Huygens Project Scientist (nicolas.altobelli@sciops.esa.int, +34 91 813 1201).

Participating Scientists may propose any investigation that would use future mission data to addresses 1) the goals of the Cassini Solstice Mission, including observing seasonal and temporal change in the Saturn system to understand underlying processes and prepare for future missions; 2) the goals of the Cassini Grand Finale, including using the high-inclination orbits to study Saturn's internal structure, atmosphere, inner magnetosphere, and rings; or 3) out-standing scientific questions in Saturn system. Science objectives supporting these goals, as well pursuing new questions posed for the Solstice Mission and Grand Finale, are posted in the CSM Traceability Matrices PDF in the other documents section on the NSPIRES web page where this call (C.10) is found. NASA, ESA, and ASI are open to considering any outstanding proposals that address these science objectives.

Participating Scientists will be joining a well-established Cassini science team. Proposers are encouraged to consider how they will most efficiently integrate themselves with the science team and any necessary instrument teams or working groups.

The Cassini project has already created a high-fidelity mission plan. The role of the Participating Scientists is focused on data analysis to suggest further refinements to this mission plan. It is not anticipated that Participating Scientists will be deeply involved in the tactical operations process. To accomplish this goal, Participating Scientists are expected to participate in all necessary team meetings. This includes, but is not limited to, Project Science Group meetings (lasting four days each and held three times each year for the entire science team, with two of the meetings held in the United States) and any relevant instrument or discipline working group meetings (lasting two days each and held approximately twice each year per instrument or working group). In addition to meetings, Participating Scientists should plan to participate in regular teleconferences totaling approximately one day per month.

The selection process for Cassini Participating Scientists has been extremely competitive and highly selective, with a selection rate below that for CDAPS program overall. NASA encourages proposals from people who have not previously participated in the Cassini or other missions. The opportunity to become a Participating Scientist is not open to those already serving on the Cassini mission as a Team Leader or Team Member on a facility instrument, Principal Investigator (PI) or Co-Investigator (Co-I) on a PI-led instrument team, or as an Interdisciplinary Scientist. The opportunity is open to all current Cassini team associates and affiliates. Proposers are encouraged to also refer to the FAQ in the "Other Documents" section of the CDAPS program element page.

In order to enable as many selections as possible, Participating Scientist proposals are strongly encouraged, as much as both possible and reasonable, to minimize funded team members and to attend the relevant Cassini meetings virtually.

2.2 Proposal Guidelines

Proposers interested in consideration as a Participating Scientist must submit a full Step-2 proposal for a scientific investigation utilizing Cassini data containing the elements described in Section 2 of the *Guidebook for Proposers*. As the selected Participating Scientist(s) will join the Cassini science teams and have access to data not available in the PDS or other archive. As part of this program, proposals are required to use future data from the Cassini Solstice Mission or Grand Finale and to focus on science questions or objectives that were not addressable with currently available data alone.

The proposer must select the Participating Scientist checkbox on the Cover Page of the proposal. In an appendix titled "Relevance to the Cassini Participating Scientist Program," limited to five pages outside the fifteen-page main body, proposals must include: (a) a description of how serving as a Participating Scientist is necessary to conduct the research described in the main body of the science research proposal; (b) an explanation of how and why the research described in the proposal cannot be completed without the use of data not yet archived in the PDS; (c) a description of how the proposed investigation will fit into the broader body of scientific research

being conducted by the Cassini science team; (d) a description of how the proposed investigation would complement the Cassini science team by filling needs enumerated by the Cassini instrument teams (see the Cassini Instrument Team Needs document on the NSPIRES CDAPS15 solicitation page); (e) a statement listing (along with rationale) which instrument team(s), working group(s), and/or Interdisciplinary Scientists with which the Participating Scientist needs to work; and (f) a statement that the proposer will abide by the appropriate Cassini team rules. The discussion in this appendix will not be used in the evaluation of the intrinsic merit of the proposal, but rather only the relevance to the participating scientist program (see Section 2.3). The proposal's budget narrative must clearly outline the budget requested for the Participating Scientist role, including any cost-sharing arrangements. The omission of any of these factors will be sufficient groups for a proposal to not be selected for funding and the proposer to not be selected as a Participating Scientist.

The Principal Investigator is expected to be the primary individual contributing to the proposed science and all proposals should indicate a commitment level in each of the fiscal years. Although not encouraged, proposals may include funded Co-Investigators and/or unfunded Collaborators only if they are critical to complete the proposed science investigation. The participation of graduate students and postdoctoral researchers is encouraged in all proposals. However, only the Principal Investigator (or Science Principal Investigator) from each proposal will be designated as a Participating Scientist on the Cassini Solstice mission; any Co-Investigators, Collaborators, graduate students, and postdoctoral researchers on the proposal will be designated as Cassini associates.

Proposals from scientists employed at non-U.S. institutions are encouraged and will be considered on a no-exchange-of-funds basis. The expected budget listed below in the summary table refers only to the NASA support. Non-U.S. proposals will be reviewed to the same standards as proposals from U.S. institutions. Proposers from non-U.S. institutions should read the Foreign PI Affiliation instructions document, which is downloadable as a PDF file from the NSPIRES web page for this program element. These proposers are strongly encouraged to include a letter of commitment promising financial support for both the investigation and the Participating Scientist duties.

2.3 Evaluation Criteria for Participating Scientists

Evaluation criteria are given in the *Guidebook for Proposers*. These criteria are intrinsic merit, relevance, and cost realism/reasonableness. In addition to the factors for each criterion given in the *Proposers Guidebook*, evaluation of proposals for a Participating Scientist position includes the following factors, based upon the material within the fifteen-page main body and the five-page appendix, as appropriate:

- **Merit will include an evaluation of whether 1) the proposed instruments are capable of providing the needed data and 2) whether the anticipated tour would provide observations in the appropriate regions of space. This evaluation will be based upon published or otherwise widely available information. It will not require that the proposal demonstrate detailed knowledge of end-of-mission spacecraft trajectory or orientation,**

which is not necessarily widely available. This second aspect of the technical feasibility of the work effort will be evaluated separately in the review process. [Added June 23, 2015]

- Relevance will additionally include evaluation of whether the proposal requires, for achieving successful closure on the science objectives, the proposer to be a Participating Scientist and the use of Cassini that is not yet archived in the PDS, including data to be acquired in the Cassini Grand Finale.
- Relevance will additionally include evaluation of the extent to which the proposal meets both goals and the applicable mission-level science objectives of the Cassini Solstice Mission or Grand Finale. Proposals to address other out-standing science questions that require the use of future Cassini mission data will not be subject to this evaluation.
- Relevance will additionally include evaluation of the extent to which the proposed investigation and the expertise of the proposer complements or extends the existing investigations and expertise of the science team.
- Cost realism/reasonableness will additionally include budget analysis to ensure that participation in science team activities and meetings is sufficiently supported.

The evaluation and selection process for Participating Scientists will be conducted jointly among NASA, the European Space Agency (ESA), and the Italian Space Agency (ASI).

3. Programmatic Information

3.1 Exclusions

Proposals to CDAPS must include a science investigation. Proposals to produce a higher-order data product that enhances the science return from one or more missions, but does not include a science investigation, should be submitted to the Planetary Data Archiving, Restoration, and Tools (PDART) Program, C.7.

3.2 Relevance Statement Requirement

Proposals to this program must discuss relevance in a (4000-character max) text box on the cover pages via the NSPIRES web interface for this program element. This section is outside of the 15-page Scientific/Technical/Management Section and the relocation of the relevance discussion does not decrease that fifteen-page limit. This requirement supersedes Section 2.3.5 of the NASA Guidebook for Proposers and the ROSES Summary of Solicitation, and the omission of this section is sufficient reason for a proposal to be returned without review. The relevance discussion must explicitly refer to this program element and the section of the solicitation to which the proposal is responsive. If the proposed work is close in scope to research covered by any other program element, this discussion must also justify why it is more relevant to this program element than that other program element. This discussion may not be used to address the proposal's intrinsic merit, budget justification, or any other factor that remains in the fifteen-page main body, or any other section, of the proposal.

3.3 Progress Reports

An Annual Progress Report will be due no later than 60 days in advance of the anniversary date

of the award. U.S. scientists will submit their progress reports to NASA and non-U.S. scientists will submit progress reports to their funding institution. Awards to NASA Centers including JPL always have an anniversary date of the start of the fiscal year, October 1.

Newly archived data will have appeared in the PDS since the original proposal was submitted; therefore, somewhat longer than usual progress reports will be expected. The PI should specifically identify any needed data for the second- or third-year work and ascertain that they are available, devoting the same amount of care to this issue as in the original proposal. It is generally assumed that the analysis and interpretation of the new data will closely parallel that of the data analyzed in year one. If this is not true, then sufficient detail must be provided so that qualified peers can review and evaluate the work plan. In those cases where the original proposal promised to deliver a higher order data product, the progress report must show satisfactory progress toward that goal. A revised budget for the second or third year is neither necessary nor expected; the multiple-year budget approved at the time of the original award is considered binding barring the development of unforeseen issues (see Section D.4 of Appendix D of the *NASA Guidebook for Proposers* for further details).

4. Resources: Information, Data, and Facilities

4.1 Limits on Use of Mission Data

For non-Participating Scientist proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply must demonstrate clearly how the proposed research does not overlap and is not redundant with data analysis, duties, or responsibilities already funded by their respective mission(s). Please see Appendix C.1, The Planetary Science Division Research Program Overview, for more information.

- Cassini mission pages can be accessed at http://saturn.jpl.nasa.gov/.
- The PDS Cassini data table of contents page is located at http://pds-atmospheres.nmsu.edu/data_and_services/atmospheres_data/Cassini/Cassini.html.
- Links to Cassini support pages of all the PDS Discipline Nodes can be obtained at http://pds-rings.seti.org/cassini/.
- A tutorial on obtaining Cassini data from the PDS can be obtained at http://pds-rings.seti.org/cassini/Tutorial_GSA2005.pdf. See also http://pds-rings.seti.org/roses/cdaps.html.

4.2 Facilities and Data Sources Available to Proposers

Proposers are advised to read Appendix C.1, The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

4.3 Data Archiving and Map Publication

Selected investigations may result in data products that are of broad use to the science community, including maps, data with improved calibrations, etc. NASA strongly encourages that such data be archived in the Planetary Data System (http://pds.nasa.gov/), or equivalent public archive, by the end of the award period. Proposers are advised to read Appendix C.1, The Planetary Science Division Research Program Overview, for information on including an archiving plan in the proposal.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Proposers are advised to read Appendix C.1, The Planetary Science Division Research Program Overview, for the USGS' information on and requirements for map production and publication.

5. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, given the nature of the new calls, and to ensure proposals are submitted to the appropriate program, this program uses a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.).

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

5.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to one page in length and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The relevance section will be used to confirm that the proposal is submitted to the correct program element. No evaluation of intrinsic merit will be performed on Step-1 proposals.

No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages.

5.2 Step-2 Proposal

All proposals to ROSES must strictly conform to the formatting rules in Chapter IV of this announcement and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the formatting of the Scientific/Technical/Management section proposals have been noted. Please pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages, 20 (15-page main body and 5-page appendix) for Participating Scientist proposals.
- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that proposers use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single-spaced.
- Figure captions: Must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

6. Early Career Fellowship Program

Early career researchers are encouraged to apply for the Early Career Fellowships (ECF) Program. The purpose of the ECF program (see C.16) is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the Principal Investigator's (PI's) future research contributions and the potential for leadership within the scientific community. Please see C.16 of ROSES for more information on the two-step process for the ECF program and the criteria for evaluating candidates.

7. Summary of Key Information

Expected program budget for first year of new awards	~ $1.8-2.3 M/Year
Number of new awards pending adequate proposals of merit	~ 15-21 total, including an expected 4 Participating Scientists
Maximum duration of awards	3 years
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Step-2 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	~6 months after Step-2 proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp for data analysis proposals; 15pp plus a 5pp appendix for Participating Scientist proposals; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan; see Table 1 of ROSES and the reference therein. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Step-1 and Step-2 proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step-1 and Step-2 proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-CDAPS

NASA point of contact concerning this program	Jared Leisner Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Email: HQ-CDAP@mail.nasa.gov Telephone: (202) 358-2016

C.11 DISCOVERY DATA ANALYSIS

NOTICE: Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 2 for details.

1. Scope of Program

The objective of the Discovery Data Analysis Program (DDAP) is to enhance the scientific return of Discovery Program missions by broadening the scientific participation in the analysis of data, both recent and archived, collected by Discovery missions.

1.1. Sources and Analysis of Mission Data

It is the responsibility of the proposers to DDAP to specifically identify any needed mission data and to ascertain that those data are publically available. Proposals dealing with mission data should provide convincing evidence that the data have sufficient quality and are available in sufficient quantity to achieve the goals set forth in the proposal. The proposer should demonstrate a familiarity with the data and an understanding of the work required to refine the data for the purposes of the analysis.

The following is a list of Discovery Missions for which archived data is available:

- NEAR
- Lunar Prospector
- Stardust
- Genesis
- Deep Impact
- MESSENGER
- Dawn

The following is a list of Discovery Missions of Opportunity for which archived data is available:

- EPOXI
- Stardust-NExT

Please note, proposals focusing on data returned from Mars Pathfinder and ASPERA-3 should be submitted to the Mars Data Analysis Program (C.9), and proposals focusing on data from GRAIL and the Moon Mineralogy Mapper (M3) should be submitted to the Lunar Data Analysis Program (C.8). Proposals primarily focusing on data from these missions are not eligible for submission to DDAP.

The DDAP supports investigations that use only data available in the Planetary Data System (PDS; http://pds.nasa.gov/) or equivalent publicly accessible archive(s), such as Genesis data at http://genesis.lanl.gov/plots/. The data must be archived and publicly available 30 days prior to the submission deadline for DDAP proposals. Spacecraft data that have not been placed in such archives are not eligible for use in DDAP investigations. In all cases, it is the responsibility of the DDAP investigator to acquire any necessary data. Investigators are encouraged to contact the PDS for assistance in identifying specifics of available datasets. Datasets to be used in the proposed work must be clearly and specifically identified in the proposal. Regardless of the archive(s) used, if the data to be analyzed have known issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome.

Proposals to DDAP must include a science investigation. Proposals to produce a higher order data product that enhances the science return from one or more missions, but does not include a science investigation, should be submitted to the Planetary Data Archiving, Restoration, and Tools (PDART) Program, C.7.

Proposals should make significant use of (or greatly enhance the use of) data returned by one or more Discovery Program missions. Proposals to work with Discovery Program data and also use ground-based or other data are acceptable, provided that the success of the proposal, as written, is dependent upon the Discovery data. Investigations that incorporate theory, modeling, laboratory studies, correlative analyses, and/or other research that would greatly increase the use of, or significantly facilitate the interpretation of, data from Discovery Program missions are also eligible. Such proposals that don't directly analyze data, but are intended to amplify its interpretation will be judged upon the perceived impact of the proposed work on the interpretation of data from the Discovery Program mission(s) emphasized.

1.2. Data Archiving into PDS

It is the responsibility of the proposers to DDAP to specifically identify any needed data and to ascertain that these data are available. Proposals dealing with mission data should provide convincing evidence that the data have sufficient quality and are available in sufficient quantity to achieve the goals set forth in the proposal. The proposer should demonstrate a familiarity with the data and an understanding of the work required to refine the data for the purposes of the analysis.

Data products produced by funded DDAP investigations must be archived in the Planetary Data System. When proposing the archiving of products into the PDS, an archive plan must be included, identifying schedule and budget to go through the PDS ingestion process. Data products should be submitted to the PDS by the end of the funded research period, unless the investigator explicitly makes a case in the proposal for a later date. For more information, please contact the Planetary Data System (http://pds.nasa.gov/). This requirement supersedes the general requirement found in Appendix C.1.

1.3 Program Exclusions

The Discovery Data Analysis Program is not intended to overlap other active data analysis or core research and analysis programs. Therefore, the DDAP does not support the analysis of:

- Lunar data (see the Lunar Data Analysis Program (LDAP) in C.8);
- Mars data obtained by missions to Mars (see the Mars Data Analysis Program (MDAP) in C.9); and
- Data from Cassini (see the Cassini Data Analysis and Participating Scientists program (CDAPS) in C.10).

PSD solicits proposals whose work efforts are primarily analysis of planetary mission data through this and other Data Analysis Programs. If a proposal would analyze data within the scope of more than one of the data analysis programs in order to perform comparative studies across the Solar System, but is not appropriate to any one data analysis program, then submission to a Core Research Program is encouraged. If a proposal is not appropriate for one of the Data Analysis programs, but does fit within the bounds of a Core Research Program (i.e., Solar System Workings or Emerging Worlds), it should be submitted to that Core Program.

Proposers to this NASA Research Announcement should also note that DDAP is not intended to support:

- Investigations whose primary emphasis is fundamental theoretical research, the development of numerical models, laboratory measurements (unless clearly demonstrating the research would greatly increase the use of, or significantly facilitate the interpretation of, data from Discovery Program missions), or detector development (other NASA programs support these research activities);
- Investigations with a focus on Exoplanets (see E.3 Exoplanets Research for support of these research activities); and
- Proposals for organizing and/or hosting scientific meetings (which should be submitted to Topical Workshops and Scientific Conferences, E.2).

Spacecraft data that have not yet been obtained (i.e., future mission data), or those that have not been accepted into approved archives, as indicated above, may not be proposed for use in DDAP investigations.

Please note that Dawn VIR data in the three-micron region are currently unavailable because they have not been submitted for archiving in the PDS.

Members of Discovery Program mission teams who wish to apply to DDAP must clearly demonstrate that their proposed investigation will use only released and publicly available data. Flight team members must scrupulously comply with the 30-days-prior-to-submission rule (above). Additionally, flight team members must clearly demonstrate how the proposed DDAP research does not overlap and is not redundant with data analysis duties, responsibilities already funded by their respective mission.

2. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, given the nature of the new calls, and to ensure proposals are submitted to the appropriate program, this program uses a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

2.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be performed on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

2.2 Step-2 Proposal

All proposals to ROSES must strictly conform to the formatting rules in Chapter IV of this announcement and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the formatting of the Scientific/Technical/Management section proposals have been noted. Please pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that proposers use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g.,, Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.

- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line-spacing settings for a selected font below single-spaced.
- Figure captions: Must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

3. Programmatic Information

3.1 Progress Reports

An Annual Progress Report will be due no later than 60 days in advance of the anniversary date of the award. Awards to NASA Centers, including the Jet Propulsion Laboratory (JPL), always have an anniversary date of the start of the Federal fiscal year, October 1.

3.2 Duration of Awards

We anticipate that most proposals will seek three years of funding. Proposals for less than three years are encouraged for projects that can be completed on shorter timescales. Four-year proposals may be selected if the need for the longer duration is sufficiently well justified.

3.3 Early Career Fellowship Program

Early career researchers are encouraged to apply for the Early Career Fellowship (ECF) Program. The purpose of the ECF program (see C.16) is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the Principal Investigator's (PI's) future research contributions and the potential for leadership within the scientific community. Please see C.16 of ROSES for more information on the two-step process for the ECF program and the criteria for evaluating candidates.

4. Resources: Information, Data, and Facilities

Proposers are strongly advised to read C.1, The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans.

4.1 Facilities and Data Sources Available to Proposers

Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

4.2 Map Publication

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for the USGS' information on and requirements for map production and publication.

5. Summary of Key Information

Expected program budget for first year of new awards	~$1.5 M
Number of new awards pending adequate proposals of merit	~10-13
Maximum duration of awards	4 years; shorter-term proposals (1-3 years) are typical; fourth year must be explicitly and scientifically justified.
Due date for Step-1 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Due date for Step-2 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Planning date for start of investigation	~Six months after Step-2 proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.

General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-DDAP
NASA point of contact concerning this program	Christina Richey Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Email: christina.r.richey@nasa.gov Telephone: 202-358-2206

C.12 PLANETARY INSTRUMENT CONCEPTS FOR THE ADVANCEMENT OF SOLAR SYSTEM OBSERVATIONS

NOTICE: Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 4 for details.

Planetary protection requirements are imposed on instruments intended to operate in an environment where Earth life could proliferate. See Section 2.1 for more details.

Proposals shall include an entry Quad Chart. See Section 2.1 for more details.

1. Scope of Program

The Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) Program supports the development of spacecraft-based instrument systems that show promise for use in future planetary missions. The goal of the program is to conduct planetary and astrobiology science instrument feasibility studies, concept formation, proof of concept instruments, and advanced component technology development to the point where they may be proposed in response to the Maturation of Instruments for Solar System Exploration (MatISSE) Program, C.13 of ROSES-2015. Therefore, the proposed instrument system or advanced components must address specific scientific objectives of likely future planetary science missions.

The PICASSO Program seeks proposals for development activities leading to instrument systems in support of the Science Mission Directorate's (SMD) Planetary Science Division (PSD). The objective of the program is to develop new technologies that significantly improve instrument measurement capabilities for planetary science missions (such as Discovery, New Frontiers, Mars Exploration, and other planetary programs). It is the responsibility of the proposer to demonstrate how their proposed technology addresses significant scientific questions relevant to stated NASA goals and not for NASA to attempt to infer this.

The PICASSO Program is intended to enable timely and efficient technology infusion into the MatISSE Program and eventually into flight missions. As such, the entry technology readiness level (TRL) that PICASSO supports is one to three**.** Proposals where the entry TRL is 4 or higher are not appropriate for the PICASSO, but should be submitted to Program Element C.13, the MatISSE program. It is the responsibility of the proposer to justify the entry and exit level TRL of the proposed technology. This program will permit appropriate funding to be applied at this early stage to develop and demonstrate key and enabling new technologies for planetary science missions, such as instrument feasibility studies, concept formulation, proof of concept, laboratory demonstrations, and advanced component technology development.

A full description of Technology Readiness Levels (TRLs) 1- 9 appears in Appendix E of NASA Procedural Requirement 7123.1B and is available on the web at http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_7123_001B_&page_name=AppendixE.

Prospective proposers are encouraged to review the most recent Decadal Survey ("*Visions and Voyages for Planetary Science in the Decade 2013-2022*" http://solarsystem.nasa.gov/2013decadal/) and goals of the Planetary Science Division as described in the 2014 Science Mission Directorate Science Plan available at http://science.nasa.gov/about-us/science-strategy/. Proposed investigations may target any body in the Solar System except for the Earth and Sun, in order to advance the objectives outlined in the Science Plan.

Proposals not appropriate for PICASSO are brassboarding and testing of complete instruments in a relevant environment. These proposals should be submitted to the MatISSE Program, C.13. In addition, PICASSO does not support proposals that seek to develop ground-based laboratory instruments, astronomical or astrophysics space observations, auxiliary instrumentation; such as spectrometers for ground based telescopes, mission operation and system software, platform technologies; such as materials and structures, Small Satellites or any spacecraft technology that does not directly address planetary science instrumentation.

The nature of specific efforts selected for funding will vary, with emphasis given to innovative technologies that improved instrument measurements capabilities. It is anticipated that the science payloads on most future planetary science spacecraft will be limited to small, low-mass, and low power consumption instruments.

2. Programmatic Considerations

2.1 Special Requirements for Proposals

Proposals are solicited under this program element for instrument development only for the mission focus areas described in the Decadal Survey or the Science Plan. All proposals submitted to this program element must specify:

- The mission focus area for which the proposed instrument or component technology is applicable. Instruments that are applicable to more than one mission focus area will be given priority.
- The science objectives of the proposed instrument or component technology. The relationship between the science objectives and the instrumental capabilities must be clearly demonstrated. For those instruments applicable to more than one mission focus area or capable of meeting multiple science objectives, examples of science objectives for the proposed mission or missions must be given. A detailed description and justification for the entry Technology Readiness Level and a detailed plan for raising the instrument system to the proposed exit Technology Readiness Level. The plan must include a description of milestones, as well as discussions of how the proposed research will advance the Technology Readiness Level of the instrument by a minimum of one TRL.

- How the proposed instrument system or component technology would address planetary protection requirements, as noted in the NASA Procedural Requirements document, NPR 8020.12, Version D. Restrictions on operation and hardware cleanliness apply to all instrument systems that are intended to operate in environments where Earth life could proliferate – currently that is considered to be Mars, Europa, Enceladus, and anywhere in the solar system where warm ice or liquid water is possible and includes instrument systems or component technology associated with detection of signs of life or biosignatures. Applicable proposals must discuss, at a level appropriate to the exit TRL level, how the instrument design and material choices are compatible with 1) bioburden reduction techniques, 2) reduction of contamination by organic compounds, and 3) the reduction of embedded bioburden. The instrument developer is encouraged to communicate informally with the Office of Planetary Protection regarding planetary protection categorization and associated requirements with a future mission interest as they relate to instrument design and development. For additional information, proposers may contact the NASA Planetary Protection Officer, Dr. Catharine A. Conley (Telephone: 202-358-3912; E-mail: cassie.conley@nasa.gov)
- An entry level Quad Chart, not counted in the page limit, shall be submitted as an appendix to the Step-2 Proposal. See section 4.2 for more details regarding Step-2 proposals. The Quad Chart shall contain the following information:
    - Upper Left Quadrant: "Project Description and Science Objectives"
    - Lower Left Quadrant: "Approach" and "Co-Investigators (Co-Is)/Partners"
    - Upper Right Quadrant: A visual, graphic, or other pertinent information
    - Lower Right Quadrant: "Top level Milestone Schedule" and "Entry TRL."

Investigators are encouraged to download a Quad Chart template from the Other Documents Section of the NSPIRES web page for this solicitation.

2.2 Additional Selection Considerations

In addition to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers,* the following will also be considered when formulating PICASSO selection recommendations.

- The extent to which the proposed instrument system or subsystem is applicable to multiple Planetary Science missions;
- The extent to which the instrument system or subsystem addresses a priority science goal of the mission or missions for which it would be a candidate for flight;
- The necessity of embarking on a long lead-time development of a very important instrument contemplated for flight on a mission that is of high priority;
- The Planetary Science Division strongly encourages proposers to investigate current and recent Small Business Innovative Research awards (http://sbir.gsfc.nasa.gov/abstract_archives) for possible teaming and leveraging of emerging technologies. Collaborations leveraging SBIR funded technologies will be given preference. In addition, selectable proposals that leverage funding from NASA technology development offices, such as the Office of the Chief Technologist, will be given additional consideration.

2.3 Technical Reporting Requirements

Once awarded, all Progress Reporting deliverables applicable to this PICASSO solicitation shall be submitted to the web-based Planetary Science (PS) Award Administration e-Book. A user account on the PS e-Book will be provided to the PI upon award. Due to NASA IT security requirements, all Principal Investigators (PIs) must register with the Identity Management and Account Exchange (IdMAX) system before a user account on e-Book will be established. To create an IdMAX account, some personal information will be required. All submissions shall be made in PDF (preferred), Microsoft Word, Microsoft Excel, or Microsoft PowerPoint.

The following deliverables shall be required of institutions that win awards. In cases where subcontract arrangements exist, consolidated project reports are the responsibility of the PI. The proposed budget should provide for these reporting requirements. In this context, "Annual" refers to a twelve-month task effort that commences at award.

2.3.1 *Annual Progress Report Deliverable*

The PI shall provide a written Annual Progress Report at the end of the first twelve-month calendar period commencing from the date of award and at twelve-month intervals thereafter. Grant recipients will have additional progress reporting requirements from the NSSC.

The Annual Report must:

1. Describe the primary findings, technology development results, and technical status, e.g., status of design, construction of prototype implementations, results of tests and/or proof-of-concept demonstrations, etc.;
2. Describe the work planned for the remainder of the project and critical issues that need to be resolved to successfully complete the remaining planned work;
3. Summarize the cost and schedule status of the project, including any schedule slippage/acceleration;
4. Provide a summary of accomplishments and anticipated results at the end of the task;
5. Include an updated Quad Chart noting milestone changes, if any, and updates to the TRL;
6. Report any educational and outreach components of the project, e.g., graduate degrees, educational activities; technology infusion or patents applied for or granted; journal or conference publications; presentations at professional conferences, seminars, and symposia; demonstrations; media exposure; and, other activities that contributed to the overall success of the research project.

The release of the PI's annual budget allocation is contingent on the timely submission of the written Annual Progress Report deliverable.

2.3.2 *Final Report*

The PI shall provide a written Final Report at the completion of the activity. The Final Report is similar to the Annual Report and includes all of the products required in the Annual Report, with the following exceptions:

- The Final Review must provide conclusions of the work performed and make recommendations for follow-on activities that should be pursued;
- As this is the Final Report, there is no need to present future work plans or a cost profile.

The written Final Report shall include the following:

1. Background of the project, including the science rationale for conducting this technology development;
2. Results of all analyses, element, subsystem, or system designs and/or prototyping implementations and designs;
3. Performance analysis results of tests and/or demonstrations; estimation of reduction(s) in size, mass, power, volume, and/or cost; improved performance; description of newly enabled capability; and documentation of technology dependencies;
4. Tables, graphs, diagrams, curves, sketches, photographs, and drawings in sufficient detail to comprehensively explain the results achieved;
5. An updated TRL assessment;
6. At the end of the period of performance, the PI shall provide a final Accomplishments Chart which contains the following information:

    - Upper Left: "Description and Objectives."
    - Middle: "Accomplishments."
    - Upper Right: A visual, graphic, or other pertinent information.
    - Bottom: "Co-Is" (name and affiliation), "Entry TRL," and "Exit TRL".

The written Final Report, Accomplishments Chart, and updated TRL assessment shall be E-mailed to the NASA Program Officer on or before the designated anniversary date. An Accomplishment Quad Chart template can be obtained from the NASA Program Officer for this program.

2.4 Early Career Fellowship Program

Early career researchers are encouraged to apply for the Early Career Fellowships (ECF) Program. The purpose of the ECF program (see C.16) is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the PI's future research contributions and the potential for leadership within the scientific community. Please see C.16 of ROSES-2015 for more information on the two-step process for the ECF program and the criteria for evaluating candidates.

2.5 NASA Postdoctoral Program Fellows

Grantees in the program are eligible to serve as mentors to NASA Postdoctoral Program (NPP) Fellows. The tenure of a Fellow must begin before the end of the award but may extend beyond it. Proposals from potential Fellows must be submitted through the standard NPP process. The PICASSO Program expects to select no more than two Fellows associated with Planetary Science or Astrobiology Instrument Development each year. More information about the NASA Postdoctoral Program may be found at http://nasa.orau.org/postdoc/ and a list of current opportunities may be found at https://www3.orau.gov/NPDoc/Catalog.

3. Resources: Information, Data, and Facilities

Proposers to this program are not required to provide a data management plan.

3.1 Limits on Use of Mission Data

For proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply must demonstrate clearly how the proposed research does not overlap and is not redundant with data analysis, duties, or responsibilities already funded by their respective mission(s). Please see Appendix C.1, The Planetary Science Division Research Program Overview, for more information.

3.2 Facilities and Data Sources Available to Proposers

Proposers are advised to read Appendix C.1, The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

4. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, and to ensure proposals are submitted to the appropriate program, this program will use a two step proposal submission process (see Section IV. (b) vii of the ROSES-2015 Summary of Solicitation.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain

the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

4.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and must include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine that the proposal is submitted to the appropriate program element. No evaluation of intrinsic merit will be performed on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

4.2 Step-2 Proposal

All proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that proposers use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single-spaced.
- Figure captions: must follow the same font and spacing rules as the main text.
- Figures and tables: for text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space
- An entry level Quad Chart, not counted in the page limit, shall be submitted as an appendix to the Step-2 Proposal. See section 2.1 for more details regarding the Quad Chart.

5. Summary of Key Information

Expected program budget for first year of new awards	~$3.5M
Number of new awards pending adequate proposals of merit	~12 awards
Maximum duration of awards	3 Years
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Step-2 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after the Step-2 proposal due date
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Step-1 and Step-2 proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step-1 and Step-2 proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-PICASSO
Main NASA point of contact concerning this program:	James R. Gaier Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington DC 20526-0001 Telephone: 260-579-3442 E-mail: james.r.gaier@nasa.gov

Other NASA points of contact related to this program all of whom share the following postal address: Planetary Science Division National Aeronautics and Space Administration Washington DC 20526-001	Questions concerning Discovery or Astrobiology Program may be addressed to: Michael H. New Astrobiology Discipline Scientist Lead Discovery Program Scientist Telephone: 202-358-1766 E-mail: michael.h.new@nasa.gov Mary A. Voytek Senior Scientist for Astrobiology Telephone: 202-358-1577 E-mail: mary.voytek-1@nasa.gov Questions concerning New Frontiers Program may be addressed to : Curt Niebur New Frontiers Program Discipline Scientist Telephone: 202-358-0390 E-mail: curt.neibur@nasa.gov Questions concerning Mars Exploration Program may be addressed to: Michael A. Meyer Lead Scientist Mars Exploration Program Telephone: 202-358-0307 E-mail: michael.a.meyer@nasa.gov

C.13 MATURATION OF INSTRUMENTS FOR SOLAR SYSTEM EXPLORATION

NOTICE: The Maturation of Instruments for Solar System Exploration (MatISSE) Program will not be competed in ROSES-2015. NASA expects to continue to solicit Planetary science instrument technology through future MatISSE solicitations. The next opportunity is currently anticipated to be included in ROSES-2016.

1. Program Description

The Maturation of Instruments for Solar System Exploration (MatISSE) Program supports the advanced development of spacecraft-based instruments that show promise for use in future planetary missions. The goal of the program is to develop and demonstrate planetary and astrobiology science instruments to the point where they may be proposed in response to future announcements of flight opportunity without additional extensive technology development (approximately Technology Readiness Level [TRL] 6). The proposed instrument must address specific scientific objectives of likely future planetary science missions.

2. Program Objectives

The MatISSE Program seeks proposals for development activities leading to instrument systems in support of the Science Mission Directorate's (SMD) Planetary Science Division. The objectives of the program are to develop new technologies that significantly improve instrument measurement capabilities for planetary science missions (such as Discovery, New Frontiers, Mars Exploration, and other planetary programs).

3. Programmatic Information

For further information about the MatISSE Program contact:

Janice Buckner
Planetary Science Division
National Aeronautics and Space Administration
Washington, DC 20546
Telephone: 202-358-0183
Email: Janice.l.buckner@nasa.gov

C.14 PLANETARY SCIENCE AND TECHNOLOGY THROUGH ANALOG RESEARCH

NOTICE: Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 2.8 for details.

1. Scope of Program

NASA analog missions research addresses the need for integrated interdisciplinary field experiments as an integral part of preparation for future human and robotic missions. Future planetary research associated with solar system exploration requires the development of relevant, miniaturized instrumentation capable of extensive operations on lunar, asteroid, and planetary surfaces throughout the Solar System. To this end, and in collaboration with other Directorates at NASA and other agencies, this Planetary Science and Technology Through Analog Research (PSTAR) program solicits proposals for investigations focused on exploring the relevant environments on Earth in order to develop a sound technical and scientific basis to conduct planetary research on other solar system bodies. The PSTAR program is a science-driven exploration program that is expected to result in new science and operational/technological capabilities to enable the next generation of planetary exploration. Proposals must demonstrate fidelity to at least two of the following three objectives:

1) Science: PSTAR seeks science investigations designed to further planetary research in terrestrial extreme environments that may be analogous to those found on other planets, past or present. Of particular interest are investigations that increase our understanding of the limits of and constraints (or lack thereof) on life in extreme environments and lead to a better understanding of how to seek, identify, and characterize life and life-related chemistry that may exist or have existed on other solar system bodies.
2) Science Operations: PSTAR seeks systems-level terrestrial field campaigns that are conducted with complete systems and in a manner that approximates operations during an actual planetary mission, providing an opportunity to understand the performance, capabilities, and efficiencies associated with the tested systems, while enabling human participants to gain operational experience with those systems in the field. Fidelity in this area means that the constraints placed on the execution of science tasks in the field are functionally similar to those of an actual mission, enabling the testing, validation, or development of new concepts of operations that may impact the design of surface infrastructure or ground support. Some examples of science operations elements include:
    a. Decision-making protocols;
    b. Traverse planning;
    c. Sample acquisition, storage, documentation, and high-grading protocols;
    d. Communications and data flow protocols to support science;
    e. Navigation unique to science support;
    f. Crew scheduling for Intra- and Extravehicular activities; and

g. Science backroom design and support for surface science activities.

3) Technology: PSTAR seeks the development and application of technologies that support science investigations, particularly those that enable remote searches for, and identification of, life and life-related chemistry in extreme environments (including lunar and planetary surfaces). These technologies include, but are not limited to:

   a. sample acquisition and handling techniques;
   b. sample manipulation;
   c. the use of mobile science platforms (including planetary rovers and astronauts);
   d. techniques for autonomous operations;
   e. self-contained deployment systems;
   f. intelligent systems and human/robotic interfaces;
   g. communication and navigation systems; and
   h. instrument packages.

PSTAR is not an instrument development program. Science instrument technology proposals should be submitted to C.12, The Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) or C.13, The Maturation of Instruments for Solar System Exploration (MatISSE) Program. Hardware development to ruggedize instruments or otherwise prepare for field trials is acceptable, but is expected to be a minor part of the overall proposed effort.

In summary, PSTAR is expected to lower the risks of planetary exploration through instrument/technology development aimed at or coupled with systems-level field tests in relevant environments that will obtain scientific data and/or develop operational capability.

The high-visibility field campaigns to the Earth's extreme environments that are expected to be supported through this program element should also provide significant opportunities for student involvement in exploration, thereby inspiring a technologically competent next generation of scientists, engineers, explorers, and citizens. Therefore, proposals to PSTAR that provide for graduate or undergraduate science training are encouraged.

In addition, because field activities, particularly those with a high degree of technology fidelity, tend to attract the attention of the public and the media, proposers must include a plan for engaging with the public and media during their field deployment. The description of the plan should be no more than one page and included as an addendum to the fifteen page technical proposal. Proposals that incorporate public engagement activities, through telepresence capabilities and involvement of professional educators and students nationwide in the fun and challenges of science and technology, are particularly encouraged. Proposers should also state in their proposals whether they are willing to host an outside public engagement activity arranged by NASA.

2. Programmatic Information

2.1 General Information

Proposals submitted in response to this call should be for new work that is not currently supported by the Planetary Sciences research and analysis program or for investigations that would extend to their next logical phase those tasks that have been funded, but whose periods of performance expired in 2015 or are expiring in the first half of 2016.

Proposers are strongly advised to read C.1, The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans.

2.2 Special Requirements for Proposals

Proposals should follow the guidelines set for all ROSES-2015 proposals, as given in the *NASA Guidebook for Proposers*.

Proposals should also specify:

- Area(s) of fidelity (Science, Science Operations, and/or Technology, as described in Section 1) that are addressed by the project.
- Specific field activity, site(s), and dates being targeted for their investigation(s), as well as a clear schedule for field preparations, training, and deployment strategy.
- Justification for field site selection (see special case for access to Antarctica Section 2.4).
- If proposed investigation(s) are to be conducted in conjunction with established field campaign(s), proposers must provide evidence of coordination with field campaign leaders.
- Field resource requirements:
    - Duration, timing, and scheduling of investigations
    - Power requirements
    - Communications requirements (bandwidth, type of communications, etc.)
    - Logistics Support Requirements
    - Permits and/or land access/use requirements
- The science objectives and expected science return of the proposed investigation – type and amount of data, validation of science requirements, expected publications, etc.
- Specific deliverables at the conclusion of the field activity.
- Source, type, and amount of external funding already received or expected, if any, for the hardware, software, or operational concepts being tested.
- Risks to the investigation, including weather scrubs, hardware failures, power failures, etc., and a mitigation plan.
- Clear budget, including field deployment costs, logistics support, direct labor, overhead, subcontracts, special equipment, travel, Education and Public Outreach, other costs, General and Administrative Expenses, fees, etc.
- A plan for engaging the public and media during field deployment (this should be no more than one page and included as an addendum).

2.3 Development of Flight Instruments

This solicitation does not request proposals for the development of advanced instrument concepts and technologies as precursors to flight instruments. Such proposals should be submitted to either C.12, Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) or C.13, The Maturation of Instruments for Solar System Exploration (MatISSE) Program.

2.4 Access to the Antarctic

The National Science Foundation (NSF) manages the U.S. Antarctic Program. NASA, therefore, collaborates with the NSF in evaluating the logistics needs of research programs that request access to Antarctic field sites. To that end:

1. Proposals requesting access to Antarctic field sites must justify their request on the grounds that Antarctica is the best or only location for their research.
2. Proposals must include, as an appendix, a Logistical Requirements and Field Plan, which will be subject to peer review, outlining the PI's logistical requests associated with the proposed field work. Proposals with fieldwork that lack this Plan are subject to return without review. The Logistical Requirements and Field Plan must include the elements listed below and should be limited to one page of text and one page of figures (if needed). These pages are in addition to the 15 page limit for the Science/Technical/Management section of the proposal.
    a. Brief statement of research objectives.
    b. List of field sites and the geographic region where they are located. For remote sites, investigators should consider providing a map of proposed field sites.
    c. Description of proposed field activities, including major logistical resources required (i.e., fixed-wing aircraft, vessels, helicopter support).
    d. Description and justification of the desired deployment schedule.
    e. Projected numbers of deploying personnel.
    f. Description of any needs for facility construction, alteration, or instrument installation.

Further information on the U.S. Antarctic Program may be found at http://www.nsf.gov/geo/plr/ant/index.jsp.

Due to the scheduling of NASA and NSF review cycles, proposals requesting access to Antarctica should expect that their first field season will start no sooner than late 2016/early 2017. Proposals requiring Antarctic access in their first performance year may suggest a start date commensurate with this schedule.

2.5 Instrumentation: Construction or Upgrade

The Planetary Major Equipment (PME) program element described in C.17 of this NRA allows proposals for upgrading the analytical, computational, telescopic, and other instrumentation required by investigations for certain programs sponsored by the Planetary Science Division (PSD) Research and Analysis Program, including this one. All new analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $40,000,

must be requested according to the PME guidelines in C.17. Two types of instrumentation requests are permitted. (1) A PME request to PSD may be made as a special section that is appended to a new research proposal to this program. This appendix is to be titled "Planetary Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal, and (2) A stand-alone PME proposal may be prepared and submitted to this program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" PSD award and should explain the relevance of the parent award to this program. See C.17, Planetary Major Equipment for details on how to prepare both types of PME requests.

2.6 Early Career Fellowship Program

Early career researchers are encouraged to apply to C.16, The Early Career Fellowship (ECF) Program. The purpose of the ECF program is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the Principal Investigator's (PI's) future research contributions and the potential for leadership within the scientific community. Please see C.16 of ROSES-2015 for more information on the two-step process for the ECF program and the criteria for evaluating candidates.

2.7 NASA Postdoctoral Program Fellows

Grantees of astrobiology-relevant awards in the program are eligible to serve as mentors to Astrobiology NASA Postdoctoral Program (NPP) Fellows. The tenure of a Fellow must begin before the end of the PSTAR award, but may extend beyond it. Proposals from potential Fellows must be submitted through the standard NPP process. The Astrobiology Program expects to select no more than two Fellows associated with PSTAR research in 2016. More information about the NASA Postdoctoral Program may be found at http://nasa.orau.org/postdoc/.

2.8. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, given the nature of the new calls, and to ensure proposals are submitted to the appropriate program, many programs will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES-2015 *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must

inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

2.8.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover page and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be performed on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to create Step-2 proposals.

2.8.2 Step-2 Proposal

All proposals submitted to ROSES must strictly conform to the formatting rules in Chapter IV of this announcement and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the formatting of the Scientific/Technical/Management section proposals have been noted. Please pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that proposers use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single-spaced.
- Figure captions: must follow the same font and spacing rules as the main text.
- Figures and tables: for text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

2.9 Duration and Size of Awards

The standard award duration is three years. NASA anticipates that most proposals will seek three years of funding. However, proposals for less than three years are highly encouraged for projects that can be completed on shorter timescales. On rare occasions, four-year projects can be considered, but appropriate justification must be provided. The appropriateness of the proposed

funding period will be reviewed and adjustments may be requested. Programmatic balance may limit the opportunities for funding in some areas.

A wide range of award sizes is expected, depending on the nature and scope of the work proposed. We anticipate funding several ASTEP-scope awards (typically $500K-1M per year) and several MMAMA-scope awards (typically $40-100K per year).

3. Summary of Key Information

Expected program budget for first year of new awards	~$5M
Number of new awards pending adequate proposals of merit	10-12, see Section 2.9
Maximum duration of awards	4 years
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Step-2 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	8 months after Step-2 proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Step-1 and Step-2 proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step-1 and Step-2 proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-PSTAR

NASA points of contact concerning this program	Sarah Noble and Mary Voytek Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone for Mary Voytek: (202) 358-1588 Telephone for Sarah Noble: (202) 358-2492 E-mail for Sarah Noble: sarah.noble-1@nasa.gov E-mail for Mary Voytek: mary.voytek-1@nasa.gov

C.15 PLANETARY PROTECTION RESEARCH

1. Scope of Program

Planetary protection involves preventing biological contamination on both outbound and sample return missions to other planetary bodies. Numerous areas of research in astrobiology/exobiology are improving our understanding of the potential for survival of Earth microbes in extraterrestrial environments, relevant to preventing contamination of other bodies by organisms carried on spacecraft. Research is required to improve NASA's understanding of the potential for both forward and backward contamination, how to minimize it, and to set standards in these areas for spacecraft preparation and operating procedures. Improvements in technologies and methods for evaluating the potential for life in returned samples are also of interest. Many of these research areas derive directly from recent National Research Council (NRC) recommendations on planetary protection for solar system exploration missions (see http://planetaryprotection.nasa.gov/documents/ for online reports and a list of publications).

As a complement to the Exobiology program (see C.5), the Planetary Protection Research program solicits research in the following areas:

- Characterize the limits of life in laboratory simulations of planetary environments or in appropriate Earth analogs. Of particular interest are studies on the potential and dynamics of organism survival and reproduction in conditions present on the surface or subsurface of Mars (e.g., gullies and ice-rich environments), or on Europa and other icy satellites – potentially in the presence of a heat source brought from Earth.
- Model planetary environmental conditions and transport processes that could permit mobilization of spacecraft-associated contaminants to locations in which Earth organisms might thrive, for example Mars Special Regions or the subsurface of icy bodies, such as Europa and other outer planet satellites.
- Develop or adapt modern molecular analytical methods to rapidly detect, classify, and/or enumerate the widest possible spectrum of Earth microbes carried by spacecraft (on surfaces and/or in bulk materials, especially at low densities) before, during, and after assembly and launch processing. Of particular interest are methods capable of identifying microbes with high potential for surviving spacecraft flight or planetary environmental conditions (e.g., anaerobes, psychrophiles, radiation-resistant organisms).
- Identify and provide proof-of-concept on new or improved methods, technologies, and procedures for spacecraft sterilization that are compatible with spacecraft materials and assemblies.

It should be noted that the evolving planetary protection requirements of NASA's planetary exploration programs may affect the priorities for funding among these areas.

2. Programmatic Information

Proposers are strongly advised to read C.1, The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans.

2.1 Proposal Constraints

Proposals are sought for new projects in planetary protection that are not within the scope of the Habitable Worlds (see C.4), Exobiology (see C.5), or Maturation of Instruments for Solar System Exploration (see C.13) programs. Proposals submitted in response to this program element should be for new work that is not currently supported by NASA or for successor proposals that seek to extend to their next logical phase those tasks performing research in Planetary Protection that are currently funded, but whose periods of performance will expire this year. Periods of performance from one to four years may be proposed, as appropriate, to the nature of the contemplated research. Approximately $300K per year of total funding is expected to be available to support approximately two research tasks selected from proposals responding to this solicitation.

2.2 Instrumentation: Construction or Upgrade

The Planetary Major Equipment (PME) program element described in C.17 of this NRA allows proposals for upgrading the analytical, computational, telescopic, and other instrumentation required by investigations for certain programs sponsored by the Planetary Science Division (PSD) Research and Analysis Program, including this one. All new analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $40,000, must be requested according to the PME guidelines in C.17. Two types of instrumentation requests are permitted. (1) A PME request to PSD may be made as a special section that is appended to a new research proposal to this program. This appendix is to be titled "Planetary Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal, and (2) A stand-alone PME proposal may be prepared and submitted to this program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" PSD award and, if not from this program, should explain the relevance of the parent award to this program. See C.17 for details on how to prepare both types of PME requests.

3. Resources: Information, Data, and Facilities

3.1 Limits on Use of Mission Data

For proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply must demonstrate clearly how the proposed research does not overlap and is not redundant with data analysis, duties, or responsibilities already funded by their respective mission(s). Please see C.1, The Planetary Science Division Research Program Overview, for more information.

3.2 Facilities and Data Sources Available to Proposers

Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

3.3 Data Archiving and Map Publication

Selected investigations may result in data products that are of broad use to the science community, including maps, data with improved calibrations, etc. NASA strongly encourages that such data products be archived in the Planetary Data System (http://pds.nasa.gov/), or equivalent public archive, by the end of the award period. Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for information on including an archiving plan in the proposal.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for the USGS' information on and requirements for map production and publication.

4. Summary of Key Information

Expected program budget for first year of new awards	~ $300K
Number of new awards pending adequate proposals of merit	~ 2
Maximum duration of awards	4 years; shorter-term proposals are encouraged.
Due date for NOIs	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	~6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.

General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-PPR
NASA point of contact concerning this program	Catharine A. Conley Planetary Protection Officer Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-3912 E-mail: HQ-PPR@mail.nasa.gov

C.16 EARLY CAREER FELLOWSHIP PROGRAM

NOTICE: Amended on November 17, 2015. This amendment releases revised text for the Early Career Fellowship program. In addition to a reorganized structure, this version differs in content most notably in the definition of the kind of position that qualifies for future Early Career Fellows to apply for start up funds. See Section 4.3 for the new definitions of "permanent" and "permanent track" positions. However, this new definition does not affect to Fellows who applied or were named under the prior definition, see Section 3.1. Extra time will be given to individuals who were delayed by this program element being TBD during much of ROSES-2015, see Section 4.2

1. Scope of Program

The Early Career Fellowship (ECF) program supports the development of individual research programs of outstanding scientists early in their careers and stimulates research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, and methods.

This program consists of two components with two different submission procedures: the first is the one-page application to be an "Early Career Fellow" (ECF) and the second is the subsequent submission of a seven-page proposal for start up funds by a previously selected ECF. Section 2 presents details on the former, the application to be an ECF. Section 3 presents details on the latter, the proposal in response to this program element by selected ECFs to apply for up to $100K in start up funds, once they obtain a permanent track position, which is defined in Section 4.3. See Section 3 for eligibility to apply for start up funds.

2. Early Career Fellowship

This section describes the Early Career Fellow (ECF), the first component of this program element. The application to become an ECF does not involve a separate proposal to this program element. Rather, the ECF application is primarily a one-page addition to a normal (full, Step-2) proposal submitted to one of the ROSES Research Program elements listed in Section 2.4. The designation of the Principal Investigator (PI) as a fellow based on this one-page ECF application does not immediately result in funding; rather, the Early Career Fellow designation confers on the PI an opportunity to apply for start up funds in the future, as described in Section 3.

2.1 Eligibility for Early Career Fellowship

To be eligible to apply for an ECF one must have received their Ph.D. (or equivalent degree such as D.Phil) within seven calendar years of the year of the submission of the research proposal to the participating program element listed below, in Section 2.4. However, see also Section 4.2.

To be eligible to be named an Early Career Fellow, an individual may not already be in either a "permanent" or a "permanent track" position at the time of submission of their ECF application. The definitions of "permanent" and "permanent track" positions are provided at the end of this program element in Section 4.3.

2.2 Fellowship Application Procedure

The process for applying to be a Fellow is as follows:

1. Be PI (or Science PI, see Section 4.1) on a (normal, full, Step-2) proposal submitted to one of the participating ROSES program elements listed in Section 2.4
2. Check the Early Career Fellowship checkbox on the NSPIRES Cover Pages of that proposal,
3. Include in that proposal an additional one-page application with the Curriculum Vitae to allow the evaluation of the potential Fellow,
4. Meet the eligibility requirements in Section 2.1, and
5. Receive an award letter for the proposal to which the ECF application was appended.

Selection of the ROSES proposal by the participating program is a prerequisite for consideration as an Early Career Fellow, but does not ensure selection as an Early Career Fellow. Only a small number of funded PIs in those participating programs are also named as Early Career Fellows. Those who are named as Early Career Fellows will receive an award letter explicitly stating that they have been named an Early Career Fellow.

As always, the ROSES proposal to which the ECF application is tied must adhere strictly to the deadlines and instructions for the participating ROSES program element to which it was submitted. Thus, the length of the proposal and any other rules defined in the participating ROSES program element must be followed. The proposal will be reviewed along with all other proposals submitted to that participating program element as part of the normal peer review process. Note that requirements and funding levels vary between the participating programs. Refer to the information in the corresponding participating program element for questions about and specific constraints and requirements for proposals to those program elements.

2.3 Evaluation Criteria for Selection as an Early Career Fellow

ECF applications will be separately evaluated for merit, relevance, and also an additional community participation and leadership criterion unique to this program.

2.3.1 *ECF Merit Evaluation*

The ECF evaluation of merit aligns well with that generally employed in ROSES. It includes assessment of the novelty of the science ideas, viability of implementation, and impact on Planetary Science. All three aspects of merit are applied to past, current, and proposed future work.

2.3.2 *Relevance to ECF*

It is to be expected that the ECF evaluation of relevance may differ from the relevance to the parent research program with which it is associated, because the scope and goals of the ECF differ from the parent research programs listed in Section 2.4. For example, Program Element E.3, the Exoplanet Research Program (XRP) is a cross-division program run and funded by both the Planetary Science and Astrophysics Divisions. A research proposal could be deemed relevant to XRP and selected for funding primarily because of its relevance to Astrophysics, yet the affiliated ECF proposal might be rejected because it is not relevant to this Planetary Science Division ECF program.

2.3.3 *Evaluation of Community Participation and Leadership*

In addition to the standard Relevance and Merit criteria above, the applicant's potential for future leadership in their scientific community will also be evaluated based on their engagement in their field. Examples of information of interest might include invited and/or public lectures, awards received, scientific program committees, conference or workshop organization, professional society activities, special international or industrial partnerships, reviewing or editorship activities, and significant Education and Public Outreach activities.

2.4 Participating ROSES Program Elements for Early Career Fellowship Applications

ROSES programs that participate in the ECF program are identified in Tables 2 and 3 of the solicitation by a "[3]" after the solicitation title. For ROSES 2015, at the time this amendment was released, the program elements listed below are participating in this program by allowing proposers to include an ECF application with their research proposal:

- Emerging Worlds (C.2);
- Solar System Workings (C.3);
- Habitable Worlds (C.4);
- Exobiology (C.5);
- Solar System Observations (C.6);
- Lunar Data Analysis (C.8);
- Mars Data Analysis (C.9);
- Cassini Data Analysis and Participating Scientists (C.10);
- Discovery Data Analysis (C.11);
- Planetary Instrument Concepts for the Advancement of Solar System Observations (C.12);
- Maturation of Instruments for Solar System Exploration (C.13);
- Planetary Science and Technology from Analog Research (C.14);
- Laboratory Analysis of Returned Samples (C.18); and
- Exoplanet Research (E.3)

3 Fellowship Start Up Funds

The application for start up funds is the second component of this program. The request for up to $100K of start up funds for those who meet the eligibility requirements in Section 3.1 takes the

form of a proposal submitted in response to this program element at any time during the open period for ROSES (i.e., there is no single fixed due date).

3.1 Eligibility for Start Up Funds

To be eligible for start up funds, the PI must have previously been named an Early Career Fellow, see Section 2, above.

Proposals for start up funds must be submitted in response to this program element within ten calendar years of the year in which the PI received their Ph.D. (or equivalent degree). However, see also Section 4.2.

To be eligible for start up funds, the PI may not already be in a permanent position at the time of submission of their ECF application. To be eligible for start up funds, the PI must be in a "permanent track" position at the time of submission of their ECF application. The definition of "permanent" position is provided at the end of this program element in Section 4.3.

Please note that this new definition does not affect to Fellows who applied (or were named) under the prior definition. That is, individuals named as Fellows based on applications affiliated with ROSES research proposals submitted after the release of this program element on November 17, 2015 are eligible to apply for start up funds only if they hold a permanent track position that satisfies the new definition. Individuals who were named as Fellows based on applications affiliated with ROSES research proposals submitted prior to the release of this program element fall under the rules laid out in the ECF program element that was active at that time. Fellows (or organizations) applying for start up funds are strongly encouraged to communicate with the point of contact listed below to verify that the position that has been offered to the Fellow satisfies the requirement for award of start up funds.

3.2 Procedure to Propose for Start Up Funds

The process for submitting proposals for start up funds is as follows:

1. Receive an award letter explicitly stating that you have been named an ECF.
2. Gain a "permanent track position"
3. Meet the eligibility requirements in Section 3.1 and
4. Submit a proposal to this program element via the organization where you have the permanent track position.

Eligible PIs may submit proposals for up to $100K in start up funds in response to this program element at any time, via the organization through which they have the permanent track position. The start up package is intended to aid Fellows in establishing a research group or laboratory in their new permanent track position. This funding is not guaranteed simply based on having been named a Fellow. Rather, it depends on the proposal submitted to this program element passing peer review.

The proposal must clearly describe how the funds will be used to establish their research program and how the proposed research is relevant to the Planetary Science Division (e.g., the Planetary Science questions and goals in the NASA Science Plan). In addition to the immediate use of the start up funds, the proposal must contain a strategy describing the Fellow's plans for the research program over the long term.

A detailed budget with a narrative justification is required as part of the proposal.

The proposal must provide evidence that the appointment meets the requirements for a "permanent track" position provided in Section 4.3.

Proposals for start up funds must adhere strictly to the rules for ROSES in general and this program element in particular. For example, the technical management section of a proposal to this program element is limited to seven pages.

3.3 Evaluation Criteria for Start-Up Proposals

Proposals for start up funds will be evaluated vs. the three standard criteria given in ROSES: merit, relevance and cost realism and reasonableness. The evaluation of start up proposals vs. these criteria will be completely independent of any prior evaluation of the application to be an ECF and its affiliated ROSES proposal (described in Section 2).

4. Programmatic Information

4.1 Role of Fellow on Proposal vs. Organizational rules

Some institutions do not allow nontenured researchers to independently apply for NASA grants, which might prevent potential PIs from proposing to this program. At either the application for the Early Career Fellowship or the proposal for start up funds, the proposal may list the Early Career researcher as the "Co-I/Science PI" and include an organizationally approved individual as the "PI" or "Co-I/Institutional PI" to allow the application to be submitted by the Authorized Organizational Representative.

4.2 Time Since Degree

This program element was closed for much of ROSES-2015 while it was being rewritten. Potential proposers who, because this program was closed during much of 2015, passed beyond the seven calendar years since their Ph.D. stipulated in Section 2 for the fellowship, or passed beyond the ten calendar years since their Ph.D., stipulated in Section 3 for start up funds, are still eligible to propose.

Moreover, potential proposers who took a leave of absence for family leave, military service, or serious health problems may request a waiver to these chronological eligibility restrictions. These applicants should write to the ECF point of contact given in Section 5 prior to proposal submission.

4.3. Definition of a Permanent and Permanent Track Position

A permanent position is one in which the organization substantially compensates the PI for his or her salary, without making it conditional on outside funding, nor limiting the term of employment. Examples of permanent positions include, but are not limited to, tenured faculty and permanent civil service appointments.

A permanent track position is one with a clearly defined process and schedule that can lead to a permanent position. Examples of permanent equivalent positions include, but are not limited to, tenure track faculty and certain term civil service appointments.

4.4 Duration of Awards

The application to be named an ECF is affiliated with a ROSES research proposal to a participating program element listed above in Section 2.4. The duration of that research award varies, depending on that program element, but has no effect on the duration of the ECF. The fellowship lasts either until the fellow has passed beyond ten years since Ph.D., (stipulated in Section 3 for start up funds) without having applied for and won start up funds or, if they have won start up funds, the end of the start up award is the end of the "Fellowship."

5. Summary of Key Information

Expected program budget for first year of new awards	N/A; all funds are distributed by the corresponding research program element
Number of awards pending adequate proposals of merit	1 to 3 per Planetary research program element
Maximum duration of awards	3 years for start-up funds, see also Section 4.4
Due date for Notice of Intent to propose (NOI)	No Notices of Intent are requested for this program element.
Due date for proposals	For consideration as a Fellow (new applicants), submit a proposal to the participating program element by the deadline specified in Tables 2 and 3 in the *ROSES Summary of Solicitation*. Proposals from Fellows selected in prior years for start-up funds may be submitted at any time in response to this program element.
Planning date for start of investigation	6 months after proposal receipt
Page limit for the central Science-Technical-Management section of proposal	7 pp, for proposals from current Fellows for start-up funds; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	Proposals must be relevant to the Planetary Science Division. See also Section 2.2.2.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.

Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-ECF (only for current Fellow applications for start up funds; otherwise please see the specific science research program element.)
NASA point of contact concerning this program	Doris Daou Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1686 E-mail: Doris.Daou@nasa.gov

C.17 PLANETARY MAJOR EQUIPMENT

1. Scope of Program

This program element allows proposals for new or upgraded analytical, computational, telescopic, and other instrumentation required by investigations in eligible Planetary Science research programs, as offered in this solicitation.

List of Eligible Programs:

- Emerging Worlds (C.2);
- Solar System Workings (C.3);
- Habitable Worlds (C.4);
- Exobiology (C.5);
- Solar System Observations (C.6);
- Planetary Science and Technology from Analog Research (C.14);
- Planetary Protection Research (C.15);
- Laboratory Analysis of Returned Samples (C.18); and
- Exoplanets (E.3).

A Planetary Major Equipment (PME) proposal may be submitted in one of two ways: (1) as a special section that is appended to a new science research proposal to one of the eligible programs in this NRA; or (2) as a stand-alone equipment proposal submitted to one of the eligible programs.

A stand-alone PME proposal must be explicitly affiliated with an existing "parent" award in the eligible program. A stand-alone PME proposal may also be affiliated with an existing award in the following list of "grandfathered" (discontinued) programs that were solicited under ROSES announcements from previous years.

List of Grandfathered Programs:

- Cosmochemistry (C.2);
- Planetary Geology and Geophysics (C.4);
- Planetary Astronomy (C.5);
- Planetary Atmospheres (C.6);
- Outer Planets Research (C.7);
- Lunar Advanced Science and Exploration Research (C.8);
- Near Earth Object Observations (C.9);
- Mars Fundamental Research (C.13);
- Astrobiology: Exobiology and Evolutionary Biology (C.17);
- Astrobiology Science and Technology for Exploring Planets (C.20); and
- Origins of Solar Systems (E.3).

If the parent award is in a grandfathered program, the stand-alone PME proposal may be submitted to any eligible program to which the parent award is relevant. In such cases, the proposal should explain the relevance of the parent award to the new program to which it is

being submitted. If there is uncertainty about which program may be the most relevant, the PI should consult with the NASA point of contact listed in Section 5.

The Principal Investigator (PI) of a stand-alone PME proposal must also be PI of the parent award. If funded, the PME will be processed as an augmentation to the parent award, which must be a multiyear award that is still active at the time of augmentation. A stand-alone PME proposal that is not affiliated with an eligible parent award is nonresponsive to this program element and will be rejected without review.

Instrumentation purchases or upgrades that may be requested through the PME program are to be of a substantial nature; that is, over $40,000.

Instrumentation, equipment, and services that are excluded from proposals to this program element include personal computers or computer peripherals (unless these are integral parts of the instrumentation requested), miscellaneous support equipment, support contracts, and the repair of equipment where the repair does not also involve significant enhancement of the instrument's basic capabilities. No funds may be requested to support maintenance and continued operations of any instrument. Proposals that seek to design, develop, test, or evaluate new instruments that are intended for commercial sale will be rejected without review.

2. Instrument Management and User Access

All PME requests must specify how the instrument is to be used in terms of one of the three categories defined below:

- An Investigator Instrument is acquired or developed by the proposer to support the PI's research, where the PI has full authority for its exclusive use, and where there are no commitments to make the instrument available to other investigators.

- An Investigator Facility Instrument is acquired or developed to support the PI's research, where an identified portion of its time is to be reserved for use by the PI, but where an additional specified portion of its time will be made available to other knowledgeable NASA-supported planetary program investigators and where all details or access, method of use, charging, and data rights are determined by the PI in negotiation with potential users.

- A Regional Facility Instrument is one of considerable cost or one that is limited to a particular location by virtue of its use on a specific facility, but which has been acquired by a PI to support the PI's research. An identified portion of a regional facility instrument's time will be reserved for use by the PI, but a significant, specified portion of its time must also be available to other NASA-supported planetary program investigators. Unlike an Investigator Facility Instrument, however, all details of access, announcement of availability, assistance to be provided on its use and methods of use (whether hands on or by a facility-based operator), charges, and data rights must be documented and agreed to by NASA and the sponsoring institution before NASA support is provided.

Collective use by other members of the scientific community is encouraged. Proposals for both types of facility instruments must include a description of the potential users community, a management plan for the instrument that includes a statement of the percentage of the instrument's time that would be available to other users, and a general statement regarding aspects of user access, such as time of day when access would be granted, whether access would be "hands on" or only by an operator or collaborator in the proposer's group, any costs to be charged for use, how such costing would be handled, and how users would apply to gain access (e.g., by personal communication, formal proposal, or other method).

It is expected that title to any equipment obtained through this program shall vest with the proposing institution in accordance with the provisions of §1260.74 of NASA's *Grants and Cooperative Agreement Handbook* found online at http://prod.nais.nasa.gov/pub/pub_library/grcover.htm. However, in cases where the equipment upgrade is for a facility owned by the U.S. Government, NASA reserves the right to negotiate title of the equipment for the best interests of the user community.

3. Costs

Whether the proposed instrument is to be purchased by the investigator from a commercial vendor or is to be designed and built by or for the investigator him/herself, only those costs directly associated with the acquisition, installation, and check-out of the instrument may be proposed through the PME program element. Costs for maintenance and operation beyond the check-out period must be requested in research proposals submitted to the appropriate Planetary Science research program elements described in this or future NRAs. No salary support can be provided for the investigators under the PME program element. Each relevant cost should be fully explained and substantiated, and a quotation should be provided for any major equipment purchased from a commercial vendor. If acquisition or development of an instrument or facility will require more than one year, the proposal should cover the complete project, but make a clear distinction between efforts in each year.

It should be noted that cost sharing between NASA and other Federal agencies is encouraged to the extent that NASA's share of the cost will ensure adequate access to the finished instrumentation by NASA investigators; this acquisition/access aspect of any proposed effort involving cost-sharing must be discussed in the proposal. The proposal must document whether any other agency has been approached or has made tentative commitments and provide the name and telephone number of the appropriate officer who can discuss his/her agency's interest.

Proposals selected for PME support will be funded through augmentation to the science research program proposal. Final reports should be sent to the cognizant science research program officer, with a copy sent to the PME Program Officer listed in the table below.

4. Programmatic Information

No data management plans are required for proposals to this program element.

Letters of affirmation from the relevant community are permitted for proposals to this program, but only for Facility Instruments.

4.1 Submission of PME proposals

All proposals must include a convincing case for instrument funding, addressing as many of the following as applicable: why the instrument is necessary for the investigator's research or how it would enhance that research, citing specific examples; why the enhanced capability is important to planetary science in general; and, if an instrument is proposed for the benefit of the science community, how the enhanced capability would benefit the larger planetary science community. All proposals should address how the requested instrument relates to existing capabilities, both in the investigator's own laboratory and other facilities.

4.1.1 *Appended PME proposals*

To submit a request for PME funds in conjunction with a new research proposal, the proposer should select the PME checkbox on the Cover Page for the affiliated science research program (see Chapter 2 of the *NASA Guidebook for Proposers*, as referenced in Section 5 below). The PME request should be listed as Equipment in the budget information, typically for year one only. The research proposal must contain an appendix entitled, "Planetary Major Equipment Request." This appendix should include: (a) A maximum of five (5) pages of description of the instrument request, including the category of instrument being requested (Investigator, Investigator Facility, Regional Facility), how this purchase will contribute to the research described in the main body of the science research proposal, any cost-sharing arrangements, and, for Facility instruments, a management plan as described above in Section 2; (b) A page of instrument specifications; (c) at least one quote for the instrument or major components. This appendix does *not* count toward page limit of the Scientific/Technical/Management section of the host proposal.

4.1.2 *Stand-alone PME proposals*

Stand-alone PME requests, made in conjunction with an existing (previously funded) "parent" award in one of the eligible or grandfathered Planetary Science Research Programs listed above, should be complete proposals prepared in full compliance with all applicable instructions and deadlines associated with the research program to which the PME proposal will be submitted. The only exception is that the Scientific/Technical/Management section of the proposal is limited to seven pages instead of fifteen. The proposer should select the PME checkbox on the Cover Page of this submission. The seven-page Scientific/Technical/Management section should contain sufficient background information on the parent research award so that the PME proposal can be reviewed without also rereviewing the parent award. It should also specify the program name, title, award number, PI name, and start/end dates of the parent award, and include a description of the instrument request, including the category of instrument being requested (Investigator, Investigator Facility, Regional Facility), how this purchase will contribute to the research described in the parent science research award, any cost-sharing arrangements, and, for both types of Facility instruments, a management plan as described above in Section 2. The

proposal should also include a separate page of instrument specifications and at least one quote for the instrument or major components.

4.2 Evaluation Criteria and Review of PME Proposals

PME proposals will be reviewed as part of the science research program peer reviews. Appended PME proposals will be reviewed in the context of their respective science research proposals. Stand-alone PME proposals will be reviewed only on the basis of information in the proposal; the previous proposal resulting in funding of the parent award will not be rereviewed. Evaluation factors will be those listed in each science research program element, with the following additions:

- In evaluating the intrinsic merit of the request, additional factors that will be considered of equal weight are the scientific merit of the science research proposal and the value that the new or enhanced capability would add to science and/or education beyond that offered specifically to planetary science.
- In considering the relevance of the request to NASA's planetary science objectives, attention will be focused on the added value that would be gained by the addition of the instrument capability to ongoing and anticipated research of the proposer, in particular, and to NASA's objectives in general.

Those proposals that most clearly meet the evaluation criteria will be considered by the Planetary Science Research Program Officers when developing their recommendations for selection.

4.3 Relationship of an appended PME proposal to the main science proposal.

PME proposals that are appended to new science research proposals will only be funded if the science proposal itself is selected for funding.

The selection of a meritorious science research proposal for funding may or may not be affected by the nonselection of an appended PME proposal. In such a case, if the PME is deemed to be required to carry out the research in the science proposal, then the science proposal may also not be selected for funding. To minimize this possibility, proposers should, where appropriate, carefully address the question of how the scientific goals of the science proposal could still be achieved if the appended PME proposal is not selected.

5. Summary of Key Information

Expected annual program budget for new awards	~ $1.4M
Number of new awards pending adequate proposals of merit	~ 5-9
Maximum duration of awards	Usually only one year.

Due date for proposals	For stand alone PME proposals, Step-1 and Step-2 proposals should be submitted to the relevant science research program according to the schedule in Tables 2 and 3 in the *ROSES Summary of Solicitation*. For PME proposals appended to new research proposals no separate Step-1 is required.
Planning date for start of investigation	See the specific science research program element.
Page limit for the central Science-Technical-Management section of proposal	7 pp for stand-alone proposals affiliated with an existing parent research award; 5 pp for appendices to new proposals in science research programs; see also Chapter 2 of the *NASA Guidebook for Proposers.*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	Please refer to the specific science research program element. It will be of the form NNH15ZDA001N-AAA where AAA is the abbreviation for that program.
NASA point of contact concerning this program	Jeffrey N. Grossman Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1218 Email: HQ-PME@mail.nasa.gov

C.18 LABORATORY ANALYSIS OF RETURNED SAMPLES

NOTICE: This program element has been corrected to remove an ambiguity in the text regarding the Step-1 proposals. Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. However, this year no PDF upload is required for the Step-1 proposals in this or any program in Appendix C. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 6 for details. New text is in bold and deleted text is struck through. The due dates remain unchanged: Step-1 proposals are due April 24, 2015 and Step-2 proposals are due June 26, 2015.

1. Scope of Program

The goal of the Laboratory Analysis of Returned Samples (LARS) Program is to maximize the scientific return from the samples provided by missions such as Genesis, Stardust, and Hayabusa (see further below) through development of laboratory instrumentation and advanced analytical techniques required for the complete analyses of the samples they return. In addition, this program supports analytical work on samples returned by recent Planetary Science Division missions, including Genesis and Stardust, as well as samples returned by Hayabusa.

Proposals solicited under this program include those that seek to develop new analytical instrumentation or combinations of analytical instruments, or new components of analytical instruments, leading to significant improvements in the precision, resolution, or sensitivity of measurements compared to the existing state of the art. Also of interest are proposals for the development of new analytical techniques for existing instrumentation that will push the limits of current technology, for example, by the elimination of analytical interferences or contamination problems. In all cases, both the development efforts and the clear relevance to NASA sample-return missions must be clearly documented in the proposals. Proposals may seek to develop analytical capabilities for future sample-return missions. However, work that addresses the needs of current or selected missions have the highest priority.

Some proposals may seek to develop instrumentation and techniques that will be used by only a small number of investigators at a single institution. However, in other instances, the high cost of the instrument and its associated support structure may allow the development of only a limited number of such facilities that must be shared by the entire research community. For these larger and more expensive facilities, proposers should include detailed plans for facility management based on the size of the anticipated user base, including facility oversight, the fraction of time that will be made available to outside users, and the mechanism for allotting such time on a regular basis. In all cases, cost-sharing arrangements in the development of new instrumentation or techniques and evidence of a long-term institutional commitment to the analysis of returned samples will be viewed favorably in the selection process. Collaborations among instrument

builders and scientists who understand the samples to be analyzed are encouraged. Ongoing laboratory support (e.g., service contracts) will generally not be supported.

This program supports analysis of extraterrestrial samples from sample return missions, with the exception of lunar samples, whose analysis is supported by the Lunar Data Analysis Program (LDAP) (C.8) and Solar System Workings (C.3). Also excluded from LARS, but included in the C.2 Emerging Worlds (C.2) program, are analyses of meteorites or cosmic dust, unless these analyses are directly in support of the interpretation of mission data.

Returned samples from NASA Planetary Science missions, plus a subset of samples returned by Hayabusa, are allocated by the Astromaterials Curator at NASA Johnson Space Center after approval by Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM) and NASA Headquarters. If your proposal requires the use of any returned material, such as that from Genesis or Stardust, please review the information at http://curator.jsc.nasa.gov/ and make a request to the Astromaterials Curator, as described.

2. Background

Genesis is a mission designed to return samples of the solar wind to provide constraints on the chemical and isotopic composition of the primitive solar nebula; it was launched in mid-2001 and returned samples to Earth on September 8, 2004. Further information may be found from the mission homepage at http://genesismission.jpl.nasa.gov/. Failure of the parachute system led to a hard landing in the Utah desert, and many of the fragile collectors were shattered on impact and contaminated. Intensive effort is underway by the Genesis science and curation teams to document the chips of collector materials and to measure and remove contamination from the chips. For information on availability of samples, check the curator's website at http://curator.jsc.nasa.gov/.

Stardust, a mission to return samples of a comet's coma, was successfully launched in 1999 and encountered comet Wild 2 in January 2004; it successfully returned its samples to Earth in January 2006. The dust grains that impacted the silica aerogel collectors during a 6.1 km/sec flyby were all small (<100 μm) and fine-grained. In most cases the particles fragmented on impact and interacted strongly with the aerogel. For example, many particles are coated and sometimes penetrated with compressed or melted aerogel. Many particles impacted on the sample collector frame, and work on particle residues in impact craters in the aluminum foils that separated the aerogel cells is also solicited. The aft-facing side of the collector was designed to collect interstellar dust particles, which are expected to be ~0.1 μm in size and to have impacted at more than 20 km/sec. Examination of this interstellar collector is extremely challenging (see http://stardustathome.ssl.berkeley.edu/). In addition to investigations involving direct analysis of Stardust materials, proposals to investigate the details of the capture process are solicited. Further information may be found from the mission homepage at http://stardust.jpl.nasa.gov/ and the curator's website at http://curator.jsc.nasa.gov/.

Hayabusa is a mission run by the Japan Aerospace Exploration Agency (JAXA) to return samples from asteroid 25143 Itokawa. It was launched in 2003, encountered the asteroid in 2005, and its sample capsule was returned to Earth in June 2010. In November 2010, JAXA announced

that a large number of small particles, most smaller than 10 micrometers, were present in the capsule, with strong evidence of asteroidal origin for many of them. A collaboration agreement between JAXA and NASA has brought some particles and will ultimately bring a representative set of particles, comprising 10 percent of the total sample mass, to the Astromaterials Curation facility at NASA Johnson Space Center. Proposals are solicited to study these particles. Selection of proposals for research on Hayabusa particles will be dependent on actual sample availability, as well as on the availability of funds.

3. Supplemental Funding for Additional Instrumentation

The Planetary Major Equipment (PME) program element described in C.17 of this NRA allows proposals for upgrading the analytical, computational, telescopic, and other instrumentation required by investigations for certain programs sponsored by the Planetary Science Division (PSD) Research and Analysis Program, including this one. All new analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $40,000, must be requested according to the PME guidelines in C.17. Two types of instrumentation requests are permitted. (1) A PME request to PSD may be made as a special section that is appended to a new research proposal to this program. This appendix is to be titled "Planetary Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal, and (2) A stand-alone PME proposal may be prepared and submitted to this program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" PSD award and, if not from this program, should explain the relevance of the parent award to this program. See C.17 for details on how to prepare both types of PME requests.

4. Early Career Fellowship Program

Early career researchers are encouraged to apply for the Early Career Fellowships (ECF) Program. The purpose of the ECF program (see C.16) is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the PI's future research contributions and the potential for leadership within the scientific community. See C.16 of ROSES-2015 for more information on the two-step process for the ECF program and the criteria for evaluating candidates.

5. Resources: Information, Data, and Facilities

5.1 Limits on Use of Mission Data

For proposals that contain mission data analysis, planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or equivalent

publicly accessible archive at least 30 days prior to the proposal submission date. Spacecraft data that have not been obtained yet (i.e., future mission data) or those that have not been accepted for distribution in approved archives are not eligible for use in investigations. Regardless of the archive(s) used, if the data to be analyzed have issues that might represent an obstacle to analysis, the proposers must demonstrate clearly and satisfactorily how such potential difficulties will be overcome. Investigators funded by spacecraft missions who wish to apply must demonstrate clearly how the proposed research does not overlap and is not redundant with data analysis, duties, or responsibilities already funded by their respective mission(s). Please see Appendix C.1, The Planetary Science Division Research Program Overview, for more information.

5.2 Facilities and Data Sources Available to Proposers

Proposers are advised to read Appendix C.1, The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

5.3 Data Archiving and Map Publication

Selected investigations may result in data products that are of broad use to the science community, including maps, data with improved calibrations, etc. NASA strongly encourages that such data products be archived in the Planetary Data System (http://pds.nasa.gov/), or equivalent public archive, by the end of the award period. Proposers are strongly advised to read C.1, The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Proposers are advised to read Appendix C.1, The Planetary Science Division Research Program Overview, for the USGS' information on and requirements for map production and publication.

6. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, given the nature of the new calls, and to ensure proposals are submitted to the appropriate program, many programs will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized

Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

6.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal will be used to confirm whether the proposal was submitted to the correct program element. No evaluation of intrinsic merit will be performed on Step-1 proposals.

~~The NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) system for proposal submission requires that Step-1 proposals include a summary describing the proposed work; the Scientific/Technical/Management section must be uploaded as the PDF "Proposal Attachment." Proposers will be notified when they are to submit their Step-2 proposals.~~

No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. [Corrected April 21, 2015]

6.2 Step-2 Proposal

All proposals submitted to ROSES-2015 must strictly conform to the formatting rules in Section IV of this announcement and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the formatting of the Scientific/Technical/Management section proposals have been noted. Please pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that proposers use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single-spaced.
- Figure captions: must follow the same font and spacing rules as the main text.

- Figures and tables: for text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

7. Summary of Key Information

Expected program budget for first year of new awards	~$3.2M
Number of new awards pending adequate proposals of merit	~ 20-30
Maximum duration of awards	4 years; shorter-term proposals are encouraged for instrument development tasks.
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Step-2 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	~6 months after Step-2 proposal due date
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Step-1 and Step-2 proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step-1 and Step-2 proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-LARS

NASA point of contact concerning this program	Jeffrey N. Grossman Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1218 Email (Preferred): HQ-LARS@mail.nasa.gov

C. 19 THE HAYABUSA2 PARTICIPATING SCIENTIST PROGRAM

NOTICE: Amended July 7, 2015. This amendment releases new text for C.19 the Hayabusa2 Participating Scientist Program. The old text has been totally replaced, the changes have not been tracked. However, the major changes are that the text now contains references to the Proposal Information Package and the roster for the Hayabusa2 Joint Science Team, both of which appear under "Other Documents" on the NSPIRES web page for this program element. The due date for Step-2 proposals is now October 5, 2015.

1. Scope of Program

The objectives of the Hayabusa2 Participating Scientist (PS) Program are to aid in mission planning and data archiving, sample analysis, and to enhance and supplement the science performed by the Hayabusa2 mission. NASA expects to select five or six instrument scientists and approximately three sample scientists.

1.1 Overview

Like the first Hayabusa mission, the goal of the Hayabusa2 mission is to retrieve samples of the surface of an asteroid and return them to Earth. The target is the C-type asteroid, 1999 JU3. Hayabusa2 should reach the asteroid in the middle of 2018, stay there about one and half years, and depart from the asteroid late in 2019 to return to Earth at the end of 2020.

Hayabusa2 is a follow-on to the Japan Aerospace Exploration Agency's (JAXA) successful Hayabusa mission, which was the first mission to retrieve samples from an asteroid, Itokawa, and bring them to Earth. The primary goal of Hayabusa2 is to again return asteroid samples to Earth, this time from C-type asteroid 1999 JU3, which is thought to contain more organic matter than the S-type asteroid explored by the original Hayabusa mission. Successful sample collection of the target asteroid is expected to provide additional knowledge on the origin and evolution of the planets, and, in particular, the origin of water and organic matter.

Hayabusa2 will utilize and improve upon the technologies used in the original Hayabusa mission. The Hayabusa2 mission will use an ion engine to access the destination asteroid in a spacecraft almost identical to the original Hayabusa, with significant modifications made to the spectroscopic equipment and sampling system. The Hayabusa2 payload will comprise a near infrared spectrometer, thermal infrared imager, small carry-on impactor, and a separation camera. The impactor will be used to create a crater from which samples will be collected, so as to include materials found beneath the surface thought to be in a more pristine state.

The Hayabusa2 mission, spacecraft, and science instruments are focused on three main scientific objectives:

1) Obtain and map surface material information of the C-type asteroid 1999 JU3.
2) Investigate the interaction between mineral, water, and organic compounds in an asteroid environment from collected sample.

3) Study the internal structure, subsurface material, and evolution processes of highly porous primitive bodies.

Hayabusa2 launched successfully on December 3, 2014, from Tanegashima Space Center, Japan, using an H2A launch vehicle. The spacecraft is expected to reach the target asteroid in June 2018, upon which it will orbit and observe the asteroid's surface using remote sensing instrumentation. At the asteroid, the spacecraft will release three rovers and a lander before collecting samples. Following their collection, it is expected that the asteroid samples will be returned to Earth through a sample reentry capsule in December 2020.

Additional information about the Hayabusa 2 mission including a section on "Participating Science options of particular interest to the Hayabusa2 Project" may be found in the Proposal Information Package (PIP), downloadable from the NSPIRES web page for this program element, under "Other Documents." Applicants are strongly encouraged to familiarize themselves with the PIP and references therein. Applicants also are encouraged to explicitly make connections between their proposed research and the objectives of the Hayabusa mission.

1.2 Participating Scientist Program

The Hayabusa2 Participating Scientist Program seeks to enhance the scientific return of the Hayabusa2 mission by broadening participation in the mission with NASA selected scientists, augmenting the existing science team to include new investigations that enhance and/or complement the currently funded investigations, and maximizing the contribution of the mission to the scientific understanding and future exploration of asteroids. The second and equally important goal of this opportunity is to increase the number of scientists supporting mission planning and execution. These scientists will become members of the science team and be required to fulfill responsibilities complementary to the current JAXA science team members. As members of the science team, they will augment the existing team to maximize the contribution of the mission to the scientific understanding and future exploration of asteroids. The selected Participating Scientists (PSs) should coordinate their activities and analyses with the JAXA Principal Investigators (PIs) and Co-Investigators (Co-Is) to achieve the essential scientific objectives of the investigation and ensure the dissemination of the results of the investigation to the scientific community and the general public.

Proposals should identify scientific ideas and unique theoretical and analytical capabilities that best meet the scientific objectives of the Hayabusa mission, as described in this solicitation. Key projected milestones, accomplishments, and deliverables during each year of the proposed investigation should be identified

Although a large fraction of the observations will be planned in advance, real-time response to a brand-new set of observations is expected to result in an ongoing requirement for significant replanning. Additional investigators will contribute substantially to enhanced understanding of the data and to improved planning stimulated by the observations.

All proposers must join one or more of the mission subteams, which are supervised by their individual PIs. Roles for proposers and publication rules (who is first author, etc.) should be

discussed with the PI and team members. Basic science policy is decided by the Hayabusa2 Joint Science Team (HJST). A complete roster for the Hayabusa2 Joint Science Team (as of April 2015) is provided separately, along with the PIP, under "Other Documents" on the NSPIRES web page for this program element.

Participating scientists proposing investigations involving the Mobile Asteroid Surface Scout (MASCOT) will also be considered. These investigations will require appropriate coordination with Deutschen Zentrums für Luft- und Raumfahrt (DLR) and Centre National d'Etudes Spatiales (CNES), as well.

Participating scientists involved in instrument investigations or sample analyses will, as appropriate:

- Become familiar with the spacecraft/the MASCOT lander, its instruments, its investigations, mission and observing plan, and sample analysis plan.
- Participate in science team, working group, sample analysis, and instrument team meetings.
- Execute the selected scientific investigations as science team members.
- Perform data analysis and carry out the analyses necessary to complete the scientific investigation.
- Present the science investigation results at science team meetings, science meetings and conferences, and other fora to enhance and disseminate the scientific results of the investigations.
- Publish the results in peer reviewed journals and other scientific publications in accordance with NASA, JAXA, and Hayabusa2 data release and publication policies.
- Prepare, validate, and deliver data products, documentation, and other pertinent investigation information for which they are responsible to the Planetary Data System, in accordance with the Hayabusa2 Science Data Management Plan.
- Participate in sample site selection, preliminary examination planning, and characterization of the returned sample, as well as curation of the samples.
- Support Education and Public Outreach efforts of the Hayabusa2 mission.

Only the Principal Investigator from each proposal selected through this program will be designated as a Participating Scientist on the Hayabusa2 mission.

1.3 Budget: Size, Format and Duration

The Planetary Science Division expects to fund eight to nine participating scientist awards. The maximum duration of awards is seven years, but this may be "phased" into more than seven fiscal years. The entire expected program budget for the full duration of all multiyear Hayabusa2 participating scientist awards is five million dollars. The NSPIRES cover page budget only accommodates five years of budget, but those who are requesting funding for more than five years in duration should include all years in the budget in the body of the proposal. Proposals from foreign organizations should not include a budget unless the proposal involves collaboration with a U.S. institution, in which case a cost plan for only the participation of the U.S. entity must be included. However, all proposals, including those from foreign organizations

should include a summary table of work effort estimating the time to be devoted to the proposed project, whether it is proposed that the cost be covered by NASA or not. NASA civil servant salary costs and associated overhead should not be included in proposals, they must be provided separately to NASA. See the ROSES *Summary of Solicitation* Section IV (iii).

1.4 Foreign Participation

Proposals from scientists employed at non-U.S. institutions are welcome and will be considered on a no-exchange-of-funds basis. The expected budget listed below in the summary table is only for NASA'a contribution and does not include that of any foreign organizations. Non-U.S. proposals will be reviewed to the same high standards as proposals from U.S. institutions. Proposers from non-U.S. institutions should read the Foreign PI Affiliation instructions document, which is downloadable as a PDF file from the NSPIRES web page for this program element.

Foreign proposers should include a letter of commitment promising support for both the investigation and the Participating Scientist duties. Unless otherwise noted, proposals from foreign entities are not required to include a cost plan unless the proposal involves collaboration with a U.S. institution, in which case a cost plan for only the participation of the U.S. entity must be included.

Proposals from U.S. institutions that include foreign participation must include a Letter of Endorsement from their government agency or funding/sponsoring institution in their country indicating that, if the proposal is selected, the proposed foreign participation will supported.

2. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel and, given the nature of the new calls, to ensure proposals are submitted to the appropriate program, most calls in Appendix C are using a two-step proposal submission process (see Section IV.(b) (vii) of the ROSES-2014 Summary of Solicitation.) Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The Step-1 proposal PI cannot be adjusted. To add funded investigators between the Step-1 and Step-2 proposals, PIs should notify to the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

2.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1

proposal may be used to determine whether the proposal was submitted to the correct program element. No evaluation of intrinsic merit will be performed on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

2.2 Step-2 Proposal

Proposers should refer to the pdf entitled "How to submit a Step-2 proposal" that will appear under "Other Documents" on the NSPIRES page for this program element after the Step-1 proposal due date. The process for preparation and submission of the Step-2 (full) proposals is essentially identical to that associated with any other ROSES proposal.

2.3 Proposal Formatting

All proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of this announcement and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the formatting of the Scientific/Technical/Management section proposals have been noted. Please pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that proposers use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line spacing settings for a selected font below single-spaced.
- Figure captions: must follow the same font and spacing rules as the main text.
- Figures and tables: for text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

3. Resources: Information, Data, and Facilities

3.1 Facilities and Data Sources Available to Proposers

Proposers are advised to read Appendix C.1, The Planetary Science Division Research Program Overview, for information on facilities and data sources that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

3.2 Data Archiving and Map Publication

Selected investigations may result in data products that are of broad use to the science community, including maps, data with improved calibrations, etc. NASA expects that such data will be archived in the Planetary Data System (http://pds.nasa.gov/), or equivalent public archive, by the end of the award period. Proposers are strongly advised to read C.1, The Planetary Science Division Research Program Overview, for information on the new mandatory data management plans.

Proposed investigations of any planetary or satellite surface that are intended to result in the publication of a Scientific Investigations Map (SIM) by the U.S. Geological Survey (USGS) should check the relevant box on the proposal Cover Page and clearly indicate this intention in the Proposal Summary, as well as in the text of the proposal. The scientific goal of such a geologic map product should be clearly explained and justified. Proposers are advised to read Appendix C.1, The Planetary Science Division Research Program Overview, for the USGS' information on and requirements for map production and publication.

4. Evaluation Criteria for Participating Scientists

Evaluation criteria are given in the *Guidebook for Proposers*. These criteria are intrinsic merit, relevance, and cost realism/reasonableness. In addition to the factors for each criterion given in the *Proposers Guidebook*, evaluation of proposals requesting consideration for a Participating Scientist position includes the following factors:

- Relevance will additionally include evaluation of the extent to which the proposal meets both goals and the applicable mission-level science objectives of the Hayabusa2 mission.
- Merit will additionally include the extent to which the proposed investigation and the expertise of the proposer complements or extends the existing investigations and expertise of the science team. Proposals should address how the proposers will integrate themselves with the science team.
- Cost realism/reasonableness will additionally include budget analysis to ensure that participation in science team activities and meetings is sufficiently supported.

JAXA will participate in the evaluation of spacecraft instruments and sample selection scientist with the possible participation of DLR and CNES in proposals involving MASCOT.

5. Summary of Key Information

Expected program budget for entirety of all multi-year awards	~$5M
Number of funded new awards pending adequate proposals of merit	8 to 9
Maximum duration of awards	7 years; only 5 years fit in the NSPIRES cover pages, but up to 7 maybe put into the proposal budget.
Due date for Step-1 proposals	**April 1, 2015 [Amended March 26, 2015]**

Due date for Step-2 proposals	**October 5, 2015.** See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	~6 months after Step-2 proposal due date
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Step-1 and Step-2 proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step-1 and Step-2 proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-HAYB2
NASA point of contact concerning this program	Tony Carro Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0349 Email: anthony.carro-1@nasa.gov

C. 20 MARS SCIENCE LABORATORY PARTICIPATING SCIENTIST PROGRAM

NOTICE: Amended on March 4, 2014. This amendment releases text for a new program element in ROSES-2015: The Mars Science Laboratory Participating Scientist Program. Mandatory Step-1 proposals are due by May 6, 2015, and full Step-2 proposals are due by June 3, 2015.

Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload or budget is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 3 for details.

1. Scope of Program

The Mars Science Laboratory (MSL) Curiosity rover landed on Mars in August 2012, with the overall science objective to explore and quantitatively assess a local region in Gale Crater, Mars, as a potential habitat for life, past or present. This mission has been successfully operated for over two years by a large team of scientists and engineers, using an integrated suite of instruments on a rover platform. A list of the prelanding mission description papers and key postlanding science results published by the science team can be found at http://mslsci.com/pubs. The rover is expected to remain active for another two to eleven years, although, as time goes by, the rover power provided by the radioisotope thermoelectric generator is expected to continue decreasing linearly.

This solicitation is for investigations in the MSL Participating Scientist (PS) program to enhance the scientific return from the mission by broadening participation in the mission to include new investigations that broaden and/or complement the funded Principal Investigator (PI)-led instrument investigations, thus maximizing the contribution of MSL to the future exploration and scientific understanding of Mars. Participating Scientist proposals can include investigations that are instrument specific or multiinstrument in nature and, in all cases, must include both science analysis and an operational component (commitment to participate in daily operations) in order to be considered. Because the intention is to enhance and broaden the scientific return, investigations submitted by MSL Instrument PIs and Instrument Co-Investigators (Co-Is) will not be considered. Existing Participating Scientists and their PS investigation team members, if they are interested in continuing as Participating Scientists, must propose and successfully recompete.

Selected PS's will become members of the MSL science team and be required to fulfill responsibilities similar to those of current science team members. The PS's will be assigned to the Project Scientist, rather than to an instrument PI. However, the PS's will be invited to attend instrument team meetings relevant to their investigation. The PS's are intended to function primarily as part of an integrated MSL science team during operations, contributing their particular expertise to the mission's ongoing scientific exploration and data analysis. As part of operations, participation of PS's in a Science Theme Group is particularly important. The

selected PS's will coordinate their activities and analyses with the MSL science team to achieve the scientific objectives of their PS investigation, within the scope and resources of the MSL project, and ensure dissemination of the results of the investigation to the scientific community and the general public.

Each PS (and any PS team members) will:

- Become thoroughly familiar with the rover, its instruments, it operations processes, and its science investigations;
- Participate in annual MSL science team meetings and, as appropriate, in instrument team meetings
- Receive training for at least one operational role;
- Work with the MSL project to secure any needed clearances for export compliance, JPL remote computer access, and JPL software licenses;
- Actively and regularly participate in daily rover science operations, including serving in at least one operational role;
- Plan and advocate for rover and payload science activities in MSL Science Discussion meetings and as a Science Theme Group Member for both the PS investigation and the general mission science investigation
- Perform initial data analysis to support operations and carry out subsequent analysis for both the PS investigation and the general mission science investigation;
- Work with other members of the science team to define the long-term science operations strategy;
- Prepare, validate, and deliver any PDS-compliant data products, documentation, and other pertinent investigation information for which they are responsible to the Planetary Data System (PDS), in accordance with the Mars Exploration Program Data Management Plan;
- Publish the investigation results in peer-reviewed journals; and
- Support education and public outreach efforts of the MSL Mission, including NASA press conferences.

This NRA is soliciting investigations primarily involving the ten instruments that comprise the MSL science payload. Proposals should include a science investigation that addresses one or more of the MSL science objectives listed below. Selected investigators will become members of the MSL science team and be expected to work in a collaborative manner with other MSL science team members after selection. All team members will be bound by the Mars Science Laboratory Project "Rules of the Road" document that describes the data access rights, data-sharing responsibilities, and data release policies of the MSL science team. The current version of this document is available at http://mslsci.com/ror. In the course of carrying out their scientific investigation, if a PS has to generate higher-level instrument products that are not already being archived (see http://pds-geosciences.wustl.edu/missions/msl/index.htm), the Participating Scientist proposal must indicate that the PS will archive those products in the PDS.

Participating Scientists may propose any investigation that addresses the goals of the Mars Exploration Program, although emphasis will be placed on investigations addressing one or more of the MSL science objectives listed here:

- Characterization of geological features contributing to deciphering geological history and the processes that have formed or modified bedrock and regolith, with emphasis on the role of water;
- Determination of the mineralogy and chemical composition (including an inventory of elements such as C, H, N, O, P, S, etc. known to be building blocks for life) of surface and nearsurface materials;
- Determination of energy sources that could be used to sustain biological processes;
- Characterization of organic compounds and potential biomarkers in representative bedrock and regolith;
- Determination of the stable isotopic and noble gas composition of the present-day atmosphere and of ancient H_2O and CO_2 preserved in hydrated minerals;
- Identification of potential biosignatures (chemical, textural, isotopic) in rocks and regolith;
- Characterization of the broad spectrum of surface radiation, including galactic cosmic radiation, solar particle events, and secondary neutrons;
- Characterization of the local environment, including basic meteorology, the state and cycling of water and CO_2, and the near-surface distribution of hydrogen;
- Identification and quantitative assessment of "taphonomic windows" for organic carbon (subset of habitable environments also capable of preserving organic compounds through exposure age dating and refined models for primary facies distributions and diagenesis); and
- Exploration and characterization of major environmental transitions recorded in the geology of the foothills of Mount Sharp and adjacent plains.

Although NASA is open to considering any outstanding proposals that meet these criteria, there are a few types of investigations that are particularly desired through this NRA:

- Investigations are sought that leverage extensive sedimentary field geology experience to the investigation of the types of rock outcrops expected on Mount Sharp, involving strategies for observation and sampling, and a focus on interpretation of sedimentary petrology, stratigraphy, and/or geochemistry.
- Investigations are sought that enhance the science return from SAM measurements of organics through innovative operational approaches and/or analog laboratory work.
- Investigations are sought that study burial diagenesis, fracturing, and vein formation.
- Investigations are sought of the evolution of the Martian crust and mantle based on reconstruction of the igneous protoliths indicated by sedimentary rocks or based directly on analysis of float rocks/conglomerate clasts of igneous origin.
- Investigations are sought that enhance the science return from the ChemCam investigation. Particular expertise is solicited to identify well-characterized Mars analog samples, work with the ChemCam team to analyze them with the flight-like LIBS instruments, and apply the results to the study of ChemCam targets on Mars.
- Investigations are sought that enhance the science return from the Dynamic Albedo of Neutrons (DAN) investigation, an instrument that measures the abundance of hydrogen and chlorine in near-surface materials.
- Investigations are sought that enhance the science results from SAM/APXS radiogenic and cosmogenic isotope age-dating.

- Investigations are sought that enhance the understanding of mineral abundances and diversity in Curiosity's field area from orbiter data sets and Curiosity's instruments using theory, laboratory work, and/or mission data.
- Investigations are sought that provide leadership in the strategies for environmental monitoring and data analysis using REMS, Mastcam, Navcam, and/or ChemCam.

NASA invites proposals from people who have not previously participated in Mars missions.

Although outdated, the Proposal Information Package for the original MSL PS Program provides more detailed background about the rover and its science payload.

Proposals from scientists at non-U.S. institutions will be considered on a no-exchange-of-funds basis. The expected budget listed below in the summary table refers only to the NASA support for those at U.S. institutions. Non-U.S. proposals will be reviewed to the same standards as proposals from U.S. institutions. Proposers from non-U.S. institutions should read the Foreign PI Affiliation instructions document, which is downloadable as a PDF file from the NSPIRES web page for this program element.

2. Programmatic Information

2.1 Proposal Guidelines

All proposals should contain the elements described in Section 2 of the *Guidebook for Proposers*. The central Science/Technical/Management section is limited to 15 pages. Only the principal investigator from each proposal selected through this program will be designated as a Participating Scientist on the Mars Science Laboratory mission; any Co-Investigators or collaborators on the proposal will be designated as MSL science team Co-Investigators or collaborators according to MSL "Rules of the Road." The Principal Investigator is expected to be the primary, if not sole, individual contributing to the proposed science and operations and all proposals should indicate a commitment level of at least 15% time by the Principal Investigator alone, in each of the fiscal year (FY) 2016-2019. At least 50% of the funding received through this NRA must be used in support of rover operations, with the rest supporting science analysis. Although not encouraged, proposals may include funded Co-Investigators and/or unfunded collaborators only if they are required to complete the proposed science investigation and are working under the supervision of the PI and co-located at the PI's institution. The participation of graduate students and postdoctoral researchers is encouraged.

Proposals should identify scientific ideas, including knowledge of terrestrial analogs (if appropriate) and unique field-work, theoretical, and analytical capabilities that best meet the scientific objectives of the MSL mission, as described in this solicitation. Key projected milestones, accomplishments, and deliverables during each year of the proposed investigation should be identified.

2.2 Operational Roles

Rover science operations are expected to occur on approximately sixteen weekdays and two Saturdays each month. Each day is an eight-hour shift and may start between 6 AM and 11 AM Pacific time (most commonly at 8 AM). Throughout this document, "daily operations" refers to this frequency and timing. The operations schedule is dependent on Earth-Mars geometry and nominally is fixed several weeks in advance, but is subject to change by up to a few hours until about a week in advance.

Proposers and their team members who will be participating in operations should be prepared to obtain the necessary training for operational positions and they should be prepared to staff operational roles on a regular basis. Proposals must include at least two three-day trips to Pasadena, CA, for training in their travel budget for each participant who will have an operations role, if they aren't already trained for MSL operations. Once selected, the Project will assist in determining the operations roles that are most suitable and recommended location(s) for training.

Most science team roles can be fulfilled by using a phone or VOIP connection for teleconferencing and a computer connected to the internet which is running Jet Propulsion Laboratory (JPL)-provided software to allow data transfer, telemetry viewing, activity planning, and instrument sequencing. Scientists participating in operations are expected to be able to bring their own PC or Mac laptop to wherever they get their operations training (running Windows 7 or higher, or Mac OSX 10.6 or higher). The same type of computer (laptop or desktop) can be used to participate in operations remotely from home institutions.

2.3 Sources of Information and Data Used in the Proposal

All information and data used in the proposal pertaining to the Mars Science Laboratory, the MSL science instruments (or testbeds or engineering models belonging to the MSL instrument teams), and MSL science data (from instruments, testbeds, or engineering models belonging to the MSL instrument teams) must be available in the public domain at least 30 days prior to the due date, or the proposal will not be considered for selection. By "released," we mean information that can be found in the published literature, at the Mars Science Laboratory website (http://mars.jpl.nasa.gov/msl/), in the PDS, or through the NSPIRES web site, or other established public archives and such information should be referenced in the proposal accordingly.

2.4 Duration of Award

Selected Participating Scientists are expected to be participating in the mission from October 5, 2015, through September 29, 2019. Selected U.S. investigators are expected to be funded for the same period. This assumes an approved extended mission beyond September 2017, the rover is still operational, and the resources permit. Such an extension will be at the discretion of NASA and subject to review based on performance. Furthermore, extended funding for the PS's may require an additional open competition. In the event that the rover does not survive its expected lifetime, any remaining funds intended to support daily operations will be returned to NASA.

2.5 Budget Information

Proposers must provide a detailed year-by-year budget covering the entire time period from October 5, 2015, through September 29, 2019. The budget must follow the guidelines described in the *Guidebook for Proposers*. The budget must include funding for training, daily operations, data analysis to support the proposed science investigation, publication costs, attendance at conferences, all travel costs, and all other necessary expenses.

Each PS proposal budget should include adequate funds for the PI to attend the minimum number of required training sessions (see Section 2.2 above). These training sessions are mandatory for all proposal team members who will be participating in rover operations. The budget should also include funds to attend one MSL science team meeting in each fiscal year. Participating Scientists closely tied to a particular instrument are also encouraged, but not required, to include travel funds in their budget for up to one to two trips per year to visit an instrument PI's institution or attend instrument team meetings located elsewhere. For simplicity, proposers should assume that the operations training sessions and MSL science team meetings will take place in Pasadena, CA, although the actual location may be different.

U.S. export law may delay the start of any participation in operations by nine to twelve months for non-U.S. persons, if JPL does not have existing license authority to share MSL technical information with those persons.

Note that rover operations will stand down (no commanding or data return) for a three to four week period of solar conjunction centered on July 27, 2017, and again, centered on September 2, 2019.

The expected total program budget and number of awards are indicated in Section 4, the Summary Table of Key Information. Funding of multiyear projects is contingent upon availability of funds and annual assessment of performance, and relevance of the research effort to the MSL mission and program requirements.

2.6 Evaluation Criteria

Evaluation criteria are given in the *Guidebook for Proposers*. These criteria are intrinsic merit, relevance, and cost realism/reasonableness. In addition to the factors for each criterion given in the Proposers Guidebook, this program specifically includes the following factors:

- Intrinsic merit will additionally include technical consideration of the capability of the rover and the MSL payload to reasonably accomplish the proposed investigation.
- Intrinsic merit will also include a consideration of whether the proposed research is complementary or duplicative of the research already being conducted by the current MSL Science Team members.
- Relevance will include evaluation of the extent to which the proposal meets both goals and the applicable mission-level science objectives of the Mars Science Laboratory mission.
- Cost realism/reasonableness will additionally include budget analysis to ensure that participation in daily operations is sufficiently supported.

2.7 Progress Reports and Deliverables

NASA has assigned administrative management of selected investigations to the MSL Project at the Jet Propulsion Laboratory. After selection, each Participating Scientist shall provide a schedule for deliverables, cost estimate, and statement of work. The Participating Scientists shall provide annual reports to the MSL Project Scientist and the NASA Headquarters Program Officer that include: accomplishments of past year, plans for the next year, issues, concerns, schedule performance, financial performance, and status of publications and other deliverables.

2.8 Award through JPL Subcontract

The Mars Exploration Program will conduct the proposal evaluations while selection of MSL Participating Scientists investigations is the responsibility of the Planetary Science Division, Science Mission Directorate, NASA Headquarters. The MSL Project is managed by the Jet Propulsion Laboratory (JPL). It is the JPL Mars Science Laboratory Project's responsibility to operate the rover and provide a project science interface to the MSL Science Team. NASA Headquarters will be responsible for the evaluation and selection process associated with this Program Element.

JPL will award subcontracts to non-Government participants selected for funding. These subcontracts may require submission of additional proposal information to JPL after selection is made. Instructions will be provided at that time. This proposal information will be reviewed by the JPL subcontracting official as the basis for negotiating and awarding a subcontract. U.S. Government organizations, including NASA centers, selected for funding under this NRA will be funded directly and will collaborate with JPL in performance of the work.

3. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, given the nature of the new calls, and to ensure proposals are submitted to the appropriate program, this program will use a two-step proposal submission process.

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The Principal Investigator (PI) cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES

web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be done on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

4. Summary of Key Information

Expected program budget	~$2.7M/year
Number of new awards pending adequate proposals of merit	~ 18
Maximum duration of awards	4 years (assuming a funding start date of October 5, 2015); extensions will be at the discretion of NASA.
Due date for Step-1 proposals	May 6, 2015
Due date for Step-2 proposals	June 3, 2015
Planning date for start of investigation	October 5, 2015
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)

Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-MSLPSP
NASA point of contact concerning this program	Michael A. Meyer Mars Exploration Program Lead Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0307 E-mail: HQ-MSLPS@mail.nasa.gov

C.21 CITIZEN SCIENCE ASTEROID DATA, EDUCATION AND TOOLS

NOTICE: Amended May 5, 2015. This Amendment presents a new call as program element C.21, Citizen science Asteroid Data, Education, and Tools (CADET).

Proposals to this program will be taken by a two-step process, in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. Step-1 proposals are due by June 15, 2015, and Step-2 proposals are due on July 15 2015. See Section 3 for details.

1. Scope of Program

The Near Earth Objects (NEO) Program within NASA's Science Mission Directorate (SMD) coordinates NASA-sponsored efforts to detect, track, and characterize potentially hazardous asteroids and comets that could approach the Earth. With over 90% of the near-Earth objects larger than one kilometer already discovered, the NEO Program is now focusing on finding 90% of the NEO population larger than 140 meters. In addition to managing the detection and cataloging of Near-Earth objects, the NEO Program Office is responsible for facilitating communications between the astronomical community and the public, should any potentially hazardous objects be discovered.

The goal of the Asteroid Grand Challenge (AGC) is to "find all asteroid threats to human population and know what to do about them." The AGC program within NASA's Office of the Chief Technologist (OCT) coordinates with and enhances NASA-sponsored asteroid efforts by engaging nontraditional partners, such as the private sector, non-Governmental organizations, coders, amateur astronomers, citizen scientists, do it yourself scientists and engineers, and the public, to collaboratively meet this challenge through open science and open innovation. AGC provides adaptation and application of emerging open science and open innovation concepts, methodologies, technologies, etc. to demonstrate their feasibility and potential to increase science return, as well as to inform missions and research disciplines of promising techniques and capabilities worthy of broader application and/or further development through full maturity.

The Citizen science Asteroid Data, Education, and Tools (CADET), a joint solicitation of the NEO and AGC programs, seeks innovative proposals to adapt, develop, and web-enable software tools for asteroid data analysis and to make them accessible and easily usable by nonprofessionals, including amateur astronomers, students, and citizen scientists.

The specific goals of the CADET program are to:

- Through agile development and other innovative methods, adapt, further develop, and web-enable asteroid data analysis software to increase the productivity of NEO and AGC research endeavors and extend the state-of-the practice in those endeavors;

- Develop easily usable and understandable software tools though the application of human-centered design best practices, including user research studies, systematic usability testing, and evaluation;
- Integrate advances in information technology with advances in cyberlearning (i.e., what is known about how people learn with technology), and integrate these software tools into learning environments so their potential is fulfilled; and
- Foster multidisciplinary collaborations that span the NASA science, computer science, design, and education disciplines.

1.1 Software Tool Development and Validation

This program element supports the adaptation, development, and dissemination of web-enabled software tools for asteroid data analysis that would facilitate the use of existing datasets, enable or enhance future science investigations of interest to the Near Earth Objects Program, and make these software tools open source, web-accessible, and easily useable by nonprofessionals, including high school and college students, amateur astronomers, citizen scientists, and other members of the public.

At minimum, the web-enabled software tool will enable the user to perform the following tasks, the first two of which should use an automated algorithm:

- Astrometry: Solve an image for the positions of the stars and moving objects within it. Allow the processing of batches of images.
- Photometry: Provide relative photometry for the moving objects within an image using reference stars from standard catalogs. Also allow the processing of batches of images.
- Light curve analysis: Provide a virtual workbench for the user to create asteroid light curves from the derived photometric values and determine the spin period of the asteroid. This analysis must take into account the particulars of asteroid light curves, such as, but not limited to, light-time correction and the phase angle effect on brightness. The software must produce, at a minimum, and in addition to data files with the results of the analyzed light curve, an image of the folded light curve that is suitable for publication in a scientific journal.

NEO and AGC do not support extensive application of these tools, but it is expected that the validity and usability of these tools by nonprofessionals will be demonstrated during the course of the proposed work. Proposals are expected to include a plan to disseminate the tools for use by a wide audience, including students, amateur astronomers, citizen scientists, and the planetary science community. In addition to any other dissemination mechanisms, investigators developing software tools are required to archive the source code, and all relevant documentation, at NASA's Github site **(https://github.com/nasa).** It is expected that user interfaces and/or executables will be made publically available at no cost.

2. Programmatic Information

Sections 2.3 and 2.4 of this solicitation provide additional details governing the proposed activities that supersede the general guidelines announced in the *Summary of Solicitation* of ROSES-2015. Awards will commence with Fiscal Year 2016 funds.

2.1 Periods of Performance

Because of the rapidly changing computing and computation technology environment, awards resulting from this call are limited to a performance period of 24 months or less. Annual reviews will be held according to the criteria in the *NASA Grants and Cooperative Agreement Handbook* (14 CFR 1260). Proposals must define clear, measureable milestones to be achieved for each year of performance in order to warrant continuation of the second year.

2.2 Program Constraints

The program will encourage direct collaborations between proposals and NEO and AGC partners. The tools and capabilities resulting from CADET investigations are expected to be available for open use as web-based applications and as available open source code. Plans for migration into a persistent software framework or infrastructure for ongoing maintenance and user support should be identified. Proposals should discuss plans for this, even if the project is not expected to reach that level of maturity in the term of the award.

2.3 Evaluation and Selection of Proposals

Evaluation criteria for this solicitation are given in Section C.2 of the *NASA Guidebook for Proposers*. One or more peer review panels will evaluate all of the proposals.

In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion "intrinsic merit" specifically includes the following factor:

- Clear objectives for the investigation and clear description of the capabilities expected to result.

In addition to including the perceived relevance of the proposed work to this call, the evaluation criterion "relevance to NASA's strategic goals and objectives" specifically includes:

- Success criteria for the investigation and potential benefits and impact on NASA science and education.

In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion "cost realism" specifically includes the factor:

- Quality and suitability of the work plan and schedule, including task breakdown, staffing, and other resources.

2.3.1 *Agile Software Development and Human Centered-Design*

Proposals must include an agile software development and testing plan to describe the software engineering practice to be used in the project. Proposals also must address how they will develop and document user personas (e.g., high school and college students, amateur astronomers, and professional astronomers), engage end users in the iterative testing and evaluation of the software tool, and how they will meet staffing expertise, as appropriate, including user experience (UX) design, user interface (UI) development, and web application development. The proposal will be considered unresponsive without this plan.

2.4 Compliance

Because scientific software is typically built piece by piece over multiple funding cycles and with different teams, the software developed under this Program Element must be designated and distributed to the public as open source software. The use of Apache License 2.0 is required.

Any proposal responding to this solicitation to adapt, develop, and web-enable the asteroid data analysis software is required to deliver to NASA a copy of such software with sufficient rights for use as Open Source Software under this Apache License 2.0.

Therefore, each proposal shall:

- Identify any proprietary software, software owned by a non-Federal entity, or open source software that is incorporated into the software being proposed;
- Indicate whether a license has been obtained in situations where proprietary software, software owned by a non-Federal entity, or open source software has been incorporated into the software that is the subject of the proposal and attach a copy of the license to the proposal, along with evidence of permission obtained from the software owner to release improvements or derivative works to the software as Open Source under the Apache License, Version 2.0.

NASA will evaluate proposals for compliance with the above open source software requirements. A proposal that does not include documentation sufficient to satisfy NASA that the developed software will be open source may not be selected.

2.5 Funding and Awards

The Government's obligation to make award(s) is contingent upon the availability of appropriated funds from which payment can be made and the receipt of proposals that NASA determines are acceptable for award under this solicitation. No additional funds beyond negotiated award value will be available.

All selected proposals will result in the award of a cooperative agreement and will be subject to the provisions of the *NASA Grants and Cooperative Agreement* handbook. Please review the handbook for any potential consequences for cost sharing because of the cooperative agreement arrangement.

It is expected that approximately $200,000 per year will be available to support new investigations selected through this solicitation. This funding will be awarded for up to two proposed projects. As always, new awards will also depend on the available Fiscal Year (FY) 2016 budget.

Because this is a new program, NASA does not have historical data (e.g., on award sizes) to guide proposers. In designing the scope and budget of the proposed project, proposers are encouraged to request what is actually needed to conduct the proposed work, keeping in mind the budget given above.

2.6 Reporting Requirements

All CADET projects are required to submit a quarterly technical report, which focuses on the preceding three months' efforts. Each report should be no longer than four pages and shall address:

- Technical status: The Principal Investigator (PI) shall summarize accomplishments for the preceding three months, including technical accomplishments (user study results, requirements analysis, design, etc.), technology development results, and results of tests and/or demonstrations.

- Schedule status: The PI shall address the status of major tasks and the variance from planned versus actual schedule, including tasks completed, tasks in process, tasks expected to complete later than planned, and tasks that are delayed in starting, with rationale for each, and recovery plans, as appropriate.

- Software engineering status: The PI shall cover how the software engineering and testing plans have been followed, including software engineering documents generated during the performing period, issues tracking, continuous integration, configuration management, and software testing status.

- Financial status: The PI shall report the financial status (e.g., invoicing the Government against the budget) and compare to the budget plan.

Quarterly Technical Reports shall be submitted in PDF, Microsoft Word, or PowerPoint compatible formats by the required due date or by close of business of the first workday following the due date, if the due date falls on a weekend or a holiday. A teleconference, Google Hangout (or similar), or brief meeting may be conducted between NASA and the PI to review and discuss each report and associated wireframes or working prototypes.

3. Proposal Submission

Proposals shall be submitted electronically via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page or via Grants.gov, as described in *NASA's Guidebook for Proposers*. Proposals submitted after the due date will not be evaluated.

To facilitate the early recruitment of a conflict-free review panel, given the nature of the new calls, and to ensure proposals are submitted to the appropriate program, this program will use a two-step proposal submission process.

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES web page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and should include a brief description of the goals and objectives to be addressed by the proposal, the methodology to be used, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be done on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

All Step-2 proposals submitted must strictly conform to the formatting rules in ROSES (e.g., Section IV of the *Summary of Solicitation*) and Chapter 2 of the *NASA Guidebook for Proposers*. Where ROSES differs from The Guidebook, ROSES takes precedence. Proposals that do not conform may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 5 pages maximum.
- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: Section 2 of the *NASA Guidebook for Proposers* requires easily read fonts having, on average, no more than 15 characters per inch (e.g., 12-point Times New Roman and Ariel). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line-spacing settings for a selected font below single-spaced.
- Figure captions: Must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, the font and spacing rules listed above are not required, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

4. Summary of Key Information

Expected program budget for first year of new awards	~$200,000
Number of new awards pending adequate proposals of merit	1-2 projects
Maximum duration of awards	2 years
Due date for Step-1 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Due date for Step-2 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Planning date for start of investigation	Three months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	5 pp maximum.
Relevance	This program is relevant to the Near Earth Observation and Asteroid Grand Challenge questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-CADET
Point of contact concerning this program	Jason Kessler Asteroid Grand Challenge Office of the Chief Technologist NASA Headquarters Washington, DC 20546-0001 Telephone: 202-358-1107 E-mail: Jason.l.kessler@nasa.gov

C.22 NEW FRONTIERS HOMESTEADER

NOTICE: Amended on May 6, 2015. This amendment releases a new program element in ROSES-2015: C.22 New Frontiers Homesteader. Mandatory Step-1 proposals are due by June 5, 2015, and full Step-2 proposals are due by July 20, 2015.

Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 4 for details.

1. Scope of Program

The Homesteader Program supports the advanced development of technology, including instruments, relevant to mission concepts for the next two New Frontiers Announcements of Opportunity (AO). The goal of the program is to mature proposed technologies and reduce their technical risk such that the accompanying mission concepts are better prepared for the next two New Frontiers AOs. Note that the Homesteader Program itself does not solicit investigations or hardware for a flight opportunity. This Homesteader opportunity is open to any technology utilized as part of at least one of the seven mission concepts included in the Decadal Survey list recommended for the New Frontiers program. It is a priority for NASA to invest in technology developments that mitigate the risks of mission concept proposals proposed in response to New Frontiers AOs.

The Homesteader Program seeks to mature technologies in anticipation of future New Frontiers AOs. Examples of applicable technology efforts include, but are not limited to, science instruments; sample acquisition, processing, and storage; advanced solar power cells, array deployment, and concentrators; extreme environment technologies (e.g., batteries); thermal protection system; radiation hardening and tolerant electronics; etc. While specific technology readiness levels (TRL) are not prescribed for the Homesteader program, proposers are reminded that the goal of the program is to mature technologies so they can be proposed as part of a selectable mission concept to a New Frontiers flight AO with reduced risk. It is the responsibility of the proposer to describe how their proposed technology development effort addresses significant risk areas and prepares the technology for a flight opportunity. Efforts that focus on advancing the TRL of a system composed of multiple existing technologies at various TRLs are allowed under this opportunity.

The seven mission concepts recommended by the Decadal Survey for New Frontiers are:

- Comet Surface Sample Return,
- Lunar South Pole-Aitken Basin Sample Return,
- Saturn Probe,
- Trojan Tour and Rendezvous,
- Venus In Situ Explorer,

- Io Observer, and
- Lunar Geophysical Network.

Prospective proposers are encouraged to review the Decadal Survey for additional information on the recommended science objectives for these mission concepts, but strict adherence to those recommended science objectives is not required.

2. Programmatic Considerations

Proposers to this program are not required to provide a data management plan.

2.1 Special Requirements for Proposals

All proposals submitted to this program must specify:

- The mission concept and the role of the proposed technology in it. A summary of the mission concept, including its science objective(s), science target(s), and concept of operations, is required. The role of the proposed technology, including the extent to which it is enhancing or enabling, must also be described.

- Technology developments to mitigate risk. The proposal must describe a) the current maturity level of the proposed technology, b) the development plan to increase that maturity (including specific developments, testing, etc. to be pursued) and how these activities will reduce risk and mature the technology, and c) the expected maturity level at the end of the Homesteader-funded development period. Note that standard NASA practice is for technologies to be at TRL 6 by the Preliminary Design Review for the flight mission. Thus, it is not expected that technologies proposed to the Homesteader Program will reach TRL 6 by the end of the Homesteader effort.

- Two year awards. Awards may not exceed two years in duration, but standard rules for no cost extensions will be followed.

2.2 Additional Selection Considerations

In addition to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers,* the following will also be evaluated as part of merit:

- The likelihood that the proposed effort will successfully mature the proposed technology; and
- The likelihood that the proposed work will help reduce the risk of a mission concept proposed to a near-term New Frontiers AO, aiding in a determination that the mission concept can be considered selectable.

In addition to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers,* the following will also be evaluated as part of relevance:

The relevance of the proposed technology development to mission concepts on the New Frontiers mission list recommended by the Decadal Survey, which consists of

- Comet Surface Sample Return
- Lunar South Pole-Aitken Basin Sample Return
- Saturn Probe
- Trojan Tour and Rendezvous
- Venus In Situ Explorer
- Io Observer
- Lunar Geophysical Network

2.3 Reporting Requirements

The following deliverables shall be required of institutions that receive awards. In cases where subcontract arrangements exist, consolidated project reports are the responsibility of the Principal Investigator (PI). The proposed budget should provide for these reporting requirements.

- Interim and final briefings to program managers at NASA Headquarters. The interim briefing may be conducted via teleconference, but budget should be allocated for a final briefing to take place at NASA Headquarters in Washington, DC.
- Final report to NASA Headquarters not to exceed 20 pages.

2.4 Participation in Other Programs

This program does not participate in the Early Career Fellowship program, the Planetary Major Equipment program, or the NASA Postdoctoral Program.

3. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, and to ensure proposals are submitted to the appropriate program, this program will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The PI cannot be adjusted and proposers that want to add funded investigators between the Step-1 and Step-2 proposals must inform the point(s) of contact below and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

3.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) webpage for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages and no PDF upload is required. The Step-1 proposal should include a

brief description of the goals and objectives of the proposal, a brief description of the methodology to be used to address them, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the appropriate program element. No evaluation of intrinsic merit will be performed on Step-1 proposals.

NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to submit Step-2 proposals.

3.2 Step-2 Proposal

This is a reminder that all proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 8 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that you use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). You may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Do not adjust line-spacing settings for your selected font below single-spaced.
- Figure captions: Must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

4. Summary of Key Information

Expected program budget for first year of new awards	~ $8M/Year
Number of new awards pending adequate proposals of merit	~ 8 awards
Maximum duration of awards	2 Years
Due date for Step-1 proposals	June 5, 2015
Due date for Step-2 proposals	July 20, 2015
Planning date for start of investigation	September 1, 2015
Page limit for the central Science-Technical-Management section of proposal	8 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*

Relevance	See Section 2.2. This program is relevant to the planetary science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Website for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-NFH
NASA point of contact concerning this program	Curt S. Niebur NASA Program Officer Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington DC 20526-0001 Telephone: 202-358-0390 E-mail: curt.niebur@nasa.gov

C.23 INTERIOR EXPLORATION USING SEISMIC INVESTIGATIONS GEODESY AND HEAT TRANSPORT PARTICIPATING SCIENTIST PROGRAM

NOTICE: Amended on December 23 2015. This amendment cancels ROSES-2015 Program Element C.23 the InSight Participating Scientist Program due to the suspension of InSight's March 2016 launch. Please see http://www.nasa.gov/press-release/nasa-suspends-2016-launch-of-insight-mission-to-mars-media-teleconference-today. NASA will evaluate the path forward for the InSight mission, and the re-issuance of this opportunity in a future ROSES solicitation will be part of that evaluation.

NASA point of contact concerning this program:

Robert A. Fogel
InSight Program Scientist
Planetary Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-2289
E-mail: rfogel@nasa.gov

APPENDIX D. ASTROPHYSICS RESEARCH PROGRAM

D.1 ASTROPHYSICS RESEARCH PROGRAM OVERVIEW

1. Introduction

The objectives of research solicited in program elements described in Appendices D.2 through D.10 of this NASA Research Announcement (NRA) are focused on achieving the goals of the Science Mission Directorate's Astrophysics Research Program, as defined in the *NASA Science Plan* (available at http://nasascience.nasa.gov/about-us/science-strategy). Proposers to the elements described in Appendix D are encouraged to read this *NASA Science Plan* to gauge the relevance of their research to the Astrophysics Research Program.

The *NASA Guidebook for Proposers* (Section 2) and the *ROSES-2015 Summary of Solicitation* (Section IV) provide clear and specific requirements for the format of proposals submitted in response to this solicitation: page limits, acceptable font sizes, line spacing, margins, etc. See also Table 1 of the *ROSES-2015 Summary of Solicitation.* Some of the program elements listed below also include formatting requirements. These requirements have been developed to ensure a level playing field for all proposers. The Astrophysics Division takes these requirements seriously, and proposals found to violate them will be penalized, even to the extent of not being considered for funding. It is the responsibility of the proposer to ensure that a submission complies with all formatting requirements.

Most proposals to ROSES will require a data management plan (DMP) or an explanation of why one is not necessary given the nature of the work proposed. This requirement will be satisfied by responding to the compulsory NSPIRES cover page question about the DMP. The kinds of proposals that require a data management plan are described in the NASA Plan for increasing access to results of Federally funded research and in the SARA FAQs for ROSES. Instrument development proposals do not require a DMP, see below.

Proposers are reminded that it is the PDF version of their proposal in NSPIRES that will be judged for compliance. In rare cases, cross-platform translation of PDF documents can alter the formatting of a document. To ensure that they still conform to all formatting requirements, proposers are strongly urged to download copies of all documents after upload to NSPIRES.

The program elements are described below. Abstracts of previously selected investigations may be found online at http://nspires.nasaprs.com/ by choosing "Solicitations" followed by "Closed/Past Selected", searching on the name or abbreviation of the program (e.g., ADAP), and downloading the selections PDF file from the home page of that Program Element.

2. Astrophysics Data Analysis

The Astrophysics Data Analysis Program (ADAP; Appendix D.2) supports research whose primary emphasis is the analysis of archival data from current and past NASA space astrophysics missions. The magnitude and scope of the archival data from those missions enables science that transcends traditional wavelength regimes and allows researchers to answer questions that would

be difficult, if not impossible, to address through an individual observing program. The program also supports the analysis of data from some approved Guest Observer (GO) programs using Suzaku and Spitzer, even if those observations have yet to be executed, or the data are still within their proprietary period.

3. Astrophysics Research and Analysis

The Astrophysics Research and Analysis program (APRA; Appendix D.3) supports suborbital and suborbital-class investigations, development of detectors and supporting technology, laboratory astrophysics, and limited ground based observing. Basic research proposals in these areas are solicited for investigations that are relevant to NASA's programs in astronomy and astrophysics, including the entire range of photons, gravitational waves, and particle astrophysics. The emphasis of this solicitation is on technologies and investigations that advance NASA astrophysics missions and goals. Projects devoted to technology development efforts (Detector Development and Supporting Technology categories) that do not generate data need not provide a data management plan and proposers may simply cite this statement in response to the NSPIRES cover page question in lieu of presenting a plan.

4. Astrophysics Theory

The Astrophysics Theory Program (ATP; Appendix D.4) supports theoretical investigations or modeling of the astrophysical phenomena targeted by past, current, or future NASA astrophysics space missions. Laboratory work related to NASA strategic goals in gravitation and fundamental physics is now supported in the Astrophysics Research and Analysis program (APRA; Appendix D.3). Theoretical work pertaining to atomic and molecular astrophysics and other topics directly related to Laboratory Astrophysics should also be proposed to APRA. NASA is not soliciting proposals for new ATP investigations in ROSES-2015.

5. Astrophysics Guest Investigators

Three program elements support science investigations that require and/or support new data obtained with currently operating NASA astrophysics space missions. Guest investigator programs are included for the Swift gamma-ray burst explorer (Appendix D.5), the Fermi Gamma-ray Space Telescope (Appendix D.6), the K2 mission with the Kepler spacecraft (Appendix D.7), and the nuclear spectroscopic telescope NuSTAR (Appendix D.10). Guest investigator programs for the Hubble Space Telescope (http://www.stsci.edu/), the Chandra X-ray Observatory (http://cxc.harvard.edu/), Stratospheric Observatory for Infrared Astronomy (SOFIA) (http://www.sofia.usra.edu/) and the Spitzer Space Telescope (http://www.spitzer.caltech.edu/) are solicited separately by the respective science centers of those missions. Please note that D.7, the K2 Guest Observer program, uses a two-step proposal submission process. Please carefully read Section 4 of the K2 Program Element.

6. Strategic Astrophysics Technology

The Strategic Astrophysics Technology program (SAT; Appendix D.8) supports focused development efforts for key technologies to the point at which they are ready to feed into major

missions in the three science themes of the Astrophysics Division: Exoplanet Exploration, Cosmic Origins, and the Physics of the Cosmos. This program is specifically designed to address middle technology readiness level (TRL) "gaps" between levels 3 and 6: the maturation of technologies that have been established as feasible, but which are not yet sufficiently mature to incorporate into flight missions without introducing an unacceptable level of risk. NASA does not require a data management plan for proposals to SAT and proposers may simply cite this statement in response to the NSPIRES cover page question in lieu of presenting a plan.

7. Nancy Grace Roman Technology Fellowships in Space Astrophysics

The Nancy Grace Roman Technology Fellowship in Space Astrophysics (RTF; Appendix D.9) gives early career researchers the opportunity to develop the skills necessary to lead astrophysics flight instruments or projects, and future space astrophysics missions. Fellows must be recent Ph.D. recipients; in general, graduating in a calendar year no earlier than seven years before the issuance date of this ROSES NRA. They must hold a nontenured early career position, such as a postdoctoral, tenure-track, term civil service, or equivalent position. The program aims to foster new talent by putting early-career instrument builders on a trajectory towards long-term positions at a U.S. institution; therefore, fellows are required to be U.S. citizens or to have lawful status of permanent residency. NASA does not require a data management plan for proposals to RTF and proposers may simply cite this statement in response to the NSPIRES cover page question in lieu of presenting a plan.

8. Exoplanet Research Program

The cross-division program on exoplanets is described in Appendix E.3. Investigations related to the detection and characterization of planetary systems that are directly tied to the NASA strategic goal to search for Earth-like planets are of interest to the Astrophysics Division.

D.2 ASTROPHYSICS DATA ANALYSIS

NOTICE: Starting in ROSES-2015 all proposers who generate data will provide a data management plan via the NSPIRES cover pages, see the DMP SARA FAQ http://science.nasa.gov/researchers/sara/faqs/dmp-faq-roses/. Those who propose astrophysical databases or the development of new data products or analysis tools must respond to the more rigorous requirements, given in subsection 1.4.3, in the Scientific/Technical section of their proposal. Those proposers may simply refer to the appropriate section of their proposal in the NSPIRES text box where it asks for a data management plan. The suitability and perceived impact of the proposed products of the investigation will be assessed as part of Merit (see subsection 2.3).

1. Scope of Program

Over the years, NASA has invested heavily in the development and execution of an extensive array of space astrophysics missions. The magnitude and scope of the archival data from those missions enables science that transcends traditional wavelength regimes and allows researchers to answer questions that would be difficult, if not impossible, to address through an individual observing program. To capitalize on this invaluable asset and enhance the scientific return on NASA mission investments, the Astrophysics Data Analysis Program (ADAP) provides support for investigations whose focus is on the analysis of archival data from NASA space astrophysics missions.

1.1 Noteworthy Changes in ADAP 2015

- Observers with approved X-ray Multi-Mirror Mission (XMM-Newton) Guest Observer (GO) programs (regardless of priority) are no longer eligible to propose for support under the ADAP until the resultant data are available in the public domain.
- Observers with approved Priority 1 Spitzer Cycle 11 GO programs are eligible to propose for data analysis support under the ADAP 2015 solicitation. In addition, observers with approved Priority 2 Spitzer Cycle 11 GO programs are eligible to propose for data analysis support if those observations have already been executed.
- Data from K2 Campaigns 0-2 have already been released or are expected to be released by the closing date of the ADAP 2015 solicitation. Therefore, proposals involving analyses of those data are eligible for funding under this ADAP cycle.
- Analysis of publicly-available data from the Stratospheric Observatory For Infrared Astronomy (SOFIA), including Guest Investigator, Guaranteed Time, Director Discretionary Time, science instrument commissioning, and calibration observations are eligible for support for the first time under this ADAP cycle.
- The budget justification of any proposal that involves the collection and analysis of new ground-based observations must include a separate budget breakout detailing the work effort and costs (e.g., salary, travel, overhead, consumables, etc.) associated with executing the ground-based observing component of the investigation.

1.2 Research Objectives

The Astrophysics Data Analysis Program (ADAP) solicits research whose primary emphasis is the analysis of NASA space astrophysics data that are archived in the public domain at the time of proposal submission. Most of these data have undergone considerable reduction and refinement by way of calibrations and ordering and extensive data analysis software tools often exist for these data. Table 1 below provides a representative - but not exhaustive - list of NASA space astrophysics missions for which suitable archival data are publicly available.

Researchers interested in analyzing datasets from missions or projects that are not included in Table 1 should contact the ADAP Program Officer before writing their proposal to confirm that their planned research program is compliant with this solicitation. Proposals found to be noncompliant will be declined and may be returned without review.

Table 1. A Representative List of Projects/Missions that had a Significant NASA Contribution and may Represent the Primary Data Source for an ADAP 2015 Proposal.

Advanced Satellite for Cosmology and Astrophysics (ASCA; formerly Astro-D)	International Ultraviolet Explorer (IUE)
Beppo Satellite di Astronomia X (BeppoSAX)	Keck Interferometer (KI) and Palomar Testbed Interferometer (PTI) Archives
Chandra X-Ray Observatory**	Keck Observatory Archive (KOA)
Compton Gamma-Ray Observatory (CGRO)	Kepler and K2
Cosmic Background Explorer (COBE)	Midcourse Space Experiment (MSX)
Extreme Ultraviolet Explorer (EUVE)	Planck
Far Ultraviolet Spectroscopic Explorer (FUSE)	Roentgen Satellite (ROSAT)
Fermi Gamma Ray Space Telescope**	Rossi X-ray Timing Explorer (RXTE)
Galaxy Evolution Explorer (GALEX)	Spitzer Space Telescope*
Gravity Probe B	Stratospheric Observatory for Infrared Astronomy (SOFIA)
Herschel Space Observatory	Submillimeter Wave Astronomical Satellite (SWAS)
High Energy Astronomy Observatories (HEAO-1, 2, 3)	Suzaku (Astro E2)*
High Energy Transient Explorer 2 (HETE-2)	Swift
Hubble Space Telescope**	Two Micron All Sky Survey (2MASS)
Infrared Astronomical Satellite (IRAS)	X-ray Multi-Mirror-Newton (XMM-Newton)
Infrared Space Observatory (ISO)	Wide-field Infrared Survey Explorer (WISE)
International Gamma-ray Astrophysics Laboratory (INTEGRAL)	Wilkinson Microwave Anisotropy Probe (WMAP).
Shuttle-based Astrophysical Observatories, including: Hopkins Ultraviolet Telescope (HUT), Wisconsin Ultraviolet Photopolarimetry Experiment (WUPPE), Ultraviolet Imaging Telescope (UIT), Broad-Band X-Ray Telescope (BBXRT), and ORFEUS-SPAS I and II	

* - including selected GO investigations; some restrictions apply; see section 1.4.4 for details.
** - data from these missions compliant only when analyzed in conjunction with the data from one or more other NASA space astrophysics missions; see section 1.4.2 for details.

Most NASA space astrophysics data may be found in one or more of the following NASA astrophysics data centers:

- High Energy Astrophysics Science and Analysis Data Center (HEASARC) (http://heasarc.gsfc.nasa.gov/);
- Infrared Science Archive (IRSA) (http://irsa.ipac.caltech.edu/);
- Mikulski Archive for Space Telescopes (MAST) (http://archive.stsci.edu/);
- NASA Exoplanet Science Institute (NExScI) (http://nexsci.caltech.edu/);
- NASA/IPAC Extragalactic Database (NED) (http://nedwww.ipac.caltech.edu/); and
- Virtual Astronomical Observatory (VAO; http://www.usvao.org/)

1.3 New Data Analysis Opportunities Available Under ADAP 2015

1.3.1 *K2 Mission Archival Data*

The K2 mission represents a repurposing of the Kepler spacecraft that entails a series of sequential observing "campaigns" of fields distributed around the ecliptic plane. K2 observations offer a photometric precision approaching that of the original Kepler mission to within a factor of ~2. Each campaign is limited by operational and Sun angle constraints to a duration of ~85 days. A description of campaign field distribution across the sky and the full mission concept is provided at http://keplerscience.arc.nasa.gov/K2/MissionConcept.shtml. It is anticipated that all data from K2 Campaigns 0-2 will be released publicly by the ADAP 2015 proposal deadline and, therefore, will be eligible for data analysis support under this solicitation. Unfortunately, the data from K2 Campaign 3 either will not be released prior to the ADAP 2015 proposal deadline, or it will be released so close to the deadline as to make it impossible to prepare a proposal based on those data. Consequently, data from K2 Campaign 3 are not eligible for data analysis support under ADAP 2015.

1.3.2 *SOFIA Archival Data*

The ADAP 2015 solicitation is the first opportunity under which analyses of archival data from the Stratospheric Observatory for Infrared Astronomy (SOFIA) may be proposed to the Program. The data sets available will include any data in the SOFIA mission archive for which the one-year exclusive-use period has expired as of the ADAP 2015 proposal submission deadline. This public archive includes data associated with all forms of observing programs, including Guest Investigator, Guaranteed Time, Director Discretionary Time, science instrument commissioning, and calibration. Instruments involved in these investigations include EXES, FLITECAM, FORCAST, GREAT, and HIPO. The data products in the SOFIA data archive may reflect different levels of processing. To determine data products that are nonproprietary and, therefore, eligible for analysis support, use the following SOFIA archive tool: https://dcs.sofia.usra.edu/dataRetrieval/SearchScienceArchiveInfo.jsp.

1.4 Limitations of the Program

1.4.1 *Use of theory, modeling, or other relevant data*

In support of any ADAP proposal – but only as a secondary emphasis and only as needed to interpret and analyze NASA's archival data – the proposed research may include the use and application of: (a) theoretical research or numerical modeling; (b) existing data from ground-

based telescopes, suborbital platforms, or non-NASA space missions; and/or (c) available laboratory astrophysics data. However, in any such instance, the onus is on the proposer to clearly establish that the data and/or models in question are used only insofar as necessary to accomplish the analysis of approved NASA archival data and are not themselves the primary object of the investigation.

Requests for the support of new ground-based observations are acceptable under the ADAP provided that the requests are clearly described, that the observations are integral to the success of the proposed ADAP effort, and that the collection and analysis of those data comprise no more than 25% of the work effort (including salary, travel, etc.) funded under the proposal. The budget justification for any such proposals must include a separate breakout of the work effort and costs (e.g. salary, travel, overhead, consumables, etc.) associated with executing the ground-based observing component of the investigation. Furthermore, the degree to which the success of the proposed investigation depends on the collection of new ground-based observations, and the perceived likelihood that the proposer will be able to obtain the needed telescope time through the normal time allocation committee process will be taken into consideration as part of the evaluation of the scientific merit of the proposal. Consequently, proposers should make clear in their proposal whether access to the necessary facilities has already been granted or, if not, provide a rationale for why such access can reasonably be expected.

1.4.2 *Analysis of data solely from Hubble Space Telescope (HST), Chandra X-Ray Observatory (CXO), or Fermi Gamma-Ray Space Telescope*

Proposals for archival research based exclusively on the data from HST, CXO, or Fermi are not eligible for funding under the ADAP. Such proposals are solicited through the associated NASA-chartered science operations centers and funded under each mission's General Observing (GO) program. However, proposals for archival research that involve a combination of data from these observatories, or data from one of these observatories in combination with the data from other NASA missions (e.g., see above list), are eligible for funding under ADAP. In such cases, the onus is on the proposer to clearly establish that the cited additional data set(s) are integral to the success of the proposed investigation and not merely window dressing added only to make what is essentially a Hubble/Chandra/Fermi archival research program compliant with the ADAP.

1.4.3 *Astrophysical databases and development of new data products/analysis tools*

Databases of fundamental atomic, molecular, nuclear, and solid-state parameters that are complete, critically evaluated, and readily accessible to the community represent a powerful tool for analyzing NASA space astrophysics data. The ADAP, therefore, accepts proposals for the development of publicly accessible compilations of existing fundamental atomic, molecular, and nuclear parameters (both experimental and theoretical), as well as the associated computational tools necessary to effectively apply those data to the analysis of astronomical observations. This opportunity is intended to support only the development of new databases or significant enhancement/maintenance of existing databases. Proposers are cautioned that new measurements or calculations of such parameters are not eligible for support under the ADAP.

In addition, recent years have seen a dramatic growth in both the size and scope of the archival astronomical data from NASA's space missions. The development of new archival data products through reprocessing or further processing of these datasets, as well as the development of tools for mining the vast reservoir of information locked within them, have the potential to open new areas of investigation and substantially increase the scientific return on those missions. Consequently, such work is also eligible for funding under the ADAP, provided that both the science it will enable and the wider impact/value of the resultant products to the community, is clearly articulated in the proposal.

Of special note, the Astrophysical Databases Research area accepts proposals for the development of publicly-accessible databases of observational data from NASA-sponsored balloon-borne and sounding rocket astrophysics suborbital experiments. However, only suborbital experiments funded under the auspices of the Astrophysics Division's Astrophysics Research and Analysis program (APRA; Appendix D.3) are eligible for this funding opportunity.

An essential component of any activity funded under the Astrophysical Databases research area of the ADAP is the ultimate dissemination of high-value data products and data analysis tools to the astronomical community. Consequently, it is essential that any proposal in this area clearly articulate what the final products of the investigation will be and how the products will be made available to the community. If the products are to be ingested and curated at an existing astrophysics archive (see list in §1.2 above), the cost of any required support for the proposed activity from the relevant archive must be included in the proposal budget. If the proposing team does not include a representative of the relevant data center, proposers are strongly encouraged to include a letter of acknowledgement from that archive in their proposal.

Finally, prospective proposers should also be aware that considerable research has already been done using NASA space astrophysics data sets by the original mission science teams, as well as by previously selected participants in the ADAP (see, for example, abstracts of currently and previously funded ADAP projects by following links to Past Selections and searching for ADAP (or ADP for 2009 and earlier) at http://nspires.nasaprs.com). Therefore, ADAP proposals in the Astrophysical Databases category must clearly demonstrate how their proposed research extends the frontier of knowledge or how their proposed data products differ from those currently available in a fundamental and important manner. If a new proposal for this program element is itself based on a previously funded research effort, the proposal must identify that work and clearly summarize all significant results from it.

1.4.4 *Support for Approved Suzaku and Spitzer Guest Investigators*

Direct support for U.S. investigators who compete and win General Observing (GO) time has been eliminated for the Suzaku mission. Consequently, scientists with approved priority A or B GO programs using Suzaku at the time of ADAP 2015 proposal submission are eligible to propose for data analysis support under the ADAP, even if those observations have yet to be executed or the data are still within their proprietary period. This waiver does not extend to priority C GO observations.

Similarly, the Spitzer GO program has been significantly descoped and now only provides support for U.S. investigators with programs involving ≥ 200 hours of observing time. Therefore, scientists with approved Priority 1 GO observations involving < 200 hours of Spitzer time are eligible to propose for data analysis support under ADAP 2015, even if those observations have yet to be executed or the data are still within their proprietary period at the time of the proposal deadline. Moreover, scientists with approved Priority 2 GO observations involving < 200 hours of Spitzer time are eligible to propose for data analysis support under ADAP 2015, providing that the awarded observations have at least been initiated at the time of the ADAP proposal submission deadline.

Table 2. Eligibility of Approved Suzaku/Spitzer GO programs for support under ADAP 2015.

Class of GO Proposal	Execution Status at ADAP 2015 proposal deadline	Eligibility for ADAP 2015 Support
Suzaku		
Suzaku, Priority A or B	Any	ELIGIBLE
Suzaku, Priority C	Any	INELIGIBLE*
Spitzer		
Priority 1, < 200 hrs	Any	ELIGIBLE
Priority 2, < 200 hrs	Partially executed or completed	ELIGIBLE
	Yet to be executed	INELIGIBLE*
Priority 1 or 2, ≥ 200 hrs	Any	INELIGIBLE*
Priority 3, any duration	Any	INELIGIBLE*

* As with any data from Suzaku or Spitzer, these data are eligible for support under the ADAP once the data are available in the public domain.

These eligibility requirements are summarized in Table 2 above. Proposers are reminded that proposals found to incorporate any ineligible GO data whatsoever are subject to being declared noncompliant and declined without review.

Proposers seeking funding support for an approved GO program are not relieved of the responsibility to provide a compelling proposal that meets all of the requirements of the ROSES-2015 NRA and the ADAP solicitation. It is not sufficient to simply submit the approved GO proposal.

1.4.5 *Exclusions*

Proposers to this NRA should note that the ADAP is not intended to support:

- Investigations whose primary emphasis is fundamental theoretical research or the development of numerical models without specific application to the analysis of NASA archival data or where archival data are used only to calibrate or benchmark the output of the computations. Such research is supported under NASA's Astrophysics Theory Program (ATP; Appendix D.4);
- Investigations involving new measurements or calculations of fundamental atomic, molecular, or nuclear parameters. Such research is supported under the Laboratory Astrophysics element of NASA's Astrophysics Research and Analysis program (APRA; Appendix D.3);

- Investigations whose primary focus is the analysis of datasets from astrophysics projects or space missions that had no significant NASA contribution (e.g., Hipparcos, Sloan Digital Sky Survey). Such data may be used to support the analysis of allowed data from a NASA mission, but may not itself be the primary object of the investigation. In any such instance, the onus is on the proposer to clearly establish that analysis of any proscribed data are (1) necessary to the achievement of the scientific goal(s) of the proposed investigation and, (2) not the object of that investigation.
- Investigations whose primary focus is on Solar System objects or on the solar-terrestrial interaction (other NASA programs support this kind of research, see Appendices B and C). In particular, proposers are cautioned that studies of Near Earth Objects and other Solar System bodies based on archival WISE data are not eligible for funding under the ADAP. Such research is eligible for funding through the Research and Analysis (R&A) programs of NASA's Planetary Science Division (see Appendix C).
- Proposals primarily for the general education and/or training of students (Note, however, that this does not preclude the involvement of undergraduate or graduate students in the proposed research);
- Proposals for organizing and/or hosting scientific meetings; or
- Proposals for the acquisition of substantial computing facilities or resources beyond nominal workstation or network requests.

In addition, proposals may not anticipate future public data releases. The scientific case for any proposed investigation must be based on - and executable with - data that are in the public domain at the time of the original proposal. Any proposal that invokes the use of data that are not public at the time of the ADAP 2015 proposal submission deadline (other than that explicitly allowed under Sec. 1.4.4) will be judged noncompliant and will not be rated or considered for funding.

1.4.6 *Proposal formatting*

In addition to the scientific scope of the ADAP described in the following sections, both the *NASA Guidebook for Proposers* (Section 2) and Section IV (b) ii of the *ROSES-2015 Summary of Solicitation* provide clear and specific requirements for the format of proposals submitted in response to this solicitation (e.g., page limits, acceptable font sizes, line spacing, margins, etc.). These requirements have been developed to ensure a level playing field for all proposers. The Astrophysics Division takes these formatting requirements seriously, and proposals found to violate them will be penalized, even to the extent of not being funded, independent of their intrinsic merit evaluation. It is the responsibility of the proposer to ensure that their proposal complies with all formatting requirements.

Proposers are reminded that it is the PDF version of their proposal in NSPIRES that will be judged for compliance. Since, in rare cases, translation of PDF documents can alter the formatting of a document, proposers are strongly urged to download copies of any documents they upload to NSPIRES to ensure that they still conform to all formatting requirements.

1.5 Identification of Proposal Data Set(s) and Research Areas

The Cover Page for ADAP proposals provides for designation of the data set(s) proposed for analysis and also for the Research Area, as defined below, which designates the primary focus of the proposal. Identification of the appropriate Research Area is important as it facilitates the assignment of each proposal to the appropriate review panel (a secondary Research Area may also be designated).

NASA reserves the right to reassign a proposal to a different primary or secondary Research Area. The ten defined Research Areas are:

1. Star and Exoplanetary System Formation (including star-forming clouds, protostars, protoplanetary and debris disks, and formation of exoplanets and exoplanetary systems);
2. Stellar Astrophysics and Exoplanets (including the structure and evolution of main sequence stars, brown dwarfs, and exoplanet detection and characterization);
3. Post-Main Sequence Stars (including the structure and evolution of post-main sequence stars, late circumstellar outflows and mass loss, white dwarfs and cataclysmic variables, and planetary nebulae);
4. Collapsed Objects and X-ray Astrophysics (e.g., neutron stars, X-ray binaries, black-hole binaries);
5. Supernovae and Gamma Ray Bursts (includes the physics of stellar explosions, but not studies of supernova remnants);
6. Interstellar Medium (including dense clouds, the diffuse ISM, supernova remnants, interstellar dust, HII regions, and diffuse galactic emission);
7. Normal Galaxies and Galactic Structure (including studies of the structure of the Milky Way and other galaxies);
8. Active Galaxies and Quasars (including interacting galaxies, starburst galaxies, Seyfert galaxies, radio galaxies, active galactic nuclei, and quasars);
9. Large Scale Cosmic Structures (including clusters of galaxies, galaxy environment and evolution, intracluster medium, diffuse x-ray background, and cosmology); and
10. Astrophysical Databases (including compilations of fundamental atomic, molecular, solid state, and nuclear parameters, development of publicly-accessible databases of observations from NASA suborbital astrophysics projects, higher-level data products based on existing archival astrophysical data sets, and data analysis tools).

2. Current Profile of the ADAP

2.1 ADAP 2014 Submission statistics

In 2014, a total of 306 proposals were submitted in response to the ADAP solicitation, a modest (10%) increase in the number of proposals compared to the ADAP 2013 solicitation. The distribution of those proposals over the various Research Areas covered by ADAP 2014 is shown in Figure 1 below. Also shown in the figure is the distribution of requested durations (one-, two-, three-, or four-years) of the proposals in each Research Area. Note: proposals in the

Astrophysical Databases Research areas (not broken out separately in the figure) were grouped into one of the other Research Areas, as appropriate, based on the subject matter of the proposal.

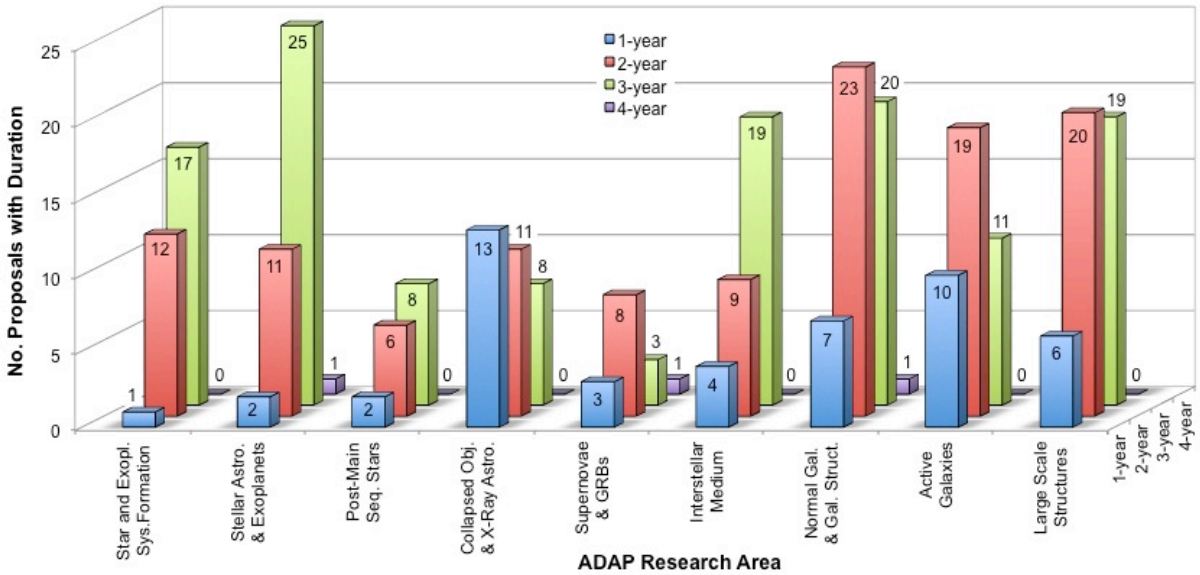

Figure 1. The distribution of 2014 ADAP proposals, broken down by proposed funding duration, across the Research Areas covered by the program. Proposals in the Astrophysical Databases Research Areas were grouped into one of the Research Areas shown based on their subject matter.

2.2 Distribution of annual funding levels for ADAP tasks

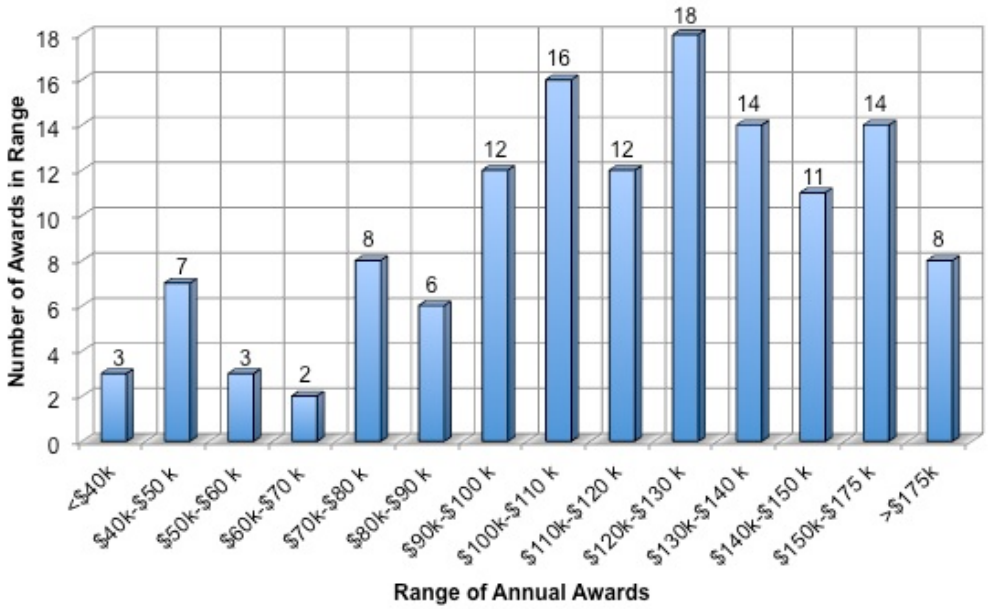

Figure 2. The distribution of annual awards for funded ADAP tasks in FY 2015. Data include both ADAP 2014 new starts and ongoing tasks from previous solicitations.

With an annual budget of around $16M, the ADAP typically supports around 130 investigations in any given year (includes new starts, plus continuing investigations). Although the average annual ADAP award is approximately $110,000, actual award amounts span the range from less than $40,000 per year to more than $175,000 per year. The plot in Figure 2, above, shows the distribution of annual awards for the ADAP in FY 2015.

2.3 Evaluation Criteria

In addition to what is described in the guidebook for proposers and the ROSES Summary of Solicitation, for this program element the merit criterion includes an evaluation of the suitability and perceived impact of the proposed products of the investigation (e.g., data products and data analysis tools) and how and when they will be made available.

3. Summary of Key Information

Expected program budget for first year of new awards	~$5.4M
Number of new awards pending adequate proposals of merit	~40 – 50
Maximum duration of awards	4 years; shorter-term proposals are welcome; four-year proposals must be especially well-justified. Proposals solely for the purposes of database development have a maximum duration of 3 years.
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	January 1, 2016
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.

Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-ADAP
NASA point of contact concerning this program	Douglas M. Hudgins Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0988 E-mail: Douglas.M.Hudgins@nasa.gov

D.3 ASTROPHYSICS RESEARCH AND ANALYSIS PROGRAM

NOTICE: Clarified on December 11, 2015. This program element now explicitly states that it does not solicit for 'astro-combs' under supporting technology (see Section 1.2.3), it highlights the timeliness of Laboratory Astrophysics proposals pertaining to JWST and ASTRO-H (see Section 1.2.4), and updates the point of contact for Laboratory Astrophysics (See Section 3). New text is in bold.

In a previous clarification the Points of Contact for Infrared, Submillimeter, and Radio Astrophysics was updated. See Section 3.

1. Scope of Program

1.1 Overview

The Astrophysics Research and Analysis Program (APRA) program solicits basic research proposals for investigations that are relevant to NASA's programs in astronomy and astrophysics and includes research over the entire range of photons, gravitational waves, and particle astrophysics. Awards may be for up to four years' duration (up to five years for suborbital investigations), but shorter-term proposals are typical; four-year or five-year proposals must be well justified. Proposals for suborbital investigations are particularly encouraged. APRA investigations may advance technologies anywhere along the full line of readiness levels, from Technology Readiness Level1 (TRL1) through TRL9. The emphasis of this solicitation is on technologies and investigations that advance NASA astrophysics missions and goals.

1.2 Categories of Proposals

The APRA program seeks to support research that addresses the best possible (i) state-of-the-art detector technology development for instruments that may be proposed as candidate experiments for future space flight opportunities; (ii) science and/or technology investigations that can be carried out with instruments flown on suborbital sounding rockets, stratospheric balloons, or other platforms; and (iii) supporting technology, laboratory research, and/or (with restrictions) ground-based observations that are directly applicable to space astrophysics missions. To meet these goals, proposals are solicited in the following five broad categories:

- Suborbital/Suborbital-class Investigations
- Detector Development
- Supporting Technology
- Laboratory Astrophysics
- Ground-Based Observations.

Specific Considerations and Exclusions:

- Investigators proposing stand-alone detector development should propose to the Detector Development category, whereas proposals for which detector development is integrated

into a suborbital/suborbital-class program should be submitted to the Suborbital Investigations category.

- The Laboratory Astrophysics category of this program element includes theoretical investigations in the area of Atomic and Molecular Astrophysics. However, all other theoretical investigations are solicited separately under the Astrophysics Theory Program described in Appendix D.4 of this NRA.
- The Ground-Based Observations category of APRA will consider proposals only from observers who are ineligible for such support from the National Science Foundation (e.g.. scientists employed by NASA or another Federal Agency). In addition:
  - The program element is not intended to support ground-based observational studies of extrasolar planets. Such proposals should instead be submitted to Appendix E.3 of this NRA. Testing and validation observations conducted at a ground-based facility as part of an exoplanet technology research program are, however, acceptable.
  - Proposals for any ground-based gamma-ray burst investigations are no longer eligible for support within the APRA program and should be submitted to the relevant mission Guest Investigator program(s).
  - Ground-based particle astrophysics observations are not supported by this program element. Such investigations in support of a NASA Astrophysics mission should be directed to the relevant mission Guest Investigator program(s).
- In the Fundamental Physics discipline area, this program element solicits proposals: 1) to test fundamental laws of physics or 2) to develop experimental concepts and/or related technologies to test fundamental laws of physics. Proposals submitted to this program element should be space-related (suborbital, orbital, etc.). This program is not intended to support applied physics or laboratory experiments. Investigations predominantly theoretical in nature should be directed to the Astrophysics Theory Program or to other Federal agencies, as appropriate.
- Projects directed mainly toward the analysis of archival data are solicited under the Astrophysics Data Analysis Program described in Appendix D.2 of this NRA.
- If a proposal is offered as a direct successor to a previous NASA award, it should include a description of the predecessor effort, including any significant findings, and describe how the proposed work extends the previous accomplishments. See Section 1.5 of the *NASA Guidebook for Proposers* for more details.
- The Principal Investigator (PI) institution is expected to fund participating Co-Investigator(s) (Co-I(s)) via subawards, except where the Co-I is at a Government laboratory, including the Jet Propulsion Laboratory (JPL). The only exception is for Suborbital/Suborbital-class Investigations, see Section 1.2.1.3 below. However, note in this case that the PI proposal must include, within the Budget Justification section, a table showing the summed cost per year for the entire investigation.
- Projects devoted to technology development efforts that do not generate data need not provide data management plans but must note on the NSPIRES cover page that they do not need to provide a data management plan because they are in the Detector Development or Supporting Technology category.

1.2.1 *Suborbital/Suborbital-class Investigations*

This APRA category supports science investigations and/or technology development utilizing payloads flown on sounding rockets, balloons, commercial reusable suborbital rockets, or similar-class payloads flown as flights of opportunity. Suborbital payloads may be recovered, refurbished, and reflown in order to complete an investigation.

Suborbital launch vehicle services include those provided by the NASA Sounding Rocket Program Office (SRPO) and the NASA Balloon Program Office (BPO) and commercial suborbital reusable launch vehicle services through the Flight Opportunities Program of NASA's Office of the Chief Technologist (OCT). The Science Mission Directorate also provides for CubeSats and International Space Station (ISS) payloads. These are described in Section V of the *ROSES Summary of Solicitation*. Investigators are strongly urged to discuss their proposed payload with the contact person(s) for the appropriate Program, as given in that section. Please pay particular attention to the additional requirements for proposals for the ISS that are described in that section. ISS payloads will be subject to oversight beyond that of a typical sounding rocket or balloon payload.

A discussion of the plans for management and for reduction and analysis of the data should be given. Although most awards are for three or four years' duration, a five-year proposal may be accepted to develop a completely new, highly meritorious investigation through its first flight. Because of the anticipated greater degree of complexity, the Scientific/Technical/Management section of proposals for these investigations may be 20 pages long, instead of the default 15 pages specified in the *NASA Guidebook for Proposers.*

Budgets are expected to cover complete investigations, including payload development and construction, instrument calibration, launch, and data analysis. The number of investigations that can be supported is limited and heavily dependent on the funds available to this program. Note that NASA does not carry reserves to accommodate any cost overrun incurred by a particular investigation, including the loss of the payload owing to a rocket or balloon system failure. Therefore, failure to achieve the proposed goals within the proposed time and budget could require either descoping the initially proposed investigation, delaying it, canceling a particular launch date opportunity, or canceling the investigation altogether.

Suborbital and suborbital-class investigations provide unique opportunities, not only for executing intrinsically meritorious science investigations, but also for advancing the technology readiness levels of future space flight detectors and supporting technologies and preparing future leaders of NASA space flight missions, such as early-career researchers and graduate students. For these proposals, specific factors that will be considered when evaluating a proposal's intrinsic merit are the scientific merit, the degree to which it advances the technology readiness level of a detector or supporting technology, and the degree to which it advances the readiness of early-career researchers or graduate students to assume leadership roles on future NASA space flight missions.

1.2.1.1 *Sounding Rocket Payloads*

Investigators proposing payloads to be flown on sounding rockets should answer the program-specific questions on the APRA proposal cover pages. For planning purposes, the Sounding Rocket Program Office uses this information to generate a rough order-of-magnitude cost estimate for the operational requirements associated with a proposed investigation. The required information includes the envisioned vehicle type, payload mass, trajectory requirements, launch site, telemetry requirements, attitude control, or pointing requirements, and any plans for payload recovery and reuse.

The Sounding Rocket Program is currently planning to provide launches from Woomera, Australia, in September of 2016 and again in April-June of 2018, subject to the availability of funds. Investigators responding to this APRA solicitation may propose sounding rocket flights launched from this southern hemisphere site for either opportunity. Normal payload recovery is anticipated for flights using either the Black Brant IX or Black Brant XI launch vehicles.

1.2.1.2 *Balloon Payloads*

The Balloon Program is planning to provide a shared platform capable of carrying multiple, independent, piggyback-like instruments in order to offer suborbital flight opportunities to more users. The intent is to support more small instruments for science investigations, technology development, and/or training of early-career scientists and engineers. Investigators should identify, on the proposal cover page, which of these three categories is the main focus of the proposal. The following table summarizes the standard services and anticipated constraints for a flight supporting about six instruments:

Balloon Altitude:	Flight Duration:	Per instrument Weight/Size:	Data Rate/Power:	Launch location:
30-37 km	6-24 hours	136 kg; 0.4 cubic meters; Standard interface	> 50 kbs LOS; 50-100 watts, regulated 28 V battery nominal	Ft. Sumner (Spring or Fall) Palestine (Summer)

Projects, including a flight from Antarctica or needing unique engineering and/or technical support services and/or vehicles and/or the Wallops Arc-Second Pointing System (WASP), should contact the Balloon Program Office directly for an estimate of the Government Furnished Equipment (GFE) cost of the desired support.

1.2.1.3 *Special Instructions for Multiple-Institution Proposals for Suborbital/Suborbital-class Investigations: Co-Investigator Proposals*

Proposals for suborbital and suborbital-class investigations often involve the development of payloads that require major hardware collaborations among several organizations. In such cases, the lead Principal Investigator (PI) may propose a direct subcontracting arrangement between his/her organization and the Co-Investigator (Co-I) organization(s) other than U.S. Government organizations, in which case all the nominal instructions in the *NASA Guidebook for Proposers*

(see further below) apply. As described in Section 2.3.10.c (ii), the activities of Co-Is at U.S. Government organizations, such as NASA centers, are always funded directly. If the PI is from a U.S. Government organization, Co-Is will be funded by awards from that organization. NASA centers apply no overhead cost to the budgets for Co-I organizations.

Alternatively, for some combinations of collaborating organizations, NASA recognizes that there may be advantages to providing separate awards to some of the collaborating organizations in response to "Co-Investigator Proposals." The lead investigator from the Co-I organization serves as the "Institutional PI" for the award to his/her organization (see Section 1.4.2 in the *NASA Guidebook for Proposers*).

For teams wishing to take advantage of such multiple-award flexibility, the following instructions should be followed:

- Only the "lead proposal" for the overall investigation, submitted by a single PI, will be reviewed. This lead proposal must include:
  - A clear statement in the first sentence of the Proposal Summary that identifies the proposal as the lead proposal.
  - The Cover Page/Proposal Summary/Budget Summary of the lead proposal, showing the summary of the budget requested by the lead organization. This should not include the budgets for those organizations submitting Co-I proposals. Support for Co-Is at organizations that do not submit separate Co-I proposals should be included in the budget summary of the lead proposal in the usual way.
  - A work statement and budget justification (narrative and details) covering the items in the budget summary of the lead proposal, appending the Task Statements and the budget justifications (narrative and details) from each of the Co-I proposals (see further below).
  - A table in the budget justification that shows, for the complete period of performance, the yearly cost for the "lead proposal," along with that for each of the Co-I proposals, and also the sum of all proposals, which together must add to the total request for the entire integrated investigation.

- Each organization submitting a Co-I proposal must:
  - Have a Proposal Title that is identical to the title of the lead proposal, except that "[Organization Name] Co-I" is added to the end.
  - Have a Proposal Summary that clearly cross-references the PI of the lead proposal in the first sentence.
  - Complete the Cover Page/Proposal Summary/Budget Summary and include all materials indicated in the *NASA Guidebook for Proposers*.
  - Contain, in lieu of the Scientific/Technical/Management section, a *Task Statement*, not to exceed five pages, that describes the contribution of the Co-I organization and the role of the Co-I(s) to the overall investigation. In the case of multiple Co-Is from the same organization, a single Co-I serving as the "Institutional PI" must be identified.
  - Include a budget justification (narrative and details) covering the Co-I organization's proposed activities.

- Be submitted electronically through the organization's Authorized Organizational Representative (AOR), with the Co-I (Institutional PI) from that organization listed as the PI.

1.2.2 *Detector Development*

This APRA category solicits investigations that either advance our understanding of the fundamental operational aspects of detectors or develop new types of detectors to the point where they can be proposed in response to future announcements of flight opportunities. Either new measurement concepts or methods to improve the performance of existing detectors may be proposed, provided they would be candidates for use in space. Among the characteristics typically desirable in space-quality detection systems are high sensitivity to relevant signals, low mass, low sensitivity to particle radiation, low power consumption, compactness, ability to operate in a vacuum (such that high-voltage arcing is minimized), vibration tolerance, ease and robustness of integration with instrumentation, and ease of remote operation, including reduced transient effects and ease of calibration.

This program does not support development of detectors or instrument subsystems that are intended primarily for ground-based astronomy. However, observing with ground-based facilities may be proposed to verify new detectors or overall system performance, if adequately justified as an integral part of a detector development program.

Proposals for new detectors will be evaluated in the context of currently available space astronomy detector technologies. Proposers are encouraged to identify potential mechanisms that could facilitate transfer of these detector technologies to other users, including Homeland Security and/or the private sector, for possible application beyond the immediate goals of NASA's programs.

1.2.3 *Supporting Technology*

This APRA category supports investigations of technologies not yet ready for incorporation into new detector or space mission systems, but that offer promise of potential breakthroughs that could lead to future advances in instrumentation useful for NASA's space astronomy and astrophysics programs. This program includes small technology efforts for future NASA Astrophysics missions, such as development of optics, mirrors, coatings, or gratings. **Unlike in APRA-2014, proposals for 'astro-combs' are not solicited this year [Clarified December 11, 2015].**

This category also supports proposals for development of new data analysis methods for future space missions. These proposals should be mission enabling or mission enhancing and directly applicable to future space flight missions, in particular (but not necessarily limited to) those that have been considered in the most recent decadal survey or Astrophysics roadmap. Missions already funded (pre-Phase A or beyond) are excluded.

1.2.4 *Laboratory Astrophysics*

The Laboratory Astrophysics category of the APRA program supports the determination of fundamental atomic, molecular, nuclear, and solid-state parameters that are essential for analyzing and interpreting the data from NASA Astrophysics missions. The program supports both experimental and computational efforts to explore the spectroscopic properties of atoms and molecules and particulate matter, as well as their chemical, physical, and dynamical properties under astrophysical conditions. The resulting data products directly impact our understanding of a wide range of astrophysical phenomena spanning the electromagnetic spectrum, and ranging from the epoch of reionization and the evolution of cosmic structure to the formation and evolution of galaxies, stars, and exo-planetary systems in the current epoch.

Laboratory Astrophysics proposals must be well motivated by a detailed description of the relevance of the proposed investigation to the analysis of measurements from NASA astrophysics missions (past, current, or future). **Such proposals pertaining to JWST or ASTRO-H would be particularly timely. [Clarified December 11, 2015].** Proposals for projects that aim to produce data products for wide use across the astronomical community should explain how those products would be made available to the intended users in a stable fashion.

1.2.5 *Ground-Based Observations*

This APRA category will consider proposals for ground-based observations, but only from observers who are ineligible for such support from the National Science Foundation (e.g., scientists employed by NASA or another Federal Agency). Moreover, this program element is not intended to support ground-based observations for general scientific objectives. Rather, these observations must be an integral part of a technology development or demonstration project for space astrophysics or directly support the planning and design of future NASA space astrophysics missions.

2. Programmatic Information

2.1 General Information

The following table provides the amount of Year -1 funding and the number of investigations that have been selected for the five APRA categories in four recent cycles; note that proposals for APRA-09 (denoted A-09) were due in 2010 and funded in FY 2011, etc. If the budget allows, we expect (but cannot guarantee) that that the selections in the coming year will be similar.

APRA Category	Total allocated to new selections [$M]					Number of New Selections (including Co-I proposals)				
	A-09	A-10	A-11	A-12	A-13	A-09	A-10	A-11	A-12	A-13
Suborbital Investigations	5.6	8.9	5.0	6.1	5.7	10	12	8	15	17

Detector Development	1.9	1.3	2.7	3.1	1.6	6	4	10	7	5
Supporting Technology	4.3	2.8	3.1	1.9	2.3	15	12	13	6	9
Laboratory Astrophysics	1.0	1.8	0.9	0.6	1.1	8	8	8	5	8
Ground-Based Observations	0.03	0.06	0	0	0	1	1	0	0	0

2.2 Student Participation

The participation of graduate students is strongly encouraged, especially if the project can be concluded within the nominal tenure of graduate training. In such cases, brief details of the educational goals and training of the participants should be included in the proposal.

2.3 Request for reviewer names

Proposers are strongly encouraged to provide names and contact information of up to five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is or stand to benefit financially from the selection (or otherwise) of the proposal. This information should be included in the proposal summary in the Notice of Intent, or E-mailed to the relevant Program Officer listed below.

3. Summary of Key Information

Expected program budget for first year of new awards	See Section 2.1
Number of new awards pending adequate proposals of merit	See Section 2.1
Maximum duration of awards	4 years (5 years for suborbital investigations)
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	Between 1 January and 31 March after the proposal due date (except that NASA Centers may plan for a start at the beginning of the fiscal year).
Page limit for the central Science-Technical-Management section of proposal	15 pp (20 pp for suborbital proposals); see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.

Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-APRA
NASA point of contact concerning this program	Michael R. Garcia Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1053 E-mail: Michael.R.Garcia@nasa.gov

Questions about the APRA Program should be directed to the point of contact above. Questions about specific discipline areas may be directed to the relevant Program Officers listed below, along with their areas of expertise. If uncertain about whom to contact, please direct your inquiries to the APRA point of contact listed above.

Astrophysics Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001

NAME	PROGRAM RESPONSIBILITY	TELEPHONE	E-MAIL
Kartik J. Sheth	Infrared, Submillimeter, and Radio Astrophysics	(202) 358-**4805**	**Kartik.Sheth@nasa.gov [Changed October 8, 2015]**
Michael R. Garcia	Ultraviolet and Visible Astrophysics	(202) 358-1053	Michael.R.Garcia@nasa.gov
Louis J. Kaluzienski	X-ray Astrophysics	(202) 358-0365	Louis.J.Kaluzienski@nasa.gov
Stefan M. Immler	Gamma-ray Astrophysics	(202) 358-0615	Stefan.M.Immler@nasa.gov

W. Vernon Jones	Particle Astrophysics and Fundamental Physics	(202) 358-0885	W.Vernon.Jones@nasa.gov
Douglas M. Hudgins	Laboratory Astrophysics	(202) 358-**0988**	**Douglas.M.Hudgins@nasa.gov [Changed Dec 11, 2015]**

D.4 ASTROPHYSICS THEORY

NASA will not solicit proposals for new Astrophysics Theory Program (ATP) investigations in ROSES-2015. The next proposal opportunity will be offered in ROSES-2016.

Although this is a break in proposal opportunities, it is not a break in ATP funding. In ROSES-2013 it was announced that the start of new ATP-13 investigations would be in fiscal year (FY) 2015. In ROSES-2014, it was specified that the start of new ATP-14 investigations would be in FY 2016. So in those two cycles, a 15-24 month delay was planned from the submission of proposals in July to initiation of funding more than a year later, in the following fiscal year. The next ATP solicitation will be for proposals that will be funded in FY 2017. Soliciting those proposals in 2016 rather than 2015, means that the delay in the initiation of funding may be only six months, with awards to start immediately following selection decisions. Thus the level of funding for the Astrophysics Theory Program will not be affected by this break.

There is no intent to create funding gaps for currently funded investigators. Current Principal Investigators (PIs) may discuss no-cost extensions and rephasing of awarded funds with their NASA technical officer.

	Proposal due date	Selections announced	Funding initiated	Delay in funding after submission of proposal
ROSES-2013	July 12, 2013	January 17, 2014	October 1, 2014 – July 1, 2015	15-25 months
ROSES-2014	July 11, 2014	NLT 180 days after proposal receipt (NLT January 7, 2015)	October 1, 2015 – July 1, 2016	15-24 months
ROSES-2015	Not solicited			
ROSES-2016	July 2016	NLT 180 days after proposal receipt (Early January 2017)	January – July 2017	6-12 months

NASA point of contact concerning this program

Keith B. MacGregor
Astrophysics Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
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D.5 SWIFT GUEST INVESTIGATOR – CYCLE 12

1. Scope of Program

1.1 Overview

The Swift Guest Investigator (GI) Program solicits proposals for basic research relevant to the Swift gamma-ray burst mission. The primary goal of this mission is to determine the origin of gamma-ray bursts (GRBs) and use these bursts to probe the early universe. Swift is also a valuable asset for obtaining multiwavelength images, spectra, and light curves on interesting Targets of Opportunity (ToOs) and other nontransient sources.

Cycle 12 observations and funding will commence on or around April 1, 2016, and last approximately 12 months. Further details on the Cycle 12 program will be posted on the Swift web pages (http://swift.gsfc.nasa.gov/proposals) in August 2015. As was the case in Swift GI Cycles 4 through 11, observing time will be made available to scientists at U.S. and non-U.S. institutions to study a wide variety of astrophysical sources. Consistent with Explorer Program policy, there will be no proprietary data rights to observations conducted with Swift. All science data will be made freely available through the Swift Quick Look web site (http://swift.gsfc.nasa.gov/cgi-bin/sdc/ql), as soon as they are received and processed.

Funding through the NASA Swift GI Program is available only to scientists at U.S. institutions who are identified as the Principal Investigators (PIs). U.S. based Co-Investigators (Co-Is) on foreign-led proposals do not qualify for funding. Funding for accepted target proposals will be initiated only after the relevant observations have begun. Proposers from non-U.S. institutions are strongly encouraged to include a letter of commitment promising financial support.

The Swift GI program is intended to provide the following to participating scientists:

1. Funding (U.S. GIs only) for:
   - New Swift projects;
   - Correlative GRB and non-GRB observations;
   - Other correlative GRB projects; and
   - Theoretical investigations that will advance the Swift mission science return.

2. Observations (and funding for U.S. GIs) for:
   - Non-ToO observations of non-GRB targets;
   - ToOs;
   - Large Programs requesting more than 100 targets or more than 100 ks total exposure time;
   - "Fill-in" targets and
   - Key projects

1.2 The Swift Mission

Swift is a Medium-class Explorer mission developed at the NASA Goddard Space Flight Center. The lead domestic partners include Pennsylvania State University and Los Alamos National Laboratory. Groups in the United Kingdom and Italy made significant contributions to the hardware development and are active participants in the operations, including provision of the Italian ground station at Malindi. The Swift Mission Operations Center (MOC) is at Pennsylvania State University, and the Swift Science Center (SSC) is at the NASA Goddard Space Flight Center.

The Swift mission was launched on November 20, 2004, from Cape Canaveral Air Force Station, Florida. Swift was launched into a low Earth orbit with an inclination of 21 degrees and an altitude of 600 km. The baseline mission duration was two years, but the mission has been extended at least another four years beyond this initial period because of its continuing scientific productivity. The orbital lifetime of the satellite is estimated to be approximately 20 years.

The Swift spacecraft carries three science instruments: a wide-field gamma-ray Burst Alert Telescope (BAT) and two sensitive, co-aligned narrow-field instruments – the X-ray Telescope (XRT) and the Ultraviolet/Optical Telescope (UVOT). The spacecraft can be autonomously pointed to direct the XRT and UVOT toward events detected by the BAT. The BAT is a wide-field gamma-ray imager that detects GRBs and rapidly sends positions of arcminute accuracy to the spacecraft and to the ground. The BAT operates in the 15–350 keV range and has a 1.4 steradian (half-coded) field-of-view. It has a GRB detection sensitivity ~2 times better than the Burst and Transient Source Experiment (BATSE) that flew on the Compton Gamma-Ray Observatory (CGRO). In addition to detecting GRBs, the BAT is performing a survey of the hard X-ray sky to a sensitivity of ~1 mCrab (2×10^{-11} erg cm^{-2} s^{-1}). It also scans most of the sky each 90-minute orbit and serves as a sensitive monitor for high-energy transients. Positions and spectra of transients detected by the BAT are telemetered to the ground and distributed immediately to the community.

In response to GRB alerts from the BAT, the spacecraft reorients on a time scale of ~1 minute to point the XRT and UVOT instruments at a GRB or other transient. These instruments perform multiwavelength measurements of the bright early afterglow (and also later-time afterglow) emission to provide subarcsecond positions, precise photometry, and fine spectroscopy. The XRT is a Wolter 1 grazing incidence telescope that operates in the 0.2–10 keV band and has a field-of-view of 23.6 arcminutes with an angular resolution of 18 arcseconds (Half Power Diameter) and positional determination accuracy of better than 5 arcseconds. The detector is a cooled CCD, providing spectroscopy with a resolution $E/\Delta E \sim 10$ at 1 keV and an effective area of 120 cm^2. The UVOT is a Ritchey-Chrétien folded-optics telescope operating in the 170–650 nm band. It has a field-of-view of 17 arcminutes × 17 arcminutes, with an angular resolution of 2.5 arcseconds and positional determination accuracy of 0.3 arcseconds. UVOT provides a sensitivity to afterglows of 22nd magnitude for a 1,000 second integration in its V filter, one of six filters for color photometry. It also has a white-light filter and two grisms for fine spectroscopy ($E/\Delta E \sim 300$) of sources brighter than 17th magnitude. The narrow-field instruments yield an accurate position and X-ray spectra of the afterglow within a few minutes of the burst. This information is distributed immediately over the Internet. Data from continued observations

of the afterglow are made available via Circulars and Reports on the Gamma-ray bursts Coordinates Network (GCN, http://gcn.gsfc.nasa.gov/) and on a public web site (http://swift.gsfc.nasa.gov/archive/). Notification of transient source detections is made through IAU Circulars (http://www.cbat.eps.harvard.edu/services/IAUC.html) and Astronomer's Telegrams (ATELs, http://www.astronomerstelegram.org/). Data from serendipitous source detections in the field-of-view of both instruments are routinely sent to the ground for analysis.

Further information on the Swift mission may be found at http://swift.gsfc.nasa.gov/.

1.3 Types of Proposals

This Swift GI Program solicits proposals in the following areas:

1. New Swift projects not requiring GI-specified observatory pointing;
2. Correlative GRB observations involving new or enhanced IR ground-based capabilities for investigating high-redshift bursts, and other correlative GRB and non-GRB observations involving non-Swift instruments and observatories.
3. Theoretical investigations that will advance the Swift mission science return;
4. Non-GRB non-ToO observations that benefit from Swift's unique capability of simultaneous multiwavelength coverage;
5. ToO observations which promise large scientific return and capitalize on Swift's unique capabilities of rapid repointing and multiwavelength observations;
6. Large Programs requesting more than 100 targets or more than 100 ks total exposure time;
7. Fill-in targets to be observed in what would otherwise be gaps in the planned science timeline; and
8. Key Projects which aim at addressing major, high-impact scientific questions by making use of the strengths of Swift.

1.3.1 *New Swift project*

GIs may propose to initiate their own Swift projects that supplement or enhance the Swift science return with their unique facilities, missions, capabilities, or methods. The extent to which the proposed research will enhance the science return from Swift and the demands placed upon mission resources by an investigation will be considered in the proposal evaluation process. Proposals in this category can also include changes or additions to current Swift strategies to detect and observe GRBs and other transient events (Swift detected or elsewhere) and can propose innovative data reduction and interpretation methods that increase our understanding of cosmic explosions. Proposals that require changes to Swift onboard capabilities or operational procedures may require special scrutiny during the review process by the Swift team for technical feasibility and may require formal approval by the Swift Configuration Control Board before implementation. Investigators considering such proposals are strongly urged to consult with the Swift team prior to proposal submission.

1.3.2 *Swift GRB and non-GRB Correlative Observations*

GRB and non-GRB correlative observations substantially augment the science return from Swift. The Swift instruments, for example, make unique measurements of GRB afterglows starting immediately following the burst, supernova (SN) shock breakouts, or tidal disruption events. However, it is not possible to follow up all targets on all time scales, since viewing constraints and scheduling conflicts will preclude some Swift observations. Also, the onboard capability, although significant, does not cover all of the scientifically valuable measurements that need to be made. Candidate correlative observations that will add significantly to the Swift science include radio imaging and photometry, spectroscopy, deep optical imaging and spectroscopy of the afterglow and possible host galaxy, surpassing the capability of the UVOT to reach 22nd V magnitude in 1,000 seconds, and rapid optical observations with time scales shorter than the 1-minute Swift response time.

To foster correlative observations, the Swift project has established joint GI observing programs with other ground- and space-based facilities (NRAO, Chandra, International Gamma-Ray Astrophysics Laboratory (INTEGRAL) and X-ray Multi-Mirror Mission (XMM-Newton)). Proposals for joint Chandra, INTEGRAL and XMM-Newton observations should be submitted to those programs and the Swift time will be recommended by those reviews. For NRAO observations, the Swift GI program can award radio observations through the Swift's joint program with NRAO. There are a number of technical and policy details regarding the Swift/NRAO joint program, and proposers are strongly encouraged to refer to the Memorandum of Understanding: http://swift.gsfc.nasa.gov/proposals/nrao.html

GRBs at high redshift are particularly compelling due to their distance and rely especially on high quality infrared (IR) observations for distance estimates, since the optical counterpart is redshifted out of Swift/UVOT's wavelength range. To encourage the development of rapid IR ground-based response to potentially high redshift GRBs, special consideration will be given to such projects. Proposals to bring new or enhanced ground-based IR capabilities online may require funding in the range of $100,000 per year. Such budget requests will be considered, provided they are strongly justified. A six-page limit for the scientific justification applies to proposals submitted in this high redshift "Correlative Observations" proposal category.

For all correlative investigations funded by Swift, rapid public availability of the data or results is in the interest of the Swift mission and the astronomical community and is strongly encouraged. Public data availability for correlative studies should be discussed in these proposals and will be considered in the evaluation of these proposals.

1.3.3 *Theoretical Investigations*

GRB and non-GRB theoretical studies have the potential to significantly enhance the scientific impact of the Swift mission. GI proposals for such theoretical investigations are also solicited and should specifically address how the anticipated results will advance Swift science objectives.

1.3.4 *Non-GRB, non-ToO observations*

A total of two million seconds of observing time will be made available during Cycle 12 for non-GRB, non-ToO pointed observations. Swift observations in this category will be performed only as the result of an uploaded ground command through the normal planning process; slewing to the target will not occur autonomously. Non-ToO observations will have a lower scheduling priority than GRBs or ToOs and will be observed on a best-effort basis when time is available in the observing schedule. Hence, successful non-GRB/non-ToO GIs should be aware that they are not assured 100% of the time awarded. Every effort will be made to observe 80% or more of an accepted program within schedule limitations of the mission. A single observation is defined as one requested pointing to a target. Proposers should be aware that, due to Swift's low Earth orbit (95 minute orbit period) and scheduling priorities for other objects, any long observation may be broken up into several different pointings on different orbits. Observations longer than a few kiloseconds (ks) might be split into several days.

Non-ToO proposals are subject to the following limitations:

- The requested time per observation (i.e., a single visit to a target) must be between a minimum of 1 ks and a maximum of 40 ks;
- Monitoring programs are defined as programs requiring two or more observations of the same object, each of which is considered a "visit;" and
- No more than 2,000 visits will be permitted in Cycle 12 (total for all proposal categories, including both monitoring and nonmonitoring requests).

Time-constrained observations are defined as observations that have to be performed within a certain time window. These can be ToOs or non-ToOs, either monitoring (more than one visit to a source) or nonmonitoring observations, but not "fill-in" observations. This includes phase-constrained proposals, coordinated observing campaigns with ground-based or satellite-based facilities, etc. Note that the unique scheduling requirements of Swift put severe constraints on time-constrained programs. Time-constrained observations are subject to the following limitations:

- The window duration must exceed three hours; and
- No more than 500 time-constrained visits will be performed during Cycle 12.

For coordinated and constrained observations, it is the proposer's responsibility to inform the Swift Science Operations Team of the observing time windows at least one week before observations start. Proposers must clearly describe how their proposal capitalizes on the unique capabilities of Swift.

Only "Key Projects" observing programs may be carried over from Cycle 12 to Cycle 13. For regular proposals, there will be no time carried over from Cycle 12 to Cycle 13, except when observing for an awarded program has commenced during Cycle 12. GIs whose observing programs have not begun in Cycle 12 will be required to repropose if they wish to acquire observing time. Targets whose observations have commenced in Cycle 12 will be awarded carryover time in Cycle 13 until the proposed observations are substantially complete. Similarly,

Cycle-11-accepted proposals that have not been initiated by the start of Cycle 12 will not be carried over. Cycle 11 GIs concerned that their programs may not be started before the end of the cycle should repropose for Cycle 12.

1.3.5 *ToO Observations*

GIs are allowed to propose for ToOs in response to transient phenomena, including GRBs found by other observatories. A total of at most one million seconds of observing time will be made available to ToO proposals, subject to the constraints listed below. Swift ToO observations will only be performed as the result of an uploaded command by the Mission Operations Center and will not be slewed to autonomously. ToO observations will have a lower scheduling priority than GRBs and will be observed on a best-effort basis. Because of this restriction, successful ToO GIs should be aware that they are not assured 100% of the time awarded, even if their ToO is triggered. Every effort will be made to observe 80% or more of an accepted program. GIs submitting ToO proposals should note that:

- Each proposal should describe how it capitalizes on the unique capabilities of Swift;
- Proposals must give exact, detailed trigger criteria and a realistic estimate of the probability of triggering the ToO during Cycle 12; and
- Proposals must assign a priority to each ToO target based on the time criticality of the observation. From the time of the trigger, the priorities are defined as
    - Highest Urgency: Observation should be performed within four hours;
    - High Urgency: Observation should be performed within 24 hours;
    - Medium Urgency: Observation can be performed within days to a week; or
    - Low Urgency: Observations can be performed within weeks.

Because new GRBs are constantly being discovered, the Swift observing schedule is revised on a daily basis. Note that Highest Priority ToOs are particularly difficult to handle at night and on weekends when the Mission Operations Center is not staffed. These should be avoided in all but the most urgent cases (e.g., transient events like a Galactic SN, a very bright GeV gamma-ray burst, or a giant soft gamma-ray repeater flare).

It is the responsibility of the Principal Investigator (PI) of an accepted ToO to alert the Swift Observatory Duty Scientist when trigger conditions for their accepted ToO have been met. This is done through the Swift ToO Request Form at https://www.swift.psu.edu/secure/toop/request.php. It is highly recommended that ToO proposers register as Swift ToO users in advance at https://www.swift.psu.edu/secure/toop/too_newuser.php. Registration is required in order to submit a ToO Request.

ToO proposals must have an astrophysical trigger. Once the trigger criteria have been met for an approved target, the PI should check if the target location is more than five hours in RA from the Sun and more than 20 degrees from the Moon before requesting Swift observations (http://heasarc.gsfc.nasa.gov/Tools/Viewing.html). ToO observations that require more than 6 ks on a given day and are closer to the Sun than five hours RA will be less likely to be approved unless they are of exceptionally high scientific priority. Observations greater than nine hours in

RA from the Sun are particularly desirable. The purpose of the anti-Sun restriction for ToOs is to maximize the amount of time Swift is pointed toward the night sky in order to optimize optical follow-up observations of BAT-detected GRBs.

Accepted Cycle 12 ToO proposals may be triggered until March 31, 2017. GIs whose ToO programs do not trigger in Cycle 12 will be required to repropose in later cycles should they wish to acquire observing time on their targets of interest. Only “Key Projects” ToO programs will be carried over from Cycle 12 to Cycle 13, and may be triggered until March 31, 2018.

Note that unsolicited ToO requests for exceptional transients will continue to be possible through the Swift ToO web site, even for those not accepted into the GI Program. The decision on whether or not to observe a ToO of either category will be made by the Swift Principal Investigator or his official designee. Such ToO requests are unfunded.

1.3.6 *Large Programs*

Proposals requesting more than 100 targets or more than 100 ks total exposure time are defined as Large Programs. A total of up to 1 Ms exposure time has been reserved for Large Programs, subject to the submission of proposals of high scientific merit.

Both long-duration observations of single targets, tiling of extended sources that exceed the fields of view of the Swift XRT and UVOT instruments, or shorter duration observations of many targets can be requested in the Large Programs proposal category. Proposers should be aware that, due to Swift’s low Earth orbit (95 minute orbit period) and scheduling priorities for other objects, any long observation exceeding a few kiloseconds will be broken up into several different pointings on different orbits.

The observations proposed for Large Programs must be completed within the 12-month period covered by this Cycle.

1.3.7 *Swift "Fill-in" Targets*

GIs may submit a list of targets for consideration as "Fill-in" targets. Their purpose is to provide a set of peer-reviewed targets to be used to fill in gaps in the planned science timeline. These must not be ToOs, must have no observational constraints, and can only be observed once (no multiple observations of the same target). UVOT Grism observations are not permitted as “Fill-in” observations because they require a slew-in-place. The minimum total integration time must be 1 ks per target. Accepted targets will be added to the Swift observing program at the discretion of the science operations team. They will be scheduled, as needed, around the higher priority GRB follow-up observations, ToO and non-ToO observations, to maximize the Swift science program. Funding is not provided for Fill-In proposals. Although GIs should have no expectation that their entire list of “Fill-in” targets will be observed, past experience has shown that fill-in proposals are usually undersubscribed and do get done. Due to the nature of Swift science planning, Swift GI “Fill-in” observations will be scheduled only about 24 hours prior to observation, and PIs will not be notified until observations have been completed for a given

target. Scheduling information will be available to GIs via the daily observing plan (http://www.swift.psu.edu/operations/obsSchedule.php).

To reiterate:

- Fill-in targets are not ToOs and cannot be triggered;
- Fill-in targets cannot be time constrained;
- No monitoring is allowed with fill-in targets. Proposers cannot request multiple target visits, but they can request more than 100 fill-in targets per proposal;
- No UVOT Grism observations are allowed; and
- Fill-in targets are scheduled at the convenience of the science planners. There is no guarantee that any of the targets in any fill-in program will be scheduled or completely observed in this Cycle.

1.3.8 *Swift Key Projects*

A new "Key Projects" category will be added in Cycle 12. Key Projects are intended to greatly advance the Swift science program, enhance its breadth of impact, and represent an enduring legacy of Swift results. Proposals in this category may request support for new Swift projects, theoretical investigations, observations of non-GRB non-ToO targets, and observations of ToO targets. The proposed research plans can be carried out in one or two years. Proposals may also require funding in the range of $100,000 per year. Such budget requests will be considered, provided they are strongly justified.

The number of Key Projects funded in any given year will be limited. It is responsibility of the proposers to strongly justify how the proposed program will address high-impact scientific questions by making use of the strengths of Swift. A six-page limit for the scientific justification applies to proposals submitted in this "Key Projects" proposal category.

Proposers requesting two-year projects that are selected at Phase 1 should not assume that they have been awarded two years of support; this determination will be made at Phase-2 of the review. PIs of approved multiyear Key Projects will be solicited for a progress report that will be reviewed by NASA to determine if appropriate progress is being made toward the proposed objectives. Because of the significant resources allocated to multiyear Key Projects, those that do not make progress consistent with the proposed investigation could be reduced or terminated.

2. Programmatic Information

2.1 General Information

It is anticipated that up to $1.2M will be available through this solicitation for the support of approximately 35 Guest Investigations of one-year duration each. Note that additional unfunded Guest Investigations are likely to be selected (for example, Fill-in proposals). Swift non-GRB pointed observations are open to all scientists at U.S. or non-U.S. institutions. Swift GI funding is open to all individuals who are identified as Principal Investigators and employed at U.S. institutions, including Swift science team members. Scientists participating in the Swift mission,

including Associate Scientists and members of the Follow-up Team who are not funded by the Project, are eligible for support under this GI Program. Swift science team members who already receive support from the Project must provide a compelling justification for the award of additional funds under the GI Program.

2.2 Proposal Submission and Evaluation

2.2.1 *Submission of Proposals to the Swift GI Program*

The Swift GI program uses a two-phase proposal process. A Phase-1 proposal shall comprise the science/technical justification; proposals requesting funds need to include a budget narrative, describing in sufficient detail how the proposed funds will be used to achieve the goals outlined in the proposal. The science/technical justification should contain a brief description of previous Swift programs carried out by the PI. Only proposers whose Phase-1 proposals are accepted will be invited to submit budget proposals in Phase 2. It is not necessary for the PI of the Phase-2 proposal to be the science PI. All proposal materials will be submitted electronically.

Awards are expected to average $35,000 per year. Only proposals in the "Key Projects" category and in the high redshift "Correlative Observations" category may require funding substantially above the average award (i.e. in the $100,000 range per year), and will need to provide a detailed cost justification. The amount of the anticipated funding request must be entered into the box provided for this purpose on the Remote Proposal System (RPS) Cover Form. The detailed cost evaluation will be deferred until Phase 2. The funding amount requested in the Phase-2 cost proposal may not exceed the amount proposed in Phase 1. "Fill-in" proposals will be unfunded.

Proposers to the Swift GI Program must adhere to the following proposal submission procedures:

- All Proposers must submit their Phase-1 proposals electronically through the Astrophysics Research Knowledgebase (ARK)/Remote Proposal System (RPS) website at http://heasarc.gsfc.nasa.gov/ark/rps/. Instructions for doing so are provided at the SSC web site, http://swift.gsfc.nasa.gov/;
- Target forms for all observation proposals are to be submitted through ARK/RPS;
- Due to the nature of prospective investigations within the Swift GI program, the Scientific/Technical/Management section of proposals is limited to four pages (six pages for high redshift "Correlative Observations" proposals and “Key Projects” proposals), instead of the default 15 pages specified in the *NASA Guidebook for Proposers*. The requirement for a table of contents in the body of the proposal is waived. No supporting material (e.g., CV, pending/current support) is required or allowed;
- Optional Latex and MS Word templates for the Scientific/Technical/Management section are provided on the SSC web site at http://swift.gsfc.nasa.gov/; and
- The Scientific/Technical/Management section must be uploaded to the RPS website as a PDF file.

All proposal materials must be submitted electronically by 4:30 p.m. Eastern time on the due date for this program given in Section 3 in order to be included in the proposal review for this

cycle of the Swift Guest Investigator program. Note that the 4:30 p.m. deadline supersedes the deadline stated in the *Guidebook for Proposers* and in the *ROSES Summary of Solicitation.*

NASA uses a single, uniform set of instructions for the submission of ROSES proposals. These instructions are given in the *NASA Guidebook for Proposers* (http://www.hq.nasa.gov/office/procurement/nraguidebook/). Swift GI Proposers should follow these instructions, except where they are overridden by the instructions given in the *ROSES Summary of Solicitation* or in this Appendix.

2.2.2 *Evaluation of Proposals submitted to the Swift GI Program*

Proposals will be evaluated by a peer evaluation panel with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*, where it is understood that the intrinsic merit of a proposal shall include the following factors:

- The suitability of using the Swift observatory and data products for the proposed investigation;
- The extent to which the investigation complements and enhances the anticipated science return from the Swift mission;
- The degree to which the proposed investigation places demands upon mission resources;
- The degree to which the proposed investigation capitalizes on the unique capabilities of Swift; and
- For theoretical investigations, the degree to which the investigation directly advances Swift science goals.

2.2.3 *Submission and Evaluation of Phase-2 proposals*

Subject to the availability of funding, successful Phase-1 proposers will be contacted by the Swift Program Officer and invited to submit a cost proposal in Phase 2. Upon notification of selection of a Phase-1 proposal, a proposer must respond as follows:

> Follow the instructions for submitting a Phase-2 proposal given in the selection notification from the Phase-1 review. Phase-2 (cost) proposals must be submitted through the NASA NSPIRES electronic proposal website (http://nspires.nasaprs.com) by an Authorized Organizational Representative (AOR) of the proposing organization according to the instructions in the *Summary of Solicitation* of this NRA. The cost proposal will consist of a Budget Details (maximum of two pages) section and a Narrative section (maximum of two pages).

NASA program personnel will evaluate the Phase-2 cost proposals against the third evaluation criterion, cost realism, and reasonableness. Comparison of the proposed cost to available funds will be performed as specified in Section C.2 of the *NASA Guidebook for Proposers.*

2.3 Supplemental Information

Further details concerning the proposal submission requirements and process can be found at the Swift Science Center website http://swift.gsfc.nasa.gov/. This website provides a detailed mission description; technical information about the Swift mission, instruments, and observation feasibility; and instructions for completing the required proposal forms.

3. Summary of Key Information

Expected program budget for first year of new awards	~$1.2M
Number of new awards pending adequate proposals of merit	~40
Maximum duration of awards	1 year; 2 years for proposals in the "Key Projects" category
Due date for Notice of Intent to propose (NOI)	Option not available
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	Funding will be awarded when the data are made available to the PI. NASA center proposers should use October 1, 2016 (6 months after start of Cycle 12 observing) as a planning date for start of observation
Page limit for Phase-1 proposals	4 pages for all proposal categories except for proposals submitted in the high redshift "Correlative Observations" category and in the "Key Projects" category, which are allowed up to 6 pages. The budget narrative has a 1-page limit that will not count toward the above page limits. LaTeX templates (available for download at http://swift.gsfc.nasa.gov/proposals/swiftgi.html) can be used for the proposals. No supporting material (e.g., CV, pending/current support) will be considered for Phase 1. Page limits include figures and references. This instruction supersedes the limits given in the *NASA Guidebook for Proposers.*
Relevance	This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/

Submission medium	Electronic proposal submission is required in PDF format; no hard copy is required. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Notice of Intent to propose (NOI)	Option not available
Web site for submission of Phase-1 proposal and required forms	https://heasarc.gsfc.nasa.gov/ark/swiftrps/ (Help Desk available at http://heasarc.gsfc.nasa.gov/ark/rps/help/)
Web site for submission of Phase-1 proposal via NSPIRES or grants.gov	Option not available
Web site for submission of Phase-2 proposals	http://nspires.nasaprs.com; See Section 2.2
Programmatic information may be obtained from the Swift Program Scientist	Martin Still Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-4462 E-mail: martin.still@nasa.gov
Technical questions concerning this program element may be directed to the Swift Guest Investigator Program	Eleonora Troja Swift Guest Investigator Program Lead Code 662 Goddard Space Flight Center National Aeronautics and Space Administration Greenbelt, MD 20771-0001 Telephone: (301) 286-0941 Email: eleonora.troja@nasa.gov

D.6 FERMI GUEST INVESTIGATOR – CYCLE 9

NOTICE: Amended on October 13, 2015. This amendment eliminates references to Suzaku (in descriptions of Fermi joint observation programs) since Suzaku is no longer operating, clarifies the language regarding the funding of proposals with non-U.S. Principal Investigators (Section 2.1), removes reference to the work plan when discussing the budget required for Phase 2 proposals (Section 2.2.1), and revises the funding expected to be available for Cycle 9 (Section 3). New text is in bold and deleted text is struckthrough.

1. Scope of Program

1.1 Overview

The Fermi Guest Investigator (GI) program solicits proposals for basic research relevant to the Fermi mission. The primary goal of this mission is to perform 20 MeV to >300 GeV gamma-ray measurements over the entire celestial sphere, with sensitivity a factor of 30 or more greater than that obtained by earlier space missions. A secondary goal includes the study of transient gamma-ray sources with energies extending from 8 keV up to 300 GeV.

The Fermi GI program is intended to encourage scientific participation by providing funding to carry out investigations using Fermi data, to conduct correlative observations at other wavelengths, to develop data analysis techniques applicable to the Fermi data, and to carry out theoretical investigations in support of Fermi observations.

The Fermi GI program also encompasses a number of joint observation program opportunities. Fermi investigators may apply for radio, optical, X-ray, or gamma-ray observing time through joint programs with the National Radio Astronomy Observatory (NRAO), the National Optical Astronomy Observatory (NOAO), Arecibo Observatory, ~~Suzaku Guest Investigator Program~~ the VERITAS ground-based Cerenkov telescope facility, and the INTErnational Gamma-Ray Astrophysics Laboratory (INTEGRAL). Please refer to Section 1.3.3 for important details. They may also apply for high-end computing resources.

Investigators may propose Fermi pointed observations, but such observations will require scientific justification through simulations and exposure calculations because default survey mode observations will satisfy the scientific requirements of most studies.

The Fermi GI program is open to all investigators, but NASA funding is available only to investigators at U.S. institutions.

During this and all future cycles of the GI program, all Fermi gamma-ray data will be nonproprietary and will be publicly released immediately after ground processing. Release of summary data from the Large Area Telescope (LAT) shall be the same as in previous cycles.

1.2 The Fermi Mission

Fermi is an international and multiagency observatory-class mission that studies the cosmos in the <10 keV to >300 GeV energy range. The primary instrument, the Large Area Telescope (LAT), has a peak effective area (>8000 cm^2), angular resolution (<3.5º at 100 MeV, <0.15º above 10 GeV), field-of-view (>2 sr), and dead time (<100 µs per event) that provides a factor of 30 or more advance in sensitivity compared to previous missions. The Fermi Gamma-ray Burst Monitor (GBM) also provides the capability for studying transient phenomena, with a field-of-view larger than the LAT and a spectral range that extends from the LAT's lower limit down to less than 10 keV. Although pointed observations are possible, the observatory primarily scans the sky continuously because of the LAT's large field-of-view. In survey mode - the main mode of operation - Fermi provides nearly uniform sky exposure every ~3 hours.

Modifications to this standard sky-survey mode were implemented during mission cycle 7 and may be continued into the future. Those alternative sky-survey strategies were designed to maximize the exposure at the Galactic Center and in turn to optimize the pursuit of several specific scientific objectives. They resulted from a solicitation of ideas from the community leading to an external committee recommendation to the Fermi project. It is anticipated that the resulting non-uniformity of sky exposure leaves Fermi's monitoring capability largely intact with a tolerable impact on other scientific endeavors. See http://fermi.gsfc.nasa.gov/ssc/proposals/alt_obs/obs_modes.html for details.

Documents providing a more complete description of Fermi can be found at http://fermi.gsfc.nasa.gov/ssc.

The product of a collaboration among NASA, the U.S. Department of Energy, and several international partners, the LAT is a pair-conversion telescope. Gamma rays pair-produce in tungsten foils, silicon strip detectors track the resulting pairs, and the resulting particle shower deposits energy in a Cesium Iodide calorimeter. An anticoincidence detector provides discrimination against the large flux of charged particles incident on the LAT. The anticoincidence detector is segmented to eliminate the self-vetoing problem encountered by previous experiments.

Astrophysical photons are only a small fraction of all the events detected by the LAT on orbit. Most events are primary cosmic rays and their associated secondary charged and neutral particles produced in the surrounding spacecraft and the Earth's atmosphere. Therefore, event filtering on board reduces the ~3 kHz detected event rate to ~350 Hz. Events that survive the onboard filter are telemetered to the ground. Further ground processing yields a "true" celestial photon average rate of about 1 to 2 Hz.

The GBM detects gamma-ray bursts. Consisting of 12 NaI (Tl) (8-1000 keV) and 2 BGO (0.2-30 MeV) detectors, the GBM extends Fermi's burst spectral sensitivity from ~8 keV to ~30 MeV and monitors more than 8 sr of the sky, including the LAT's field-of-view. Bursts are localized by comparing rates in different detectors and rapidly distributed via the Gamma-ray bursts Coordinates Network (GCN). An initial location, computed automatically, is sent within several seconds, and is expected to have an accuracy of 5 to 10 degrees for strong bursts (fluence > ~10

photons cm^{-2}). A more accurate location (~3 degrees for strong bursts) is sent within 24 hours. The threshold of the onboard trigger is a flux of about 0.7 photons cm^{-2} s^{-1} (50 to 300 keV band), for a 1-second burst, and uses a variety of energy band and time windows.

Fermi was launched on June 11, 2008, into a circular, initial orbit of ~565 km altitude at an inclination of 25.6°. The mission design lifetime is five years, with a goal of ten years. After a checkout period, science operations began on August 4, 2008. The extended mission began in August 2013.

The GI community is supported by the Fermi Science Support Center (FSSC), which is managed by the NASA Goddard Space Flight Center. All publicly available data products, software, calibration files, and technical documents that have been developed jointly with the instrument teams are available through the FSSC (see http://fermi.gsfc.nasa.gov/ssc/).

1.3 Types of Proposals

The Cycle 9 Fermi GI program solicits proposals in the following areas:

1. The analysis of LAT or GBM data from the beginning of science operations or development of data analysis techniques;
2. Requests for LAT pointed observations (but proposers should be aware that compelling science justification and analysis will be required to quantify the additional scientific benefit of such observations – see the Fermi Users' Group (FUG) analysis at http://fermi.gsfc.nasa.gov/ssc/proposals/pointing_analysis/). The total time allocated to pointed observations will be between 0 and 15%. Pointed observations will follow the same open data policy as sky survey data, i.e., they will become public immediately;
3. Analysis of correlative multiwavelength observations with other instruments and observatories that are directly relevant to Fermi science objectives (see FUG recommendation at http://fermi.gsfc.nasa.gov/ssc/resources/multi/); and
4. Theoretical investigations that will advance the science return of the Fermi mission.

1.3.1 *Analysis of all LAT gamma ray and GBM event data*

The LAT team's science goals are (1) development of event-reconstruction and background-rejection techniques; (2) production of a comprehensive full-sky catalog of gamma-ray sources; and (3) a description of the diffuse gamma-ray emission. Proposed Fermi investigations should avoid duplication of the first two of these goals. The extent to which the proposed research will enhance the science return from Fermi will be considered in the proposal evaluation process (see Section 2.2 below).

The LAT's primary science data product is a list of events detected within the LAT's field-of-view. These events can be used to detect sources and study their temporal and spectral properties. Fermi observes the sky in a survey mode that provides nearly uniform sky exposure every ~3 hours; this mode will suffice for nearly all scientific observations. GIs may request funding to analyze any accumulated data and may receive funding even if they did not request a specific observation.

The GBM provides event lists with measured energies and arrival times, permitting both temporal and spectral studies. In addition, binned background count rates with differing temporal and spectral resolution are also available, enabling background studies and source detection through occultation steps.

The GBM science team is already funded to provide the community with a catalog of GRBs, including localizations and spectra. Proposals construed by peer reviewers as duplicative of this goal may, therefore, be deemed to have lower priority than those perceived as addressing other objectives.

New data analysis techniques that will maximize the mission's scientific yield are also encouraged. While the Fermi mission will provide a set of analysis tools with which a complete analysis of the data can be accomplished (refer to http://fermi.gsfc.nasa.gov/ssc/data/analysis/ for details)**,** specialized analyses to address specific scientific issues, such as blind pulsar period searches, the discovery of faint transients, or the detection of sources through occultation steps in the GBM background light curves, may require alternative techniques and additional software. GI proposals for such new data analysis techniques are solicited and should specifically address how the proposed techniques will advance Fermi science objectives.

1.3.2 *Requests for LAT pointed observations*

As noted before, GIs may also request pointed observations to accumulate sky exposure of a particular source at a rate higher than provided by survey mode observations. Similarly, GIs may request Target-of-Opportunity observations. Because pointed observations often provide only moderate advantage over survey mode, requests for pointed observations must provide a compelling scientific justification for interrupting survey mode. It will, therefore, be incumbent upon the proposer to demonstrate that a pointed observation is required to achieve the scientific objectives. Proposers thinking of requesting pointed observations are strongly encouraged to contact the FSSC (http://fermi.gsfc.nasa.gov/ssc/help/).

1.3.3 *Multiwavelength observations*

Because correlative observations will substantially augment the science return from Fermi, such proposals are encouraged. Examples of correlative observations that will add significantly to the Fermi science include monitoring of blazars, follow-up observations of gamma-ray bursts, and determination of pulsar ephemerides. To foster correlative observations, the Fermi project has established joint observation programs with other ground- and space-based facilities. The Fermi GI program can award optical, radio, X-ray or high-energy gamma-ray observations through Fermi's joint programs with NRAO, NOAO, Arecibo, ~~Suzaku,~~ VERITAS, and INTEGRAL. Note that only a single year of joint-program observations can be awarded through the Fermi GI Program regardless of the duration of awarded Fermi support. There are a number of important technical and policy details regarding these joint programs and prospective proposers are strongly encouraged to refer to the respective MOUs:

http://fermi.gsfc.nasa.gov/ssc/proposals/nrao.html,

http://fermi.gsfc.nasa.gov/ssc/proposals/noao.html,
http://fermi.gsfc.nasa.gov/ssc/proposals/arecibo.html,
~~http://fermi.gsfc.nasa.gov/ssc/proposals/suzaku.html,~~
http://fermi.gsfc.nasa.gov/ssc/proposals/veritas.html, and
http://fermi.gsfc.nasa.gov/ssc/proposals/integral.html

~~Regarding Suzaku, proposers should review the web page of the U.S. Guest Observer Facility to assess the current mission status in light of recent subsystem degradations and possible impacts on future observation plans.~~

For VERITAS, there are a number of technical and programmatic issues and it is strongly recommended that proposers, in addition to carefully reading the aforementioned MOU, submit a (nonbinding, nonmandatory) Notice of Intent (NOI) to propose through the FSSC VERITAS-NOI web site (http://fermi.gsfc.nasa.gov/ssc/proposals/veritas/noi/).

The LAT instrument team will post the light curves (including spectral information) of the sources listed at http://fermi.gsfc.nasa.gov/ssc/data/policy/LAT_Monitored_Sources.html. They will also announce the discovery of high-amplitude variations among these sources or of newly discovered bright transients to the community via Astronomer's Telegrams and GCN notices. The FSSC will provide light curves and locations for these new sources.

1.3.4 *Theoretical investigations*

Theoretical studies related to the observations conducted with Fermi hold the potential to significantly enhance the scientific impact of the mission. GI proposals for such theoretical investigations are also solicited and should specifically address how the anticipated results will advance Fermi science objectives.

1.4 Classes of Proposals

There are two proposal classes: (1) Regular proposals with research plans that can be completed in one or two years, and (2) Large proposals whose research plans are more expansive and may take up to three years to complete. Regular proposals spanning two years are intended for projects that could be partially accomplished in a single year, but would benefit from a more comprehensive multiple year study, as opposed to Large proposals whose scope cannot be accomplished in a single year. Large programs will remain prioritized for projects that are inherently resource intensive and large in scope. The number of Large projects funded in any given year will be limited.

The burden of justifying the need for Large projects is on the proposers. The peer-review committees will not be authorized to descope Large projects. They must be recommended for selection (or not) as proposed. Proposing a project in duplication as a single year plus as a Large program is strongly discouraged. On the other hand, requests for Regular Multiyear Programs may be descoped to single year programs based on peer-review recommendations and/or programmatic considerations.

Proposers requesting two-year projects that are selected at Phase 1 should not assume that they have been awarded two years of support; this determination will be made before Phase 2 of the review. All ongoing projects will be reviewed each year to determine if appropriate progress is being made toward the proposed objectives.

PIs of approved Large projects must submit a progress report annually on the proposal due date, rather than on the anniversary of the award date. The progress report should comply with the page limit and format requirements of Phase-1 Regular proposals. It should list the deliverables (papers, public software, etc.) that have resulted from the ongoing work, as well as an adherence to the schedule specified in the original proposal. Progress reports should be submitted through the Astrophysics Research Knowledgebase Remote Proposal System (RPS) system. Because of the significant resources allocated to large multiyear projects, those that do not make progress consistent with the proposed investigation could be reduced or terminated.

The continuation into year two of Regular Projects that were approved for two years duration will not require a second scientific peer evaluation. The PIs of such projects will, however, be solicited by the NASA Shared Services Center (NSSC) for a progress report that will be reviewed by NASA prior to the release of year two funds.

1.5 Proposal Page Limits

The page limit for the central Science/Technical/Management section of Phase 1 proposals is four pages for Regular proposals (one or two years) and six pages for Large proposals. These page limits include figures and references. An additional page is required to describe the technical justification for the observation time, as well as the telescope and instrumentation configurations being requested through the joint programs with NOAO, NRAO, Arecibo, **INTEGRAL** ~~Suzaku~~, and VERITAS.

Proposals should be single-spaced, typewritten, English-language text, using one or two columns, and using an easily read font size 12-point or larger and no more than 15 characters per horizontal inch. No smaller font should be used in the subsections of the proposal, including references, however, figure captions can be in fonts as small as 10-point. In addition, the proposal shall have no more than 5.5 lines per inch of text. Pages should have at least one-inch (2.5 cm) margins on all sides. Proposals not conforming to the format above will be declared noncompliant and may be rejected without further review.

For detailed requirements on the formatting other than those stated above, please refer to the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/

2. Programmatic Information

2.1 General Information

Awards for Regular (one or two year duration) proposals are expected to average $60,000 per year and generally to be less than $70,000; for Large proposals, the corresponding levels are $150,000 and $200,000 per year. Regular proposals for more than $70,000 per year and Large

proposals for more than $200,000 per year are unlikely to be approved without extremely compelling justification.

Awards for triggered analyses (e.g., transients meeting specific criteria) may not be released until after such triggers occur. Fermi GI funding is open only to individuals employed at U.S. institutions.

~~Proposals with a foreign-based PI and U.S. based Co-Is will be eligible for funding at a typical level of $10,000-$15,000 and will be generally for less than $20,000. Proposals of this type for more than $20,000 are unlikely to be approved without extremely compelling justification.~~

Only proposals led by a US-based PI will be considered for funding. **As always, participation by individuals at foreign organizations is permitted only on a no exchange of funds basis.**

Fermi science team members already receiving support from the Project are eligible for support, but must provide a compelling justification for the award of additional funds under the GI Program. It is the intent of this program that most of the available GI funding be awarded to proposers not formally associated with Fermi.

2.2 Proposal Submission and Evaluation

2.2.1 *Submission of Phase 1 Proposals to the Fermi GI Program*

The Fermi GI program will use a two-phase proposal process. The first phase will be the submission and evaluation of the science/technical justification. Proposals should include a management section with a statement of work and an estimate of the resources needed to accomplish this work. The required proposal forms must be submitted through the RPS.

Proposals requiring more than one year of effort (two-year Regular and Large proposals) should include a schedule list of expected deliverables and/or milestones for each year of the requested support. For large projects, this schedule will be considered in the peer-evaluation of progress reports prior to years two and three.

Each proposer who anticipates requesting funding must provide a budget estimate, i.e., an estimated maximum of the total cost to NASA (including overhead) of his/her proposed investigation. A box for entering the total budget is provided on the RPS Cover Form.

In the second phase, proposers whose Phase 1 proposals are accepted will be **required** ~~asked~~ to submit a budget for review via their home institution. ~~This budget should accurately reflect the work plan that was submitted via the RPS forms in Phase 1.~~ This is particularly important for multiyear proposals (two-year Regular and Large proposals). Proposers should append, as an NSPIRES attachment, a budget justification for each year of proposed work and specify what they expect to accomplish at the end of each of the years proposed. Every line item in the NSPIRES budget needs to be explained in the accompanying text. All proposal materials will be submitted electronically.

Proposers to the Fermi GI Program must adhere to the following procedures for proposal submission:

- Proposers will submit their Phase 1 proposals electronically through the RPS website at: http://heasarc.gsfc.nasa.gov/ark/rps/. Instructions for doing so are provided at the FSSC web site at: http://fermi.gsfc.nasa.gov/ssc/proposals/.
- Target lists are submitted through the RPS form. All proposals involving joint-program correlated observations or Fermi pointed observations must include a target list.
- Due to the nature of prospective investigations within the Fermi GI program, the Scientific/Technical/Management section of proposals is limited to four pages for Regular proposals (one and two years) and six pages for Large proposals, instead of the default 15 pages specified in the *NASA Guidebook for Proposers*. Figures and references are included within these four or six page limits. An additional page must be added to describe the technical details of proposed joint program TeV gamma ray, X-ray, radio, or optical observations.
- The standard ROSES requirement for a table of contents in the body of the proposal is waived.
- The Scientific/Technical/Management section will be uploaded to the RPS website as a PDF file.

All proposal materials must be submitted electronically by 4:30 p.m. Eastern Time on the due date for this program given in Tables 2 and 3 of the *ROSES Summary of Solicitation* in order to be included in the proposal review for this cycle of the Fermi Guest Investigator program. Note that the 4:30 p.m. deadline replaces the deadline stated in the *Guidebook for Proposers* and in the *ROSES Summary of Solicitation*.

NASA uses a single, uniform set of instructions for the submission of ROSES proposals. These instructions are given in the *NASA Guidebook for Proposers* (http://www.hq.nasa.gov/office/procurement/nraguidebook/). Fermi GI proposers should follow these instructions, except where they are overridden by the instructions given in the *ROSES Summary of Solicitation* or in this Appendix.

2.2.2 *Evaluation of Phase 1 Proposals Submitted to the Fermi GI Program*

A peer evaluation panel will review all proposals with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*, where it is understood that the intrinsic merit of a proposal shall include the following factors:

- The suitability of using the Fermi observatory and data products for the proposed investigation;
- The extent to which the investigation enhances the anticipated science return from the Fermi mission;
- The degree to which the proposed investigation places demands upon mission resources (this is particularly relevant for pointed observations); and

- In the case of Progress Reports (i.e., requests to continue multiyear projects), demonstrable progress towards the stated milestones of the original science proposal.

It is understood that the relevance of a proposal shall include the following factor:

- For data analysis development and theoretical investigations, the degree to which the investigation directly advances Fermi science goals.

2.2.3 *Submission and Evaluation of Phase 2 proposals*

Subject to the availability of funding, successful Phase 1 proposers will be contacted by the NASA Selecting Official and invited to submit a cost proposal in Phase 2. Upon notification of selection of a Phase 1 proposal, a proposer must respond as follows:

- Follow the instructions for submitting a Phase 2 proposal given in the selection notification from the Phase 1 review. Phase 2 (cost) proposals must be submitted through the NASA NSPIRES electronic proposal website (http://nspires.nasaprs.com/) by an Authorized Organizational Representative (AOR) of the proposing organization.
- The total budget may not exceed the budget estimate the proposer provided in the Phase 1 proposal.
- Budget Details are limited to three pages, and the Budget Narrative is limited to two pages. Any substantive changes from the budget management plan already submitted in Phase 1 should be justified explicitly.

NASA program personnel will evaluate the Phase 2 cost proposals against the third evaluation criterion, cost realism and reasonableness, and will also compare the proposed cost to available funds, as specified in Section C.2 of the *NASA Guidebook for Proposers*.

2.3 Supplemental Information

Further details concerning the proposal submission requirements and process can be found at the Fermi Science Support Center website http://fermi.gsfc.nasa.gov/ssc/. This website provides a detailed mission description; technical information about the Fermi mission, instruments, and feasibility of different types of observations; and instructions for completing the required proposal forms.

3. Summary of Key Information

Expected total program budget for new awards.	Funding for the GI program is expected to be ~$~~3-4~~ **3-3.5** M/year of which **~1.9-2.4** M is available for new awards **This might permit, for example, the selection of ~30-40 Regular proposals with average awards of $60K and generally less than $70K per year, and 2 or 3 Large proposals with average awards of $150K per year and generally less than $200K per year.**
Maximum duration of awards	1 or 2 years for Regular proposals and up to 3 years for Large proposals (see Section 1.3)
Due date for Notice of Intent to propose (NOI)	Option not available
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation.*
Planning date for start of investigation	5-10 months after proposal due date.
Page limit for the central Science-Technical-Management section of Phase 1 proposal	4 pp for regular proposals, 6 pp for large proposals; 1 additional page is required to describe joint program observations (see Section 1.5). Page limits include figures and references. This instruction supersedes the limits given in the *NASA Guidebook for Proposers.*
Relevance	This program is relevant to the astrophysics strategic goals and subgoals; see Table 1 of ROSES and the reference therein. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required in PDF format; no hard copy is required. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Notice of Intent to propose (NOI)	Option not available
Web site for submission of Phase 1 proposal and required forms	http://fermi.gsfc.nasa.gov/ssc/proposals/ (Help Desk available at http://heasarc.gsfc.nasa.gov/ark/rps/help/)
Web site for submission of Phase 1 proposal via NSPIRES	Option not available
Web site for submission of Phase 1 proposal via Grants.gov	Option not available
Fermi Science Support Center helpdesk	http://fermi.gsfc.nasa.gov/ssc/help/

Programmatic information may be obtained from the Fermi Program Scientist	Keith B. MacGregor Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-2463 E-mail: keith.b.macgregor@nasa.gov
Technical questions concerning this program element may be directed to the Fermi Science Support Center	Chris Shrader Code 661 NASA Goddard Space Flight Center Greenbelt, MD 20771-0001 Telephone: (301) 286-8434 Email: Chris.R.Shrader@nasa.gov Help Desk: http://fermi.gsfc.nasa.gov/ssc/help/
Questions concerning Fermi capabilities may be directed to the Fermi Project Scientist	Julie McEnery Code 661 NASA Goddard Space Flight Center Greenbelt, MD 20771 Telephone: 301-286-1632 Email: Julie.E.McEnery@nasa.gov

D.7 K2 GUEST OBSERVER – CYCLE 3

NOTICE: Amended on April 2, 2015. This amendment details the Campaign 9 Microlensing Science Team opportunity in Section 1.2.1 and amends the due dates for proposals to allow for submission of a target list to the spacecraft for an on-time start of Campaign 8. The due date for Step-1 proposals is June 2, 2015, and the due date for Step-2 proposals is July 1, 2015. New text is in bold and deleted text is struck through.

Proposals to this program will be accepted by a two-step process in which the Notice of Intent is replaced by a limited, but mandatory, Step-1 proposal submitted by an Authorized Organizational Representative. No PDF upload is required for the Step-1 proposal. Step-1 proposers must merely fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal will be eligible to submit a Step-2 (full) proposal. Potential proposers are strongly encouraged to carefully read the information about the two-step proposal process provided in Section IV(b)(vii) of the ROSES-2015 *Summary of Solicitation* and in Section 4 of this appendix.

Note also that the Astrophysics Division plans to issue two amendments to the ROSES-2015 solicitation. ~~The first will provide additional information regarding Campaign 9, which makes up part of the K2 Guest Observer (GO) solicitation for Cycle 3 proposals.~~ The second will be the K2 Guest Observer (GO) solicitation for Cycle 4 proposals.

1. Scope of Program

This program element solicits proposals for the acquisition and analysis of new scientific data from the K2 mission (http://keplerscience.arc.nasa.gov/K2). K2 repurposes the space-borne hardware and ground-based operations of the Kepler mission (http://keplerscience.arc.nasa.gov) for a pointed survey of predetermined locations along the ecliptic plane. The single, visible-wavelength instrument on board K2 provides high-precision photometry capability, with short cadence and long cadence modes (1 minute and 30 minute exposures), and provides a powerful tool for broadband variability analyses of planetary, stellar, extragalactic, and solar system sources.

1.1 Background

The loss of a second of the four reaction wheels on board the Kepler spacecraft in May 2013 brought an end to its four plus year primary science mission to continuously monitor more than 150,000 stars in the 116 square degree Kepler field for transiting exoplanet candidates. Developed over the months following this failure, the K2 mission represents a new concept for spacecraft operations that enables continued scientific observations with the Kepler space telescope. The K2 mission entails a series of sequential observing "Campaigns" of fields distributed around the ecliptic plane and offers a photometric precision approaching that of the original Kepler mission to within a factor of approximately two (http://keplerscience.arc.nasa.gov/K2/Performance.shtml). Operating in the ecliptic plane minimizes the torque exerted on the spacecraft by solar wind pressure, reducing pointing drift to the point where spacecraft attitude can effectively be controlled through a combination of

thrusters and the two remaining reaction wheels. Each ecliptic Campaign is limited by Sun angle constraints to a duration of approximately 80 days. Therefore, four to five K2 Campaigns can be performed during each future 372-day orbit of the spacecraft. A description of the Campaign field distribution across the sky and the full mission concept is provided at http://keplerscience.arc.nasa.gov/K2/MissionConcept.shtml.

1.2 Scope of this Solicitation

This solicitation is specifically for science utilizing data collected within K2 Campaigns 8, 9, and 10 observing fields, which are currently planned for execution over the periods January 3 to March 26, 2016 (Campaign 8), April 7 to July 6, 2016 (Campaign 9), and July 7 to September 27, 2016 (Campaign 10). The Campaign 8 field features a region at high galactic latitude where the relatively low source confusion will provide aperture photometry of the highest available quality. Campaign 9 will primarily be dedicated to microlensing science in the direction of Baade's Window. Campaign 10 will be another high galactic latitude field in the region of the North Galactic Cap. Supporting technical and scientific material is available at the Kepler Science Center website for the K2 mission (http://keplerscience.arc.nasa.gov/K2). A separate solicitation will be released in approximately nine months for Campaign 11 and 12 observations.

1.2.1 *Campaign 9*

Campaign 9 will be dedicated to a study of gravitational microlensing events. The Campaign 9 microlensing experiment involves the Kepler spacecraft observing in the +VV direction at fields toward the Galactic bulge. The aim of this program is to simultaneously observe gravitational microlensing events with K2 and from Earth in order to see a parallax effect in the shape and time of the lensing event.

In order to best maximize the scientific returns from the microlensing data, Campaign 9 targets are preselected and the GO solicitation will not be for scientific ~~proposals~~ **targets**. Campaign 9 will differ from Campaigns 8 and 10, as well as previous campaigns, **in that** no long cadence pixel resources are offered **through this solicitation**. **Proposals that seek to use** Campaign 9 data for purposes other than the microlensing study will **not be selected.**

~~The Campaign 9 solicitation will be for inclusion in a Microlensing Science Team which will make recommendations to the K2 GO Office on ways to optimize science output from the investigation, ensure collection of ground-based data and dissemination of that data to the scientific community, and facilitate timely publication of the collected data and scientific results.~~

There is expected to be a small, unfunded Directors Discretionary Targets (DDT) program run by the K2 GO office to allow exceptional targets to be observed. Campaign 9 is undertaken in the positive velocity vector (+VV) direction that allows for simultaneous observations from the ground. **DDT proposals will be handled through the GO Office, outside of ROSES.**

The Campaign 9 opportunity requests proposals for inclusion in a Microlensing Science Team. This Team, consisting of approximately five to ten members, will coordinate with and make recommendations to the K2 GO office and K2 project regarding the observational planning of Campaign 9. The intention is to form a cohesive team that can work to represent and serve the best interests of the microlensing scientific community.

Proposals are expected to address one or more of the specific areas of work relevant to the exploitation of K2 microlensing experiment data. The selected team members will be expected to coordinate their activities with the K2 GO Office and the other members of the Microlensing Science Team. All data, products, analyses, and results obtained by Team members are nonproprietary. Data shall be suitably reduced, analyzed, and documented, and will be required to be delivered to a public archive (reduced data and results) in a timely fashion on a schedule proposed and coordinated with the Microlensing Science Team and the Kepler GO Office.

The proposed investigations can be analytical or observational in nature. Investigations must involve research activities that relate to the detection, characterization, or understanding of gravitational microlensing events observed by K2. Priority for selection will be determined by the programmatic relevance of the proposed investigation to the K2 microlensing experiment, as well as its technical merit and cost reasonableness, so proposers are advised to pay particular attention to clearly articulating the importance of their proposed investigation and the value these efforts have to the wider scientific community. Proposals for participation in the Microlensing Science Team by scientists who can provide or facilitate coordinated ground-based observations are strongly encouraged.

Some possible programs include (but are not limited to):

- **Facilitating simultaneous ground-based data collection and analyses of those ground based data;**
- **Development and execution of methods that ensure accurate under-sampled crowded field photometry;**
- **Characterization and removal of systematic biases, target selection effects, background contamination, and detection efficiency to inform completeness and reliability estimates of detected events**

~~Further details on this solicitation and procedures outlining application for membership on the Microlensing Science Team will be provided in a future amendment to ROSES-2015.~~

1.3 Changes Since K2 Guest Observer (GO) Cycle 2 in ROSES-2014

PDF attachments are no longer required as part of the Phase 1 submission. See Section 4 below.

1.4 The K2 Mission

1.4.1 *K2 Mission Science*

Unlike the Kepler mission, there are no primary science objectives for the K2 mission in most Campaigns (with the exception of Campaign 9). While K2 continues to further the science goals of the Kepler mission – identifying planet candidates and providing data for the calculation of planet occurrence rates – the spacecraft is now primarily a general-user facility (http://keplerscience.arc.nasa.gov/K2).

1.4.2 *Instrumentation and Technical Capabilities*

Kepler is in a heliocentric orbit, which insures a thermally stable environment and provides the ability to remain on a single pointing for the duration of each Campaign. Pointing is maintained by a combination of two reaction wheels and thrusters, reacting to motion data provided by fine

guidance sensors (fine-point observing) or star trackers (coarse-point observing). With only two remaining reaction wheels, these operations are only possible while pointing within the orbital plane of the spacecraft, which approximates to the ecliptic. Only this specific family of pointings yields operational configurations where solar pressure is largely mitigated by spacecraft geometry, thereby making viable precision pointing and photometry approaching the quality for the Kepler mission. It is anticipated that K2 will achieve a benchmark photometric precision on an $m_v = 12$ G2V star of 170 parts-per-million (ppm) in 30 minutes of integration, i.e., one long cadence exposure. This corresponds to ~50 ppm over a 6.5-hour transit of an Earth-sized body around that star.

While stars brighter than $m_v = 11.5$ will saturate some pixels, K2 performs well on stars as bright as $m_v = 4$, provided the scientific benefit justifies the large number of pixels needed to capture saturated flux bleeding along CCD columns. Kepler also has many faint-target scientific applications where $m_v = 20$ objects yield a photometric precision of 10% over 30 minutes.

The broad photometric bandpass has a half-maximum transmission range of 430 to 840 nm. The instrument has neither changeable filters, dispersing elements, nor a shutter. The detector has a pixel scale of 3.98 arcseconds. Image quality varies with position in the focal plane, with the 95% encircled energy diameter ranging from 3.1 to 7.5 pixels, with a median of 4.2 pixels. The percentage of point-source flux concentrated in the center pixel is between 20% and 62%, with a median value of 45%.

1.4.3 *Observing Modes and Data Products*

Constraints imposed by onboard storage and communications dictate that at most 6% of the data from the full focal plane are saved and downloaded. Instead, data for specific, predetermined targets are saved and transmitted as subimages with a typical area of 160 pixels, depending on source brightness. The brighter a target, the more pixels are required to capture it. Image size can be tailored further to accommodate extended or very bright, saturated objects. The current solicitation requests target proposals for Campaigns 8 and 10. The Kepler Science Center will derive pixel masks for those targets successfully justified by proposers and upload these targets to the spacecraft before each Campaign. The pixels selected for downlink for the Campaign 9 microlensing program will be selected based on a recommendation from the Microlensing Science Team to the GO Office. It is anticipated that these pixels will make up large continuous regions. An amendment to ROSES-2015 will solicit applications for membership to the Microlensing Science Team.

All observations are taken at one of two temporal resolution settings: long (30-minute) or short (1-minute) cadence. It is expected that on the order of 10,000 long cadence targets will be available per Campaign, and on the order of 50 short cadence targets. Extended or bright objects requiring larger aperture sizes decrease the total number of targets available to the GO program and must be justified carefully. The Campaign 9 microlensing experiment data will be collected at long cadence.

Data distribution and archival services will be performed by the Space Telescope Science Institute's MAST archive (https://archive.stsci.edu). Final data products available to observers will include original and calibrated pixel values and light curves for each individual target. The calibration will correct for bias level, smear, galactic cosmic rays, flat fielding, dark current, background, and instrument noise. Simple aperture photometry will be used to generate light curves. No photometry is anticipated to be performed on the Campaign 9 microlensing data

because the field of interest is likely to be tiled with large superapertures. Photometric analysis of the microlensing data will fall within the scope of the Microlensing Science Team.

Data will be delivered to the observer in Flexible Image Transport System (FITS) format. A thorough understanding of the noise sources and systematic errors of K2 will be needed by observers in order to generate their own light curves from the original (uncalibrated or calibrated) pixel data or interpret structure found in archived light curves. There is no exclusive use period associated with any K2 GO data (this includes all Campaign 9 data).

2 Guest Observer Science

2.1 Permitted GO Science Areas

There are no guaranteed, or predetermined, targets for K2 Campaigns 8 and 10. All K2 targets are proposed by the community through the GO program. In Campaign 9 pixels will be selected based on a recommendation from the Microlensing Science Team.

For Campaign 8 and 10 targets, the K2 GO Program welcomes proposals addressing compelling scientific questions in any area of astrophysics and planetary science providing the required observations are amenable to the operational characteristics and constraints of the mission. These may include, but are not limited to, exoplanet detection, stellar astrophysics, galactic and extragalatic astrophysics, and Solar System science. All science proposals must be compelling and carefully justified scientifically and technically. Proposers should particularly note that short cadence resources and bright targets are expensive in pixels and onboard storage and have historically been in high demand. Short cadence proposals must justify scientifically and technically the need for higher cadence monitoring relative to long cadence observations.

Proposers must take into account the difference between science that can be achieved exclusively using archived K2 and Kepler data and science that requires new observations by K2. The K2 GO program is specific to the case of science requiring new observations. Funding for archival science is provided through the Astrophysics Data Analysis Program (ADAP; Appendix D.2 of ROSES-2015). This includes all Kepler data and K2 Campaigns 0-2. All proposals to this call must justify the need for new observational data within their program. However, we welcome proposals that build upon data already collected and programs requiring more data to enhance or complete investigations.

2.2 On-source Monitoring Times

Each K2 Campaign has a duration of approximately 80 days and remains fixed upon a single boresight position. The target list remains fixed throughout the full duration of a Campaign; targets cannot be swapped during a Campaign. The fixed locations and observing windows of Campaigns 8, 9, and 10 are provided at http://keplerscience.arc.nasa.gov/K2/Fields.shtml.

2.3 Target Selection Tools

Pointed observations away from the single stare position of any given field cannot be accommodated by K2; Campaign targets are limited to the objects available in the fixed field of view. Small gaps between the 42 detector CCDs result in additional loss of available objects that would otherwise be within the Kepler field of view. A documented target search tool, http://archive.stsci.edu/k2/epic/search.php, determines if an object of a particular coordinate lies

close to the observable field of view. The target search tool accesses the Ecliptic Plane Input Catalog (EPIC), which provides physical data, coordinates, magnitudes, and colors, for sources close to K2 silicon. The EPIC is complete to only $m_v \sim 17$; specifications of the catalog are documented at http://archive.stsci.edu/k2/epic.pdf. It is the proposer's responsibility to identify targets that are faint or missing from the EPIC. K2 collection of valid data relies on the delivery of accurate celestial positions and magnitudes of each target. Proposals must state the origin for this information, especially if it does not come from the EPIC. Determining whether or not desired targets fall on active regions of the focal plane is also the responsibility of the proposer. The Kepler Science Center at http://keplerscience.arc.nasa.gov/K2/ToolsK2FOV.shtml provides a tool to identify which targets fall upon active silicon. Only those targets within the active fields of view should be proposed.

2.4 Target Table

All proposals for targets are required to include a target table with the format shown in Table 1 to specify desired observing modes and other needed parameters. A definition of each column and a template for insertion into the proposal may be downloaded from the Kepler Science Center website at http://keplerscience.arc.nasa.gov/K2/ProposalPreparationTargetTable.shtml. In addition to appearing as text within the proposal, this table must also be submitted electronically (see Section 3.4) to the Kepler Science Center. Table 1 below includes example entries.

Table 1: Required Format of Target Table.
See http://keplerscience.arc.nasa.gov/K2/ProposalPreparationTargetTable.shtml for instructions on completing the table.

Object	Right Ascension (deg) J2000	Declination (deg) J2000	Kp (mag)	Cadence (min)	Proper motion ("/yr)		extent (arcsec)	Comments
					δRA	δDec		
204436324			12.6	30				
203457483			13.9	1				
J113853.2+010514.6	174.72172	1.08747	18.3	30				Not in EPIC; Kp estimated from SDSS
201744789			11.4	30			11	Extended object with radius 11.0 arcsec
207942582	172.57983	-2.96567	14.5	30	0.13	0.35		High propose motion star

3. Programmatic Information

3.1 Proposal Submission and Evaluation

There are three categories of K2 guest observer proposals in Cycle 3. They are:

- Small proposals—proposals requesting fewer than 1000 targets, with a budget capped at $30,000.
- Large proposals—proposals requesting 1000 or more targets, with a budget capped at $100,000. Large proposals must also include the development and dissemination of a value-added community resource product.
- Microlensing Science Team - proposals requesting admission to the science team that will lead the exploitation of the data collected as part of the Campaign 9 microlensing experiment.

The above cost caps are for the total cost of the award, including NASA Civil Servant Salary and overhead. Proposers should not include detailed budget information with either Step-1 or Step-2 proposals. NASA will seek detailed budgets from selected proposals after peer review.

Proposals submitted to NASA in response to this solicitation will be evaluated with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers,* which are intrinsic merit, relevance to the K2 Cycle 3 GO solicitation, and the realism/reasonableness of the proposed work effort and resources. In addition to the factors for intrinsic merit given in the *NASA Guidebook for Proposers,* intrinsic merit includes the following factors:

- The suitability of using the K2 observatory and data products for the proposed investigation;
- The legacy value of the data collected;
- The degree to which the investigation uses K2's unique capabilities;
- The feasibility of accomplishing the objectives of the proposed investigation with the requested observations, including the degree to which the proposal satisfies K2's observational constraints; and
- The feasibility and suitability of the proposed analysis techniques.

3.2 **Budget Justification,** Period of Performance, and Availability of Funds

For Campaigns 8 and 10, funding amounts will be determined formulaically based on target allocation. For GO Cycle 1, covering two campaigns, 27 awards were made, including five awards at $100K, two awards at $75K, and 20 awards at $30K or less. For Campaigns 8 and 10, award sizes will range from $10K for a few targets to up to $30K for 999 targets. Proposals of over 1000 targets may receive up to the maximum award amount of $100K.

For Campaign 9, targets are preselected and awards will not be based on target allocation, but should be based on funding needs for Science Team participation, as detailed in the proposed statement of work and budget. While an attached budget spreadsheet is not required, Campaign 9 proposals should include a half-page (approximately) Budget Summary table and a management plan that includes a statement of proposed work and a budget justification narrative. The proposed budget should be carefully considered and fully justified. It is anticipated that five to ten team members will be selected with an average budget allocation of $50K, but not more than $100K.

K2 Cycle 3 Guest Observer (GO) programs will exploit data collected in K2 Campaign 8, Campaign 9, and/or Campaign 10 fields and will begin on or about January 3, 2016. Funding for selected programs **in Campaigns 8 and 10** will start upon availability of Campaign data to the Principal Investigator (PI) in July 2016 All data will be made available through the public archive at the Mikulski Archive for Space Telescopes (MAST). There is no exclusive use period associated with any K2 GO data. The duration of awards will be one year, not including no-cost extensions.

For Campaign 9, we expect to have an overall funding amount of $500K available, and funds to successful PIs will be made available once Campaign 9 proposals are formally accepted (near October 1, 2015). This early funding is to allow for the organization of ground-based observations and to assure time to work with the K2 project in understanding spacecraft capabilities and Campaign 9 plans.

3.3 Eligibility

Except as described in the following paragraph, application to the K2 GO program is open to all investigators, including those from outside the U.S. under NASA's no-exchange-of-funds policy. Investigators who are not affiliated with a U.S. institution are not eligible for funding through this program. Co-Investigators (Co-Is) affiliated with a U.S. institution are eligible to receive funding under a proposal led by a foreign PI. In this scenario, only a single Co-Investigator per proposal will be considered as a lead PI for funding purposes, and proposals should identify a lead Co-Investigator within the U.S.

However, in accordance with Public Law 113-76, Division B, Title V, Section 532, NASA cannot support bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement. See Section III(c) of the ROSES-2015 NRA and the ROSES FAQ on this subject for more information on these restrictions.

4. Submission of Proposals to the K2 Cycle 3 GO Program

4.1 The Two-Step Proposal Submission Process

To facilitate the early recruitment of conflict-free reviewers, and to ensure that proposal concepts are responsive to and compliant with the solicitation, the K2 GO program will use a two-step proposal submission process (see Section IV(b)(vii) of the ROSES-2015 *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). Step-1 proposals will not be submitted to a formal, binding peer-review. The purpose of the Step-1 proposal is simply to avoid conflicts in the assembly of the review panel, and no response will be provided to proposers unless concerns regarding the responsiveness/compliance of their proposal concept are identified. However, a generic communication will go out to all who submitted a Step-1 proposal to indicate that Step-2 proposals can be submitted when the Step-2 "response structure" is opened on the NSPIRES web page. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must address the same scientific goals proposed in the Step-1 proposal. The Step-1 proposal title and PI cannot be adjusted. To add funded investigators between the Step-1 and Step-2 proposals, proposers must notify the NASA point of contact listed in Section 5 in writing (E-mail with cc to sara@nasa.gov) at least two weeks in advance of the Step-2 proposal due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later. No budget is required for either the Step-1 or Step-2 proposals. The funding level for selected proposals are cost capped, see Section 3.1.

4.1.1 *Step-1 Proposals.*

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Step-1 proposal should identify the PI and all funded Co-Is on the proposal. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the information submitted in NSPIRES and should include a description of the science goals and objectives of the proposal, an estimate of the number of targets to be observed (a target table is not required), a brief description of the methodology to be used, and a

description of the relevance of the proposed research to this solicitation. The relevance section will be used to confirm that the proposal is responsive to the requirements of this call.

The NSPIRES system for proposal submission requires that Step-1 proposals include a summary (i.e., abstract) describing the proposed work as outlined above. The proposal summary is entered directly into a text field in NSPIRES. No PDF attachment is required for Phase 1 proposal submission. All information will be entered within the 4000-character Proposal Summary text box on the NSPIRES web interface cover pages. Proposers will be notified by E-mail when they are able to submit their Step-2 proposals. If NASA determines that the proposed investigation is likely to be either nonresponsive or noncompliant with the solicitation, proposers will be notified in advance of the submission of their Step-2 proposal. In such cases, proposers are not precluded from submitting their Step-2 proposal, but should be aware that, without addressing the issues identified in the notification, there is a risk that their proposal may be declined without review.

4.1.2 *Step-2 Proposals.*

Proposers should refer to the PDF entitled "How to submit a Step-2 proposal" under "Other Documents" on the NSPIRES page for this program. The process for preparation and submission of the Step-2 (full) proposal is essentially identical to that associated with any other ROSES proposal, subject to the following program-specific constraints:

a) Large proposals must include a section of no more than one page in length describing a value-added community resource product that the Large proposal will provide at the end of the period of performance of the grant and how that product will be made available to and benefit the community. This product should be greater than simply a published paper. Example products might be delivery of a uniform set of well-produced open cluster star light curves, follow-up ground-based observations of exoplanet host stars, or a catalogue of sources with additional astrophysical information. This information will be used in Large proposal evaluation. The target list of any Large proposal may be reduced if the need for a large number of targets is not adequately justified in the proposal.
   If the products are to be ingested and curated at an existing astrophysics archive (e.g., the MAST archive at the Space Telescope Science Institute (STScI) or the NASA Exoplanet Database), the proposal should include a letter of acknowledgement from the relevant archive.
b) Campaign 9 proposals to join the Microlensing Science Team must address what valuable resource, skill or expertise they bring to the team. Individual expertise should be addressed, but also placed in context of the proposer's ability to contribute resources or expertise to the betterment of the overall team. Proposals should make a point of emphasizing the value of their contribution to the community as a whole rather than solely as an individual science investigator.
c) The Scientific/Technical/Management section of the Step-2 proposal, which consists of text, tables (excluding the target table), and figures must not exceed four pages for proposals in the Small category, or six pages for proposals in the Large category. References do not count against the page limit.
d) A complete table of proposed targets (see Section 2.4) must also be included at the end of the Scientific/Technical/Management section of the proposal, but does not count against the page limit of that section. However, the target table should be truncated in instances where its incorporation will cause the Scientific/Technical/Management section to exceed a length of 15-pages. No target table is required for Campaign 9 Microlensing Science Team proposals.

e) For the purpose of submitting proposals through NSPIRES, proposers from non-U.S. institutions must affiliate in NSPIRES with the Kepler Guest Observer Office, which will submit the proposal on their behalf. For details, see http://keplerscience.arc.nasa.gov/ProposalPreparationSubmit.shtml.
f) Complete and submit electronically the proposal through NSPIRES (http://nspires.nasaprs.com). Hard-copy submissions are not permitted.
g) A separate electronic version of the target table must be submitted to the Kepler Science Center by the proposal deadline. An Excel template for the target table, which is suitable for direct insertion into the proposal, instructions about the required file format for submission to the Kepler Science Center, and information regarding the file-naming convention for the target table file are available at http://keplerscience.arc.nasa.gov/K2/ProposalPreparationContent.shtml.
h) All electronic proposal materials (proposal and separate electronic target file submitted to NSPIRES and the Kepler Science Center, respectively) must arrive at the designated destinations by 11:59 p.m. Eastern time on the due date given in Section 5 in order to be included in the proposal review for this cycle of the K2 GO Program.

4.2 Proposal Formatting

This is a reminder that all proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the ROSES *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Any proposal found to violate these formatting rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: The *NASA Guidebook for Proposers* requires easily read fonts having, on average, no more than 15 characters per inch (e.g., 12-point Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line-spacing settings for a selected font below single-spaced.
- Figure captions: Must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Proposers may not place expository text in tables or figures in order to gain space.

4.3 Sources of Additional Information

The Kepler Science Center (http://keplerscience.arc.nasa.gov/K2), located at the NASA Ames Research Center, provides support to Guest Observers and to proposers of this solicitation, such as technical information about the K2 mission and instrument, and other information supporting proposal preparation, including a Frequently Asked Questions link and template files for proposal preparation. Contact information may be found in Section 5.

5. Summary of Key Information

Expected program budget for Campaigns 8, 9, & 10 awards	~$1.5M**; $500K each for Campaigns 8, 9, and 10**
Estimated number of funded investigations selected for observations	~5 Large investigations containing >1,000 observed targets over Campaigns 8 and 10 combined, and ~15 Small investigations containing <1,000 observed targets over Campaigns 8 and 10 combined. ~$0.5M in supporting funds will be available to the Microlensing Science Team
Maximum duration of awards	1 year
Due Date for electronic submission of MANDATORY Step-1 proposals	**June 2, 2015.** See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due Date for electronic submission of Step-2 proposals	**July 1, 2015.** See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	Funds will be awarded when the data are made available to the PI. Proposers should use July 15, 2016 as the probable date for receiving data from Campaign 8
Page limit for the Step-2 central Science- Technical-Management section	Small proposals: No more than four pages for the Scientific/Technical/ Management section, including text, tables, and figures. Large proposals and Campaign 9 Microlensing Science Team proposals: No more than six pages for the Scientific/Technical/ Management section, including text, tables, and figures. References and the required target table do not count against these page limits, but the target table should be truncated in cases where it would cause this section to exceed 15 pages.
Relevance	This program is relevant to the Astrophysics strategic goals and subgoals in NASA's *Strategic Plan*. Proposals that are relevant to this program are, by definition, relevant to NASA
General information and overview of this solicitation	See *ROSES Summary of Solicitation*
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/
Submission medium and number of copies	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-K2GO3

Mandatory submission of electronic version of target table	http://keplerscience.arc.nasa.gov/K2/ProposalPreparationTargetTable.shtml
Kepler Science Center	Webpage: http://keplerscience.arc.nasa.gov/K2 Email: keplergo@mail.arc.nasa.gov
Technical questions concerning this program element may be directed to the Kepler Science Center	Dr. Thomas Barclay Kepler Guest Observer Office NASA Ames Research Center, MS 244-30 Moffett Field, CA 94035-1000 Telephone: (650) 604-3560 Email: keplergo@mail.arc.nasa.gov
NASA point of contact for programmatic information	Dr. Debra J. Wallace Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0917 Email: debra.j.wallace@nasa.gov

D.8 STRATEGIC ASTROPHYSICS TECHNOLOGY

NOTICE: Amended on March 24, 2015. When setting the schedule for ROSES-2015, the proposal due date for this program element was inadvertently placed on Saturday. This amendment corrects that error, shifting the due date to the prior Friday. Proposals are now due by March 18, 2016. Notices of Intent to propose are still due by January 22, 2016.

1. Scope of Program

1.1 Overview

Over the next decade and beyond, NASA's Astrophysics Division expects to undertake space flight missions that will explore the nature of the universe at its largest scales, its earliest moments, and its most extreme conditions; missions that will study how galaxies and stars formed and evolved to shape the universe we see today; and missions that will search and characterize the planets and planetary systems orbiting other stars. To enable implementation of these missions, the NASA Science Mission Directorate's Astrophysics Division has established the Strategic Astrophysics Technology (SAT) program to support the maturation of key technologies to the point at which they are feasible for implementation in space flight missions.

The 2010 Decadal Survey of Astronomy and Astrophysics (hereafter, Astro2010), strongly endorsed the SAT program (http://www.nap.edu/catalog.php?record_id=12951). The SAT program is a key element of the strategy adopted by the Astrophysics Division in implementing the Astro2010 recommendations (see the Astrophysics Implementation Plan at http://science.nasa.gov/media/medialibrary/2012/12/20/Rev1-StrategicIImplementationPlan-20Dec2012.pdf).

The focus of the SAT program is described in terms of the Technology Readiness Level (TRL) of the technologies involved. NASA uses a nine-level classification system to rate the readiness of a particular technology for use in a space flight mission. The TRL definitions are articulated in detail in NPR 7123.1B Appendix E (http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_7123_001B_&page_name=AppendixE). Briefly, TRL levels one to three are generally considered to be basic research on new technologies, while TRL levels seven to nine correspond to the development of flight hardware

The SAT program is designed to support the maturation of technologies whose feasibility has already been demonstrated (i.e., TRL 3), to the point where they can be incorporated into NASA flight missions (TRL 6-7). Table D.8.1 provides the definitions for the midrange TRLs supported by the SAT program.

Table D.8.1. Expanded Maturity Definitions for Midrange TRLs (SAT Program)				
TRL	Definition	Hardware Description	Software Description	Exit Criteria
3	- Analytical and experimental critical function and/or characteristic proof-of-concept	Analytical studies place the technology in an appropriate context and laboratory demonstrations, modeling and simulation validate analytical prediction.	Development of limited functionality to validate critical properties and predictions using nonintegrated software components.	Documented analytical/experimental results validating predictions of key parameters.
4	Component and/or breadboard validation in laboratory environment.	A low fidelity system/component breadboard is built and operated to demonstrate basic functionality and critical test environments, and associated performance predictions are defined relative to final operating environment.	Key, functionality critical software components are integrated and functionally validated to establish interoperability and begin architecture development. Relevant environments defined and performance in the environment predicted.	Documented test performance demonstrating agreement with analytical predictions. Documented definition of relevant environment.
5	Component and/or breadboard validation in relevant environment.	A medium fidelity system/component brassboard is built and operated to demonstrate overall performance in a simulated operational environment with realistic support elements that demonstrate overall performance in critical areas. Performance predictions are made for subsequent development phases.	End-to-end software elements implemented and interfaced with existing systems/simulations conforming to target environment. End-to-end software system tested in relevant environment, meeting predicted performance. Operational environment performance predicted. Prototype implementations developed.	Documented test performance demonstrating agreement with analytical predictions. Documented definition of scaling requirements.

TRL	Definition	Hardware Description	Software Description	Exit Criteria
6	System/subsystem model or prototype demonstration in a relevant environment.	A high fidelity system/component prototype that adequately addresses all critical scaling issues is built and operated in a relevant environment to demonstrate operations under critical environmental conditions.	Prototype implementations of the software demonstrated on full-scale, realistic problems. Partially integrated with existing hardware/software systems. Limited documentation available. Engineering feasibility fully demonstrated.	Documented test performance demonstrating agreement with analytical predictions.

The Astrophysics Division has three main science programs: Exoplanets Exploration (ExEP), Physics of the Cosmos (PCOS), and Cosmic Origin (COR), which cover, respectively, the search for planets outside the Solar System, the origin and evolution of the universe, and the birth of stars and galaxies. These areas of scientific interest are represented within the SAT program through its three elements:

- Technology Development for Exoplanet Missions (TDEM)
- Technology Development for Physics of the Cosmos (TPCOS)
- Technology Development for the Cosmic Origins (TCOR)

1.2 Requirements for SAT Proposals

This section describes the general requirements for SAT proposals common to TDEM, TPCOS, and TCOR. Proposers are also urged to read Sections 2, 3, and 4 for further details on the requirements specific to each science area.

Proposers shall:

- Identify the SAT element(s) most closely related to the proposed technology (e.g., TDEM, TPCOS, TCOR; see Section 3). Proposed technologies may be relevant to more than one of these three areas. Consequently, NASA reserves the right to reassign a proposal to any of the three Programs for the purposes of review and funding;
- Identify a strategic mission or mission concept to which the proposed technology is anchored (competed missions, such as Explorers, are not considered *strategic* missions);
- Describe the proposed path to achieving the goals of the proposed technology. In particular:
  (a) Provide proof that the technology being proposed is already at TRL=3;
  (b) Specify the expected end TRL at the conclusion of the proposed program. However, it is neither required nor expected that proposers will complete this entire

development process (or even advance a full step on the TRL scale) within the two or three year duration of proposals solicited in this call;

(c) Define at least one objectively verifiable milestone that represents a meaningful advancement of their chosen technology and provide a schedule for achieving that (those) milestone(s) over the course of their proposed project;

(d) Describe a work plan that fully articulates the technical parameters to be demonstrated for all technical milestones identified. This work plan should include the measurements to be made, analyses to be applied, success criteria, and documentation to be provided. The work plan and associated milestones will be critically evaluated as part of the peer-review process.

In addition, both the *NASA Guidebook for Proposers* (Section 2) and Section IV (b) ii of the *ROSES-2015 Summary of Solicitation* provide clear and specific requirements for the format of proposals submitted in response to this solicitation (e.g. page limits, acceptable font sizes, line spacing, margins, etc.). Proposals found to violate these guidelines will be penalized, even to the extent of being declined without review, or not being funded, independent of their intrinsic merit evaluation. Proposers are reminded that it is the PDF version of their proposal in NSPIRES that will be judged for compliance. Since, in rare cases, cross-platform translation of PDF documents can alter the formatting of a document, proposers are strongly urged to download copies of any documents they upload to the NSPIRES system to ensure that they still conform to all formatting requirements. NASA does not require a data management plan for proposals to this program element.

1.3 Annual Program Office Presentations

In addition to the annual progress report, successful proposers may also be asked to present orally their results to the Program Office and other relevant officers (See Sections 2, 3, and 4). NASA reserves the right to terminate a grant if it deems that achievement of the proposed goals according to the proposed schedule is unlikely to occur.

2. Technology Development for the Exoplanet Exploration Program

NASA's Exoplanet Exploration Program (ExEP) supports the development of those technologies that will allow us to search and characterize extrasolar planets and planetary systems. As compelling as these future ExEP missions are, implementing them presents many daunting technological challenges. The Technology Development for Exoplanet Missions (TDEM) element of the SAT Program is designed to support the maturation of key technologies that will overcome these challenges and pave the way to ever more ambitious exoplanet exploration missions.

2.1 TDEM Areas of Emphasis

The ultimate goal for exoplanet exploration envisioned by Astro2010 is a "*New Worlds Mission*" that would conduct imaging and spectroscopy of rocky planets in the habitable zones of stars in the Solar neighborhood. To meet the challenge of Astro2010, the TDEM element of the SAT program solicits investigations that will advance the technology readiness of technologies that

feed directly into key starlight suppression techniques (coronagraphy, external occulters) that will enable a future strategic *New Worlds Mission*. Detailed discussion of the current technology needs in the relevant areas can be found in the Exoplanet Exploration Program Technology Plan, which can be downloaded at http://exep.jpl.nasa.gov/reportsAndDocuments. Prospective SAT/TDEM proposers are strongly encouraged to review this document before preparing their proposal, as it reflects the programmatic considerations that will be taken into consideration in the review and selection of TDEM submissions.

Technology activities of particular interest to the Exoplanet Exploration Program and the TDEM Program are those that undertake milestones in the following areas:

1. *Starlight Suppression Demonstrations*
Demonstration of technologies that will enable a space observatory to reject scattered starlight to the degree that the light of an exoplanet can be separated from that of its parent star (10^7 contrast ratio at infrared wavelengths; 10^{10} contrast ratio at visible wavelengths). For coronagraph technologies, there is special interest in demonstrations with obscured, segmented apertures suitable for operation with 10m-class telescopes.

For starshade technologies, there is interest in (a) deployment activities, such as petal unfurling mechanisms and latches, (b) shielding (aka blanketing) concepts and demonstrations such as opacity testing and resistance to micro-meteoroids, (c) stray light investigation and analyses, including petal surfaces and edges, (d) as with coronagraphs, there is special interest in starshades suitable for operation with 10m-class telescopes.

2. *Wavefront Sensing and Control of Scattered Starlight*
In order to achieve the requisite degree of starlight rejection, the light paths within both coronagraphic systems must be controlled to picometer precision consistent with 10^{-11} contrast stability. Advances in control algorithms, sensing technology, and deformable mirror technology are, therefore, central to implementing such instruments on a space-based platform. Likewise, external occulter observatories require sensors and algorithms that enable the system to move from star to star and that enable the system to meet and maintain positional stability during science observations.

3. *System Performance Assessment*
Testing new subsystems, instruments, and observatory designs on the ground for performance verification may not be feasible, even if they are small enough to fit in existing vacuum chambers. Thus, future exoplanet missions will have to rely on high-fidelity, very high density models that capture the physics properly and seamlessly integrate thermal, mechanical, and optical models, to infer expected picometer-level on-orbit performance based on nanometer-level ground measurements.

Relevant technology development activities involving ground-based astronomical facilities are eligible for funding under the TDEM element, providing there is clear and explicit traceability to a future exoplanet mission. Unfortunately, due to budgetary constraints, proposals for suborbital programs are not solicited at this time.

Over the years, the ExEP has developed a number of advanced testing and modeling tools to support the development of exoplanet exploration technologies. These tools are available to the community and proposers are encouraged to take advantage of them, as appropriate. An informational workshop will be held in advance of the proposal deadline to provide information for proposers wishing to take advantage of one or more of the available ExEP test facilities and/or tools and to provide guidance for developing quantitative, practical technology milestones for their proposed task. Information about the scheduling of the workshop and instructions for participation will be posted at http://exep.jpl.nasa.gov/news. Prospective proposers should be aware, however, that high-priority technology development activities associated with the advancement of a potential coronagraph for an AFTA-based WFIRST mission (see description below) will nearly fully subscribe the time available on the ExEP's two High Contrast Imaging Testbeds (HCIT). Consequently, it is likely that little to no time will be available on either of those testbeds to support new TDEM investigations.

2.2 TDEM-specific Exclusions.

Proposals in the following areas are specifically not solicited under the TDEM element of SAT 2015:

- Investigations that advance technologies for future missions with goals other than the direct detection of extrasolar planets (e.g. astrometry, high-precision photometry, transit spectroscopy);
- Investigations that advance technologies for ancillary measurements that (although they may enhance the scientific capabilities of a future mission) do not directly enhance the ability of the system to isolate and analyze the light emitted or reflected from an exoplanet;
- Investigations that advance technologies leading to the development of infrared interferometry as the basis for a future strategic exoplanet direct detection mission;
- Proposals for the development of technologies for potential competed (e.g., Explorer) exoplanet direct detection missions;
- Investigations that address general technology maturation activities without specific application to the requirements of a future strategic exoplanet direct detection mission;
- Proposals for development and maintenance of testing facilities and/or tools that substantively reproduce the capabilities of existing ExEP infrastructure;
- Proposals for the advancement of technologies in the following specific areas: (1) detector technology; (2) mirror technology (with the exception of adaptive systems associated with wavefront sensing and control in coronagraphs); (3) telescope assembly technology; (4) spacecraft sunshields and thermal control; (5) propulsion systems; (6) vibration isolation systems; and (7) spacecraft pointing control (with the exception of telescope-starshade alignment control in external occulter systems).

Finally, the potential use of one of the 2.4-m space telescopes NASA obtained from another Federal agency (termed the Astrophysics Focused Telescope Assets, or AFTA) as the basis for implementing the Wide Field InfraRed Survey Telescope (WFIRST) envisioned in the Astro2010 Decadal Survey has unexpectedly created a new, near-term opportunity in exoplanet

exploration. Studies commissioned by the Astrophysics Division have established that an AFTA-based WFIRST mission (WFIRST-AFTA), augmented by the addition of a coronagraphic instrument, could be capable of conducting direct detection observations of planets as small as Neptune in the Solar neighborhood. In view of this promise, a coronagraph is now included as a component of the baseline WFIRST-AFTA mission concept, and advancement of relevant coronagraph technologies has been incorporated into the directed technology development program that NASA has established to bring WFIRST-AFTA to a suitable level of technology readiness on a timescale consistent with its expected implementation (i.e., after the launch of JWST). Consequently, coronagraph technologies that will be advanced under the WFIRST-AFTA technology development are not eligible for funding under the auspices of the SAT Program. Technologies that are not eligible include: (1) masks/apodizers for Shaped-pupil, hybrid Lyot, and Phase-Induced Amplitude Apodization Complex Mask (PIAA-CMC) coronagraphs; (2) Low-order wavefront sensing and control; (3) data post-processing; (4) system-level performance demonstration and modeling of obscured aperture systems.

2.3 The TDEM Technology Development Model.

The ExEP model for advancement of technologies is founded on the following three interrelated components:

1. Demonstration of milestone performance must be stable and repeatable, thereby demonstrating that the result is not spurious or transient;
2. Modeling of the milestone demonstration must be consistent with the demonstrated result, thereby establishing that the behavior is thoroughly understood; and
3. Error budget for the milestone must be consistent with the models.

Milestones proposed under the auspices of the TDEM element may involve one or all of these elements. In addition, milestones for all SAT/TDEM investigations that make use of ExEP high-contrast testbeds shall incorporate both predictive and posttest validated modeling. In the interests of consistency and comparability, investigators will be expected to make use of the ExEP's existing modeling capability.

For all technical milestones identified in a proposal, the PI will be expected to prepare a milestone white paper—a work plan that fully articulates the technical parameters to be demonstrated, the measurements to be made, analysis to be applied, success criteria, and documentation to be produced. That white paper will be reviewed by an independent technology assessment committee and may be iterated until an agreement between the technologists, the reviewers, and NASA is reached. When the PI believes that his/her team has achieved all of the requirements set forth in their milestone white paper, they will be required to write a milestone report that addresses all of the aspects identified in the original white paper. The milestone report will then be subject to independent review and interaction by the same groups involved in the initial white paper.

3. Technology Development for Physics of the Cosmos (TPCOS) Missions

The primary science objectives of the Physics of the Cosmos (PCOS) Program are to understand the origin and destiny of the Universe, the physics of phenomena near black holes and other compact objects, and the nature of gravity, addressing the question "How does the Universe work?" (see http://science.nasa.gov/about-us/smd-programs/physics-of-the-cosmos/). Missions that are directed at advancing the fields of cosmology, high-energy astrophysics, and fundamental physics are nominally within the scope of this program. Detailed discussion of the current PCOS technology needs in the relevant areas can be found in the most recent version of the PCOS Program Annual Technology Report, which is available from the PCOS Program web site at http://pcos.gsfc.nasa.gov/. Prospective SAT/TPCOS proposers are urged to review this document before preparing their proposals.

The following technological areas are identified as of particular interest for the TPCOS Program:

- *Technologies for X-ray Astrophysics,* including, but not limited to, high-resolution microcalorimeter arrays, lightweight replicated optics and precision structures, high-resolution gratings (both transmission and reflection).
- *Technologies for Gravitational Wave Astrophysics,* including, but not limited to: dimensionally stable, optical telescopes; frequency-stabilized metrology lasers; high-resolution phasemeters; low-noise microthrusters; ultra-quiet inertial references; and long-distance, laser metrology techniques.
- *Technologies for CMB Polarization Measurements,* including, but not limited to, high-throughput cold mm-wave telescopes and large low-background multiplexed arrays of detectors.

Due to the limited budget available, proposals requiring a dedicated suborbital flight (balloon or rocket) for technology tests or risk reduction are not solicited in this call, but may be included in future solicitations. However, proposals that require suborbital balloon or rocket flights may be considered if they piggyback with a payload of an already approved suborbital mission, or a payload on a Suborbital Reusable Launch Vehicle. Questions concerning piggyback payloads may be addressed to the individuals listed in the table below.

Piggyback Balloon Payload	Piggyback Sounding Rocket Payload
Debora Fairbrother Balloon Program Office Code 820 Wallops Flight Facility NASA Wallops Island, VA 23337 Telephone: (757) 824-1453 Email: Debora.A.Fairbrother@nasa.gov	Philip Eberspeaker Sounding Rocket Program Office Code 810 Wallops Flight Facility NASA Wallops Island, VA 23337 Telephone: (757) 824-2202 Email: Philip.J.Eberspeaker@nasa.gov

Piggyback Suborbital Reusable Launch Vehicles (sRLV)
LK Kubendran Flight Opportunities Space Technology Program NASA Headquarters Washington, DC 20546 Telephone: (202) 358-2528 Email: lk@nasa.gov

The proposal must address the question of how a potential future mission that primarily addresses PCOS science goals will be enabled or enhanced by the proposed suborbital work.

Annual reports for a selected TPCOS investigation must be submitted to the Program Scientist before funds for the following year of the grant are disbursed. The annual report shall contain detailed documentation of the progress towards the milestones identified in the proposal and a description of the plan forward and its expected outcomes.

In addition, PIs of selected investigations shall submit a short status update on a bimonthly basis and make an annual progress presentation to the PCOS Program Office. By the end of the full term of the investigation, the Program Office convenes a technology management board to evaluate the technology readiness level realized during the course of the project.

4. Technology Development for the Cosmic Origins Program (TCOR)

The Cosmic Origins Program (COR) seeks to investigate how planets, stars, galaxies, and cosmic structure come into being and when and how the elements of life in the Universe arose. In general, areas of astronomy and astrophysics not explicitly called out in the previous program definitions fall within the Cosmic Origins Program. Further information on the scope, activities, and the Program Annual Technology Report (PATR) of the Cosmic Origins theme can be found in the website at: http://cor.gsfc.nasa.gov. First and second priorities for areas of long-lead and mission enabling technology development that are of particular interest to the Cosmic Origins Program include:

1. *Next Generation Detectors*
Highly sensitive detectors and large arrays of detectors are fundamental to the capabilities of COR missions. In particular, high- Quantum Efficiency (QE), large-format, photon counting and ultra-low-noise detectors from the extreme ultraviolet to the far-infrared portion of the spectrum and their associated technologies (e.g., manufacturability, read-out electronics, packaging) will be critical to achieving the goals of future Cosmic Origins investigations. Of particular interest are detectors sensitive to wavelengths shortward of 2000 Å and photon counting detectors from the visible to near-IR wavelengths.

2. *Optical Coatings, Gratings and Filters*
Improved coatings for optics, for reflective purposes as mirrors, for antireflective (AR)

uses on optical elements such as gratings and detectors, and for wavelength-selective applications as filters, dichroics, or blockers, could yield more sensitive instruments and permit more instrument design freedom. The known UV reflective materials and protective coatings used on Al, such as MgF_2, LiF, CaF_2, LaF_3, etc., may have reached performance limitations, and we are seeking new and superior solutions that could be incorporated into flight hardware. For reflective coatings, most crucially in the Lyman ultraviolet (900-1300 Å), increasing system throughput is a very cost-effective way to achieve more science. Studies of improved deposition processes for known Lyman UV-reflective coatings (e.g., SiC) and investigations of new coating materials with promising Lyman UV performance, with reflectivities in excess of 50%, and reflectivities close to unity at longer UV wavelengths are areas where progress would be valuable. Because SAT proposals assume a TRL entry gate of at least 3, proposals that address the needs outlined here, but do not meet this TRL threshold, should be submitted as APRA proposals.

3. *Precision Large Optics*
Missions within COR rely heavily on their ability to collect sufficient light with appropriate angular resolution to address important relevant questions. Therefore, a premium is placed on the ability to develop scalable manufacturing techniques, including the testing and control optics of suitable and affordable mirror sizes. Keys to advancements in this arena are new techniques and technologies for reducing areal density of optics, production times, and cost; manufacturing ultra-precise, low-mass structures to reduce launch volume for large-aperture space telescopes and interferometers; operation at short wavelengths (900 – 2000 Å); and mechanisms and methods for improving thermal and dynamic stability, and wavefront sensing and control.

Proposals that are building on previously funded COR technology development must be justified with new, distinct, objectives for the new investigation. Such proposals should also include a clear description of prior advances, milestones, and TRL achieved. The proper justification and demonstration of the TRL level 3 or higher of the proposed technologies is an explicit requirement for compliance with this SAT call for proposals. The annual report for selected efforts should contain documentation of the progress towards the milestones identified in the proposal.

Due to the limited budget available, proposals requiring a dedicated suborbital flight (balloon or rocket) for technology tests or risk reduction are not solicited in this call, but may be included in future solicitations. However, proposals that require suborbital balloon or rocket flights may be considered if they piggyback with a payload of an already approved suborbital mission. Questions concerning piggyback payloads may be addressed to the individuals listed in the table above in Section 3.

The proposal must address the question of how a potential future mission that primarily addresses COR science goals will be enabled or enhanced by the proposed suborbital work.

An Annual Report for each selected investigation must be submitted, containing detailed documentation of the progress towards the milestones identified in the proposal, and a

description of the plan forward and its expected outcomes. This Report will be included in the Program Annual Technology Report.

In addition, PIs of selected investigations submit a short status update on a bimonthly basis, and make an annual progress presentation to the Program Office. By the end of the full term of the investigation, the Program Office convenes a technology management board to evaluate the technology readiness level realized during the course of the project.

5. Programmatic Information

5.1 General Information

The period of performance for proposals submitted in response to this solicitation may not exceed two or three years depending on the program element (see Section 6). The following table provides the approximate amount of funding available for new awards, distributed over Fiscal Years 2017 and 2018. It also gives the number of new investigations that may be selected for the three SAT categories pending the availability of funds and an adequate number of proposals of sufficient merit.

SAT Category	Approximate Funds for New Selections [$M]	Approximate Number of New Selections
TDEM	$2.0 per year	~2-5
TPCOS	$2.0 per year	~2-5
TCOR	$2.0 per year	~2-5

5.2 Student Participation

When appropriate, participation of graduate students is encouraged, especially if the project can be concluded within the nominal tenure of graduate training. In such cases, a brief summary of the educational and training goals of the student participants should be included in the proposal.

5.3. Request for reviewer names

Proposers are strongly encouraged to provide names and contact information of up to five nonconflicted experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is. This information should be included in the proposal summary in the Notice of Intent.

6. Summary of Key Information

Expected program budget for first year of new awards	See Section 5.1
Number of new awards pending adequate proposals of merit	See Section 5.1

Maximum duration of awards	3 years for TDEM and TCOR elements, 2 years for TPCOS; proposals with a term shorter than 2 years will be accepted, but are not encouraged.
Due date for Notice of Intent to propose (NOI)	**March 18, 2016** See Tables 2 and 3 in the *ROSES Summary of Solicitation*. [**Amended March 24, 2015]**
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	January 1 of the year following the proposal due date (except proposers from NASA Centers may plan for a start at the beginning of the fiscal year).
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-SAT
NASA point of contact concerning this program	The relevant Program Officers listed below with their areas of expertise, all share the same mailing address: Astrophysics Division Science Mission Directorate NASA Headquarters 300 E Street SW Washington, DC 20546-0001

Name	Program Element	Telephone	E-mail
Douglas Hudgins	TDEM	(202) 358-0988	Douglas.M.Hudgins@nasa.gov
Rita M. Sambruna	TPCOS	(202) 358-2166	Rita.M.Sambruna@nasa.gov
Mario R. Perez	TCOR	(202) 358-1535	Mario.Perez@nasa.gov

D.9 NANCY GRACE ROMAN TECHNOLOGY FELLOWSHIPS IN SPACE ASTROPHYSICS FOR EARLY CAREER RESEARCHERS

1. Overview

The goals of the Nancy Grace Roman Technology Fellowship (RTF) program in Astrophysics are to give early career researchers the opportunity to develop the skills necessary to lead astrophysics flight instruments/projects and become Principal Investigators (PIs) of future astrophysics missions; to develop innovative technologies for space astrophysics that have the potential to enable major scientific breakthroughs; and to foster new talent by putting early-career instrument builders on a trajectory towards long-term positions.

Institutions and organizations are encouraged to submit proposals to the RTF program on behalf of their outstanding early career researchers, including postdoctoral researchers, nontenured faculty members, term civil servants, and employees who intend to develop careers involving innovation and technology development for space astrophysics, with the individual as the PI of the proposal.

The RTF awards will be issued as grants, except in the case of Government employees, who will be directly funded.

The RTF is structured into three components with specific gates for entering the next phase. The first component is a one-year Concept Study Phase to generate the detailed plans and commitments for developing the proposed space astrophysics technology (Section 3.2). The final report from the Concept Study, due nine months after the start of the award, will be peer reviewed. A subset of the Technology Fellows will be selected to continue the fellowship and implement the plans conceived during the Concept Study. This Development Phase (Section 3.3), the second component of the RTF structure, is for an additional four-year duration. Finally, the third component is an opportunity for Fellows in the four-year Development Phase to apply for start-up funds (Section 3.4) when they obtain a tenure-track, permanent civil service, or equivalent position.

Prospective proposers should note that for programmatic reasons, the Astrophysics Division plans to offer the Nancy Grace Roman Technology Fellowship program in 2015, and in alternate years thereafter.

2. Eligibility

To be eligible for an RTF award, proposal PIs must meet the following requirements at the time of submission:

- Be a recent Ph.D. recipient, defined as having graduated on or after January 1 of a year that is no more than seven years before the issuance date of this ROSES NRA. Individuals who have interrupted their careers for substantive reasons, such as family leave or serious health problems, and are more than seven years beyond the receipt of their Ph.D. degrees, may also be eligible. These applicants should make a written request

for prior concurrence from NASA before the due date for Notices of Intent to propose. NASA will provide a written response within three weeks of receipt of this request.

- Be in an early career position such as a postdoctoral, tenure-track, term civil service, or an equivalent nontenured position, as long as the employing institution assumes the responsibility of submitting the proposal with the individual as the proposed PI. In the event that a proposer's institution does not allow nontenured faculty or postdoctoral researchers to apply independently for NASA grants, the proposal may include a mentor as the Institutional PI with the fellowship applicant as the Science PI, as outlined in Section 1.4.2 of the *NASA Guidebook for Proposers.*

- Be a U.S. citizen or have lawful status of permanent residency (i.e., holder of a U.S. Permanent Resident Card, also referred to as the Green Card)[1] in order to support the RTF goal of fostering new talent by putting early-career instrument builders on a trajectory towards long-term positions at a U.S. institution.

- Not hold or have held a career civil service[2], tenure, or equivalent position on or before the submission deadline of this program.

- Not be a current or former recipient of the RTF or a PECASE award.

Note: Each year, NASA selects nominees for Presidential Early Career Awards for Scientists and Engineers (PECASE) from the exceptionally meritorious awardees sponsored by its research programs. PECASE awards recognize outstanding scientists and engineers who, early in their career, show exceptional potential for leadership at the frontiers of knowledge. Each Presidential award is of five-years duration. NASA does not issue a special announcement for the PECASE award. The awardees of the RTF Program constitute one (but not the only) source of nominations for the PECASE by the Astrophysics Division. If an RTF awardee is selected for the PECASE award, the duration for the combined honor is five years. Conversely, a current or former recipient of a PECASE award is not eligible to apply to the RTF.

3. Programmatic Information

3.1 Evaluation Criteria

The proposed research will be evaluated on how well it addresses the goals of the RTF program: to give early career researchers the opportunity to develop the skills necessary to lead a flight instrument/project and become Principal Investigators of future space astrophysics missions, to develop innovative space astrophysics technologies that have the potential to enable major

[1] The prospective fellow may submit a proposal to RTF if he or she is reasonably certain that the Green Card will be in hand soon after the proposal submission. The evaluation of proposals and announcement of selection takes approximately three to four months. NASA will not make an award if the submitting institution cannot certify the prospective fellow's eligibility.

[2] Both career conditional and career tenure civil servant appointments are referred to in this solicitation as simply career civil servants. The RTF program does not differentiate between these two types of appointments.

scientific breakthroughs, and to foster new talent by putting early-career instrument builders on a trajectory towards long-term positions.

Proposals submitted to NASA in response to this solicitation will be evaluated with respect to the criteria specified in Appendix C of the NASA *Guidebook for Proposers*, which are intrinsic merit, relevance, and cost realism/reasonableness.

In addition to the factors stated in the NASA *Guidebook for Proposers*, intrinsic merit will also include the following factors:

- The long-term commitment to the early career researcher's career development by the employing institution.
- Novel technology likely to enable innovative future space astrophysics missions. The proposed technology may be part of a suborbital activity, as long as the prospective fellow has a leading role in developing the technology and the proposed development effort is distinct from the separately funded suborbital activity.
- As a secondary factor, the potential for broader application of the technology to other NASA programs, and space-based programs of other Government agencies.

Relevance will be judged on the basis of the proposed technology to advance one or more of the three Astrophysics science themes: Cosmic Origins, Exoplanet Exploration, and Physics of the Cosmos.

3.2 Submission of Proposals for the Concept Study Phase

During the one-year Concept Study Phase, the Fellow should develop definitive information regarding the cost, risk, and feasibility of the proposed investigation. The content and format of the Concept Study Phase proposal should follow the *NASA Guidebook for Proposers* with the following additional guidance:

- The proposal should include a detailed budget for the one-year Concept Study Phase, plus a rough estimate of the budget required for the four-year Development Phase.

- The proposal should include a detailed work plan for the duration of the one-year Concept Study Phase, plus a notional plan for the first year of the Development Phase.

- The proposal should include a letter from the host institution indicating it recognizes that a substantial institutional commitment for laboratory space and other institutional resources will be required for the four-year Development Phase. The proposal should also contain a plan for obtaining firm institutional commitments for laboratory space and other institutional resources that will be required throughout the four-year Development Phase.

The award amount for the Concept Study Phase is judged according to the scope of the proposed work and the overall competition. Funds may be used for fellow's salary; support of students (undergraduate or graduate) and/or postdoctoral fellows who are involved in the proposed research; research expenses such as costs incurred in field experiments; purchase of

equipment and/or supplies, computing, travel, etc. If research collaboration is a component of the proposal, it is presumed that the collaborator(s) have their own means of research support; that is, an RTF award may not include expenses for personnel or activities at collaborating institutions, nor salary costs for other senior personnel. Proposers may request up to $100K for the Concept Study Phase.

3.3 Submission of Concept Study Report for Entering the Development Effort

Recipients of a Concept Study RTF will be eligible to apply for a four-year Development Phase award to implement the plans developed during the Concept Study. Continued funding throughout the Development Phase is contingent upon availability of funds and satisfactory progress. Progress will be assessed by review of required annual progress reports and a progress review near the end of the second year that will be based on milestones defined in the proposal. Fellows should present a Development Phase budget request in their Concept Study Report submitted to NASA nine-months after the award of the Concept Study through NSPIRES (instructions will be provided to the PI). The content and format of the Concept Study Report are the same as those for a full proposal as described in the *NASA Guidebook for Proposers.* The Concept Study Report will be peer reviewed and a subset of the Technology Fellows will be selected to continue the fellowship and implement the plans conceived during the Concept Study.

The award amount for the Development Phase is judged according to the scope of the proposed work and the overall competition. Funds may be used for the fellow's salary, support of students (undergraduate or graduate), and/or postdoctoral fellows who are involved in the proposed research; research expenses, such as costs incurred in field experiments; purchase of equipment and/or supplies, computing, travel, etc. If research collaboration is a component of the proposal, it is presumed that the collaborator(s) have their own means of research support; that is, an RTF award may not include expenses for personnel or activities at collaborating institutions, nor salary costs for other senior personnel.

Researchers who are in tenure-track, career civil servant, or equivalent positions at the time of requesting the four-year Development Phase support may request salary for the Fellow for up to four years (including associated fringe benefits and indirect costs), plus up to $500K for institutional indirect costs, capital equipment, and other project costs. Researchers who are not in tenure-track or equivalent positions may request salary for the Fellow for up to four years (including associated fringe benefits and indirect costs), plus up to $300K for institutional indirect costs, capital equipment, and other project costs. As discussed above, salary and other expenses should be responsive to NASA's evaluation criteria on cost realism and reasonableness.

The Concept Study Report and the request for Development Phase support must include an institutional commitment for laboratory space and other institutional resources required for the proposed work. NASA strongly encourages, but does not require, that the submitting institution contribute to the cost of the proposed project. Of special interest is support by the employing institution that would provide paid release time to enable the applicant to more fully concentrate on the activities related to the proposal. Institutional support of equipment purchase and co-funding of student and/or postdoctoral support would also be recognized as a valuable

contribution. Institutional commitments for these resources should be included in the Concept Study Report.

3.4 Submission of Requests for Start-up Funds

Active fellows who obtain a tenure-track, career civil servant, or equivalent position at an institution of their choice during their four-year Development Effort may request up to $200K (inclusive of indirect costs) in laboratory start-up funds (this is in addition to the $300K included in the Development Phase request). This funding is not guaranteed and is subject to peer review.

The start-up support is intended to aid Fellows in establishing a research group and/or laboratory in their new position, thus enabling them to continue their NASA-funded investigation. The funds may be used for the Fellow's salary, student and research associate salaries, purchasing laboratory equipment, and other expenses associated with establishing research efforts. Requests for start-up funds may not include expenses for personnel or activities at collaborating institutions, nor salary costs for other senior personnel.

To request start-up funds, Fellows should provide a short proposal detailing the research group they plan to establish upon starting a tenure-track, career civil servant, or equivalent position. Fellows should submit their proposals for start-up funds through NSPIRES under the sponsorship of the institution at which they have obtained their new position (instructions will be provided to the PI). The proposal must describe any needed equipment and facilities and anticipated staffing plans (including the role of undergraduate students, graduate students, and postdoctoral researchers). The proposal must contain a strategy describing how the Fellow plans to sustain the research group or laboratory over the long term. A detailed budget with a narrative justification is required as part of the proposal. Fellows should also describe how the planned research group would benefit NASA and further its goals.

NASA encourages, but does not require, that the submitting institution contribute to the cost of the proposed project. An example is support by the employing institution that would provide release time to enable the applicant to concentrate more fully on the activities related to the proposal. Institutional support of equipment purchase and co-funding of student and/or postdoctoral support would also be recognized as a valuable contribution. Institutional commitments for laboratory space, matching or startup funds, and other institutional resources required for the proposed work should be included in the proposal.

Proposals for start-up funds may be submitted at any time the Fellow meets the requirements described above.

NASA does not require a data management plan for proposals to this program element.

4. Summary of Key Information

Expected program budget for first year of new awards	Concept Studies: $0.9M (FY 2016) Development Phase $1.2M (FY 2017)

Number of new awards pending adequate proposals of merit	About 3-6 for the study phase; 1-2 for the development phase
Maximum duration of awards	Two years for a new study phase; the four-year Development Effort would augment the original award and extend the period of performance; start-up funds for a current fellow would augment the original award without extending the period of performance.
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-RTF
NASA point of contact concerning this program	William D. (Billy) Lightsey Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 306-1896 E-mail: Billy.Lightsey@nasa.gov

D.10 NuSTAR Guest Observer – Cycle 2

NOTICE: Amended on September 10, 2015. This amendment releases final text for Program Element D.10 NuSTAR Cycle 2. The new text replaces in its entirety the prior version of the text released with ROSES-2015 in February 2015. The significant changes are as follows:
1. Cycle 2 Phase-1 Proposal due date has been delayed from November 16, 2015, to December 11, 2015;
2. Cycle 1 and 2 Observing periods have been extended by one month: Cycle 1 = April 1, 2015 – April 30, 2016; Cycle 2 = May 1, 2016 – May 31, 2017;
3. Due to the termination of operations of the Suzaku mission, joint NuSTAR-Suzaku observations are no longer possible;
4. Proposals for joint NuSTAR-XMM observations are now solicited under this call (Section 1.3.1)
5. Proposals for observations of anticipated Targets of Opportunity are now permitted in Cycle 2 (Section 1.3.3);
6. The policy regarding the disposition of Cycle 2 proposals for as yet unobserved Cycle 1 Category C targets is clarified (Section 1.3);
7. The time available for observations of bright sources has been increased from 300 ksec to 1 Msec in Cycle 2 (Section 1.3.1);
8. Limited funding is now available for support of Cycle 2 Category C U.S. Principal Investigator proposals (Section 2.1).

1. Scope of Program

1.1 Overview

The Nuclear Spectroscopic Telescope Array (NuSTAR) Small Explorer (SMEX) mission is the first orbiting telescope to focus light in the high energy X-ray region of the electromagnetic spectrum (E > 10 keV), with an effective bandpass of 3 – 79 keV. The observatory provides a combined improvement in sensitivity and spatial/spectral resolution by factors of 10 to 100 over previous missions that have operated at these energies. The NuSTAR Guest Observer (GO) Program solicits proposals for basic research relevant to the NuSTAR mission.

The second round of Guest Observations (Cycle 2) will commence on or about May 1, 2016, and last for a nominal period of 13 months. Prospective proposers should note that NuSTAR operations are currently funded through the end of FY 2016; the extension of operations beyond September 30, 2016, is contingent upon the outcome of the 2016 NASA Astrophysics Senior Review process. Further details on the Cycle 2 program may be found on the NuSTAR Guest Observer Program website (http://nustar.gsfc.nasa.gov). Observing time will be made available to scientists at both U.S. and non-U.S. institutions. There will be a one-year exclusive-use period for data from approved GO observations selected through Cycle 2 proposals. This period will begin at the time of receipt of the processed data by the observer. Proposals for observations of anticipated Targets of Opportunity (ToO) may now be submitted in Cycle 2 (see Section 1.3.3). Individuals interested in the potential execution of an unanticipated ToO observation should consult the NuSTAR website (http://nustar.caltech.edu/page/too_policy).

In addition to investigations utilizing NuSTAR observations only, proposals involving coordinated observations with the European Space Agency (ESA)/NASA X-ray Multi-Mirror Mission (XMM)-Newton X-ray observatory are also solicited as part of this Call for Proposals. Prospective proposers of joint NuSTAR-XMM observations should refer to Section 1.3.1 for details governing the evaluation and implementation of such proposals. Opportunities for carrying out NuSTAR observations in conjunction with NASA's Chandra X-ray Observatory or XMM-Newton are also available through the relevant Calls for Proposals for those observatories. Note that "snapshot" (1 - 2 ks) observations are performed by NASA's Swift mission for most NuSTAR observations.

All NuSTAR public science data will be made freely available through the High Energy Astrophysics Science Archive Research Center (HEASARC) website (http://heasarc.gsfc.nasa.gov). Funding for investigations selected under the NuSTAR GO Program is available only to individuals at U.S. institutions who are identified as Principal Investigators (PIs). U.S.-based Co-Investigators on foreign-led proposals are not eligible for funding. Proposers from non-U.S. institutions should read the Foreign PI Affiliation instructions document, which is downloadable as a PDF file from the NSPIRES web page for this program element. These proposers are strongly encouraged to include a letter of commitment promising financial support.

Proposals for investigations directed primarily towards the conduct of supporting theoretical or laboratory astrophysics research or ground-based observations relevant to the NuSTAR mission are not solicited by this program.

1.2 The NuSTAR Mission

NuSTAR is a PI-led NASA Small Explorer (SMEX) mission. The PI institution is the California Institute of Technology, which is responsible for the overall direction of the program. NASA's Jet Propulsion Laboratory (JPL) is responsible for the project management. The lead domestic partners include Columbia University, the University of California at Berkeley, and NASA's Goddard Space Flight Center. The Danish Technical University Space Centre and the Agenzia Spaziale Italiana (ASI) made significant contributions to the hardware and data analysis software development, respectively. ASI is an active participant in mission operations, providing access to the Italian ground station at Malindi, Kenya. The NuSTAR Mission Operations Center (MOC) is at the University of California at Berkeley Space Sciences Laboratory, and the Science Operations Center (SOC) is at the California Institute of Technology.

NuSTAR was launched on June 13, 2012, from the Kwajalein Atoll in the Marshall Islands into a low-Earth orbit with an inclination of 6 degrees and an altitude of 650 km × 610 km. After an initial six-week checkout period, the NuSTAR baseline mission was initiated for a period of two years (through July 31, 2014), with a subsequent two-month extension through September 30, 2014. As a result of the NASA 2014 Senior Review process, the mission was extended through September 30, 2016, and funding was approved for initiation of a GO program. NuSTAR has been invited to participate in the 2016 NASA Astrophysics Senior Review process; the extension of mission operations beyond September 30, 2016, is contingent upon the results of that review.

The observatory has no expendables, and the orbit lifetime is estimated at ~10-15 years from launch.

The NuSTAR spacecraft carries two sensitive, co-aligned, narrow-field instruments. Table 1 summarizes the primary performance specifications. Details of the observatory and instrument design can be found at http://nustar.caltech.edu/, as well as the NuSTAR mission paper, Harrison et al. (2013; ApJ, 770, 103).

Table 1: Key Observatory Performance Parameters

Parameter	Value
Energy range	3–78.4 keV
Angular resolution (HPD)	58″
Angular resolution (FWHM)	18″
FoV (50% resp.) at 10 keV	10′
FoV (50% resp.) at 68 keV	6′
Sensitivity (6–10 keV) (10^6 s, 3σ, ΔE/E = 0.5)	2×10^{-15} erg cm^{-2} s^{-1}
Sensitivity (10–30 keV) (10^6 s, 3σ, ΔE/E = 0.5)	1×10^{-14} erg cm^{-2} s^{-1}
Background in HPD (10–30 keV)	8.4×10^{-4} counts s^{-1}
Strong source (>10σ) positioning	1.5″ (1σ)
ToO response time	< 24 hr
Slew rate	0.06° s^{-1}
Settling time	200 s (typically)

1.3 NuSTAR Cycle 2 General Information

The total amount of time allocated to Guest Observations during the second year of the GO phase of NuSTAR is expected to be 8.5 Ms (50% of the total observing time). Of this, it is anticipated that up to 6.5 Ms of observing time will be awarded to selected Cycle 2 investigations; of the remaining time (~ 2Ms), up to 1.5 Ms is expected to be awarded to joint NuSTAR/XMM-Newton proposals submitted to the XMM-Newton Cycle 15 Call for Proposals, and up to 0.5 Ms to NuSTAR/Chandra Joint Observing Projects proposals submitted to the Chandra Cycle 18 Call for Proposals. It is anticipated that approximately 40 investigations will be selected for implementation under the NuSTAR Cycle 2 GO program.

The remaining 50% of the observing time will be allocated through the NuSTAR Project as follows: NuSTAR legacy survey observations (~ 25% of the total observing time); NuSTAR PI discretionary time, including unanticipated ToO observations open to the scientific community (~ 15%); and calibration observations, engineering tasks, and resolving operational issues (~ 10%).

The NuSTAR legacy surveys represent extensions of the Galactic and Extragalactic surveys conducted during the baseline mission. Community input will be solicited to assist in defining the surveys (see http://www.nustar.caltech.edu for additional information); the NuSTAR science team will perform the detailed planning, execution, and analysis of the surveys. The legacy survey data will be immediately made public, and source catalogs and spectra will be released as

soon as they have been processed. Individuals with accepted ToO observations will have exclusive use of the data for a six-month period commencing at the time of receipt of the processed data.

During the baseline mission, the remainders of the fields of view for specific targets were used to create a wide-area serendipitous source survey. This practice is being continued in the GO phase, with the incorporation of nontarget background sources in GO fields into the legacy surveys. However, the PI for a particular GO investigation will retain data rights for the duration of the exclusive-use period to any background source in the field of his/her primary target that is of interest beyond contributing to the wide-area survey statistics.

Proposers to this program must clearly describe how their proposed investigation capitalizes on the unique capabilities of NuSTAR. Investigations involving targets previously observed or currently planned for observation with NuSTAR must provide a justification of the need for the requested additional data. The "as-flown" observing timeline may be found at http://www.srl.caltech.edu/NuSTAR_Public/NuSTAROperationSite/AFT_Public.php. A list of NuSTAR team observations that are scheduled to be carried out prior to the beginning of Cycle 2 and legacy observations that are planned to be performed by the end of Cycle 2 will be made available on the NuSTAR website http://nustar.caltech.edu/page/researchers. The list of approved NuSTAR Cycle 1 Guest Observations is available at http://heasarc.gsfc.nasa.gov/docs/nustar/c1_acceptarg.html.

For those Phase-1 proposals recommended for implementation, the approved target observations will be assigned a Category (A, B, or C) and a recommended exposure time. Note that for proposals including observations of multiple targets, the priority of each target observation will be separately categorized. Assuming nominal operational efficiency, it is anticipated that observations of all Category A and B targets will be carried out during Cycle 2; however, any Category A and B targets *not* observed during Cycle 2 will be carried over to Cycle 3. Observations of Category C targets will be executed on a best-effort basis. Category C targets not scheduled during Cycle 2 will not be carried over to Cycle 3; such observations may be reproposed to a future observing cycle. Finally, note that observations of Cycle 1 Category C targets that have not yet been scheduled may be reproposed to Cycle 2. However, as such observations may be executed prior to the end of Cycle 1, the disposition of the corresponding Cycle 2 proposals will be taken into account by NASA at the time of the Phase-1 selection. Multiyear observing proposals will not be accepted in Cycle 2.

Proposers should note that NuSTAR's low-inclination (6°), low-Earth orbit allows, on average, a maximum continuous exposure of ~ 3.2 ksec per 5.7 ksec satellite orbit for targets below a declination of ~ 65°; for targets at high declination, |Dec| > 65°, the unocculted period may be longer. Unless there is a specific reason why the total elapsed time of an observation is important, proposers should specify only the net exposure time required for achievement of the proposed science goals, excluding observational efficiency factors (Earth occultations and South Atlantic Anomaly passages) in the observing time calculation; specification of the total elapsed time requirement will result in the observation being classified as time-constrained.

1.3.1 *Programmatic constraints*

Proposals are subject to the following limitations:

- The requested time per observation (i.e., a single "visit" to a target) must be between a minimum of 20 ks and a maximum of 500 ks;
- Targets for which time-constrained observations are requested will only be guaranteed scheduling if they are designated Category A (see Section 1.3.2);
- Due to the limited number of ground station passes, observations of high count-rate targets place significant demands upon mission resources. Consequently, it is anticipated that the time available for observation of bright sources (predicted instrument count rate above 100 counts s^{-1} for both modules using 50% PSF extraction with no deadtime) during Cycle 2 will be limited to a maximum of 1 Msec. Note that for very bright sources the instrument count rate is significantly lower than the incident event rate due to deadtime effects;
- Sources with fluxes > 10^{-11} ergs s^{-1} cm^{-2} within 5° of the target may cause increased nonuniform background gradients due to stray light. Users should check observations for potential stray light contributions using the tools available at http://nustar.caltech.edu/page/researchers. If a field is designated as 'heavily contaminated,' proposers should submit a request for a feasibility analysis to nustar-help@srl.caltech.edu at least two weeks prior to the proposal submission deadline;
- Proposals for joint NuSTAR-XMM programs in Cycle 2 will be accepted up to a total of 1.5 Msec of XMM-Newton observing time. Joint proposals must provide a strong justification of the need for both the NuSTAR and XMM-Newton data for achieving the primary science goals;
- Proposals requesting coordinated observations with other space- or ground-based observatories will be designated time-constrained and subject to the restrictions described in Section 1.3.2.

Individuals may submit the same proposal to XMM AO-15 and NuSTAR Cycle 2. Note, however, that the XMM-Newton AO-15 approved program will be taken into account during the NuSTAR Phase-1 peer review, and duplicate observations of the same targets by NuSTAR will typically not be awarded. Category C NuSTAR-XMM observations will be treated the same as NuSTAR-only Category C observations.

1.3.2 *Time-Constrained Observations*

Time-constrained observations are defined as observations that must be performed within a specific time window. This includes phase-constrained observations and coordinated observing campaigns with ground-based or space-based facilities. Time-constrained observations are subject to the following limitations:

- Time-constrained observations will not be guaranteed scheduling unless they are designated Category A. Time-constrained observations of Category B or C targets will be executed on a best-effort basis. Finally, note that the time constraint must occur during the Cycle 2 observing period (May 1, 2016–May 31, 2017).

- Monitoring programs are defined as investigations requiring two or more observations of the same target, each of which is considered a "visit." For such programs, the time interval between successive visits must be ≥ 14 hours. Note that programs in which the time interval between any two successive visits is ≤ 1 week will be designated as time-constrained.

For coordinated or time-constrained observations, it is the proposer's responsibility to inform the NuSTAR SOC of the observing time windows as soon as possible, but at a minimum of one month before initiation of the observations. In cases where observations involve coordination with other space-based observatories, the NuSTAR SOC will be responsible for communicating detailed schedule constraints with the relevant operations team(s).

1.3.3 *ToO Observations*

A total of up to 500 ks of NuSTAR Cycle 2 observing time will be made available for proposals to observe anticipated ToOs, subject to the constraints listed below. Data from observations of Cycle 2 ToO targets will have a six-month exclusive-use period, commencing upon receipt of the data by the proposer. Individuals interested in submitting ToO proposals should note the following:

- Proposals must provide exact, detailed trigger criteria and a realistic estimate of the probability of triggering the ToO during Cycle 2;
- Proposers should indicate on the Astrophysics Research Knowledgebase (ARK)/Remote Proposal System (RPS) proposal submission form (http://heasarc.gsfc.nasa.gov/ark/rps/) the response time required to meet the scientific objectives. Note that the minimum allowed required response time is 48 hours;
- ToO observations must have an astrophysical trigger and be designated as Category A to be eligible for execution; and,
- Subject to the Phase-2 review process, successful ToO proposals will be awarded funding only if the observation is triggered during Cycle 2.

It is the responsibility of the PI of an accepted ToO proposal to alert the NuSTAR SOC when the trigger conditions for their accepted ToO have been satisfied. This is done via submission of a NuSTAR ToO Request Form at http://nustar.caltech.edu/page/too_policy. Prior to submission of this form, the PI should verify the visibility of the target at http://www.srl.caltech.edu/NuSTAR_Public/NuSTAROperationSite/CheckConstraint.php. Accepted Cycle 2 ToO observations may be triggered until the end of the cycle. ToO observations not triggered during Cycle 2 will *not* be carried over to Cycle 3; such observations may be reproposed to a subsequent cycle.

ToO proposals to observe either a core collapse supernova in the Local Group or a Type 1a event to the distance of the Virgo Cluster will not be accepted. Such observations constitute part of the NuSTAR core science program; should either event occur, the observations will be planned and executed by the NuSTAR Project.

Note that unsolicited requests for observations of both anticipated and unanticipated ToOs may be submitted through the NuSTAR ToO web site

(http://www.srl.caltech.edu/NuSTAR_Public/GO/GOsubmit.php). Decisions regarding the disposition of unsolicited ToO requests will be made by the NuSTAR Principal Investigator or official designee. Unsolicited ToO observations are ineligible for support under the NuSTAR GO Program.

2. Programmatic Information

2.1 General Information

It is anticipated that up to $1.5M will be available for the support of Guest Observations during Cycle 2. Proposals ranked as Category A or B by the Phase-1 peer review panel will be given the highest priority for funding. However, limited support will be made available in Cycle 2 for Category C proposals that are executed during the cycle. NuSTAR GO funding is open to individuals who are identified as Principal Investigators and employed at U.S. institutions. The amount of funding awarded to PIs of Category A and B proposals will be based upon NASA's evaluation of the cost realism and reasonableness of the Phase-2 cost proposal. In addition, limited funding for support of costs such as travel, page charges, etc., will be held in reserve for Category C proposals executed during Cycle 2. NuSTAR science team members and scientists participating in the NuSTAR mission are eligible for support under this GO Program. Note that GO proposals from NuSTAR team members who receive funding from the Project must clearly demonstrate that the proposed investigation is not redundant with their science team responsibilities. Following the Phase-1 peer review, Phase-2 (cost) proposals will be solicited from eligible PIs and subsequently evaluated for cost realism and reasonableness by the Phase-2 review panel. Joint NuSTAR-XMM proposals selected through this Call for Proposals are eligible for funding *only* through the NuSTAR GO program (i.e., Phase-2 cost proposals should *not* be submitted to the U.S. XMM-Newton Guest Observer program).

2.2 Proposal Submission and Evaluation

The NuSTAR GO program utilizes a two-phase proposal process. Phase-1 proposals shall provide a detailed description of the proposed investigation, including the requested NuSTAR observation(s) and associated scientific/technical justification. U.S. PI's whose Phase-1 proposals are assigned a Category A/B rating by the peer review panel will be invited to submit a Phase-2 (cost) proposal; U.S. PI's whose Phase-1 proposals are assigned a Category C rating will be invited to submit a Phase-2 proposal only after execution of the corresponding Phase-1 proposal observations. Phase-2 proposals must include a detailed budget and accompanying narrative, providing a detailed description of how the requested funds will be used to achieve the goals outlined in the proposal. It is nominally expected that the PI of the Phase-1 proposal will serve as the Phase-2 proposal PI; however, for administrative purposes, an alternate individual from the Phase-1 PI's institution may serve as PI on the Phase-2 proposal. All proposal materials shall be submitted electronically, as specified below. NASA uses a single, uniform set of instructions for the submission of ROSES proposals. These instructions are given in the *NASA Guidebook for Proposers* (http://www.hq.nasa.gov/office/procurement/nraguidebook/). NuSTAR GO Proposers should follow these instructions, except where they are superseded by the instructions provided in the *ROSES Summary of Solicitation* or in this Appendix.

2.2.1. *Submission and Evaluation of Phase-1 NuSTAR GO Proposals*

Individuals submitting Phase-1 proposals to the Cycle 2 NuSTAR GO Program must adhere to the following proposal submission procedures:

- Proposers must submit their Phase-1 proposals (including the accompanying target forms) electronically through the ARK/RPS website at http://heasarc.gsfc.nasa.gov/ark/rps/. Instructions for submitting proposals via ARK/RPS are provided at the HEASARC NuSTAR web site: http://nustar.gsfc.nasa.gov/;
- Due to the nature of prospective investigations within the NuSTAR GO program, the Scientific/Technical/Management section of proposals is limited to four pages, in lieu of the default 15 pages specified in the *NASA Guidebook for Proposers*. The requirement for a table of contents in the body of the proposal is waived. No supporting material (e.g., Curriculum Vitae, pending/current support) is required or allowed;
- Optional LaTeX and MS Word templates for the Scientific/Technical/Management section are provided at http://nustar.gsfc.nasa.gov;
- The Scientific/Technical/Management section must be uploaded to the RPS website as a PDF file.

In order to be included in the review of proposals for this cycle of the NuSTAR Guest Observer Program, all proposal materials must be submitted electronically by 4:30 p.m. Eastern Time on the Phase-1 due date provided in Tables 2 and 3 of the *ROSES Summary of Solicitation*.

Proposals will be evaluated by a science peer panel with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*, where it is understood that the intrinsic merit of a proposal shall include the following factors:

- The suitability of using the NuSTAR observatory and associated data products for the proposed investigation, including the degree to which the investigation exploits the unique capabilities of NuSTAR;
- The feasibility of accomplishing the objectives of the proposed investigation with the requested observations, including the degree to which the proposal satisfies NuSTAR observational constraints and the feasibility of the proposed analysis techniques;
- The extent to which the proposed investigation complements and enhances the anticipated science return from the NuSTAR mission;
- The degree to which the proposed observation(s) places demands upon mission resources.

2.2.2 *Submission and Evaluation of Phase-2 proposals*

Subject to the availability of funding, eligible Phase-1 proposers will be contacted by the NuSTAR Program Scientist and invited to submit a Phase-2 (cost) proposal. Upon notification of selection of a Phase-1 proposal, proposers eligible for Phase-2 must follow the instructions for submitting a Phase-2 proposal given in the selection notification letter from the Phase-1 review. Phase-2 proposals must be submitted through the NASA NSPIRES electronic proposal website (http://nspires.nasaprs.com) by an Authorized Organizational Representative (AOR) of the proposing organization following the instructions in the *Summary of Solicitation* of this NRA.

The cost proposal shall consist of a "Budget Details" section (maximum of two pages) and a "Budget Narrative" section (maximum of two pages).

NASA will evaluate the Phase-2 cost proposals for cost realism and reasonableness. Comparison of the proposed cost to available funds will be performed as specified in Section C.2 of the *NASA Guidebook for Proposers.* Following the Phase-2 review process, proposers will be notified regarding the award amount for their Cycle 2 investigation(s) by NASA.

2.3 Supplemental Information

Further details concerning the proposal submission requirements and process can be found at the NuSTAR Guest Observer website (http://nustar.gsfc.nasa.gov/). This website provides instructions for completing the required proposal forms. A detailed description of the NuSTAR mission, including technical information relevant to the observatory, instruments, and observation feasibility can be found at http://nustar.caltech.edu/page/researchers. Answers to frequently asked questions can be found at http://heasarc.gsfc.nasa.gov/docs/nustar/nustar_faq.html.

3. Summary of Key Information

Expected program budget for Cycle 2 awards	~ $1.5 M
Expected number of new awards pending adequate proposals of merit	30 – 50
Maximum duration of awards	1 year
Due date for Notice of Intent to propose (NOI)	Option not available.
Due date for Phase-1 proposals	December 11, 2015, see Section 2.2.1.
Planning date for start of investigation	Funding will be awarded when the data are made available to the PI. NASA Center proposers should use October 1, 2016 (5 months after start of the Cycle 2 observing program) as a planning date for start of observations.
Page limit for Phase-1 proposals	4 pages. LaTeX and MS Word templates (available for download at http://nustar.gsfc.nasa.gov/) can be used for the proposals. No supporting material (e.g., CV, pending/current support) will be considered for Phase-1. Page limits include figures and references. This instruction supersedes the limits given in the *NASA Guidebook for Proposers.*
Relevance	This program is relevant to the Astrophysics strategic goals and subgoals; see Table 1 of ROSES and the reference therein. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.

Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook.
Submission medium	Electronic proposal submission is required in PDF format; no hard copy is required. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Notice of Intent to propose (NOI)	Option not available.
Web site for submission of Phase-1 proposal and required forms	http://heasarc.gsfc.nasa.gov/ark/nustar/ (Help Desk available at http://heasarc.gsfc.nasa.gov/ark/rps/help/)
Web site for submission of Phase-1 proposal via NSPIRES	Option not available.
Web site for submission of Phase-1 proposal via Grants.gov	Option not available.
Programmatic information may be obtained from the NuSTAR Program Scientist	Louis Kaluzienski Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0365 E-mail: louis.j.kaluzienski@nasa.gov
Technical questions concerning this program element may be directed to the NuSTAR Guest Observer Program Office	Craig Markwardt NuSTAR Mission Scientist Code 662 Goddard Space Flight Center National Aeronautics and Space Administration Greenbelt, MD 20771-0001 Telephone: (301) 286-1506 E-mail: Craig.Markwardt@nasa.gov

D.11 WFIRST SCIENCE INVESTIGATION TEAMS AND ADJUTANT SCIENTISTS

NOTICE: Updated September 21, 2015. A clarification regarding the award mechanism has been added. It is not the intent of this solicitation to inhibit any institution from proposing due to the contractual vehicles being contemplated. Please See FAQ 20.

Updated September 11, 2015. Normally, ROSES rules allow a two-page Curriculum Vitae (CV) for the Principal Investigator (PI), a one-page CV for Co-Investigators, and CVs for other team members are not permitted at all. However, for this Program element, in addition to the two-page CV for the PI, proposals may also include one-page CVs for all team members, even collaborators.

Amended on July 17, 2015. This Amendment releases final text for ROSES-2015 Appendix D.11, for WFIRST Science Investigation Teams and Adjutant Scientists. Required Notices of Intent (NOI) are due August 17, 2015, and the due date for submission of proposals is October 15, 2015.

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1. Scope of Program

This Program Element is to solicit proposals for Science Investigation Teams (SITs) for the Wide-Field InfraRed Survey Telescope (WFIRST), which will result in the formation of a Formulation Science Working Group (FSWG) for the mission. In addition to the WFIRST SITs, this call solicits an individual to serve as Adjutant Scientist for the WFIRST Wide-Field Instrument (WFI) and another as Adjutant Scientist for the WFIRST Coronagraphic Instrument (CGI).

WFIRST is the top-ranked large space mission recommended by the National Research Council (NRC) decadal survey of astronomy and astrophysics for 2012-2021, *New Worlds, New Horizons in Astronomy and Astrophysics* (NWNH, National Academies Press, http://www.nap.edu/catalog.php?record_id=12951).

Selected teams will be funded by contract to fulfill obligations outlined in this call for proposals. The selected SITs shall be responsible for the following tasks in support of the proposed scientific investigations with WFIRST:

- Development of scientific performance requirements;
- Design of notional observing program(s);
- Development of science data analysis techniques; and
- Development of simulations and data challenges to validate the above items.

The selected individuals for the Adjutant Scientist positions will be responsible for:

- Coordinating the performance requirements and observing program activities of the SITs, with respect to the relevant instrument (WFI or CGI);
- Acting as a liaison between the SITs and WFIRST Project scientists/relevant instrument team;
- Advising on the optimization of the use of the relevant instrument to achieve all WFIRST science outcomes in balance; and
- Coordinating with the astronomical community on science capabilities of the relevant instrument.

WFIRST is currently in a study, or preformulation, phase. NASA has not yet committed to starting WFIRST. The mission timeline described in this solicitation is notional and should be used for the purpose of writing proposals in response to this solicitation. The mission timeline (Section 1.2) and available funding profile (Section 2.5) assume a budget profile for the mission that represents neither a commitment from NASA nor an expectation of future appropriations.

This Program Element does not solicit proposals that would provide science instruments, the development of flight hardware, or ground-system software or other support. NASA does not currently intend to offer a solicitation for WFIRST instruments with a science component, hence scientists interested in participation in WFIRST should consider this to be the only near-term opportunity for such involvement. The intent of this solicitation is to put in place SITs and an FSWG that can support WFIRST science activities during the preformulation and formulation phases through to the critical design review (CDR).

It is anticipated that CDR could occur within five years of the FSWG selection, hence, for planning purposes, proposers shall assume that SIT activities will take place over a five-year term. For the sake of concreteness, the term will be stated as five years throughout this Announcement, but if the date of the CDR changes significantly, then the term of the SITs will be adjusted accordingly. At that time, NASA will decide how to continue or solicit new SITs via a second competition for the implementation and operational phases of WFIRST.

This call solicits the two Adjutant Scientist positions for a term also of five years, during WFIRST preformulation, formulation, and development. The same considerations for activities, term, and continuation/competition as apply to SITs shall apply to Adjutant Scientists.

NASA expects to enter formulation for WFIRST during the term of these SITs, and will stand up a WFIRST Project to execute the mission. The WFIRST Project, as referred to in this solicitation, should be considered to be the WFIRST Project Office, anticipated to be at NASA's Goddard Space Flight Center (GSFC), project scientists for assigned work at NASA's Jet Propulsion Laboratory (JPL), and project scientists of the WFIRST Science Center (which may be at one or more institutions).

1.1 Overview of this Opportunity

This solicitation solicits proposals addressing one or more of the following topical areas:

A. Galaxy Redshift Survey investigations, using baryon acoustic oscillation (BAO) and/or redshift space distortion (RSD) techniques;
B. Type Ia Supernovae (SNe Ia) investigations;
C. Weak Lensing and Cluster Growth investigations;
D. Exoplanet Microlensing investigations;
E. Exoplanet Coronagraphy investigations;
F. Guest Investigator (GI)/Guest Observer (GO) science: investigations using the archival data from the surveys conducted in support of the science investigations listed above and/or new observations with WFIRST, in order to optimize the science return from the GI/GO programs;
G. Adjutant Scientist position for the WFI (WAS)
H. Adjutant Scientist position for the CGI (CAS).

NASA intends to select proposals addressing all of the above topical areas, with each of topical areas A-F the purview of at least one SIT, and one individual for each of the Adjutant Scientist positions (see Sections 2.2 and 2.3). The science merit assessment of the investigation described in the proposal will be the partial basis for the proposal evaluation and selection, along with additional criteria described in Section 2.7. The investigations that successful proposers may eventually perform will have to comply with the science capabilities of WFIRST as they evolve.

The WFIRST Formulation Science Working Group (FSWG) will be formed from key scientists of the WFIRST Project, the Principal Investigators (PIs) of each selected SIT, the two Adjutant Scientists, and other *ex officio* members appointed by NASA. The *ex officio* members will include, at a minimum, several scientists from the WFIRST Project and the WFIRST Program Scientist at NASA Headquarters. The Project Scientist will chair the FSWG, with the Adjutant Scientists acting in the role of Deputy Chairs. The WFIRST FSWG will work with the WFIRST Project in the design, development, and implementation of the WFIRST observatory. The FSWG

will be responsible for the development and flowdown of scientific performance requirements for WFIRST. The FSWG is also the senior body for the adjudication of scientific issues concerning the mission.

The WFIRST Formulation Science Team will also be formed from this solicitation. This body will consist of the PI, Co-Investigators (Co-Is), and Collaborators of the selected SITs, in addition to all project scientists, Adjutant Scientists, other *ex officio* members appointed by NASA, as well as any representatives for possible future foreign collaborations. The Formulation Science Team will be collectively responsible during formulation for the science planning, simulations, and algorithm development necessary for conducting WFIRST science investigations.

Prospective proposers are advised that funds are not available for awards at the time of the release of this program element solicitation. The Government's obligation to make awards is contingent upon the availability of sufficient appropriated funds, as well as the receipt of proposals that NASA determines are acceptable for award under this solicitation.

1.2 Overview of the WFIRST-AFTA Mission

New Worlds New Horizons emphasized that a wide field infrared survey telescope could produce compelling science in areas ranging from the study of dark energy to the search for exoplanets. Provided the highest ranking in that report, NASA has been studying means of implementing the NWNH recommendation since then in the form of WFIRST, the Wide-Field Infrared Survey Telescope. The transfer of the Astrophysics Focused Telescope Assets (AFTA) to NASA in 2012 enables a truly compelling version of WFIRST. The mission presently envisioned in this solicitation uses one of the repurposed 2.4-m AFTA telescopes equipped with a wide field instrument (WFI), comprising a wide field camera with a field of view (FoV) 200 times larger than HST's powerful WFC3 to conduct definitive experiments in both dark energy and exoplanet microlensing and an integral field unit (IFU) for spectroscopy of supernovae and distant galaxies. The large aperture also permits a capable coronagraphic instrument (CGI), which will be incorporated as a technology demonstration instrument to provide the first space-based capability to characterize the atmospheres of any super-Earth planets close to the habitable zone around nearby stars. This mission addresses all three of the questions identified for astrophysics in the NASA 2014 Science Plan:

– *How does the universe work?*
– *How did we get here?*
– *Are we alone?*

In addition to these dedicated science investigations, WFIRST will also have great archival data value and a robust GO program. These other programs are not mere add-ons to the key science projects listed above, but are considered by NWNH to be "an essential element of the mission." Specifically, WFIRST will offer both "a guest investigator program… and archival studies to address a broad range of astrophysical research topics." Befitting WFIRST's pivotal role in advancing astrophysics in the next decade, it will provide a significant capability for addressing the NWNH science frontier discovery areas:

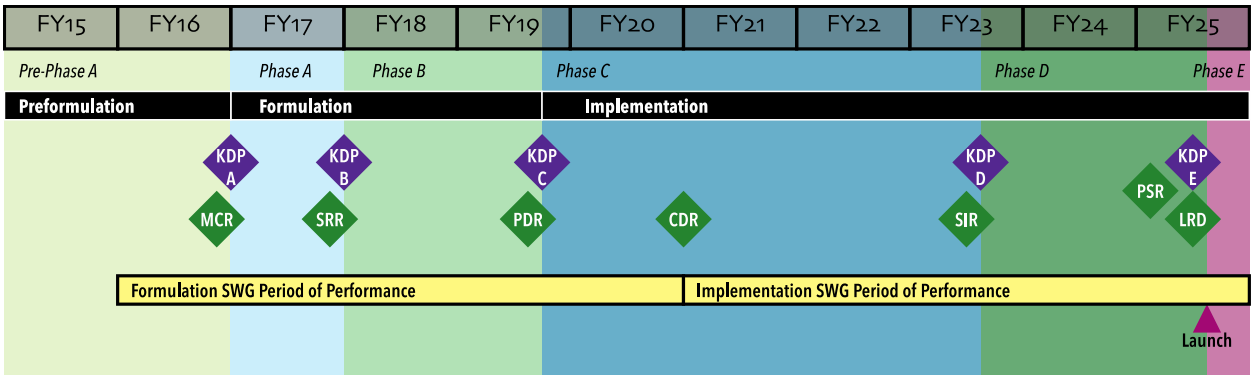
– Identification and characterization of nearby habitable exoplanets (via precursor science and technology),

– Time-domain astronomy (both for discovery and characterization),
– Gravitational wave astronomy (via time-domain astronomy),
– Astrometry, and
– The epoch of reionization.

As noted in NWNH, "WFIRST addresses fundamental and pressing scientific questions and will contribute to a broad range of astrophysics." The report further calls out time-domain astronomy specifically, stating that WFIRST will "open up the time domain to reveal remarkable surprises and enable the creation of massive databases that will be mined for decades."

WFIRST will be a strategic mission with competitively selected Principal Investigator (PI)-led science investigations. This solicitation represents the opportunity for the selection of these science investigations for the formulation phase only. The selected SITs, WAS, and CAS will not provide flight hardware. NASA or its partners will provide the mission's science payload components, mission-level components, including launch services and the spacecraft bus, and mission operations and science center capabilities to generate calibrated and validated Level 1 science data for use by the selected science investigations. During the formulation phase, the WFIRST Science Center is expected to be able to provide preliminary processing to convert simulated astronomical data into simulated Level 1 and Level 2 science data.

A notional timeline for the WFIRST project is shown below. While this is an executable plan, NASA has not yet committed to starting this mission (a mission's new start is designated Key Decision Point A, or KDP-A). Further, the timeline shown is that which results in a 2025 launch, which assumes a budget profile that should not be seen as a commitment from NASA nor as an expectation of future appropriations. The intent of this solicitation is to put in place SITs and an FSWG that can support WFIRST science through to the critical design review (CDR).



The WFIRST Reference Mission has been defined by NASA's WFIRST Study Office and the WFIRST Science Definition Team (SDT), as detailed in the *WFIRST-AFTA 2015 Report* (hereafter the SDT 2015 Report; available at http://wfirst.gsfc.nasa.gov/science/sdt_public/WFIRST-AFTA_SDT_Report_150310_Final.pdf). The two science instruments in the WFIRST Reference Mission are:

- A Wide-Field Instrument with multiple capabilities:
  - Imaging over a 0.28 square degree FoV, with 0.11″ pixel scale, using selectable filters: z (0.76 - 0.98μm), Y (0.93-1.19μm), J (1.13-1.45μm), H (1.38-1.77μm), F184 (1.68-2.0μm), W149 (0.93-2.00μm);

- Imaging Spectroscopy over the same FoV using a grism: 1.35-1.89μm, providing R=461$\lambda_{\mu m}$;
- Integral Field Spectroscopy over a 3″ square and 6″ square FoV, covering 0.6-2.0μm at R~80-120, with 0.075" pixel scale; and

- A Coronagraph Instrument with multiple capabilities:
  - Imaging over a 1.63″ FoV (radius), with 0.01-0.02″ pixel scale, 10^{-9} final contrast, 100-200 mas inner working angle, and covering 0.43-0.91μm in four bands (430-500nm, 520-610nm, 810-860nm, 860-910nm);
  - Integral Field Spectroscopy with the same inner working angle and contrast ratio, over a 0.82″ FoV (radius), covering 0.60-0.97μm in three bands (600-720nm, 700-840nm, 810-970nm) at R~70.

Operationally, WFIRST is expected to conduct a six-year primary observational operations mission that is divided among multiple surveys in support of its primary science goals. The preliminary time allocation of these surveys is given in the 2015 SDT Report (cf. its §3.10). Respondents to this solicitation should assume a time of roughly one and a half years available for the GO program (ibid, its §2.6), including GO time using the coronagraphic instrument.

Proposals for Science Investigation Teams shall strictly adhere to the WFIRST Reference Mission description provided in the SDT 2015 Report. The final configuration and capabilities of WFIRST may differ from this Reference Mission, in part as these evolve under advisement from the FSWG. The SDT 2015 Report, the relevant documents for this solicitation on NSPIRES, and all other public documents available on the WFIRST web site at http://wfirst.gsfc.nasa.gov, shall constitute the entirety of references made available to potential respondents to this solicitation.

2. Details of this Opportunity

2.1 Eligibility to Propose

Participation in this solicitation is open to individuals from all categories of U.S. organizations, including educational, industrial, and not-for-profit organizations, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), NASA Centers, the Jet Propulsion Laboratory (JPL), and other Government agencies. Proposers are responsible for and allowed to assemble investigation teams from any and all of these organizations. Proposers may also include individuals from foreign organizations as Collaborators. There is no restriction on the number of proposals submitted to this call in which any individual may participate. NASA reserves the right to make partial selections that may result in changing the participants on any selected investigation.

The PI is accountable to NASA for the success of the investigation, with full responsibility for its scientific integrity and for its execution within committed cost and schedule. Proposals shall identify and designate one, and only one, PI as the individual responsible for the proposed investigation.

Contributions from independently funded institutions to the proposed SIT are welcome. These could include, but are not limited to, assets funded by other Government agencies or institutions;

staff supported by other means who join the SIT as Collaborators; telescope time or data from non-NASA facilities; and proprietary data or tools for relevant scientific activities. All contributed portions of the SIT shall be clearly described in the proposal and differentiated from the NASA-supported portions, and the proposal shall further indicate whether the contributions are essential to the successful completion of the SIT tasks or are enhancing synergistic activities. Proposals including contributions from foreign partners should include any contributed foreign team members and shall be accompanied by institutional letters of support for the contributed resources.

A Co-Investigator is defined as an investigator who plays a necessary role in the proposed investigation and whose services are funded by NASA or are contributed by her/his employer. For proposals addressing multiple topics, a Lead Co-Investigator for each may be designated in the proposal. Every Co-I shall have a clearly defined role that is required for the successful development of the investigation, including the degree of involvement in deliverables for the investigation. Insufficiently justified Co-Is may result in the downgrading of an investigation and/or the offer of only a partial selection by NASA.

In addition to the PI and, if applicable, topical Lead Co-I(s), proposals may designate Deputies for those positions. NASA will later make a decision as to whether the Deputy positions are to be members of the FSWG, depending on project considerations, including the number and size of selected SITs. Such FSWG memberships can be appointed after selection and may be replaced during the period of performance. Any replacement of these key members in PI-led investigation teams, including but not limited to the PI, requires concurrence by NASA.

A Collaborator is an individual who is useful, but not as critical to the successful development of the investigation as a Co-Investigator. A Collaborator may not be funded through the award from this program element. A Collaborator may be committed to provide a focused contribution to the investigation for a specific task. If funding support is requested in the proposal for an individual, that individual must not to be identified as a Collaborator, but rather is to be identified as another category of team member (cf. the *Guidebook for Proposers*, §1.4.2).

Potential respondents to this solicitation should note the recent posting of a Request for Information (RFI) for WFIRST Industry Engagement (https://prod.nais.nasa.gov/cgibin/eps/synopsis.cgi?acqid=166149). Released on July 7, 2015, this effort will look into options for the commercial provision of major elements of WFIRST hardware, including the two science instruments. Please note the probable conflict of interest that would result from participation both in WFIRST science investigation teams and in the activities described in the RFI and any subsequent Request for Proposals. Respondents are advised to consider avoiding any such conflicts of interest. Individuals associated with successful proposals to both opportunities will be subject to an ethics review to ensure they have no conflicts of interest.

2.2 Proposal Topical Research Areas (Excluding Adjutant Scientist)

WFIRST SIT proposals will be accepted only from individual Principal Investigator-led teams that propose to meet one or more of the science outcomes listed below. For proposals addressing multiple topics, a primary topic shall be designated on the NSPIRES cover sheet and one or more

secondary topics shall be indicated. In the body of the proposal or in the table of Personnel and Work Effort, a Topical Lead, who may be the PI or a Co-Investigator, for each topic may be designated.

A. Galaxy Redshift Survey investigation: using one or more techniques employing a standard ruler (BAO) approach to measure the expansion rate and/or a growth of structure probe (RSD), design a survey that provides a statistically robust measurement of the history of dark energy and potential deviations from general relativity. For reference, see the SDT 2015 Report, section 2.2.4.

B. Type Ia Supernovae (SNe Ia) investigation: using one or more techniques employing a standard candle approach to measure cosmological distances with subpercent precision, design a survey that provides a statistically robust measurement of the history of dark energy and potential deviations from general relativity. For reference, see the SDT 2015 Report, section 2.2.2.

C. Weak Lensing and Cluster Growth investigation: using one or more techniques employing galaxy imaging surveys to measure dark matter clustering and the growth of structure with subpercent precision, design a survey that provides a statistically robust measurement of the history of dark energy and potential deviations from general relativity. For reference, see the SDT 2015 Report, section 2.2.3.

D. Exoplanet Microlensing investigation: using the gravitational microlensing technique, design a survey that provides a census of exoplanetary systems able to detect Mars-mass planets at 1 AU from their host star, searches for free-floating planets, and optionally allows surveying for transit photometry of two hundred times as many stars as was surveyed by Kepler. For reference, see the SDT 2015 Report, section 2.4.2.

E. Exoplanet Coronagraphy investigation: using the WFIRST coronagraph instrument, design a program to search for, and, if possible, discover and characterize exoplanets spectroscopically and survey debris disks. For reference, see the SDT 2015 Report, section 2.4.3.

F. Investigations to use archival WFIRST data as if under the GI program and/or to use new WFIRST data as if obtained under the GO program: design a specific broad and ambitious GI and/or GO project. A GI component should serve as a point of departure to develop requirements and strategies for the archive from the surveys conducted above to support the utilization of the archive by GIs in order to conduct science investigations in support of the Science Mission Directorate (SMD) goals and to help inform the design of a competed GI program. A GO component should serve as a point of departure to develop requirements on observing and data processing, archiving, and analysis and strategies for WFIRST mission operations and its science center in order to enable GOs to conduct science investigations in support of SMD goals, and help inform the design of a competed GO program. The observing time should derive from the proposed project, and need only comply with a reasonable fraction of the overall one and a half year allocation; of greater relevance is the extent to which the proposed project can adequately envelope a reasonable set of requirements for a multitude of other GO projects. For reference, see the SDT 2015 Report, section 2.6 and Appendix D.

Respondents, including research area E (exoplanet coronagraphy), should presume that the selection of coronagraph direct imaging target stars will be informed through a series of community-led, open workshops occurring in parallel with the implementation of WFIRST. The workshops will be organized by NASA, in cooperation with the relevant SITs and the FSWG. A NASA-appointed Coronagraph Target Working Group will provide advice on the selection of

target stars. It is expected that this formalism will be put in place during the period of performance of selected WFIRST SIT awards.

Respondents to all research areas, and in particular area F (GI and/or GO), should note that no expectation of the selected SITs being responsible for or involved in actual WFIRST observational projects is implied by this solicitation, nor should any obligation to carry out any projects be inferred. These efforts are strictly conjectural plans for use in the formulation of WFIRST, with the observing plans and the allocation of GO time during the mission being solicited in future call(s).

The Astrophysics Division has an objective to select an investigation to address each of the above topical areas. It is possible that the topical areas A-E may be addressed by more than one selected investigation, in which case teams may be asked to collaborate or work in parallel to achieve proposed goals; the FSWG will serve as the body to adjudicate on reconciling differing requirements definitions. NASA intends to select two or more investigations for Topic F; the expectation of the scale of these investigations is for them to be markedly smaller than those for Topics A-E. Each investigation will have a five-year term in order to provide adequate time to yield outputs appropriate to the anticipated timeline of the WFIRST mission development. As the end of this term approaches, NASA will decide how to solicit new or continued SITs via a second competition for the implementation and operational phases of WFIRST.

2.3 Required Content for WFIRST SIT Proposals

Proposals shall identify to the extent possible any resources needed to fulfill the responsibilities described in this solicitation. These include, but are not limited to: the funding required, access to high performance computing capabilities, data on the design of WFIRST, and unnamed individuals to be hired to play necessary roles in the investigation. For any high performance computing needs, to the extent possible, proposers shall quantify the requirements on scale and timeline and indicate whether the intent is to seek NASA-provisioned computing resources or whether access will be provided or sought by other means.

SIT proposals shall describe, as appropriate for the investigation:

- Specifics of how the team will address the six tasks listed in Section 3.1
- How the team will iteratively flow down science objectives to the measurements to be conducted;
- How the proposed observational plan will be developed;
- How to simulate synthetic astronomical ‘truth’ data (e.g., synthetic sky images, events, or objects);
- How to simulate the observational data output, including calibration;
- The planned analyses to validate derived astronomical information (e.g., dark energy parameters; exoplanet parameters);
- How the above will be used to fulfill the required tasks and deliverables outlined in Section 3; and
- How the above will be used to define scientific performance requirements and a complete plan for the science investigation.

Proposals must identify the role that each proposal team member will play in the proposed Science Investigation Team. NASA reserves the right to partially select proposals; nonselected proposal team members may not participate in the relevant science investigation portions. Similarly, NASA reserves the right to merge two overlapping proposal teams to maximize the merit of the science investigation in combination.

All proposals shall describe the proposed management approach, including the management organization and decision-making process, teaming arrangement, and the responsibilities of the PI and other team members. Proposals shall identify the key team members, shall describe the qualifications and experience of the key team members, and shall demonstrate that these qualifications and experience are commensurate with the technical and managerial needs of the proposed investigation.

Each proposal shall provide a budget justification for each year of the proposed effort and shall be supported by appropriate narrative material and budget details in compliance with the following instructions. The Budget Narrative must describe the basis of estimate and rationale for each proposed component of cost, including direct labor, subcontracts/subawards, consultants, other direct costs (including travel), and facilities and equipment. A required element of the Budget Narrative is a table of Personnel and Work Effort, summarizing the work effort required to perform the proposed investigation. The table must have the names and/or titles of all personnel necessary to perform the proposed effort, regardless of whether those individuals require funding. For each individual, list the planned work commitment to be funded by NASA, per period in fractions of a work year. In addition, include planned work commitment not funded by NASA, if applicable. Where names are not known, include the position, such as postdoctoral or technician.

2.4 Proposal Category and Required Content for Adjutant Scientist Positions

In addition to the WFIRST SITs, this call solicits proposals from individuals to serve as WFI Adjutant Scientist (WAS) and CGI Adjutant Scientist (CAS). WFIRST Adjutant Scientist proposals will be accepted only from individual Principal Investigators, without Co-Investigators. However, it is allowable for funds from this call to be used for additional personnel, such as postdoctoral researchers or support staff, to enable the efficient discharge of the responsibilities described above. As with the SITs, the two Adjutant Scientist positions shall be proposed for a term of five years, during WFIRST formulation. The WAS and CAS will serve as Co-Deputy Chairs of the FSWG. As the end of the term approaches, NASA will decide how to solicit new or continued WAS and CAS investigations via a second competition for the implementation and operational phases of WFIRST.

Proposals shall identify to the extent possible any resources needed to fulfill the responsibilities described in this solicitation. These include, but are not limited to: salary for the Adjutant Scientist, salary for additional personnel needed to enable the Adjutant Scientist’s functions, and support for travel, including for community interaction. Each proposal shall provide a budget justification for each year of the proposed effort and shall be supported by appropriate narrative material and budget details in compliance with the following instructions. The Budget Narrative must describe the basis of estimate and rationale for each proposed component of cost. List the planned work commitment to be funded by NASA, per period in fractions of a work year.

Adjutant Scientist proposals shall describe, in alignment with the statement of work in Section 3.1, intended approaches to:

1. Coordinate the performance requirements and observing program activities of the SITs and FSWG such that a comprehensive and self-consistent requirements specification will result;
2. Develop scientific performance and calibration metrics for instrument integration and test plans;
3. Enhance communication between the SITs and FSWG and the relevant instrument team, to ensure rapid transmission of information between them;
4. Optimize the use of the relevant instrument to achieve all WFIRST science outcomes in balance, especially the approach to conducting analyses to achieve equilibrium between competing science requirements and to build a consensus among stakeholders;
5. Inform and be responsive to the astronomical community on science capabilities of the relevant instrument, in collaboration with the WFIRST Science Center;
6. Conduct the agenda and actions of the FSWG meetings so as to address and resolve issues effectively; and
7. Identify and assess nascent science investigations that warrant consideration for WFIRST.

2.5 Funding Expectations

A notional funding profile is shown in Table D.11-1 for the available funding profile through FY 2020 that NASA is considering for the total of all investigations selected in response to this solicitation. The total science team funding for FY 2016 through FY 2020 would be roughly $33M in real-year funds. While this is an executable profile, NASA has not yet committed to starting this mission. Further, the available funding profile shown is that which results in a 2025 launch, which assumes a budget profile that should not be seen as a commitment from NASA nor as an expectation of future appropriations. The intent of this solicitation is to put in place SITs and a FSWG that can support WFIRST science through to the critical design review (CDR).

Table D.11-1. Available Funding Profile for all Selected Proposals ($M) in the five-year term.

Fiscal Year	FY16	FY17	FY18	FY19	FY20
Funding $M	$3.1	$5.0	$8.1	$8.4	$8.6

Proposers should take this guideline as an indication of the expected level of effort during the phases of WFIRST mission formulation, development, and operation. Proposers are required to include in their proposals a work plan and budget profile, and this will be assessed for realism and reasonableness as part of the evaluation. Proposers must fully justify the requested level of funding, including any significant deviation from the guideline provided in Table D.11-1.

The proposal must identify specific and essential responsibilities for each funded investigator of an investigation team. Travel costs should include the relevant FSWG meetings, typically at the NASA Goddard Space Flight Center (GSFC) or the Jet Propulsion Laboratory (JPL), WFIRST

Formulation Science Team meetings that take place at domestic venues, and community meetings. For planning purposes, proposers should assume three FSWG meetings and one Formulation Science Team meeting per year, two of which are held at GSFC and two of which are held at JPL. To estimate travel costs, proposers should allocate funds consistent with meetings held at the locations that result in the higher costs for attendance.

It is allowable for funds from this call to be used towards ground-based support observations. Eligible data are those that are acquired with dedicated observatory time by the proposing team directly or collaboratively and to which the team has data access rights. All such data shall be made public within one year of acquisition; proposals should include a brief explanation of how this will be done so as to make the data usable by the community. Formal institutional commitments for any proposed ground-based observatory time or contributions of necessary ground-based data shall be supplied in the proposal. It is also allowable for funds from this call to be used towards supporting the analysis of archival and new observations from NASA facilities.

Those investigators whose research requires high-performance computing should refer to the Research Opportunities in Space and Earth Science (ROSES)-2015 *Summary of Solicitation*, Section I(d), "NASA-provided High-End Computing Resources." This section describes the opportunity for successful proposers to the WFIRST SIT program to apply for computing time on either of two NASA computing facilities at the NASA Goddard Space Flight Center's Computational and Information Sciences and Technology Office or at the Ames Research Center's Advanced Supercomputing Division.

It is allowable for funds from this call to be used towards high-performance computing needs; such proposals must justify the use of these funds as opposed to available high-end computing resources. It is allowable for such assets to be provided by other institutions. Formal institutional commitments for any proposed high-performance computing time shall be supplied in the proposal.

For proposals addressing the Adjutant Scientist positions, it is allowable for funds from this call to be used for support personnel, including postdocs, but not Co-Is; see Section 2.4.

2.6 Request for Reviewer Names

Proposers are strongly encouraged to provide names and contact information for up to five experts qualified to review their proposal. These experts must not be from the institutions of the proposers. This information may be provided by a WFIRST web form that will be posted at http://science.nasa.gov/researchers/suggested-reviewers.

2.7 Evaluation of Proposals

Proposals will be evaluated by a peer evaluation panel with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers.* In addition to the factors given in the *NASA Guidebook for Proposers*, the intrinsic merit of a proposal for SITs shall include the following factors (not in priority order):

- The extent to which the proposed goals and objectives address WFIRST mission science outcomes as listed in Section 2.2 above;
- The extent to which the proposed investigation's design requirements development will equal or surpass the level of refinement provided in the WFIRST SDT 2015 Report;
- The readiness of the proposing team to conduct astronomical modeling, detailed simulations of WFIRST capabilities, and produce simulated WFIRST data products;
- The likelihood of success of the investigation's formulation activities (including, but not limited to: merit of resource usage, realism of the plan, resiliency to challenges, and organizational strategy);
- The ability of the proposing team in conducting astronomical research, especially in relevant fields;
- Demonstrated ability of the PI in leading successful research or community teams, particularly those using consensus-based decision-making strategies;
- The team's qualities of innovation, breadth of perspective, and enterprising scientific research.
- The level of effort that the PI and key Co-Is intend to focus on the proposed investigation with teams of more dedicated investigators receiving preference;
- Merits of observations (ground-based or space-based), if proposed; and
- Merits of plans for the dissemination of results in the form of publication, data archive, code repository, or other means, in coordination with the WFIRST Science Center.

In addition to the factors given in the *NASA Guidebook for Proposers*, the intrinsic merit of a proposal for Adjutant Scientist positions shall include the following factors:

- The extent to which the proposed goals and objectives address tasks as listed in Section 2.4 above;
- Demonstrated ability of the proposer in leading successful research or community teams, particularly those using consensus-based decision-making strategies;
- The readiness of the proposer to carry out the responsibilities listed for the position;
- The ability of the proposer in conducting relevant astronomical research;
- The familiarity of the proposer with the acquisition, calibration, and/or analysis of data from astrophysics instrumentation, particularly for space-based missions; and
- Plans for cost-effective community coordination activities to be carried out in coordination with the WFIRST Science Center.

2.8 Notice of Intent to Propose

All prospective proposers must submit a Notice of Intent (NOI) to propose by the deadline specified in Section 5. The Notice of Intent to Propose (NOI) is a required element for all prospective proposers.

Material in a NOI is deemed confidential and will be used for NASA planning purposes only. Only those who submit NOIs will be permitted to submit a full proposal or receive any WFIRST

Project updates or amendments that may occur, up to the time of the proposal submittal deadline. The NOI shall contain a brief summary of the work that is expected to be proposed and what topical research area(s) is/are intended.

2.9 Modifications to ROSES-2015 for WFIRST SIT/WAS/CAS Proposals

Proposers should be aware of several details of the submission of WFIRST SIT/WAS/CAS proposals that supersede the standard ROSES-2015 NASA Research Announcement and the *Guidebook for Proposers*.

The page limit for the Science/Technical/Management sections of the proposal is 15 pages, but 20 pages may be used when a proposal addresses more than one of science topics A-F listed in Section 2.2 above. Proposals for the WAS and CAS are limited to 10 pages.

The Notice of Intent to Propose (NOI) is a required element for all prospective proposers (Section 2.8).

A change was made in the ROSES-2015 solicitation after its initial release, modifying the required content of the Current and Pending Support section. Proposers should not include the cost of the team member (PI or Co-I) on all current project or pending proposals, but instead should provide only that individual's level of effort anticipated during the remaining period of performance of that project, through the WFIRST SIT/WAS/CAS period of performance.

Members of selected investigations in key roles (PI and Co-I) may be changed after selection, only with concurrence by NASA.

Since this solicitation is intended to award contracts rather than grants, the Budget Narrative should contain the table of personnel and work effort (cf. the *Guidebook for Proposers*, §2.3.10(a))

Since data archiving will be done in coordination with the WFIRST Science Center and will be evaluated as part of merit (see Section 2.7) no separate Data Management Plan will be required on the NSPIRES cover pages for this program element.

Normally, ROSES rules allow a two-page Curriculum Vitae (CV) for the Principal Investigator (PI), a one-page CV for Co-Investigators, and CVs for other team members are not permitted at all. However, for this Program element, in addition to the two-page CV for the PI, proposals may also include one-page CVs for all team members, even collaborators. [Changed, September 11, 2015]

2.10 Additional Proposal Information

Questions and answers regarding this solicitation will be posted on its NSPIRES index page. Information on the WFIRST mission may be found at http://wfirst.gsfc.nasa.gov, with particular attention to the SDT 2015 Report (http://wfirst.gsfc.nasa.gov/science/sdt_public/WFIRST-AFTA_SDT_Report_150310_Final.pdf). This Report, the relevant documents for this solicitation on NSPIRES, and all other public documents available on the WFIRST web site at http://wfirst.gsfc.nasa.gov, shall constitute the entirety of references made available to potential respondents to this solicitation.

3. Statement of Work and Timeline

3.1 Statement of Work

All proposals must describe a complete science investigation with goals and objectives that address one or more of the WFIRST mission science objectives listed in Section 2.2 above. Investigators should fully explain their approach to the formulation of WFIRST as described, with an eye to the selection criteria in Section 2.7 above. This call solicits SIT, WAS, and CAS proposals for a term of five years, during WFIRST formulation and the beginning of implementation, at which point the project is anticipated to have passed its Critical Design Review (CDR). At that time, NASA will decide how to solicit the SITs, WAS, and CAS via a second competition for the implementation and operational phases of WFIRST.

The following statement of work should be assumed in the development of appropriate work levels, skill sets, and other resources for the proposal. All dates provided below are notional for planning purposes of this proposal only; see the timeline in Section 3.2.

- Pre-Phase A: selection through KPD-A
  - Science Investigation Concept documentation
  - Preliminary scientific performance requirements flowdown
  - Preliminary science architecture with key drivers
  - Preliminary observational strategy concept
- Phase A: through KDP-B
  - Updated science investigation concept
  - Baseline architecture for execution of science investigation
  - Baseline scientific performance requirements at project/system level
  - Updated observational strategy concept
- Phase B: through KDP-C
  - Updated science investigation concept
  - Updated observational strategy concept
  - Finalized scientific performance requirements
  - Preliminary design documentation for execution of science investigation
- Phase C: through end of term
  - Updated science investigation concept
  - Baseline observational strategy concept
  - Baseline design documentation for execution of science investigation

Selected SITs will be responsible for the following tasks in support of the proposed scientific investigations with WFIRST:

1. Development of scientific performance requirements for topical areas A-E, associated with cosmology, microlensing, and coronagraphy, and similar but limited scientific requirements for topical area F;
2. Design of observational strategy concept(s);
3. Development of science data analysis techniques;
4. Development of ground and space calibration requirements;
5. Development of simulations and data challenges to validate the above items; and
6. Development of complete plans, in coordination with the WFIRST Project, for all aspects (as applicable) of science simulations, precursor observations, ground calibration, observational needs, data processing, ancillary data collection/incorporation, analysis, dissemination and documentation of the proposed science investigation.

The first element is an effort to develop detailed science requirements, including calibration requirements, operational requirements, data processing requirements, and preliminary or contemporaneous data needed from sources other than the relevant WFIRST survey. These data needs can include archival data or new observations from other facilities or, in the case of contemporaneous needs, from WFIRST. The second element is directed at producing a detailed notional observing sequence in support of the science investigation, taking into account the synergies and balance with all other science investigations. This notional observing plan will be used to validate the requirements and simulations portions of the efforts to demonstrate a means of achieving requisite dataset qualities. The actual operations plan for WFIRST will be decided in a later mission phase. The third effort concerns the development of preliminary data analysis and data processing approaches that will be necessary to apply to Level 1 data in order to achieve the science investigation goals. The fourth effort is aimed at producing a considered enumeration and explanation of the needs of a given science investigation for data taken to calibrate or characterize the instrument and the science data, whether during ground calibration (including precursor observations or data from other facilities) or in space (including both dedicated calibration data and science data from other investigations). The fifth effort concerns conducting simulations for WFIRST data, including astronomical modeling, observation simulation, data challenges, and the dissemination of data products suitable to support the development of pipeline products by the WFIRST Science Center. This modeling should also serve to validate the chosen hardware, operations, and analysis requirements. Proposals should assume that the data challenges will include pipeline elements being developed by the WFIRST Science Center, and should plan the effort accordingly. The sixth effort is the production of a thorough plan for how the science investigation can be carried out, from the time of inception through to completion, to serve as a guide for the scope of the science investigation and of its relationships to other science investigations, hardware elements, and the WFIRST Science Center.

The selected SITs will provide their findings via the PIs to the FSWG, where optimization across WFIRST will be decided. The FSWG will provide a notional detailed breakdown of how the four and a half years of defined time (the sum total of all investigations in the first six years, excepting the GO program allocation) will be distributed over the course of the mission. This will include operational observing plans for each science investigation, considering target fields and cadences. The FSWG oversees the balancing of notional observing allocations across the

SITs, in order to demonstrate a means of achieving requisite dataset qualities for all topical areas. The actual operations plan for WFIRST will be decided in a later mission phase.

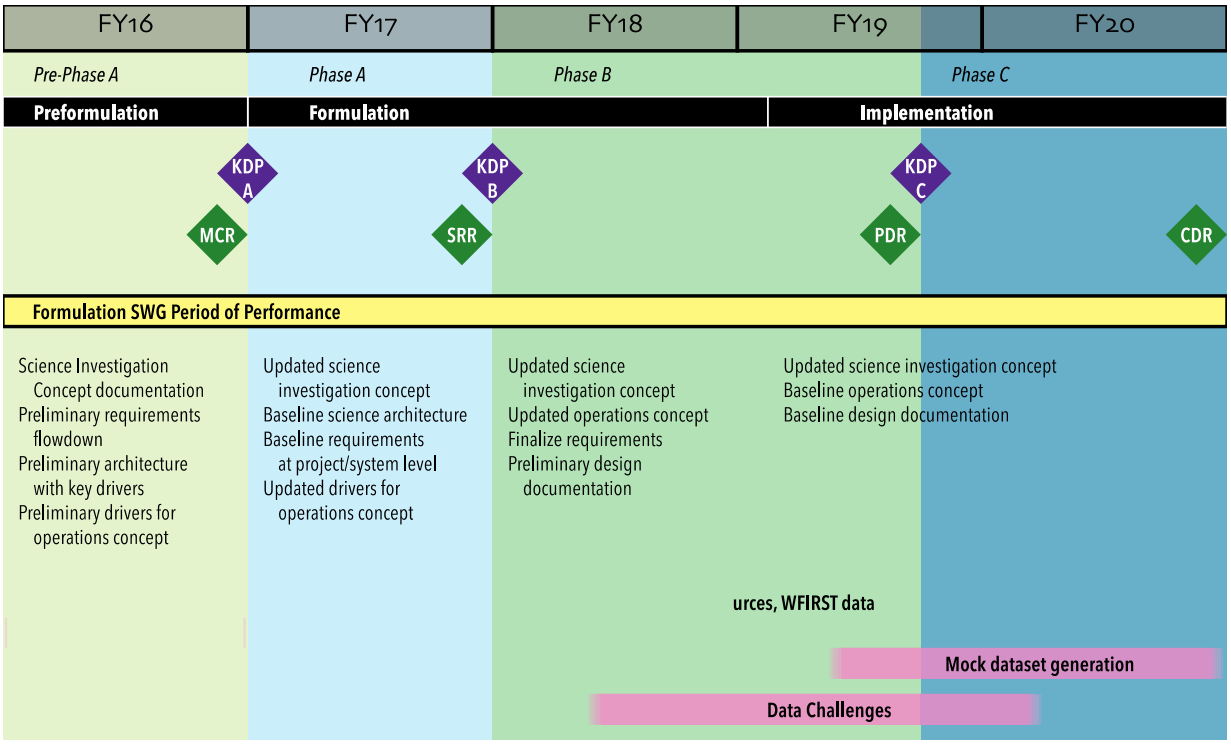
Selected Adjutant Scientists will be responsible for:

1. Coordinating the performance requirements and observing program activities of the SITs and FSWG with respect to the relevant instrument (WFI or CGI), including leading the documentation of such requirements as input to the WFIRST Project;
2. Developing, in conjunction with the instrument team, scientific performance and calibration metrics for instrument integration and test plans;
3. Acting as a liaison between the SITs and FSWG and the relevant instrument team, including participation in telecons or other meetings for these teams to ensure rapid transmission of information between them;
4. Advising the WFIRST Project Scientist and FSWG on the optimization of the use of the relevant instrument to achieve all WFIRST science outcomes in balance, including leading analyses to achieve equilibrium between competing science requirements;
5. Interacting, in collaboration with the WFIRST Science Center, with the astronomical community on science capabilities of the relevant instrument;
6. Fulfilling committee duties as Co-Deputy Chairs of the FSWG, particularly in the organization of agendas for FSWG meetings; and
7. Identifying and analyzing emergent science investigations using the relevant instrument that warrant consideration for WFIRST.

The first element is an effort to synthesize the concepts being levied by each SIT on the relevant instrument and to identify synergies between investigations and, thus, recommend ways to balance requirements and optimize the overall science return of WFIRST. The second element requires that the Adjutant Scientists be cognizant of the activities of the SITs and the technical developments of the WFI and CGI instrument teams, and will coordinate/facilitate exchanges between these groups. For the third element, the selected Adjutant Scientists will provide their findings to the FSWG and will provide recommendations to the FSWG Chair on issues related to the optimization of science investigations across WFIRST. The fourth element requires frequent participation with the broader astronomical community to identify new discoveries, concepts, or approaches pertinent to WFIRST that may not obviously align with an individual SIT, such as interdisciplinary science or advances in astronomical techniques. The WAS and CAS may organize topical small workshops to aid in gathering information in support of this element. In addition, the CAS will chair the Coronagraph Target Working Group.

3.2 Timeline

A notional timeline for the WFIRST during the term of the solicited science investigation teams is shown below. The intent of this solicitation is to put in place SITs and an FSWG that can support WFIRST science through to the critical design review (CDR). As a guideline for proposers, the major activities anticipated during the term are shown, as are the necessary science-driven products for the reviews indicated.



3.3 Deliverables

Proposers shall plan investigations around the execution of the tasks outlined in this solicitation. The areas of responsibility described above provide guidance as to the expectation of the work being done by each SIT, and proposers are provided latitude in presenting a compelling case for their approach to fulfilling these responsibilities. At a minimum, however, all proposed investigations must plan for the following deliverables to NASA via the WFIRST Project, so that they can be publicly disseminated through the WFIRST Science Center:

- As warranted by events provided in the timeline in Section 3.2 above, documentation describing detailed scientific performance requirements;
- As warranted by events provided in the timeline in Section 3.2 above, documentation describing a design of observing program(s);
- As warranted, documentation of science data analysis techniques;
- Simulations and data challenges to validate the above items. These shall include items as appropriate to the investigation, including:
    - Source code for astronomical simulations, instrument simulation, observations, data processing, and science analysis;
    - Results (e.g. FITS files, data tables) from simulations;
    - As warranted, coordinated efforts with the broader community on data challenges resulting in workshops, publications, or other output.
    - Archives or data repository of products; and
- Algorithms used to perform processing of science data to serve as a basis for the WFIRST pipeline.

Proposers shall assume that they will coordinate with the WFIRST Science Center (WSC) on data challenges and public release of output. All deliverables as described above will be provided to the WFIRST Project such that they can be documented, archived, and distributed to enable homogenous public access across all WFIRST material disseminated by the WSC. See Section 4.3 for further information on intellectual property rights. It is anticipated that the WSC will be staffed during the period of performance to work on a WFIRST data pipeline, and that the SITs should rely on the WSC for certain aspects of the deliverables. The WSC-produced pipeline for data processing will rely on input from the SITs representing data produced by WFIRST observations; this pipeline will produce output Level 1 data to be analyzed by the SITs in the data challenges. Further, it is anticipated that WSC resources for facilities and support staff may be available to SITs to provide public dissemination of code and other data products, including maintaining accessible repositories and responding to end user queries.

As one of the standard deliverables for a contract, there are regular reporting requirements to be fulfilled by submission of electronic documents in a standard format to the WFIRST Project Scientist. Reporting requirements for selected SITs shall consist of the following:

- Monthly brief (~1 page) status summaries reporting progress, anticipated near-term work, potential challenges with that work, and identifying any concerns regarding the coevolution of the work of the SIT and that of the WFIRST Project.
- An annual report recapitulating the accomplishments of the prior year.

For the WAS and CAS, reporting requirements shall consist of the following:

- Monthly brief (~1 page) status summarizing recent developments and providing perspective on the progress of scientifically relevant formulation activities from both the related SITs and the instrument team.
- An annual report recapitulating the accomplishments of the prior year.

Additional reporting requirements may be negotiated during the contracting phase.

4. Roles for WFIRST Science Investigation Teams

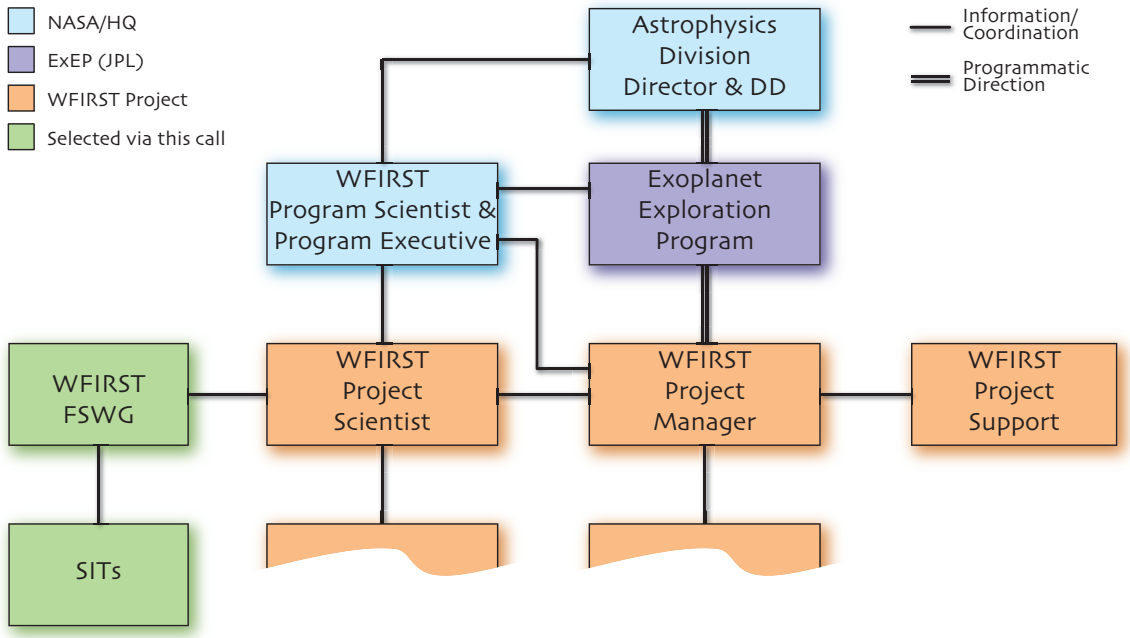
4.1 Interaction between WFIRST SITs, the WFIRST Project, and NASA Headquarters

All investigators selected under the WFIRST SITs program will coordinate their efforts with the WFIRST Project, primarily via the Project Scientist or other assignee.

For administrative matters relating to the submission, review, selection, and funding of proposals under the WFIRST SIT program, the point of contact is the WFIRST Program Scientist at NASA Headquarters given in Section 5 below. The organizational hierarchy of WFIRST is shown in the chart below.

NASA intends to select one or more proposals via this solicitation, with the PIs of the SITs and any Lead Co-Investigators, and Deputies as designated in the proposal and accepted by NASA representing the selected investigations on the WFIRST FSWG. In addition to the these members and the two Adjutant Scientists, the FSWG will consist of select scientists in the WFIRST Project, other *ex officio* members appointed by NASA, and representatives of foreign partnerships, once such partnerships are arranged. The Project Scientist will chair the FSWG, with the Adjutant Scientists acting on the FSWG in the role of Deputy Chairs. The WFIRST

FSWG will work with the WFIRST Project in the design, development, and implementation of the WFIRST observatory.



All proposal team members will be members of the WFIRST Science Team, which will consist of the selected SITs, WAS, and CAS, in addition to all WFIRST Project scientists. The only exception to this rule are graduate students; graduate students may participate in the science investigations of the WFIRST Formulation Science Team through their major advisor who is a member of the WFIRST Formulation Science Team. A postdoctoral fellow who is funded by a WFIRST SIT will be a member of the WFIRST Formulation Science Team, even if the postdoctoral fellow is unnamed at time of proposal submission.

Because WFIRST is a strategic mission, the plan is that the WFIRST Project will be managed in accordance with NASA policies and procedures for strategic missions, including NASA Procedural Requirement (NPR) 7120.5E, *NASA Space Flight Program and Project Management Requirements*. For this purpose, the SMD Associate Administrator will establish the WFIRST Project Office at Key Decision Point A (KDP-A), anticipated to occur within the first year of the period of performance of WFIRST SIT investigations. The WFIRST Project Manager reports to the Exoplanet Exploration Program Manager at JPL, who, in turn, reports to the Astrophysics Division Director in SMD at NASA Headquarters.

Any replacement or addition of key members in PI-led investigation teams, including but not limited to the PI, requires concurrence by NASA.

4.2 International Participation

International participation on WFIRST SITs is allowed. Owing to NASA's policy to conduct research with non-U.S. entities on a cooperative, no-exchange-of-funds basis, NASA does not normally fund non-U.S. research proposals or non-U.S. research efforts that are part of U.S.

research proposals. Rather, cooperative research efforts are normally implemented via agreements between NASA and the appropriate non-U.S. entity. Non-U.S. proposers, whether as primary proposers or as participants in U.S. research efforts, are expected to arrange for non-U.S. financing for their portion of the research.

As of the release of this announcement, NASA does not have formal agreements in place with foreign partners on contributions to WFIRST. This solicitation does not prohibit the inclusion of unfunded foreign Collaborators, but the selection of any such investigations does not impute an agreement between NASA and any foreign agencies on any in-kind contributions of science or hardware. It is anticipated that agreements between NASA and foreign agencies that take place during the term of this work will result in the addition of representative members to the FSWG and may necessitate additional coordination of the SITs with these new partners.

Any proposed international contribution essential to the success of the proposed investigation shall be described at the same level of detail as those of U.S. partners. Proposals with non-U.S. participation shall include a table listing: (i) non-U.S. participants (individuals, institutions), (ii) roles and responsibilities, (iii) funding organization, (iv) approximate value of contribution and method for estimating value, and (v) cross-reference to any Letters of Commitment in the proposal appendix.

4.3 Intellectual Property Rights

The PIs of the selected science investigations will have access to those WFIRST Study Office data products that are necessary for their proposed science investigations. This includes, but is not limited to, optical and instrument designs (such as can be distributed), technology development performance data, predicted mission environmental factors, and other relevant data.

It is expected that WFIRST-related code, models, tools, observations, and data produced during the formulation phase, including ground-based data taken in support of the investigations, will be made available to the public as soon as practicable, but not more than one year, following acquisition or production. Any exception to this policy must be justified on the basis of scientific merit, shall be proposed in response to this program element, must be peer reviewed, and must be accepted by NASA.

All such products of the SITs, WAS, and CAS shall be documented, validated, and calibrated in physical units that are usable by the scientific community at large.

5. Summary of Key Information

Expected program budget for new awards	~ $33M; see Section 2.5
Number of new awards pending adequate proposals of merit	No fewer than 9; see Sections 2.1, 2.2, and 2.3
Maximum duration of awards	5 years; shorter term proposals not accepted
Mechanism of Award	**Via contract; see FAQ question 20. [Clarified September 21, 2015]** ~~Via fixed-term, fixed price contract (TBR)~~

Due date for required Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*. August 17, 2015
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*. October 15, 2015
Planning date for start of investigation	December 1, 2015
Page limit for the central Science- Technical-Management section of proposal	15 pp; 20 pp for multi-topical area proposals; 10 pages for WAS/CAS proposals; see also Chapter 2 of the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Relevance	This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the ROSES Summary of Solicitation.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers*
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-WFIRST
NASA point of contact concerning this program	Dominic Benford Astrophysics Division Science Mission Directorate, NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1261 E-mail: Dominic.Benford@nasa.gov

D.12 SOFIA THIRD GENERATION SCIENCE INSTRUMENT

NOTICE: Updated September 11, 2015. The point of contact for this program element has been changed. The new point of contact is Hashima Hasan, who may be reached at nasa-sofia-po@mail.nasa.gov.

Amended on July 9, 2015. This Amendment releases the final text for ROSES-2015 Appendix D.12 for the SOFIA Third Generation Science Instrument. Proposals to this program will be accepted by a two-step process, in which the Notice of Intent is replaced by a limited, but mandatory, Step-1 proposal submitted by an Authorized Organizational Representative. Only organizations that submit a Step-1 proposal will be eligible to submit a Step-2 (full) proposal. Potential proposers are strongly encouraged to carefully read the information about the two-step proposal process in Section 7 of this program element. Mandatory two-page Step-1 Proposals are due August 19, 2015, and full 25-page Step-2 proposals are due by October 7, 2015. NASA will host a preproposal telecon for prospective proposers on July 23, 2015. See Section 7.3 for details.

1 Background

1.1 Programmatic Overview

The Stratospheric Observatory for Infrared Astronomy (SOFIA) consists of a German-built 2.7-meter (2.5-meter useable aperture) telescope mounted in a Boeing 747-SP aircraft supplied and modified by NASA. Operations costs and observing time are shared by the United States (80%) and Germany (20%). Flying at altitudes up to 45,000-feet, SOFIA observes from above more than 99 percent of Earth's atmospheric water vapor, thereby providing wavelengths for astrophysical observations not available from the ground. SOFIA plans to offer international science teams approximately 800 or more cloud-free, high-altitude science observing hours per year. More than 50 science observing programs, selected through a competitive peer review process, are expected to be undertaken each year. The primary impact of SOFIA is its science return, but other benefits are also provided. Compelling discoveries follow the development of new technologies, which can be more easily and inexpensively demonstrated on SOFIA than with other NASA space missions. Young scientists-in-training, educators, and journalists also fly on SOFIA, allowing the observatory to serve as both a valuable training platform and as a public ambassador for science.

Six first-generation science instruments have already been commissioned, and two additional second-generation instruments are scheduled to complete their development by mid CY 2016. The associated instrument development teams are from institutions in both the U.S. and Germany, and the instruments include imaging, spectroscopy, and polarimetry capabilities (see http://www.sofia.usra.edu/Science/instruments/). The SOFIA observatory has been designed to support observations at wavelengths from 0.3 μm to 1.6 mm. The observatory is capable of high-resolution spectroscopy ($R > 10^7$) in discrete wavelength bands at wavelengths between 5 and 600 μm with its existing instruments. SOFIA's diffraction-limited imaging longward of 45

μm can produce the sharpest images of any current or planned IR telescope operating in the 30 to 330 μm region.

Additional information on SOFIA may be found at http://www.sofia.usra.edu/ and in the SOFIA Program Library available under "Other Documents" on the NSPIRES page for this ROSES program element.

The SOFIA Observatory concept embodies a number of key advantages that make it a unique tool for astronomy. One of the most important advantages is that SOFIA is a near-space observatory that comes home after every flight. Therefore, its scientific instruments can be exchanged periodically, unlike most space missions, to accommodate changing science requirements and to incorporate new technologies. The ability to update instrumentation is a tremendous advantage, as was amply shown by the five servicing missions to the Hubble Space Telescope. As such, a key, long-standing goal for SOFIA has been to include an instrumentation program that would periodically introduce new technologies that, in turn, would enable new scientific frontiers to be explored. Accordingly, in keeping with this long-standing goal, the development of the next, or third generation, SOFIA Science Instrument (SI) is being sought. This call is issued to solicit proposals to provide such an instrument.

1.2 Intent of this ROSES Program Element

This solicitation specifically requests the successful proposer to:

- Identify a specific scientific goal and/or objective for SOFIA (either included in or beyond that which is already defined) that clearly and succinctly presents a substantial, compelling scientific case for developing new capabilities on SOFIA, that can be realized by a third generation instrument, and is consistent with the science recommendations of the 2010 decadal survey in astronomy and astrophysics and NASA's overall scientific goals and objectives (see Section 2.3 and 2.4); and,
- Propose a specific scientific investigation that addresses the above scientific goal and/or objective and requires the development of a new, third generation SOFIA science instrument; and,
- Design, build, and deliver to NASA the third generation SOFIA science instrument that will enable the proposed specific scientific investigation, as well as a set of future Guest Investigations (GI) that are not possible or feasible with the existing suite of first and second generation SOFIA instruments.

This call is specifically not intended to solicit:

- Proposals for individual scientific research and development projects;
- Proposals for technology development or demonstration projects; and
- Proposals for ground-based technology test beds.

Proposals submitted in response to this solicitation should address all aspects of instrument delivery, including, but not limited, to:

- Instrument design and fabrication, including a high-level preliminary schedule and cost estimate;

- Development of instrument control software and data reduction and analysis pipeline software;
- Expected instrument performance;
- Both Concept Study and Implementation/Delivery phases; and
- Commissioning and delivery (through acceptance review) and any required post delivery support.

This solicitation also provides an opportunity for NASA to inform potential partners that they are invited to submit proposals that make use of SOFIA as a platform for other than astronomical observations. This opportunity is discussed in more detail in Section 5.10 below.

2 Third Generation Science Instrument: Management, Goals, and Objectives

The SOFIA instrument selected under this solicitation will be installed as a Facility Science Instrument (FSI). Observing time will be made available to the scientific community through the SOFIA time allocation committee (TAC) process. The instrument will not be a PI-class instrument, and the instrument team will retain no rights to the instrument or to its data products beyond commissioning. However, it is anticipated that the instrument award may include an allocation of Guaranteed Time Observations (GTO) as described in Section 5.7.

It is expected that proposals submitted in response to this solicitation will be evaluated and selected through a two-phase competitive process. In the initial proposal phase (Phase I), all compliant proposals submitted in response to this solicitation shall be subject to a scientific and a top-level technical peer review. Based on the results of that review, not more than two (2) proposals will be selected to conduct an Instrument Concept Study (ICS). During the ICS phase (Phase II), the selected proposing teams will receive $250,000 each to mature their instrument design and refine the schedule and budget for fabrication, installation, and commissioning of the instrument on SOFIA. Further details of the required content of the ICS will be provided to the instrument teams at the time of their selection to proceed to this phase. The ICS phase will last not more than four months. At the end of the ICS phase, one instrument concept will be selected to move forward into implementation.

NASA reserves the right to condense the evaluation and selection process to a single phase competitive process, resulting in the selection of a single instrument at the end of the proposal phase, if it should be in the best interests of NASA to do so.

This solicitation is not restricted to instruments capable of addressing a single scientific investigation. Instead, proposers are encouraged to make a compelling case for their proposed instrument based on its intrinsic scientific capabilities and its ability to address a wide range of critical data needs for current and future NASA science goals. This case will be an important factor in the evaluation process and selection decision.

2.1 NASA Management of the Instrument Development and Commissioning

The review of the proposals submitted to this ROSES program element, as well as the Phase II ICSs, will be managed by the Astrophysics Division within the Science Mission Directorate at NASA Headquarters, with programmatic and technical support from the SOFIA staff at the NASA Ames Research Center (ARC). In accordance with this role, a conflict avoidance plan has been implemented to prevent any ARC personnel involved in the evaluation process from having had any involvement with proposers and proposing teams (see Section 3.1). During the ICS phase, selected instrument teams should anticipate regular, but brief, progress/status meetings via telephone or video conferencing, and at least an early (first) progress review emphasizing an understanding of requirements and a final (second) review of the instrument’s preliminary design and implementation plan (schedule, cost, and risks). Teams should also expect to provide short (three pages maximum) status reports on four-week intervals of technical, schedule, cost, and risk progress during the ICS.

The product of the ICS shall be a Preliminary Design-level description of the instrument, including both its flight software and the necessary ground data processing software, a preliminary instrument calibration and commissioning plan, the development management plan, a more detailed cost estimate, and a more detailed development schedule.

A detailed management plan for the development of the selected instrument shall be developed during the ICS. This plan shall include, at a minimum, Project Management Reviews on six-week intervals with the SOFIA Program Office and a Critical Design Review near the start of actual instrument implementation. The schedule shall include a set of milestones. Completion or delivery status of these milestone products will be reviewed by the SOFIA Program Office at six-week intervals.

2.2 SOFIA Program Management

SOFIA is a program within the Cosmic Origins theme of the Astrophysics Division of the Science Mission Directorate (SMD). SMD has assigned program management for the SOFIA Program to the NASA Armstrong Flight Research Center (AFRC); now that development of SOFIA has been completed and it has entered its operations phase, program management will be transitioned to the Ames Research Center.

The execution of the SOFIA Program is carried out under three management directors: the Operations Director, whose staff is responsible for the aircraft operations and the AFRC ground facilities; the Science Mission Operations Director, whose staff is responsible for science observing proposal solicitation and evaluation, science flight planning, pipeline processing of the science data, maintenance of the SOFIA science archive, and operation of the SOFIA Facility Instruments; and the Observatory Systems Director, whose staff is responsible for Observatory improvements and new science instrument development (once they are selected by NASA Headquarters).

2.3 NASA Astrophysics Goals

The *2014 Science Plan for NASA's Science Mission Directorate* (http://science.nasa.gov/about-us/science-strategy/) articulates NASA's strategic objective in astrophysics as "discover how the universe works, explore how it began and evolved, and search for life on planets around other stars." Three broad scientific questions emanate from this objective:

- How does the universe work?
- How did we get here?
- Are we alone?

Each of these questions is accompanied by a science goal that shapes the Astrophysics Division's efforts towards fulfilling NASA's strategic objective:

- Probe the origin and destiny of our universe, including the nature of black holes, dark energy, dark matter and gravity

- Explore the origin and evolution of the galaxies, stars and planets that make up our universe
- Discover and study planets around other stars, and explore whether they could harbor life

NASA's astrophysics program seeks to be responsive to scientific priorities articulated in reports from the National Academy of Science's National Research Council, especially decadal surveys. The most recent decadal survey in astronomy and astrophysics is *New Worlds, New Horizons in Astronomy and Astrophysics* (NRC, 2010), available at http://www.nap.edu/catalog.php?record_id=12951.

2.4 SOFIA Science Goals and Objectives

The objective of SOFIA is to make fundamental scientific discoveries that contribute to our understanding of the universe through rigorous collection, analysis, and distribution of unique scientific data. This objective will be accomplished by extending the range of astrophysical observations significantly beyond that of previous infrared airborne observatories through increases in sensitivity and angular resolution. SOFIA will also make contributions in the areas of education and public outreach and in demonstrating new instrument technology.

SOFIA, with its large suite of science instruments and broad wavelength coverage, is capable of undertaking a significant breadth of different investigations. A sample of science programs that might be undertaken with SOFIA is described in *The Science Vision for the Stratospheric Observatory for Infrared Astronomy*, available in the SOFIA Program Library and at http://www.sofia.usra.edu/Science/science_cases/.

3 Technical Information, Requirements, and Constraints

3.1 Eligibility to Participate in This Solicitation

Proposals from any category of organizations or institutions, U.S or non-U.S. (but non-German), are welcome to respond to this solicitation. Specific categories of organizations and institutions that are welcome to respond include, but are not limited to, educational, industrial, and not-for-profit organizations, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), NASA Centers, the Jet Propulsion Laboratory (JPL), and other Government agencies.

The Memorandum of Understanding (MOU) between NASA and Deutsches Zentrum für Luft und Raumfahrt (DLR), the German Aerospace Center, gives the authority for selection of German participants in the SOFIA program to DLR. Therefore, German institutions are not eligible to submit proposals to NASA in response to this solicitation. Co-Investigators (Co-Is) at German institutions are not precluded from participating on a no exchange of funds basis in proposals submitted by non-German institutions.

Non-U.S. participation in this solicitation is subject to the requirements set forth in the ROSES-2015 NRA.

In addition to its role as the site of the SOFIA Science Center, NASA ARC is eligible to submit and participate in proposals in response to this solicitation. The Science Mission Directorate at NASA Headquarters will manage the evaluation and selection process, while the SOFIA staff at ARC and AFRC will be serving in a supporting capacity. In order to manage ARC's two potential roles as both proposers and SOFIA science support, SMD has established functional and organizational firewalls between the SOFIA program and its associated Science Center, and those components of ARC that might participate in proposals. These firewalls ensure that personnel identified as supporting SMD in the solicitation process will protect all nonpublic information from all proposers, including those at ARC, and will be free of financial and other conflicts of interest with proposers.

NASA contracts for the services of outside, non-Governmental organizations for support in evaluating proposals. Organizational conflicts of interest (OCI) between proposing, evaluating, and executing organizations must be avoided. The approach to avoiding organizational conflicts of interest depends on the unique characteristics and roles of each evaluating organization. For non-Governmental organizations, this requires limiting the extent to which the outside evaluating organizations can participate in proposal development and/or execution of the work proposed.

The NASA contract with Universities Space Research Association (USRA) for SOFIA science and mission operations includes technical evaluation support under this solicitation. In the event that any business unit of USRA has a proposed role as prime contractor, subcontractor, or participating organization, this support creates an organizational conflict of interest for USRA that cannot be mitigated. Because of this organizational conflict of interest, USRA personnel are precluded from participating in any capacity in support of a respondent under this solicitation.

USRA is a private, nonprofit corporation whose current membership consists of 105 universities in the U.S. and abroad that have graduate programs in space-related sciences and/or engineering. NASA has determined that there is a need for USRA employees to perform technical evaluations of proposals for new science instruments due to their unique qualifications. In order to address any apparent or actual organizational conflict of interest that arises between USRA employees and the 105 member universities of USRA, the NASA Assistant Administrator for Procurement has approved a waiver in accordance with FAR 9.504(e) to permit peer review evaluation by USRA employees for all proposals received, including proposals received from the USRA member universities.

3.2 Policies Applicable to this Solicitation

The following policies shall impose development requirements on the final instrument that results from the Phase II concept study down-select. These policies are stated here as an aid to defining the scope of the proposed instrument development effort, but need not be addressed in detail in the initial, Phase I proposal solicited here. That is, these details shall be addressed in the Phase II concept study for those proposals selected to conduct an ICS.

3.2.1 NASA Project Requirements

Owing to the significant expenditure of Government funds on the SOFIA instruments, integration on the SOFIA platform, and the complexity of the science flight operations themselves in utilizing the instruments, NASA intends to maintain an essential degree of insight into instrument development. NASA will exercise essential oversight to ensure that the implementation is responsive to NASA requirements and constraints. NASA requirements and constraints are spelled out in the *SOFIA Instrument Developer's Handbook* and in other documents available in the SOFIA Program Library. Overall project oversight of the instrument development will be provided by the SOFIA Instrument Development Manager at ARC (who reports to the SOFIA Program Manager, Project Scientist, and Observatory Systems Director). Within their areas of purview, additional independent oversight will be conducted by the SOFIA Chief Engineer's staff and the SOFIA Safety and Mission Assurance staff.

3.2.2 Safety, Reliability and Quality Assurance Requirements

The science instrument (SI) development must follow NASA Armstrong Flight Research Center (AFRC)-approved safety and mission assurance (S&MA) practices. Safety, reliability, and quality assurance requirements are described in the SOFIA Program Library.

3.2.3 NASA Center Role in Public Affairs and Outreach

Successful media relation activities require close cooperation between NASA and the selected investigations. NASA ARC, NASA AFRC, and NASA Headquarters have specific expertise in media relations and/or public affairs. All selected investigations shall coordinate media relations and/or public affairs with the SOFIA public affairs representation.

NASA is to be informed in a timely manner of any newsworthy mission event or issue before public release of information. Strategies for using new and social media shall also be developed collaboratively to insure that common and consistent messaging will occur in a timely manner. NASA and the selected investigation will establish and maintain a detailed coordination media relations plan and communication process.

3.2.4 Remediation, Termination, or Cancellation

For the Phase II Concept Study report, each selected Principal Investigator (PI) must include a commitment by the PI for the PI-managed instrument development cost, schedule, and award associated with the instrument. To maximize the efficiency of the concept study investment, the selected PI shall work with NASA to develop top-level science and technical performance requirements, including a set of performance metrics for project evaluation with NASA. These metrics shall include cost, schedule, and others, as appropriate.

Once an investigation has been selected for implementation following down-select of the concept studies, failure of the PI to maintain reasonable progress within the committed schedule and cost, and/or failure to operate within other applicable constraints, will require a review by NASA to ascertain if the development should continue. If, at any time, the cost, schedule, or scientific performance commitments made in the Phase 2 concept study report appear to be in peril, the

instrument development will be subject to cancellation, accompanied by appropriate award action, which may involve termination.

4 General Proposal Requirements

This Section provides general requirements for proposals submitted in response to this solicitation. Requirements on standard proposal content and format are provided in the ROSES-2015 NRA.

4.1 Science Requirements

Proposals submitted in response to this solicitation shall identify a specific scientific goal and/or objective for SOFIA, either included in or beyond that already defined, that requires the new capabilities provided by the proposed new instrument. The proposal should include, but not be limited to, the following science requirement elements:

- Proposals should describe a scientific goal or objective that emphasizes studies involving the understanding of specific physical processes that can only be uniquely enabled and accomplished through the analysis of data obtained by SOFIA with the proposed new instrument. A proposed scientific goal and/or objective that includes supporting observations from any other missions or facility is encouraged, but these supporting observations must be a secondary requirement to the SOFIA observations.

- The proposal should include one or more specific example science investigations that, if performed with the new instrument, would address the proposed goal and/or objective. Proposals should clearly state the relationship between the proposed goal and/or objective and these example investigations, their required measurements, and the capabilities required of an instrument to produce the associated data. These examples should be described briefly and succinctly and to a level of detail sufficient to demonstrate how the proposed new FSI will fully achieve the proposed science objectives.

- Intended studies should have linkage to broader science areas and provide context for other science investigations that could be conducted by the astronomical community as part of an overall SOFIA GI program. Proposed science instruments should avoid overlapping or duplicating capabilities from spaced-based, suborbital, ground-based facilities, or existing SOFIA instruments unless the proposal provides a compelling case that the proposed instrument will provide specific and substantial benefits.

- Proposers are encouraged to describe how investigations enabled by their proposed instrument are, or could be, valuably complementary to those possible with either the James Webb Space Telescope (JWST) or the Atacama Large Millimeter Array (ALMA). All proposers must clearly describe their instrument's SOFIA science merit and are encouraged, if appropriate, to describe how their instrument can enhance the science output of either JWST or ALMA.

- Proposals should discuss the potential, if any, for enhancing the SOFIA data archive. Data having broad science application beyond the GI investigations will be considered a significant strength of the associated proposals.

- The SOFIA Program is intended to perform focused science investigations that conclude with the timely publications of papers in peer-reviewed journals, as well as deposition of appropriately processed and calibrated data and derived products in designated data archives. As such, the proposals should include a discussion of the scope of these example science investigations (for example, the number of objects, the total time or number of flights to obtain the data, expected time to reduce and analyze the data, etc.) and of the estimated time it would take to produce published results.

4.2 Technical Requirements

This ROSES program element solicits the development of a science instrument, not technology or advanced engineering development projects. The proposal solicited here can be less detailed on technical, management, and cost, as these aspects are to be defined and detailed in the reports provided by selected Phase 2 concept studies. However, the proposals must contain enough technical detail to provide sufficient confidence that the preliminary instrument design can be completed in the allocated timeframe of the concept studies and that the final instrument can be successfully completed within the technical, schedule, and cost goals proposed. Proposals can accomplish this task by explicitly identifying the areas that will be the topic of further development in the concept studies. The proposal should include, but is not limited to, the following technical requirement elements:

- Proposals shall describe the proposed instrument design and describe what components or aspects of the design are subject to further definition or identification following the results of a funded concept study.

- Due to the relatively rapid instrument development period covered by this solicitation, any proposed instrument designs shall be compliant with the existing SOFIA interfaces, performance, and capabilities, as defined within the SOFIA Program Library.

- Proposed instruments shall use technologies that have a Technical Readiness Level (TRL) no less than 6. The proposal should present compelling evidence of the TRL assessment. Proposed instruments are expected to have mature technologies in order to insure an accelerated development for the third generation Facility Science Instrument (FSI). While the details of the technical architecture will be further developed in those proposals selected for Phase 2 concept studies, the proposal must identify all enabling technologies, and the NASA TRL should be defined and justified, establishing confidence that the instrument design can be adequately developed in the timescale of the concept study.

4.3 Cost Requirements

Proposals submitted in response to this solicitation shall include a high-level cost plan that is compatible with NASA's funding availability for this new instrument development (in Table 2); more refined cost estimates will be further developed for those proposals selected for a Phase 2 concept study. The following elements should be included:

- Proposals shall include a high level estimate for the full cost of the facility science instrument development. Since a detailed budget will be developed and validated through a funded concept study, if selected, proposals should provide only enough information to adequately demonstrate that the proposed instrument design could be developed, with a reasonable expectation, within the cost cap. Aspects of the design that are potential cost-drivers and those that may need further consideration as part of the funded concept study should be explicitly identified.

- Because SOFIA is a crewed NASA Program and as a special reminder, proposal cost estimates shall include the costs of complying with the airworthiness and mission assurance requirements and processes as described in the *Science Instruments System Specification* and *Instrument Developer's Handbook* documents.

- The proposal shall provide a brief budget justification for conducting a concept study. Proposals shall include the full cost of conducting the Phase II concept study if selected. The proposed cost for this study shall comply with the Phase II concept study cost cap.

- In the event that a Phase II concept study, if conducted, concludes that the costs would significantly and substantially exceed the available budget, the proposal should identify potential, high-level descope options to the instrument, along with associated, anticipated science impacts.

- In addition to the estimated cost of instrument development, the proposal shall include estimates for all other costs associated with the commissioning and acceptance of the instrument.

- Proposals including costs for NASA Centers shall conform to the full cost policy stated in the ROSES-2015 NRA.

- Proposals shall identify the methodologies and rationale used to develop the proposed estimated cost of the instrument development (including a brief discussion of sources of cost uncertainties) and provide a discussion on the proposed management approaches for controlling cost growth.

- If a proposal includes contributions that are essential to the success of the proposed instrument development or are in the critical path, the proposal shall include: (i) demonstrations of clear and simple technical and management interfaces in the proposed cooperative arrangements, (ii) explicit evidence that the proposed contributions are within the contributor's scientific and technical capabilities, and (iii) contingency plans

for coping with potential failures of proposed cooperative arrangements or, where no mitigation is possible, an explicit acknowledgement to that effect and an explicit rationale for accepting the risk.

4.4 Schedule Requirements

Although a detailed schedule will be a product of the Phase II studies, for planning purposes the initial, notional schedule requirement in this proposal will be to deliver the instrument to SOFIA for commissioning in calendar year 2018, or an implementation period of two to three years. NASA recognizes that this is significantly shorter than the typical development time for previous SOFIA instruments or for most other astronomical instrumentation, but this solicitation is explicitly seeking alternative or innovated approaches to achieving an accelerated delivery time.

In order to achieve this notional requirement, this solicitation is explicitly structured to avoid using technologies or designs that require lengthy development tasks. Instead, this solicitation seeks proposals that concentrate on using components that can be purchased or fabricated within the time scale of 2018. If this accelerated timescale is patently impractical or unfeasible for the proposed instrument concept, an alternative schedule may be proposed provided a detailed explanation for the new schedule is provided. If the proposal plans to meet the accelerated schedule, there must be a discussion with sufficient detail to reasonably indicate that a successful schedule can be developed in Phase II.

It is insufficient to simply claim that the project will meet the proposed schedule; to be rated as a major strength, a proposal must describe how this will be accomplished and what changes from current practices will be required in order to meet NASA's notional schedule described above.

5 SOFIA Related Technical Information and Requirements

Since the third generation instrument will be a facility class instrument on an operating and crewed NASA aircraft, the instrument must conform to current, established SOFIA Observatory policies and requirements. A discussion of the information and requirements that a proposer of this solicitation must consider is presented below and in the SOFIA Program Library.

5.1 SOFIA Observatory

The SOFIA telescope was supplied by Deutsches Zentrum für Luft und Raumfahrt (DLR), the German Aerospace Center, as a major part of the German contribution to the SOFIA observatory. The telescope is mounted in an open cavity in the aft section of the aircraft and views the sky through a port-side doorway. The pointing of the telescope is articulated by magnetic torquers, surrounding the spherical bearing and through which the Nasmyth beam passes. The telescope has an unvignetted elevation range of 23-58 degrees. Since the cross-elevation travel is only a few degrees, the airplane must be steered to provide most of the azimuthal telescope movement required for tracking. Hence, the list of targets to be observed determines the flight plan. The focal plane instruments and the observers are on the pressurized side of the 21-foot diameter bulkhead on which the spherical bearing is mounted, allowing a shirt-sleeve working environment for the researchers and crew.

5.2 SOFIA First and Second Generation of Instruments

Six first and two second generation Science Instruments (SIs) are commissioned or under development for SOFIA. These include three Facility Science Instruments (FSIs): the High-resolution Airborne Wideband Camera (HAWC+), the Faint Object Infrared Camera for the SOFIA Telescope (FORCAST), and the First Light Infrared Test Experiment Camera (FLITECAM). The U.S. facility instruments are maintained and operated by the SMO staff. FSI pipeline-reduced and flux calibrated data are archived for general access by the astronomical community after a one-year exclusive access (commonly referred to as "proprietary") period. In addition, the Focal Plane Imager (FPI+), which is the standard tracking camera for the SOFIA telelscope, is available as a FSI.

In addition, there are four Principal Investigator (PI) instruments maintained and operated by the SI teams: the Echelon-Cross-Echelle Spectrograph (EXES), the Field Imaging Far-Infrared Line Spectrometer (FIFI-LS), the German Receiver for Astronomy at Terahertz Frequencies (GREAT and the upgraded version upGREAT), and the High-speed Imaging Photometer for Occultation (HIPO). These instruments are designed to be less general in their potential applications than are the facility instruments. General investigators can propose to use these latter instruments in collaboration with the SI team that developed the instrument. In the present development plans, pipeline reduced data from the U.S. PI instruments will also be added to the science archive, again after a one-year exclusive access period. Two of the PI instruments are being developed in Germany (FIFI-LS, GREAT/upGREAT), although the German PI instrument FIFI-LS is available as a facility instrument under arrangement with DLR and the FIFI-LS team. The FIFI-LS data will be pipeline-reduced and flux-calibrated before it is placed in the data archive.

Further information about all the currently available instruments can be found at http://www.sofia.usra.edu/Science/instruments/index.html.

5.3 Observatory Capabilities

The most recent, comprehensive description of the Observatory capabilities can be found in "The SOFIA Observatory at the Start of Routine Science Operations: Mission capabilities and performance," Pasquale Temi, et al, *Astrophys. J. Suppl.* **212,** 24, 2014, and in the supporting documents found in the SOFIA Program Library.

5.4 Science Instrument System

The "SI System" is generally considered to consist of:

- One to three "PI Rack(s)" of SI equipment, installed over the center wing section of the main deck floor. The dual-bay, short, 19-inch rack frame structures are provided by NASA to the SI developer.
- A "Counterweight Rack," mounted on the Telescope Assembly, which can be populated with SI equipment. The19-inch rack frame structure is provided by NASA to the SI developer.
- The SI assembly (consisting of a cryostat, optics, and electronics), mounted at the instrument flange of the Telescope Assembly.

- Chopper interface electronics (optional) to drive the Telescope Assembly secondary mirror assembly (SMA) chopper.
- A SI installation cart used to transport the SI through the ground facility, onto the aircraft, and install the instrument on the Telescope Assembly instrument flange.
- Any laboratory stands or ancillary ground support equipment required for routine maintenance of the instrument.

5.5 Government Furnished Equipment

The SOFIA Program will support selected investigations' integration with the Observatory with equipment, services, and facilities. Government Furnished items include:

- PI rack(s),
- PI rack installation dolly,
- Counterweight rack,
- Counterweight rack installation cart,
- Laboratory space at DAOF for integration activities,
- Laboratory technicians and supplies to support integration,
- Observatory cryo-refrigerator system,
- Cryogens at the DAOF.

A more complete list of Government furnished equipment (GFE) and Government furnished services (GFS) for science instruments is described in the *Instrument Developer's Handbook* (available in the SOFIA Program Library).

5.6 Science Instrument Requirements

The general, overall requirements levied on any SOFIA instrument development project are available in a complete set of documents contained in the SOFIA Program Library. As such, the SOFIA third-generation science instrument requirements shall be included in this solicitation by reference to this library. The two most important documents include, but are not limited to, the *Instrument Developer's Handbook* and the *Science Instruments System Specification* document.

5.6.1 Top-Level Requirements

Proposals submitted in response to this opportunity shall include a list of performance requirements that the science instrument shall achieve in order to enable the proposed scientific goal and/or objective and the supporting example science investigations. These minimum performance requirements will form the basis of the top-level science and technical performance requirements. The final top-level science and technical performance requirements will be detailed in Phase II, if awarded concept study funding, and possibly further negotiated with the SOFIA Program prior to the SI System Requirements Review (SRR).

5.6.2 Instrument Safety and Mission Assurance

To ensure the safety of the personnel onboard the aircraft and of the SOFIA observatory, all equipment onboard the aircraft needs to be deemed airworthy before it can be flown. The

airworthiness approval process for science instruments is described in the *Instrument Developer's Handbook*. The *Science Instruments System Specification* document (available in the SOFIA Program Library), contains the requirements for airworthiness, safety, mission assurance, and quality assurance for Science Instruments. The *Instrument Developer's Handbook* also includes a section on instrument mission assurance and an example statement of work, as well as the process requirements listed in the example statement of work.

5.6.3 Data Analysis Pipeline and Data Management

Properly reduced SOFIA data will require a data processing pipeline that can account for, among other things, wavelength calibration, flat fielding, detector signatures, etc. The development and delivery of functioning algorithms, and associated supporting documentation, that can be used by the SOFIA Science Mission Operations Center (SMOC) staff to develop an in-house pipeline is a required component of the selected instrument. Functioning algorithms can include, for example, software code or pipelines developed and used by the development teams during the implementation and commissioning phases. Consequently, proposals should specifically address pipeline development, and any such activities should be accounted for in the proposed schedule and budget.

The SMOC will be responsible for data management after the instrument is commissioned, so a data management plan is not required as part of this solicitation.

5.7 Commissioning and Guaranteed Observing Times

If selected for a Concept Study, proposers shall estimate the number of flight research hours required to verify their instrument's performance, commission the instrument for use by general investigators, and obtain any required generic calibration data and provide that estimate at the end of the Concept Study phase. Observing time estimates do not need to include observatory overhead values (for telescope set-up and initial source acquisition), but should include observation overheads (time on target, time off-target for background subtraction via chop and/or nod, etc.). The estimated number of 'line operations observing hours' (observations with the aircraft parked on the ground) required to commission the instrument shall also be estimated during the ICS. The number of hours proposed for commissioning the instrument and for line operations should be kept as small as practical, and the number of hours estimated shall be justified with the appropriate documentation.

It is anticipated that the instrument award will include an allocation of time for a GTO program during the initial operating period. The magnitude and duration of the GTO time allocation will be determined by NASA upon successful commissioning of the instrument and will take into account both the cost and schedule fidelity of the development process and the performance of the instrument against its design specifications. The team will be required to submit a proposal for any GTO observations, and any GTO granted will be scheduled by the SMO Director within two years following the formal acceptance of the instrument.

5.8 Summary of Instrument Development Policies

Table 1: Summary of Instrument Development Policies

Responsibility	Facility Science Instruments
Development	PI responsibility
Preliminary design review (PDR)	Yes
Critical design review (CDR)	Yes
Pre-ship review (PSR)	Yes
Acceptance Review (AR)	Yes
SI specification (including airworthiness and mission assurance)	Applies
Commissioning time	As proposed
Guaranteed time observer (GTO) time	TBD hours
Oversight and approvals	NASA
Interface to SOFIA Program	NASA
Operations	SMO (after acceptance)
Data analysis	GI responsibility
Data analysis pipeline	Delivery of functioning algorithms by PI; implemented and operated by SMO
Data archiving	Raw, reduced, and calibrated
General investigator (GI) access	Yes
Retirement	Per *Instrument Developer's Handbook*

Reviews indicated by "Yes" in Table 1 shall be conducted with NASA-assigned reviewers and a NASA review chair. The content of these reviews is described in the *Instrument Developer's Handbook* and are based on *Criteria for Flight Project Critical Milestone Reviews* (GSFC-STD-1001) and *NASA Systems Engineering Handbook* (SP-2007-6105) tailored appropriately for SOFIA, i.e., content applicable to space flight replaced with SOFIA airworthiness content.

5.9 Exceptions to ROSES-2015 NRA Requirements

Instructions provided in this program element, including Sections 6.2 and Section 6.3, supersede the instructions in the ROSES-2015 NRA and in the *Guidebook for Proposers*.

5.10 Use of SOFIA for Other Purposes (Not Solicited in this Program Element)

This solicitation does not include the use of SOFIA as a platform for purposes other than astronomical observations. However, this program element provides an opportunity for NASA to inform potential partners that they are invited to submit proposals that make use of SOFIA as a platform for other than astronomical observations. It may be possible that SOFIA provides an opportunity for conducting experiments, tests, or other activities that make use of SOFIA other

than as an astronomical observatory. Such investigations may address science objectives relevant to science disciplines other than astrophysics (e.g., heliophysics, planetary science, Earth science, life and microgravity science, etc.).

This solicitation provides an opportunity for NASA to inform potential users of SOFIA that they are invited to discuss concepts with NASA.

Any such proposal is subject to the following constraints and conditions.

- The proposed activity may make use of SOFIA's facilities and operations other than the use of the Telescope Assembly. Some possible SOFIA facilities and operations include, but are not limited to, use of the upper flight deck on the Boeing 747-SP, carrying passive measuring devices in one of SOFIA's cargo or storage areas, etc.
- Any such proposal must be on a no cost basis with the SOFIA Program. The SOFIA Program has no funding to provide in support of any such proposal. This includes development of the experiment, any needed modifications to SOFIA to accommodate the experiment, operation of the experiment, etc.
- Any such proposal must be on a no interference basis with the SOFIA Program. The SOFIA Program will not delay or interrupt its science program to accommodate any experiment. Any modifications needed to accommodate the experiment, e.g., installing mounting racks, must be consistent with being accomplished in parallel with regular SOFIA operations. Any operational activities must take place on a noninterference basis with regular SOFIA operations. Experiments will not have access to the SOFIA data systems during flight.
- Any such proposed use must satisfy all SOFIA safety, airworthiness, electrical and magnetic noninterference, and other requirements.

Although the use of SOFIA as a platform for purposes other than astronomical observations is being described in this solicitation, proposals of this kind should not be submitted through NSPIRES in response to this Program Element (because they do not meet the basic requirements detailed in this solicitation); rather they should be submitted as unsolicited proposals. The review, selection, and negotiation process will be handled as necessary based on the unique nature of any proposal received. NASA requirements for unsolicited proposals may be found at http://prod.nais.nasa.gov/pub/pub_library/unSol-Prop.html.

Any proposers considering submitting a proposal of this type are strongly encouraged to communicate with the point of contact for this solicitation or the SOFIA Program Office before submitting a proposal (see Section 9).

6 Proposal Evaluation and Selection

The evaluation of proposals submitted in response to this solicitation will be in accordance with the evaluation factors stated in the *NASA Guidebook for Proposers*, as well as the additional factors described below.

- The evaluation criterion "intrinsic merit" will include consideration of the scientific merit of the proposed scientific goal and/or objective, the proposed example investigation, the

scientific potential of the instrument for future GI programs, and the uniqueness of the proposed science to be provided exclusively by SOFIA.

- The evaluation criterion "programmatic relevance" will include consideration of the programmatic value of the proposed scientific goal and/or objective and the proposed science investigations to be conducted by the proposed instrument, with an emphasis on the degree to which the proposed instrument is able to uniquely advance the scientific capabilities of SOFIA in the context of other recent past and near future infrared facilities within NASA's portfolio.
- The evaluation criterion "cost realism and cost reasonableness" will include consideration of the implementation and Cost Risks factors. Factors such as the maturity of the design, the probability of technical success, the technology readiness level, the probability of meeting cost, the adequacy of the proposed management plan and schedule, the adequacy of the instrument to conform and meet SOFIA Observatory requirements, and the merit of the data calibration and pipeline plans.

Proposals will be assigned a rating based on these roughly equally weighted evaluation factors. The resulting overall rating will be used for the development of selection recommendations for presentation to the selecting official (the NASA Science Mission Directorate Astrophysics Division Director). The selection recommendations and selection decision may also include consideration of programmatic factors, such as the availability of funds, total cost, anticipated operational date, implementation and management risk, and potential benefit to NASA missions.

7 Proposal Preparation and Submission

To facilitate the early recruitment of conflict-free reviewers, and to ensure that proposal concepts are responsive to and compliant, the solicitation program will use a two-step proposal submission process (see Section IV(b)(vii) of the *ROSES-2015 Summary of Solicitation*) for Phase I.

7.1 Step-1 Proposals.

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). Step-1 proposals will not be submitted to a formal, binding peer-review. The purpose of the Step-1 proposal is simply to avoid conflicts in the assembly of the review panel, and no response will be provided to proposers unless concerns regarding the responsiveness/compliance of their proposal concept are identified. However, only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must address the same instrument concept described in the Step-1 proposal. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Scientific/Technical/Management section of the Step-1 proposal is restricted to at most two pages in length and should include a brief description of the instrument concept and science goals that will be addressed in the Step-2 proposal. No cost estimate is required in this Step-1 submission. This description will be used to confirm that the proposal is responsive to the requirements of this call and will also be used by

NASA as an aid to the selection of its proposal peer review panel members. No evaluation of intrinsic merit will be done on Step-1 proposals.

The Step-1 proposal title and PI cannot be adjusted. To allow us to identify conflicts of interest among reviewers, NASA strongly urges proposers to identify all team members on the Step-1 proposal. However, if necessary, adjustments to the team may be made up to two weeks in advance of the Step-2 proposal due date; to add team members, proposers must notify the NASA point of contact via E-mail (with cc to sara@nasa.gov) at least two weeks in advance of the Step-2 proposal due date.

The NSPIRES system for proposal submission requires that Step-1 proposals include both a summary (i.e., abstract) describing the proposed work and a two-page overview of the Scientific/Technical/Management section described above. The proposal summary is entered directly into a text field in NSPIRES, while the brief Scientific/Technical/Management section (limited to two pages) must be uploaded as the PDF "Proposal Attachment." The Step-1 proposals must be submitted by the PI's institutional organization, not by the PI himself/herself. If NASA determines that the proposed investigation is likely to be either nonresponsive or noncompliant with the solicitation, proposers will be notified in advance of the submission of their Step-2 proposal. In such cases, proposers are not precluded from submitting their Step-2 proposal, but should be aware that, without addressing the issues identified in the notification, there is a risk that their proposal may be declined without review.

7.2 Step-2 Proposals.

Proposers should refer to the PDF entitled "How to submit a Step-2 proposal" under "Other Documents" on the NSPIRES page for this program. The process for preparation and submission of the Step-2 (full) proposals is essentially identical to that associated with any other ROSES proposal, subject to the following program-specific constraints:

a) The Scientific/Technical/Management section of the Step-2 proposal, which consists of text, tables, and figures, must not exceed 25 pages. References do not count against the 25-page limit.
b) Proposals must be completed and submitted electronically through NSPIRES (http://nspires.nasaprs.com). Hard-copy submissions are not permitted.
c) All electronic proposal materials must be submitted by 11:59 p.m. Eastern time on the due date given in Section 9 in order to be included in the proposal review for this solicitation.

7.3 Preproposal Workshop

NASA will host a preproposal teleconference for prospective proposers to this solicitation on July 23, 2015 at 2 pm eastern. The workshop will cover the scope and intent of the solicitation, expectations for the Instrument Concept Study, NASA oversight of the development and commissioning process, and the characteristics of SOFIA. Prospective proposers may connect to the teleconference at 800-779-9017 (toll free within the United States) or at the international toll number 1-212-287-164 with passcode 1958408. Additional information about the workshop will be posted under "Other Documents" on the NSPIRES page for this program element.

7.4 Proposal Formatting

Formatting of the proposal must conform to the stylistic requirements described in the 2015 *NASA Guidebook for Proposers* (http://www.hq.nasa.gov/office/procurement/nraguidebook/) and the ROSES-2015 NRA. Foldout pages (11 x 17 inches) may also be employed at the proposers' discretion. Each foldout counts as two pages toward the 25-page limit. There is no minimum requirement for fonts used within figures and tables but all text in figures and tables shall be legible; fonts smaller than 8-point are often illegible. Proposals that do not conform to the page limits and formatting requirements described or referenced in this solicitation will be subject to penalty up to and including decline without review.

The Scientific/Technical/Management section of the proposal is subject to a strict 25-page limit. Proposal appendices, such as list of participants, letters of commitment, resumes, international participation plans and/or contributions, list of abbreviations, and list of references, are not part of this page limit. Proposers should consult Section 2 of the *NASA Guidebook for Proposers*, which contains additional and relevant information, for proposal preparation and compliance.

7.5 International Agreements

Proposals from scientists employed at non-U.S. institutions will be considered on a no-exchange-of-funds basis. Non-U.S. proposals will be reviewed to the same standards as proposals from U.S. institutions. Proposers from non-U.S. institutions should read the Foreign PI Affiliation instructions document, which is downloadable as a PDF file from the NSPIRES web page for this program element. All foreign investigators, whether proposing as PI from a foreign organization or Co-Is participating on proposals from U.S. organizations, must be endorsed by a funding/sponsoring institution or agency in the foreign country to demonstrate that resources are available to support the proposed investigation.

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, NASA's Office of International and Interagency Relations, Science Division, will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal agency-to-agency Memorandum of Understanding.

8 Award Administration and Funding of the Investigation

For those proposals selected for Phase II and beyond, the award types depend on the nature of the work proposed, but it is anticipated that Instrument Concept Study awards will be grants and any subsequent (full) awards will be made as cooperative agreements. Awards made through this solicitation for the SI development following Phase II will follow the policies stated in the ROSES-2015 NRA. The initiation of the selected award(s) will take place as soon as possible after notification of selection. If the proposing organization of the instrument selected for implementation is external to the Federal Government, funding for the development, installation,

and commissioning of the instrument may be issued as an award from ARC. If the proposing organization is a NASA Center or other Government Laboratory, funding will be issued through normal internal NASA or interagency processes.

Once an instrument is selected for implementation (following Phase II), the technical oversight and management of the selected third generation SI development will be assigned to the NASA SOFIA Science Instrument Manager located at ARC. The responsibilities of this manager will include the overall oversight of the design, development, and implementation of the third generation science instrument. The SOFIA program will provide system engineering methodology to assist the PI-led team in tracking progress against milestones, decision key points, budget and schedule, and goals and objectives, as well as the negotiated project plan, and specific aspects unique to SOFIA, such as air worthiness considerations.

9 Summary of Key Information

Expected program budget	$17 M over the period FY16-FY19, not to exceed $5 M in any given year.
Number of new awards pending adequate proposals of merit	Not more than two proposals shall be selected to conduct an ICS, see Section 2.
Maximum duration of awards	ICS phase shall be not more than four months. The schedule for implementation and delivery of the selected instrument will be determined during the ICS, with a goal of 2-3 years
Date for Pre-proposal Workshop	2 PM Eastern Time on July 23, 2015. See Section 7.3
Due Date for Step-1 Proposals	11:59 PM Eastern Time on August 19, 2015
Due Date for Step-2 Proposals	11:59 PM Eastern Time on October 7, 2015
Planning date for start of Instrument Concept Study	~3 months after Step-2 due date
Page limit for the Scientific, Technical, and Management section of proposal	25 pages. See Section 6.2 above and Section 2 of the *NASA Guidebook for Proposers* for additional information.
SOFIA Program Library	Available under "Other Documents" on the NSPIRES page for this ROSES program element.
Web site for additional information for SOFIA investigations	http://www.nasa.gov/mission_pages/SOFIA/
NASA on-line Document Information System	NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents are available through the NASA On-line Document Information System (NODIS) at http://nodis3.gsfc.nasa.gov/.
Web site for submission of electronic proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)

Relevance	This program is relevant to the Astrophysics strategic goals and sub-goals in NASA's *Strategic Plan*. Proposals that are relevant to this program are, by definition, relevant to NASA See also Section 6.
General information and overview of this solicitation	See *ROSES Summary of Solicitation*
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-S3GSI
NASA point of contact **[Changed September 11, 2015]**	**Hashima Hasan** Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-**0692** **E-mail: nasa-sofia-po@mail.nasa.gov**

D.13 K2 GUEST OBSERVER – CYCLE 4

NOTICE: Amendment 32 releases a new opportunity, K2 Guest Observer (GO) Cycle 4. The text in this program element is different from that which appeared as K2 GO Cycle 3 in program element D.7, so please read it carefully. The execution of the K2 Guest Observer Cycle 4 is contingent upon the outcome of the 2016 Senior Review. Step-1 proposals are due February 5, 2016, and Step-2 proposals are due March 4, 2016.

Proposals to this program will be accepted by a two-step process in which the Notice of Intent is replaced by a brief mandatory, Step-1 proposal submitted by an Authorized Organizational Representative. No PDF upload is possible for the Step-1 proposal. Step-1 proposers must merely fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal will be eligible to submit a Step-2 (full) proposal. Potential proposers are strongly encouraged to carefully read the information about the two-step proposal process provided in Section IV(b)(vii) of the ROSES-2015 *Summary of Solicitation* and in Section 7 of this Program Element.

1. Scope of Program

This program element solicits proposals for the acquisition and analysis of new scientific data from the K2 mission (http://keplerscience.arc.nasa.gov). K2 repurposes the space-borne hardware and ground-based operations of the Kepler mission (http://keplerscience.arc.nasa.gov) for a pointed survey of predetermined locations along the ecliptic plane. The single, visible-wavelength instrument on board K2 provides high-precision photometry capability, with short cadence and long cadence modes (1 minute and 30 minute exposures, respectively), and provides a powerful tool for broadband variability analyses of planetary, stellar, extragalactic, and solar system sources.

1.1 Background

The loss of a second of the four reaction wheels on board the Kepler spacecraft in May 2013 brought an end to its four plus year primary science mission to continuously monitor more than 150,000 stars in the 116 square degree Kepler field for transiting exoplanet candidates. Developed over the months following this failure, the K2 mission represents a new concept for spacecraft operations that enables continued scientific observations with the Kepler space telescope. The K2 mission entails a series of sequential observing "Campaigns" of fields distributed around the ecliptic plane and offers a photometric precision approaching that of the original Kepler mission to within a factor of approximately two (http://keplerscience.arc.nasa.gov/k2-observing.html#fine-point-photometric-precision). Operating in the ecliptic plane minimizes the torque exerted on the spacecraft by solar wind pressure, reducing pointing drift to the point where spacecraft attitude can effectively be controlled through a combination of thrusters and the two remaining reaction wheels. Each ecliptic Campaign is limited by Sun angle constraints to a duration of approximately 80 days. Therefore, four to five K2 Campaigns can be performed during each future 372-day orbit of the spacecraft. A description of the Campaign field distribution across the sky and the full mission concept is provided at http://keplerscience.arc.nasa.gov/k2-fields.html and http://keplerscience.arc.nasa.gov/k2-observing.html.

2. Scope of this Solicitation

This solicitation is specifically for science utilizing data collected within K2 Campaigns 11, 12, and 13 observing fields, which are currently planned for execution over the periods September 24 to December 8, 2016 (Campaign 11), December 15, 2016, to March 4, 2017 (Campaign 12), and March 8 to May 27, 2017 (Campaign 13). Campaign 11 will cover a dense field near the Galactic Center. Campaign 12 is a high galactic latitude field in the region near the South Galactic Cap. Campaign 13 will be a slightly dense field near the Galactic Anti-Center. Supporting technical and scientific material is available at the Kepler Science Center website for the K2 mission (http://keplerscience.arc.nasa.gov). A separate solicitation will be released in approximately nine months for future Campaigns. There is also expected to be a small, unfunded Director's Discretionary Targets (DDT) program run by the K2 GO office to allow exceptional targets to be observed. DDT proposals will be handled through the GO Office (http://keplerscience.arc.nasa.gov/k2-ddt.html), outside of ROSES.

3. Changes Since K2 Guest Observer (GO) Cycle 3 in ROSES-2015

This solicitation is for different K2 observing fields, namely Campaigns 11, 12 and 13, described in Sections 2 and 5. Investigations that have broadly similar goals and team members to selected Cycle 1 proposals may use up to an additional 0.5 pages to describe progress they have made to delivering value-added community resources. The point of contact has changed, see the Summary of Key Information in Section 8.

4. The K2 Mission

4.1 K2 Mission Science

Unlike the Kepler mission, there are no primary science objectives for the K2 mission in most Campaigns (with the exception of Campaign 9). While K2 continues to further the science goals of the Kepler mission – identifying exoplanet candidates and providing data for the calculation of planet occurrence rates – the spacecraft is now primarily a general-user facility (http://keplerscience.arc.nasa.gov).

4.2 Instrumentation and Technical Capabilities

The Kepler spacecraft is in a heliocentric orbit, which insures a thermally stable environment and provides the ability to remain on a single pointing for the duration of each Campaign. Pointing is maintained by a combination of two reaction wheels and thrusters, reacting to motion data provided by fine guidance sensors (fine-point observing) or star trackers (coarse-point observing). With only two remaining reaction wheels, these operations are only possible while pointing within the orbital plane of the spacecraft, which approximates to the ecliptic. Only this specific family of pointings yields operational configurations where solar pressure is largely mitigated by spacecraft geometry, thereby making viable precision pointing and photometry approaching the quality for the Kepler mission. K2 has demonstrated a benchmark photometric precision on an m_v = 12 G2V star of ~170 parts-per-million (ppm) in 30 minutes of integration, i.e., one long cadence exposure. This corresponds to ~50 ppm over a 6.5-hour transit of an Earth-sized body around that star.

While stars brighter than $m_v = 11.5$ will saturate some pixels, K2 performs well on stars as bright as $m_v = 4$, provided the scientific benefit justifies the large number of pixels needed to capture saturated flux bleeding along CCD columns. Targets brighter than $m_v = 3$ will not be observed because they bleed off the CCD. K2 also has many faint-target scientific applications where $m_v = 20$ objects yield a photometric precision of a few percent over 30 minutes.

The broad photometric bandpass has a half-maximum transmission range of 430 to 840 nm. The instrument does not have changeable filters, dispersing elements, nor a shutter. The detector has a pixel scale of 3.98 arcseconds. Image quality varies with position in the focal plane, with the 95% encircled energy diameter ranging from 3.1 to 7.5 pixels, with a median of 4.2 pixels. The percentage of point-source flux concentrated in the center pixel is between 20% and 62%, with a median value of 45%.

4.3 Observing Modes and Data Products

Constraints imposed by onboard storage and communications dictate that at most 6% of the data from the full focal plane are saved and downloaded. Instead, data for specific, predetermined targets are saved and transmitted as subimages with a typical area of 160 pixels, depending on source brightness. The brighter a target, the more pixels are required to capture it. Image size can be tailored further to accommodate extended or very bright, saturated objects. The current solicitation requests target proposals for Campaigns 11, 12, and 13. The Kepler Science Center will derive pixel masks for those targets successfully justified by proposers and upload these targets to the spacecraft before each Campaign.

All observations are taken at one of two temporal resolution settings: long (30-minute) or short (1-minute) cadence. It is expected that on the order of 10,000 to 20,000 long cadence targets will be available per Campaign, and approximately 50-100 short cadence targets. Extended or bright objects requiring larger aperture sizes decrease the total number of targets available to the GO program and must be well justified.

Data distribution and archival services will be performed by the Space Telescope Science Institute's MAST archive (https://archive.stsci.edu). Final data products available to observers will include original and calibrated pixel values and long cadence light curves for each individual target. The calibration will correct for bias level, smear, galactic cosmic rays, flat fielding, dark current, background, and instrument noise. Simple aperture photometry will be used to generate the light curves.

Data will be delivered to the observer in Flexible Image Transport System (FITS) format. A thorough understanding of the noise sources and systematic errors of K2 will be needed by observers in order to generate their own light curves from the original (uncalibrated or calibrated) pixel data or interpret structure found in archived light curves. There is no exclusive use period associated with any K2 GO data.

5 Guest Observer Science

5.1 Permitted GO Science Areas

There are no guaranteed, or predetermined, targets for K2 Campaigns 11, 12, and 13. All K2 targets are proposed by the community through the GO program or the DDT program.

For Campaign 11, 12, and 13 targets, the K2 GO Program welcomes proposals addressing compelling scientific questions in any area of astrophysics and planetary science providing the required observations are amenable to the operational characteristics and constraints of the mission. These may include, but are not limited to, exoplanet detection, stellar astrophysics, galactic and extragalatic astrophysics, and Solar System science. A single proposal can be used to request targets in more than one campaign. All science proposals must be compelling and well-justified scientifically and technically. Proposers should particularly note that short cadence resources and bright targets are expensive in pixels and onboard storage and have historically been in high demand. Short cadence proposals must justify scientifically and technically the need for higher cadence monitoring relative to long cadence observations.

Proposers must take into account the difference between science that can be achieved exclusively using archived K2 and Kepler data and science that requires new observations by K2. The K2 GO program is specific to the case of science requiring new observations. Funding for archival science is provided through the Astrophysics Data Analysis Program (ADAP; Appendix D.2 of ROSES-2015). This includes all Kepler data and K2 Campaigns 0-7. All proposals to this call must justify the need for new observational data within their program. However, we welcome proposals that build upon data already collected and programs requiring more data to enhance or complete investigations.

5.2 On-source Monitoring Times

Each K2 Campaign has a duration of approximately 80 days and remains fixed upon a single boresight position. The target list remains fixed throughout the full duration of a Campaign; targets cannot be swapped during a Campaign. The fixed locations and observing windows of Campaigns 11, 12, and 13 are provided at http://keplerscience.arc.nasa.gov/k2-fields.html.

5.3 Target Selection Tools

Pointed observations away from the single stare position of any given field cannot be accommodated by K2; Campaign targets are limited to the objects available in the fixed field of view. Small gaps between the 42 detector CCDs result in additional loss of available objects that would otherwise be within the Kepler field of view. A documented target search tool, http://archive.stsci.edu/k2/epic/search.php, determines if an object of a particular coordinate lies close to the observable field of view. The target search tool accesses the Ecliptic Plane Input Catalog (EPIC), which provides physical data, coordinates, magnitudes, and colors, for sources close to K2 silicon. The EPIC is complete to only $m_v \sim 17$; specifications of the catalog are documented at http://archive.stsci.edu/k2/epic.pdf. It is the proposer's responsibility to identify targets that are faint or missing from the EPIC. K2 collection of valid data relies on the delivery of accurate celestial positions, proper motions (if needed), and magnitudes of each target. Proposals must state the origin for this information, especially if it does not come from the EPIC. Determining whether or not desired targets fall on active regions of the focal plane is also the responsibility of the proposer. The Kepler Science Center at http://keplerscience.arc.nasa.gov/software.html#k2fov provides a tool to identify which targets fall upon active silicon. Only those targets within the active fields of view should be proposed.

5.4 Target Table

All proposals for targets are required to include a target table with the format shown in Table 1 to specify desired observing modes and other needed parameters. A definition of each column and a template for insertion into the proposal may be downloaded from the Kepler Science Center website at http://keplerscience.arc.nasa.gov/k2-proposing-targets.html#target-table. In addition to appearing as text within the proposal, this table must also be submitted electronically to the Kepler Science Center. Table 1 below includes example entries.

Table 1: Required Format of Target Table.
See http://keplerscience.arc.nasa.gov/k2-proposing-targets.html#target-table for instructions on completing the table.

Object	Right Ascension (deg) J2000	Declination (deg) J2000	Kp (mag)	Cadence (min)	Proper motion ("/yr)		extent (arcsec)	Comments
					δRA	δDec		
204436324			12.6	30				
203457483			13.9	1				
J113853.2+010514.6	174.72172	1.08747	18.3	30				Not in EPIC; Kp estimated from SDSS
201744789			11.4	30			11	Extended object with radius 11.0 arcsec
207942582	172.57983	-2.96567	14.5	30	0.13	0.35		High propose motion star

6. Programmatic Information

6.1 Proposal Submission and Evaluation

There are two categories of K2 guest observer proposals in Cycle 4. They are:

- Small proposals—proposals requesting fewer than 1000 targets, with a budget capped at $50,000.
- Large proposals—proposals requesting 1000 or more targets, with a budget capped at $150,000. Large proposals must also include the development and dissemination of a value-added community resource product.

The above cost caps are for the total cost of the award, including NASA Civil Servant Salary and overhead. Proposers should not include detailed budget information with either Step-1 or Step-2 proposals. NASA will seek detailed budgets from selected proposals after peer review.

Proposals submitted to NASA in response to this solicitation will be evaluated with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*, which are intrinsic merit, relevance to the K2 Cycle 4 GO solicitation, and the realism/reasonableness of the proposed work effort and resources. In addition to the factors for intrinsic merit given in the *NASA Guidebook for Proposers*, intrinsic merit includes the following factors:

- The suitability of using the K2 observatory and data products for the proposed investigation;
- The legacy value of the data collected;
- The degree to which the investigation uses K2's unique capabilities;
- The feasibility of accomplishing the objectives of the proposed investigation with the requested observations, including the degree to which the proposal satisfies K2's observational constraints; and
- The feasibility and suitability of the proposed analysis techniques.

6.2 Budget Justification, Period of Performance, and Availability of Funds

For Campaigns 11, 12, and 13, funding amounts will be determined formulaically based on target allocation. For GO Cycle 3, which covered two standard campaigns, 19 awards were made, which included seven awards at $100K and 12 awards at $30K or less. An additional six awards totaling $476K were made to support the microlensing science team in GO Cycle 3. For Campaigns 11, 12, and 13, award sizes will range from $30K for a few targets to up to $50K for 999 targets. Proposals of over 1000 targets may receive up to the maximum award amount of $150K.

K2 Cycle 4 Guest Observer (GO) programs will exploit data collected in K2 Campaign 11, Campaign 12, and/or Campaign 13 fields and will begin on or about September 24, 2016. Funding for selected programs in Campaigns 11, 12, and 13 will start once data is made available through the public archive at the Mikulski Archive for Space Telescopes (MAST), anticipated to begin around March 19, 2017. There is no exclusive use period associated with any K2 GO data. The duration of awards will be one year, not including no cost extensions.

6.3 Eligibility

Except as described in the following paragraph, application to the K2 GO program is open to all investigators, including those from outside the U.S. under NASA's no-exchange-of-funds policy. Investigators who are not affiliated with a U.S. institution are not eligible for funding through this program. Co-Investigators (Co-Is) affiliated with a U.S. institution are eligible to receive funding under a proposal led by a foreign Principal Investigator (PI). In this scenario, only a single Co-Investigator per proposal will be considered as a lead PI for funding purposes, and proposals should identify a lead Co-Investigator within the U.S.

However, in accordance with Public Law 113-76, Division B, Title V, Section 532, NASA cannot support bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement. See Section III(c) of the ROSES-2015 NRA and the ROSES FAQ on this subject for more information on these restrictions.

7. Submission of Proposals to the K2 Cycle 4 GO Program

7.1 The Two-Step Proposal Submission Process

To facilitate the early recruitment of conflict-free reviewers, and to ensure that proposal concepts are responsive to and compliant with the solicitation, the K2 GO program will use a two-step proposal submission process (see Section IV(b)(vii) of the ROSES-2015 *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). Step-1 proposals will not be submitted to a formal, binding peer-review. The purpose of the Step-1 proposal is simply to avoid conflicts in the assembly of the review panel, and no response will be provided to proposers unless concerns regarding the responsiveness/compliance of their proposal concept are identified. However, a generic communication will go out to all who submitted a Step-1 proposal to indicate that Step-2 proposals can be submitted when the Step-2 "response structure" is opened on the NSPIRES web page. Only proposers who submit a Step-1 proposal are eligible to submit a

Step-2 proposal. Full (Step-2) proposals must address the same scientific goals proposed in the Step-1 proposal. The Step-1 proposal title and PI cannot be adjusted. The Step-1 proposal summary (i.e., abstract) is not binding and can be revised in Step-2. Only the Step-2 proposal summary will be considered in the peer-review process. To add funded investigators between the Step-1 and Step-2 proposals, proposers must notify the NASA point of contact listed in Section 8 in writing (E-mail with cc to sara@nasa.gov) at least two weeks in advance of the Step-2 proposal due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later. No budget is required for either the Step-1 or Step-2 proposals. The funding level for selected proposals are cost capped, see Section 6.1.

7.1.1 *Step-1 Proposals.*

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Step-1 proposal should identify the PI and all funded Co-Is on the proposal. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the information submitted in NSPIRES and should include a description of the science goals and objectives of the proposal, an estimate of the number of targets to be observed (a target table is not required), a brief description of the methodology to be used, and a description of the relevance of the proposed research to this solicitation. The relevance section will be used to confirm that the proposal is responsive to the requirements of this call.

The NSPIRES system for proposal submission requires that Step-1 proposals include a summary (i.e., abstract) describing the proposed work as outlined above. The proposal summary is entered directly into a text field in NSPIRES. No PDF attachment is required for Step-1 proposal submission. All information will be entered within the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages. Proposers will be notified by E-mail when they are able to submit their Step-2 proposals. If NASA determines that the proposed investigation is likely to be either nonresponsive or noncompliant with the solicitation, proposers will be notified in advance of the submission of their Step-2 proposal. In such cases, proposers are not precluded from submitting their Step-2 proposal, but should be aware that, without addressing the issues identified in the notification, there is a risk that their proposal may be declined without review.

7.1.2 *Step-2 Proposals.*

Proposers should refer to the PDF document entitled "How to submit a Step-2 proposal" under "Other Documents" on the NSPIRES page for this program. The process for preparation and submission of the Step-2 (full) proposal is essentially identical to that associated with any other ROSES proposal, subject to the following program-specific constraints:

a) Large proposals must include a section of no more than one page in length describing a value-added community resource product that the Large proposal PI will provide at the end of the period of performance of the grant and how that product will be made available to and benefit the community. This product should be greater than simply a published paper. Example products might be delivery of a uniform set of well-produced open cluster star light curves, follow-up ground-based observations of exoplanet host stars, or a catalogue of sources with additional astrophysical information. This information will be used in Large proposal evaluation. Investigations that have broadly similar goals and

team members to selected Cycle 1 proposals may use up to an additional 0.5 pages to describe progress they have made to delivering value-added community resources.
The target list of any Large proposal may be reduced if the need for a large number of targets is not adequately justified in the proposal.
If the products are to be ingested and curated at an existing astrophysics archive (e.g., the MAST archive at the Space Telescope Science Institute (STScI) or the NASA Exoplanet Database), the proposal should include a letter of acknowledgement from the relevant archive.

b) The Scientific/Technical/Management section of the Step-2 proposal, which consists of text, tables (excluding the target table), and figures must not exceed four pages for proposals in the Small category, or six pages for proposals in the Large category. An additional 0.5 pages to describe progress they have made to delivering value-added community resources. References do not count against the page limit.
c) A complete table of proposed targets (see Section 5.4) must also be included at the end of the Scientific/Technical/Management section of the proposal, but does not count against the page limit of that section. However, the target table should be truncated in instances where its incorporation will cause the Scientific/Technical/Management section to exceed a length of fifteen-pages.
d) For the purpose of submitting proposals through NSPIRES, proposers from non-U.S. institutions must affiliate in NSPIRES with the Kepler Guest Observer Office, which will submit the proposal on their behalf. For details, see http://keplerscience.arc.nasa.gov/k2-proposing-targets.html.
e) Complete and submit electronically the proposal through NSPIRES (http://nspires.nasaprs.com). Hard-copy submissions are not permitted.
f) A separate electronic version of the target table must be submitted to the Kepler Science Center by the proposal deadline. An Excel template for the target table, which is suitable for direct insertion into the proposal, instructions about the required file format for submission to the Kepler Science Center, and information regarding the file-naming convention for the target table file are available at http://keplerscience.arc.nasa.gov/k2-proposing-targets.html.
g) All electronic proposal materials (proposal and separate electronic target file submitted to NSPIRES and the Kepler Science Center, respectively) must arrive at the designated destinations by 11:59 p.m. Eastern time on the due date given in Section 8 in order to be included in the proposal review for this cycle of the K2 GO Program.

7.2 Proposal Formatting

This is a reminder that all proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the ROSES *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Any proposal found to violate these formatting rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: The *NASA Guidebook for Proposers* requires easily read fonts having, on average, no more than 15 characters per inch (e.g., 12-point Times New Roman and Arial). Proposers may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Proposers may not adjust line-spacing settings for a selected font below single-spaced.

- Figure captions: Must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Proposers may not place expository text in tables or figures in order to gain space.

7.3 Sources of Additional Information

The Kepler Science Center (http://keplerscience.arc.nasa.gov), located at the NASA Ames Research Center, provides support to Guest Observers and to proposers of this solicitation, such as technical information about the K2 mission and instrument, and other information supporting proposal preparation, including a Frequently Asked Questions link and template files for proposal preparation. Contact information may be found in Section 8.

8. Summary of Key Information

Expected program budget for Campaigns 11, 12, & 13 awards	~$1.5M
Estimated number of funded investigations selected for observations	~7 Large investigations containing >1,000 observed targets over Campaigns 11, 12, and 13 combined, and ~12 Small investigations containing <1,000 observed targets over Campaigns 11, 12, and 13 combined.
Maximum duration of awards	1 year
Due Date for electronic submission of MANDATORY Step-1 proposals	February 5, 2016. See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due Date for electronic submission of Step-2 proposals	March 4, 2016. See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	Funds will be awarded when the data are made publicly available. Proposers should use March 19, 2017 as the probable date for receiving data from Campaign 11
Page limit for the Step-2 central Science- Technical-Management section	Small proposals: No more than four pages for the Scientific/Technical/ Management section, including text, tables, and figures. Large proposals: No more than six pages for the Scientific/Technical/ Management section, including text, tables, and figures. Up to an additional 0.5 pages is allowed to describe progress toward delivery of value-added community resource products by PIs with selected K2 GO Cycle 1 proposals. References and the required target table do not count against these page limits, but the target table should be truncated in cases where it would cause this section to exceed 15 pages.
Relevance	This program is relevant to the Astrophysics strategic goals and subgoals in NASA's *Strategic Plan*. Proposals that are relevant to this program are, by definition, relevant to NASA

General information and overview of this solicitation	See *ROSES Summary of Solicitation*
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/
Submission medium and number of copies	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-K2GO4
Mandatory submission of electronic version of target table	http://keplerscience.arc.nasa.gov/K2/ProposalPreparationTargetTable.shtml
Kepler Science Center	Webpage: http://keplerscience.arc.nasa.gov/K2 Email: keplergo@mail.arc.nasa.gov
Technical questions concerning this program element may be directed to the Kepler Science Center	Thomas Barclay Kepler Guest Observer Office NASA Ames Research Center, MS 244-30 Moffett Field, CA 94035-1000 Telephone: (650) 604-3560 Email: keplergo@mail.arc.nasa.gov
NASA point of contact for programmatic information	Mario Perez Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1535 Email: mario.perez@nasa.gov

APPENDIX E: CROSS-DIVISION RESEARCH

E.1 CROSS-DIVISION RESEARCH OVERVIEW

The Science Mission Directorate (SMD) sponsors program elements that apply across more than one of its four science research areas as defined in Section I of the *ROSES Summary of Solicitation*. Such cross-division program elements are listed here in Appendix E of this ROSES NASA Research Announcement (NRA). At the time of the initial release of this NRA, there are two such programs:

Most proposals to ROSES will require a data management plan (DMP) or an explanation of why one is not necessary given the nature of the work proposed. Proposers to E.3, the Exoplanets Research Program, must satisfy this requirement by responding to the compulsory NSPIRES cover page question about the DMP. The kinds of proposals that require a data management plan are described in the NASA Plan for increasing access to results of Federally funded research and in the SARA FAQs for ROSES. E.2 TWSC proposals do not require a DMP.

The Topical Workshops, Symposia, and Conferences program element (E.2) solicits proposals for topical workshops, symposia, conferences, and other scientific/technical meetings that advance the goals and objectives of only the Earth Science and Planetary Science Divisions. This program has no fixed due date or budget; proposals may be submitted at any time, but are dependent on the availability of funds in the specific program or focus area.

The Exoplanets Research Program (E.3) solicits basic research proposals to advance our knowledge and understanding of exoplanetary systems. This program is shared between the Planetary Science Division and the Astrophysics Division. Its objectives are the detection and characterization of planets and planetary systems outside of our Solar System, including the determination of their compositions, dynamics, energetics, and chemical behaviors. Research supported by this call may include observations, theoretical studies, and modeling.

Any other cross-division programs that are defined during the calendar year will be issued as amendments to ROSES-2015, typically 90 days in advance of their established Proposal Due Dates.

E.2 TOPICAL WORKSHOPS, SYMPOSIA, AND CONFERENCES

NOTICE. Clarified May 14, 2015. Text has been added to Section 5 to indicate that not all proposals to this program element are necessarily peer reviewed. Also, the final date to submit proposals is March 31, 2016.

1. Introduction

In order to address its strategic goals and objectives (see Section I of the *ROSES Summary of Solicitation*), the Science Mission Directorate (SMD) acknowledges the need to bring together members of scientific communities relevant to NASA in order to:

- encourage and facilitate the use of mission data,
- increase the efficiency of investigators through the open exchange of ideas, and
- expose investigators to new subject areas.

In the past, SMD has supported topical workshops, symposia, conferences, and other scientific/technical meetings through both solicited and unsolicited proposals. SMD will no longer consider those unsolicited proposals that could have been submitted in response to this solicitation.

The scope of this solicitation across SMD is described in Section 2. Section 3 describes how proposals submitted in response to this solicitation must convincingly connect the proposed content of the event to specific goals, e.g., in SMD program elements or the *NASA Science Plan*. Section 4 describes principles and constraints that constrain proposals in response to this solicitation; in particular, the proposed participants, logistics, and level of NASA support must be, and appear to be, appropriate given NASA's science goals and objectives.

2. Scope of Program

This program element solicits proposals for topical workshops, symposia, conferences, and other scientific/technical meetings (herein referred to as "events") that advance the goals and objectives of only the following SMD Divisions: Earth Science and Planetary Science.

Proposals are not limited to traditional in-person meetings of scientists but may also include requests for support of other methods of bringing together members of the scientific communities relevant to NASA, such as online discussion forums and web-based collaboration portals, especially in support of a traditional event. Proposals for multiple related events should be well justified.

This solicitation is directed at scientific and technical events of interest to SMD, not education, public outreach, or administrative (nonscientific, nontechnical) conferences.

Where other ROSES program elements specifically solicit for events, proposals must be submitted in response to those solicitations instead of this one.

3. Relevance to SMD's Goals and Objectives

Proposals submitted in response to this solicitation must demonstrate the relevance of the event to SMD by showing how the scientific/technical area(s) to be covered will advance not only high-level SMD goals and objectives, but also specific (existing or anticipated) outcomes identified in ROSES program elements, SMD roadmaps, other SMD program documents, the *NASA Science Plan*, findings in decadal surveys, or the reports of NASA advisory bodies or groups relevant to NASA. Proposers are not constrained to show relevance to the program elements that appear in ROSES-2015; some calls do not appear every year, but research in that area continues and proposals would still be considered relevant. The subjects of the proposed events are not limited to the targeted science (or data analysis that leads to science) itself, but also include technologies, methods, and capabilities that enable the attainment of relevant goals, such as (but not limited to) code development, data compression algorithms, higher order data products, model intercomparisons, the enhancement and/or application of new equipment to make pertinent measurements, etc.

Proposers must explicitly state from what source (e.g., ROSES program element, roadmap, or decadal survey) the claim of relevance derives.

3.1 Additional Information on Earth Science Relevance

Proposals for workshops, symposia, conferences, or scientific/technical meetings in Earth Science should be carried out in support of NASA Science Questions and Goals from the 2014 Science Plan for NASA's Science Mission Directorate. NASA's Earth science research is conducted in four major areas: research and analysis, satellite missions, applied sciences, and enabling capabilities (e.g., data and information systems, high-end computing, airborne science, and technology development). Proposals for events under any of these four Earth science areas will be considered under this program element. NASA Earth Science's research and analysis programs emphasize interdisciplinary topics and interagency collaboration and coordination through the U.S. Global Change Research Program (http://www.globalchange.gov/). NASA's applied sciences area supports efforts to discover and demonstrate innovative and practical uses of NASA Earth science observations and research through applications projects carried out in partnership with end user organizations (http://AppliedSciences.nasa.gov/). NASA's enabling capabilities area supports efforts that engage the broader Earth science community to encourage partnerships and collaborations among data providers, users, and information technology experts to improve data and data system interoperability (http://science.nasa.gov/earth-science/earth-science-data/). Thus, events proposed to address the goals of NASA Earth Science research must, in many cases, involve substantial participation by interagency partners and/or end user organizations, and such participation will be considered as a positive factor in establishing relevance to NASA.

4. Program Principles and Proposal Constraints

4.1 Allowable Focus of Proposal Goal

The goal of any proposed activity must be to enable science, and the logistics, which may be funded as a result of the proposed activity, are merely an incidental means to achieve that goal. Proposals to this program must be written so that the objective of the proposed activity is clearly focused on the desired effect that is to be achieved (e.g., science), rather than the means to that end (e.g., logistics). It is acceptable to have a goal of developing an output that is a prerequisite to achieving a target laid out in a ROSES program element, roadmap, decadal survey, etc., and to pay for the logistics as an expense on the way to accomplishing that goal. However, a proposal with a stated goal of simply paying for logistics in support of an event would not be considered responsive to this solicitation.

4.2 Competition and Criteria for Selecting Event Participants

SMD principles include the use of competition to increase the effectiveness of awarded funds. Although SMD may provide only a small fraction of the total funds required for an event, SMD expects the individuals participating in the event to be identified through competition; exceptions require adequate justification. If funds are requested for limited participants to attend an event, then an open call for abstracts is expected where their evaluation would play a role in selecting participants. The merit rating of the science abstract need not be the only factor; consideration of other factors, such as diversity, in order to achieve a balanced portfolio is to be expected. There may be compelling reasons to justify selecting certain participants without competition in order to attain the stated scientific or technical aim of the event; in such cases, the justification must be provided in the proposal.

4.3 Availability of Funding

No specific budget is identified for this program element; selected proposals will be funded by the benefitting program. The number of proposals selected will be dependent on the number and quality of proposals submitted and on the availability of funds from the benefitting program. Potential proposers are encouraged to contact the appropriate SMD Program Officer to investigate the availability of funds in that specific program for funding selected proposals. Contact information for SMD Program Officers is available at http://science.nasa.gov/researchers/sara/program-officers-list/.

4.4 Constraints on Logistics

The logistics of the event must be, and appear to be, appropriate for accomplishing the stated purpose. This includes the size, location, duration, scheduling, and cost of the event for both sponsors and attendees. Proposers are discouraged from choosing what might appear to be a resort location. Similarly, proposers are discouraged from choosing a foreign location; proposed events outside of the U.S. must be adequately justified.

The funding request, whether a small grant to subsidize student participation or full sponsorship of a large symposium, must be commensurate with (a) the role of NASA in stewarding the subject science and the benefiting science community, and (b) the importance of the event to NASA in attaining its goals and objectives.

Proposers to this program element are strongly encouraged to review the guidelines found in the SMD memo on "Priorities for Conference Spending" of April 27, 2009, which can be found at http://nasascience.nasa.gov/researchers/sara/library-and-useful-links/SMD2009memo.pdf.

4.5 Award Duration

Most awards from this program element are expected to be one year in duration. Under certain circumstances, and if properly justified, it may be permissible to propose multiple meetings that span across a period of more than a year. For example, a pair of meetings before and after fieldwork, targets of opportunity (oil spills, comet appears, etc.) or another large project, make sense to plan and propose together. Otherwise, proposers should plan on a single meeting.

5. Other Factors

The amount that NASA can spend on administrative (nonscientific, nontechnical) conferences is limited. Support for such administrative conferences is not solicited within this program element, which is exclusively for scientific/technical subjects or the dissemination of scientific/technical information.

This solicitation cannot result in the award of a contract, only a grant, cooperative agreement, an interagency agreement, or internal funding to a NASA Center.

Letters of affirmation from the relevant community are permitted for proposals to this program.

Not all Proposals to this program element are necessarily peer reviewed; some submissions may be reviewed only by program managers at NASA HQ. [Added May 14, 2015]

Events that are proposed in response to this call must have the benefit of the event flow directly to the recipient and its members, not to NASA. The principal purpose of the event will be to advance the research or other purposes of the recipient. Thus, NASA may not direct a recipient in arranging the event or in providing other services for NASA's benefit. The proposed event must be run by the recipient, not by NASA. NASA projects that would satisfy a NASA requirement or provide a crucial deliverable (such as a decadal survey) through an event cannot be supported through this call. Events sponsored or initiated by NASA primarily to meet a specific NASA need or obtain information for the direct benefit of NASA must be supported by means of a contract and may not be proposed in response to this solicitation.

NASA Interim Directive (NID) 9700.1 provides the financial management requirements for conference planning, approval, attendance, and reporting for NASA. The NID notes that it is applicable to recipients of grants and cooperative agreements only to the extent specified or referenced in the award. Specifically, Section 4.3.2. (b) Non-Reportable Expenses indicates that

"Conference costs paid by a recipient of financial assistance (i.e., using grant or cooperative agreement funds from NASA)" are not subject the reporting requirements. However, it goes on to note: "To ensure proper use, cooperative agreements should limit the use of funds for conference activities directed at a public purpose like technical assistance to presenters. To the extent a proposed grant or cooperative agreement also supports NASA mission needs and objectives related to hosting or assisting another to host a conference, the proposed use shall be reviewed with procurement and legal to determine whether a procurement contract should be used in lieu of all or part of the proposed grant or cooperative agreement."

If the proposer anticipates that the resulting award will not be a grant or cooperative agreement (i.e., if the proposing institution is a Government laboratory, including the Jet Propulsion Laboratory) and the result of the award is that NASA will be the primary sponsor of a conference (see FAQ 4-2 of NID 9700.1 for a discussion of when NASA is a primary sponsor), then the proposal must clearly state this fact, because NASA must provide detailed reports for NASA-sponsored conferences. In addition, there are other constraints imposed by both statute and regulation that limit options for NASA-sponsored conferences (e.g., use of non-Federal facilities, charging of registration fees).

No NSPIRES cover page question on data management plans will be posed for proposals to this program element, but you may present one or NASA may require one, if appropriate.

6. Summary of Key Information

Expected annual program budget for new awards	No specific budget is identified; selected proposals will be funded by the benefitting program.
Number of new awards pending adequate proposals of merit	The number of proposals selected will be dependent on the number and quality of proposals submitted and on the availability of funds from the benefitting program.
Maximum duration of awards	Typically 1 year, but see section 4.5
Due date for Notice of Intent to propose (NOI)	No Notices of Intent are requested for this program element.
Due date for proposals	**Proposals may be submitted at any time until 11:59 pm Eastern time on March 31, 2016**
Planning date for start of investigation	6 months after proposal receipt.
Page limit for the central Science-Technical-Management section of proposal	5 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	See section 3. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.

Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-TWSC
NASA point of contact concerning this program	Max Bernstein Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0879 E-mail: sara@nasa.gov

E.3 EXOPLANETS RESEARCH

Notice: Proposals to this program will be taken by a two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an organization Authorized Organizational Representative. No PDF upload is required. Step-1 proposers merely must fill in the Proposal Summary text box on the NSPIRES cover pages. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. See Section 3 for details.

The Exoplanets program element solicits basic research proposals to conduct scientific investigations related to the research and analysis of extrasolar planets (exoplanets). Its broad objectives include the determination of compositions, dynamics, energetics, chemical behaviors of extrasolar planets, and the detection and characterization of other planetary systems. This program element is shared between the Planetary Science Division and the Astrophysics Division.

1. Scope of Program

The Exoplanets Research program solicits basic research proposals to advance our knowledge and understanding of exoplanetary systems. Its objectives are the detection and characterization of exoplanets (including their surfaces, interiors, and atmospheres) and exoplanetary systems, including the determination of their compositions, dynamics, energetics, and chemical behaviors.

Research supported by this call may include observations, laboratory studies, theoretical studies, and modeling. Investigations that incorporate theory, modeling, laboratory studies, correlative analyses, and/or other research that would greatly increase the use of, or significantly facilitate the interpretation of, observational studies of exoplanetary systems are eligible for the Exoplanets Research Program. Such proposals that don't directly contain observational studies, but are intended to amplify their interpretation, will be judged upon the perceived impact of the proposed work on the interpretation of current and future observations of exoplanetary systems.

Investigations are expected to directly support the goal of understanding exoplanetary systems, by doing one or more of the following:

- aid in the detection of new exoplanets
- interpret observations of exoplanetary systems
- understand the chemical and physical processes of exoplanets (including their surfaces, interiors, and atmospheres)
- improve understanding of the origins of exoplanetary systems.

This program differs from the former Origins of Solar Systems (OSS, E.3, ROSES-2013) program by focusing exclusively on exoplanetary systems. Proposals to investigate the formation and early evolution of our Solar System are not solicited: see Section 2.1 below.

Proposed investigations may include ground-based observations made at any ground-based facility, public or private, including those supported by NASA. If new observations are to be

made, the facility must be in scientific operation at the time of submission of the proposal and the proposal must state whether or not observing time to support the proposed investigation has been awarded.

2. Programmatic Information

2.1 Exclusions

The breadth of this call inevitably results in overlap in subject matter between this and other ROSES program elements.

Proposals aimed at identification and characterization of signals and/or properties of extrasolar planets that may harbor intelligent life should be submitted to the Exobiology Program (C.5). Research aimed at investigating the habitability of an exoplanet should be submitted to the Habitable Worlds program element (C.4). Proposals in these research areas are not solicited in this program element.

Investigations with the primary objective of developing, or commissioning instruments are not solicited in this program element, except as described in Section 2.4.

Investigations with a primary focus on analysis of NASA space astrophysics data from a public domain archive (including the Kepler Mission and K2) are not solicited in this program element.

Investigations to develop the theory of exoplanetary systems may be submitted to this call and will be managed by the Planetary Science Division. However, investigations to develop the theory of planets or planetary systems as they relate directly to our Solar System should instead be submitted to the Emerging Worlds program element (C.2). Theoretical investigations that deal predominantly with objects beyond the Solar System may also be submitted to the Astrophysics Theory program (ATP; D.4).

2.2 Facilities Available to Proposers

Those investigators whose research requires high-performance computing should refer to the *Summary of Solicitation*, Section I(d), "NASA-provided High-End Computing Resources." This section describes the opportunity for successful proposers to the Exoplanets Research program to apply for computing time on either of two NASA computing facilities at the Goddard Space Flight Center's Computational and Information Sciences and Technology Office or at the Ames Research Center's Advanced Supercomputing Division.

Proposers are advised to read C.1, The Planetary Science Division Research Program Overview, for information on facilities that are available to supported investigators. If their use is anticipated, this should be discussed and justified in the submitted proposals (especially note the provision for such discussion in the proposal section entitled Facilities and Equipment). Also note that, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support may be required from any facility required for the proposed effort.

2.3 Planetary Science Division: Additional Funding for Relevant Instrumentation Construction or Upgrade

The Planetary Major Equipment (PME) program element described in C.17 of this NRA allows proposals for upgrading the analytical, computational, telescopic, and other instrumentation required by investigations for certain programs sponsored by the Planetary Science Division (PSD) Research and Analysis Program, including this one. All new analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $40,000, must be requested according to the PME guidelines in C.17. Two types of instrumentation requests are permitted. (1) A PME request to PSD may be made as a special section that is appended to a new research proposal to this program. This appendix is to be titled "Planetary Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal, and (2) A stand-alone PME proposal may be prepared and submitted to this program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" PSD award and should explain the relevance of the parent award to this program. See C.17 for details on how to prepare both types of PME requests.

2.4 Planetary Science Division: Early Career Fellowship Program

The purpose of the Early Career Fellowships (ECF) program (see C.16) is to support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the areas supported by the Planetary Sciences Division. This Program is based on the idea that supporting key individuals is a critical mechanism for achieving high impact science that will lead the field forward with new concepts, technologies, methods, and more.

Applicants requesting consideration for ECF may include an additional page to their Curriculum Vitae to provide information that can be used by reviewers to evaluate the PI's future research contributions and the potential for leadership within the scientific community. Please see C.16 of ROSES for more information on the two-step process for the ECF program and the criteria for evaluating candidates.

Astrophysics early career technologists are encouraged to apply to the Nancy Grace Roman Technology Fellowship program element (Program Element D.9).

2.5 Duration of Awards

We anticipate that most proposals will seek three years of funding. Proposals for less than three years are encouraged for projects that can be completed on shorter timescales. Four-year proposals may be selected if the need for the longer duration is sufficiently well justified.

2.6 Selecting Officials

The Selecting Official for investigations that are managed by the Planetary Science Division is the Research and Analysis Lead for the Planetary Science Division. The Selecting Official for

investigations that are managed by the Astrophysics Division is the Director of the Astrophysics Division.

3. The Two-Step Submission Process

To facilitate the early recruitment of a conflict-free review panel, and to ensure proposals are submitted to the appropriate program, this program will use a two-step proposal submission process (see Section IV. (b) vii of the ROSES *Summary of Solicitation*.)

A Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). No budget is required. Only proposers who submit a Step1 proposal are eligible to submit a Step-2 proposal. Full (Step-2) proposals must broadly contain the same scientific goals proposed in the Step-1 proposal. The Step-1 proposal title and PI cannot be adjusted. To add funded investigators between the Step-1 and Step-2 proposals, proposers must write to the point(s) of contact below and cc sara@nasa.gov at least four weeks in advance of the Step-2 due date. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 (full) proposal later.

3.1 Step-1 Proposal

Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) web page for this program. The Step-1 proposal should identify the PI and team members on the proposal. The Scientific/Technical/Management section of the Step-1 proposal is restricted to the 4000 character text box on the NSPIRES web interface cover pages and should include a description of the science goals and objectives to be addressed by the proposal, a brief description of the methodology to be used to address the science goals and objectives, and the relevance of the proposed research to this call. The Step-1 proposal may be used to determine whether the proposal was submitted to the correct program element. No evaluation of intrinsic merit will be done on Step-1 proposals.

The proposal is entered directly into a text field in NSPIRES, and no attachment is required. Proposers will be notified when they are able to submit their Step-2 proposals. NSPIRES will notify proposers whether their Step-2 proposal is encouraged or not, at which point they will be able to create Step-2 proposals.

3.2 Step-2 Proposal

Proposers should refer to the document entitled "How to submit a Step-2 proposal" under "Other Documents" on the NSPIRES page for this program. The process for preparation and submission of the Step-2 (full) proposals is essentially identical to that associated with any other ROSES proposal. This is a reminder that all proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the *Summary of Solicitation* and Chapter 2 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review. In previous years, problems with the following aspects of formatting proposals have been noted. Proposers should pay particular attention to:

- Length of the Scientific/Technical/Management section: 15 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 11 inches.
- Font: The *NASA Guidebook for Proposers* requires that you use a 12-point or larger font. The selected font must meet the requirement of having, on average, no more than 15 characters per inch (e.g., Times New Roman and Arial). You may not adjust the character spacing or otherwise condense a font from its default appearance.
- Line spacing: Font and line-spacing settings should produce text that contains no more than 5.5 lines per inch. Do not adjust line-spacing settings for your selected font below single-spaced.
- Figure captions: Must follow the same font and spacing rules as the main text.
- Figures and tables: For text in figures and tables, font and spacing rules listed above do not apply, but all text must be judged to be legible to reviewers without magnification above 100%. Do not place expository text in tables or figures in order to gain space.

4. Summary of Key Information

Expected program budget for first year of new awards	$2.0-2.5 M
Number of new awards pending adequate proposals of merit	15-20
Maximum duration of awards	3 years; 4 years if well justified (see Section 2.5)
Due date for Step-1 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Due date for Step-2 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Planning date for start of investigation	January 1, 2016
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Planetary Science and Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required. See also Section IV in the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)

Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-XRP
NASA points of contact concerning this program	Christina Richey Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-2206 Email: christina.r.richey@nasa.gov Mario Perez Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1535 Email: mario.perez@nasa.gov