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RESEARCH ANNOUNCEMENT

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCE – 2012

(ROSES 2012)

PROPOSALS DUE: **May 1, 2012 THROUGH MARCH 22, 2013**

OMB Approval Number 2700-0087

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

HEADQUARTERS

SCIENCE MISSION DIRECTORATE

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WASHINGTON, DC 20546-0001

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES – 2012 (ROSES-2012)

NASA RESEARCH ANNOUNCEMENT (NRA)

SOLICITING BASIC AND APPLIED RESEARCH PROPOSALS

NNH12ZDA001N

CATALOG OF FEDERAL DOMESTIC ASSISTANCE (CFDA) NUMBER: 43.001

ISSUED: FEBRUARY 14, 2012

PROPOSALS DUE
STARTING NO EARLIER THAN MAY 1, 2012
THROUGH NO LATER THAN APRIL 30, 2013

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES (ROSES)–2012

EXECUTIVE SUMMARY

This National Aeronautics and Space Administration (NASA) Research Announcement (NRA), entitled *Research Opportunities in Space and Earth Sciences (ROSES)–2012*, solicits basic and applied research in support of NASA's Science Mission Directorate (SMD). This NRA covers 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, stratospheric balloon, suborbital rocket, International Space Station, 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 intra-agency transfers depending on the nature of the proposing organization and/or program requirements. The typical period of performance for an award is four years, although a few programs may specify shorter or longer (maximum of five years) 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. Any changes or modifications to any of these guidelines 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 2013, at which time release of a subsequent ROSES NRA is planned. A web archive (and RSS feed) for amendments, clarifications, and corrections to ROSES-2012 can be found at: http://nasascience.nasa.gov/researchers/sara/grant-solicitations/roses-2012/. This NRA will be available upon its release at http://go.nasa.gov/ROSES12.

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Note: 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 at http://go.nasa.gov/ROSES-12, or by going to http://nspires.nasaprs.com/ and selecting “Solicitations” then “Open Solicitations” and “NNH12ZDA001N.”

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Note: Any amendments to the Table of Contents for Appendices A through E may be found in Table 3 of this NRA. Table 3 of this NRA is posted as a separate document on the ROSES-2012 homepage, which can be reached either by following the hypertext link embedded in the electronic version of this document above, or at http://go.nasa.gov/ROSES-12, or by going to http://nspires.nasaprs.com/ and selecting “Solicitations” then “Open Solicitations” and “NNH12ZDA001N.”

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES (ROSES)–2012

SUMMARY OF SOLICITATION

I. FUNDING OPPORTUNITY DESCRIPTION

(a) Strategic Goals of NASA's Research Program

The National Aeronautics and Space Administration (NASA) is chartered in the National Aeronautics and Space Act [Public Law No. 85-568, 2 Stat. 426 (July 29, 1958) As Amended] 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 program of space exploration and develop, acquire, and use civil space systems to advance fundamental scientific knowledge of our Earth system, solar system, and 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 *2011 NASA Strategic Plan* identifies the following strategic objectives as those to be pursued by SMD:

- Advance Earth System Science to meet the challenges of climate and environmental change;
- Understand the Sun and its interactions with the Earth and the solar system;
- Ascertain the content, origin, and evolution of the solar system and the potential for life elsewhere; and
- Discover how the universe works, explore how it began and evolved, and search for Earth-like planets.

Further valuable, in depth insight into these strategic objectives and supporting research areas may be found in the following documents:

- The *2011 NASA Strategic Plan*, available at http://www.nasa.gov/news/budget/ and/or http://nasascience.nasa.gov/about-us/science-strategy; and
- The *2010 Science Plan for NASA's Science Mission Directorate* (hereafter the *NASA Science Plan*), available at http://nasascience.nasa.gov/about-us/science-strategy.

The NASA strategic goals and research objectives for science from the *NASA Science Plan* are given in Table 1. These NASA research objectives, and their corresponding strategic outcomes, are also used to assess NASA's research progress for compliance with the *Government Performance and Results Act* (GPRA) of 1993 and the *GPRA Modernization Act* of 2010. Each program element in this NASA Research Announcement (NRA) is explicitly relevant to these NASA strategic goals, science outcomes, and the *NASA Science Plan*. Each proposer to this NRA demonstrates relevance of the proposed research to NASA's goals and objectives by demonstrating relevance to the programmatic goals and objectives of the appropriate program element (further instructions concerning this requirement are provided in Section IV(e) below).

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

The NASA Science Mission Directorate (SMD) pursues NASA's strategic goals 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 the latter of these two types of programs, in particular, 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 goals and 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 Earth Science Research Program is managed by the Earth Science Division.
- 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 Heliophysics Research Program is managed by the Heliophysics Division.
- 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 Planetary Science Research Program is managed by the Planetary Science Division.
- 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 Astrophysics Research Program is managed by the Astrophysics Division.

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) Opportunities for Education and Public Outreach

(i) Overview

SMD is committed to fostering the broad involvement of the Earth and space science research communities in Education and Public Outreach (E/PO) and contributing to NASA's three education goals:

- Strengthen NASA and the Nation's future workforce;
- Attract and retain students in science, technology, engineering, and mathematics (STEM) disciplines; and
- Engage Americans in NASA's mission.

The NASA Science Mission Directorate's vision for Education and Public Outreach is:

> *To share the story, the science, and the adventure of NASA's scientific explorations of our home planet, the solar system, and the universe beyond, through stimulating and informative activities and experiences created by experts, and delivered effectively and efficiently to learners of many backgrounds via proven conduits, thus providing a return on the public's investment in NASA's scientific research.*

Progress towards achieving these goals has become an important part of the broad justification for the public support of Earth and space science. A more detailed discussion may be found in the *NASA Education Strategic Coordination Framework* (http://www.nasa.gov/offices/education/performance/strategic_framework.html).

SMD sponsors a broad spectrum of educational activities ranging from kindergarten to postgraduate levels via several vehicles of solicitation. A variety of information about recent E/PO activities in Earth and space science can be found at http://nasascience.nasa.gov/researchers/education-public-outreach. This site includes *Explanatory Guides to E/PO Evaluation Factors*, strategic planning and implementation documents, catalog or directory of E/PO resources, and list or abstracts of selected E/PO awards.

(ii) E/PO Opportunities

Historically two kinds of SMD E/PO programs are included in the ROSES NRA: Cross division midsized E/PO projects that are not being solicited this year, and opportunities for early career scientists offered by certain science divisions. Though the former are not being called for this year, the latter are solicited in the form Appendix C.22, Fellowships for Early Career Researchers in Planetary Science (via participating calls in Appendix C), and Appendix D.9 the Nancy Grace Roman Technology Fellowships in Astrophysics.

Other opportunities to participate in SMD's E/PO programs are not included in this ROSES NRA, but are solicited separately. These include E/PO opportunities embedded in SMD missions and programs, opportunities available through SMD's E/PO support network organizations to provide E/PO support to the scientific and educational enterprise inside and outside of NASA, and opportunities sponsored by NASA's Office of Education to develop systematic and sustainable educational efforts **[Corrected April 23, 2012]**.

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

Stephanie Stockman
SMD Lead for Education and Public Outreach
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-0039
Email: HQ-SMD-ROSES-EPO@hq.nasa.gov

(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 Goddard Space Flight Center (GSFC), and the NASA Advanced Supercomputing (NAS) facility at 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 who 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
Email: Tsengdar.J.Lee@nasa.gov
Telephone: 202-358-0860

(e) 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.

(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) Significant Changes from Recent ROSES

Proposers should be aware of the following significant changes in this NRA from recent years.

- All team members identified on the NSPIRES proposal cover page must both acknowledge their participation in the investigation and indicate their institutional affiliation via NSPIRES (Section IV(b)(iv)).
- Proposals submitted in response to ROSES-2012 can be submitted through either NSPIRES or Grants.gov. However, certain caveats apply, see Section IV(b)(v) for details.
- Unless specifically allowed by an individual program element (program elements are the appendices to ROSES), multiple PIs (as described in Section 1.4.2 of the *NASA Guidebook for Proposers*[1]) 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,

[1] The *Guidebook for Proposers Responding to a NASA Research Announcement (NRA) or Cooperative Agreements Notice (CAN)* (hereafter referred to as the *NASA Guidebook for Proposers*) is at http://www.hq.nasa.gov/office/procurement/nraguidebook; see Section IV(a) of this NRA for further information.

Institutional PI, and Co-PI (from a non-U.S. organization under specific circumstances), remain permitted.

- In the past support for conferences and workshops was primarily provided in response to unsolicited proposals, since there were few ROSES program elements that included this kind of work (*Living with a Star Targeted Research and Technology* (Appendix B.6) and *Mars Fundamental Research* (Appendix C.13) being notable exceptions). Unsolicited proposals for topical workshops, symposia, conferences, and other scientific/technical meetings will no longer be accepted. Proposals for such events should be submitted to those few program elements that include it or in response to the *Topical Workshops, Symposia, and Conferences* program element found in Appendix E.2.

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

- 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 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/.
- In accordance with Public Law 112-55, Section 539(a), 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. See Section III (c) on restrictions involving China.
- Proposal submission for *Land Cover / Land Use Change* (Appendix A.2), *Geospace Science* (Appendix B.3), *Solar and Heliospheric Science* (Appendix B.4), and *Cassini Data Analysis and Participating Scientists* (Appendix C.10) will use a two-step process, in which the Step-1 proposal (which replaces the Notice of Intent) is required. See Section IV(b)(vii) and the text of those program elements for details.
- The opportunity for PIs of selected research investigations to receive education or outreach awards as supplements to their research award (*Supplemental Outreach Awards for ROSES Investigators*, *Supplemental Education Awards for ROSES Investigators*) is not offered in ROSES-2012.

In addition to the listed significant changes, this NRA and 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 the release of ROSES-2011. All proposers are urged to read this NRA and the 2012 edition of the *NASA Guidebook for Proposers* carefully, since all proposals must comply with their requirements, constraints, and guidelines.

II. AWARD INFORMATION

(a) Funding and Award Policies

The amount of funds expected to be available 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. Given the submission of proposals of merit, the number of awards that may be made for each program element is also given in this location.

In all cases, NASA's goal is to initiate new awards within 46 days after the selection of proposals is announced for each program element. However, this time period may be longer based on 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. 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 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, only one type of award may be offered, 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 anticipated **[Sentence added April 23, 2012]**. 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*[2] 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) Successor Proposals and Resubmissions

Generally, 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 (see Section 1.5 of the *NASA Guidebook for Proposers*). However, it is SMD policy that such successor proposals will be considered with neither advantage nor disadvantage along with new proposals that are submitted for that same program. Instructions regarding successor proposals may be found in Section 1.5 of the *NASA Guidebook for Proposers*.

Proposals that were submitted but not selected for any previous NASA solicitation may be submitted either in a revised or original form. Such submissions will be subjected to full peer review and considered with neither advantage nor disadvantage along with new proposals that are received by NASA.

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[2] 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.

(c) 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 is four years, but it can range from one year for activities of limited scope to as long as five years for extensive, comprehensive studies.

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 choose to support an award of shorter duration than was proposed.

(d) Rephasing of Award Budgets

Occasionally the schedule for delivery of funds for SMD awards are 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 Agency's family friendly stance, SMD will accommodate all reasonable requests from the PI or AOR to rephase ROSES awards, as long as it does not compromise previously agreed upon project goals, timelines, or deliverables. This is consistent with our adherence to FDP terms that to allow grantee initiated first time no-cost extensions of up to 12 months **[Sentences above added April 23, 2012]**.

To facilitate the reduction of 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 a year or more of funds 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 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 science should never be halted for a lack of approved 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. 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 112-55, Section 539(a), 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 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 12 FAQ 1a on the SARA web page at http://science.nasa.gov/researchers/sara/faqs/#1. **[FAQ added June 26, 2012]**

Grant Information Circular 12-01 instructs us 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 The Department of Defense and Full-Year Appropriation Act, Public Law 112-10 Section 1340(a); The Consolidated and Further Continuing Appropriation Act of 2012, Public Law 112-55, Section 539; 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. **[This section added June 26, 2012]**

(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 VII(a) below.

The summary table of names and planned work commitment of all personnel necessary to perform the proposed effort, regardless of whether those individuals require funding (see the *Guidebook for Proposers* Section 2.3.10), is needed for the purposes of evaluating the proposal. 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". **[This paragraph added 05/22/2012]**

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 *Guidebook for Proposers Responding to a NASA Research Announcement (NRA) or Cooperative Agreements Notice (CAN)* (hereafter referred to as the *NASA Guidebook for Proposers*), located at http://www.hq.nasa.gov/office/procurement/nraguidebook. By reference, the 2012 edition of the *NASA Guidebook for Proposers* is incorporated into this NRA. 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 of Key Information* subsection that concludes each

program element description. 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 Central Contractor Registry (CCR).

- 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 the proposals 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-step 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) <u>Proposal Format and Contents</u>

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, and consistent with our Announcements of Opportunity. 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.

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 your proposal. In order to increase the ease in reviewing your proposal, you should crop and compress any embedded photos and graphic files to an appropriate size and resolution. Most electronically submitted proposals will be less than 2 MB in size.

(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. Proposers should include all relevant details (with the exception of salaries for NASA civil servants) in the budget justification, and a detailed budget should be included at the end of the proposal document. 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, the 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/.

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-2012 proposal for a two-year award that starts in mid FY 2012 could phase the funds for a half year of funding in FY 2012, a full year in FY 2013, and a half a year in FY 2014.

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 the amount which shows 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. JPL proposers and Co-Investigators may still include the award fee for informational purposes in their budget narratives and detailed budgets.

(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). 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 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 email 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 email 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 cover page 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 an ! 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 appropriate peer or NASA 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 email 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

NASA offers proposers the option to use Grants.gov to prepare and submit proposals in response to this ROSES NRA. Grants.gov allows organizations to electronically find and apply for competitive grant opportunities from all Federal grant-making agencies; it provides a single access point for over 1000 grant programs offered by the 26 Federal grant-making agencies. The U.S. Department of Health and Human Services is the managing partner for Grants.gov.

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.

- Complete the required Grants.gov forms including the SF424 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 application 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 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 <u>may not</u> submit the application to Grants.gov unless he/she is an AOR.

Potential applicants are urged to access Grants.gov site <u>well in advance</u> 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 User Guide* at http://www.grants.gov/applicants/app_help_reso.jsp. 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 email 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 advertised through this solicitation, 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 for each program element in Appendices A through E. 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 must be submitted via NSPIRES regardless of whether 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 email as directed in Section 3.1 of the *NASA Guidebook for Proposers.*

(vii) The Two-Step Proposal Process and the Two-Phase Proposal Process

The Two-Step Proposal Process

On occasion, NASA will solicit proposals using a two-step proposal process for which the Step-1 proposal is a synopsis of the intended research. When employed, Step-1 proposals are submitted by the NOI/Step-1 due date given in Tables 2 and 3 of this NRA; this site will be open for the submission of Step-1 proposals starting ~30 days in advance of their due date. NASA will review this Step-1 proposal to determine if the anticipated research project exhibits sufficient programmatic relevance and responsiveness to the current solicitation to warrant submission of a full Step-2 proposal. All submitters of Step-1 proposals will be informed by NASA no later than eight weeks after the Step-1 due date that they are, or are not, invited to submit a full Step-2 proposal by the proposal due date established for that program element. The provision of feedback on Step-1 proposals prior to the Step-2 due date is not ensured. Note that Step-1 proposals are required. A Step-2 proposal may be submitted only if a Step-1 proposal is submitted and that Step-1 proposal results in an invitation to submit a Step-2 proposal.

The required synopsis for the Step-1 proposal is submitted as 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 in an invited Step-2 proposal) but in other cases the team is binding, so please read the program element carefully. Budget and detailed program data should not be included with the Step-1

proposal. 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.

Optionally the two-step program element may state a limit on the number of Step-1 proposals that an individual PI may submit.

At the time of release, this ROSES-2012 NRA contains three program elements that solicit proposals using a two-step process: *Land-Cover/Land-Use Change* (Appendix A.2), *Geospace Science* (Appendix B.3), *Solar and Heliospheric Science* (Appendix B.4) and *Cassini Data Analysis and Participating Scientists* (Appendix C.10).

The Two-Phase Proposal Process

On occasion, NASA will solicit proposals using a two-phase proposal process for which Phase-1 is an observing 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 be requested for a Phase-1 observing request by the NOI due date, and the Phase-1 observing request must be submitted by the proposal due date in Tables 2 and 3 of this NRA.

Grants.gov does not provide NOI or Phase-1 observing request capability; therefore, NOIs and Phase-1 observing requests cannot be submitted via Grants.gov regardless of whether the Phase-2 funding proposal will be submitted via NSPIRES or Grants.gov. The Phase-2 proposal for funding must be submitted via either NSPIRES or Grants.gov 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.

At the time of release, this ROSES-2012 NRA contains two guest investigator/guest observer program elements using the two-phase proposal process: *Swift Guest Investigator* (Appendix D.5) and *Fermi Guest Investigator* (Appendix D.6).

(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. All proposals must be submitted electronically using either NSPIRES or Grants.gov (see Sections IV(b)(i–iii) above).

Proposals submitted later 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. Late proposals may not be submitted via Grants.gov.

(d) Proposal Funding Restrictions

In addition to the funding restrictions and requirements given in the *Guidebook for Proposers* and the *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.
- As directed in the *NASA Guidebook for Proposers*, Section 2.3.10(c)(iii), 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 program element appendix, 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 by the proposers and found to be in the interests of the government and consistent with appropriate law, regulation, policy and practice **[Clarified October 2, 2012]**.
- Regardless of whether a Co-I will be funded through a subaward or through a separate award, and with the exception of salaries for NASA civil servants (see Section IV(b)(iii)), the budget for the proposal must include all funding requested from NASA for the proposed investigation. This must be reflected in the budget totals that appear in the proposal and its budget forms. Any required budget for Co-Is or Government facilities that will be separately funded 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 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 *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 under NASA's reduced travel budget to approve the proposed travel.
- 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 the 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 participant who is not participating while 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)).
- 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 *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.

(e) Proposal Requirements for Relevance

Proposals for all NASA sponsored research programs are evaluated on three criteria: intrinsic merit, relevance to NASA's objectives, and cost realism and reasonableness (see Appendix C of the *NASA Guidebook for Proposers*).

Each program element includes a specific description of how it is relevant to the *NASA Strategic Plan* and/or the *NASA Science Plan* (see Section I(a)). Therefore, unless otherwise stated in the program element, it is not necessary for individual proposals to show relevance to NASA's broader goals and objectives. The proposal only needs to demonstrate relevance by discussing how the proposed investigation addresses the goals and objectives of the specific program element.

V. Suborbital and Suborbital-Class Investigations

(a) Overview of Suborbital and 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. Because flight investigations solicited through ROSES generally use suborbital platforms (though there are exceptions) and generally have modest costs appropriate for the research program, these investigations are referred to as suborbital or suborbital-class investigations.

Platforms for suborbital and suborbital-class investigations include aircraft, balloons, sounding rockets, suborbital reusable launch vehicles, the International Space Station (ISS), and CubeSats. 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.

(b) Points of Contact for Suborbital and Suborbital-Class Platforms

NASA provides different avenues for procurement of suborbital launch vehicle services: the use of NASA-provided services for sounding rockets (managed by the NASA Sounding Rocket Program Office (SRPO) at NASA Wallops Flight Facility) and balloons (managed by the NASA Balloon Program Office (BPO) at NASA Wallops Flight Facility) and the purchase of suborbital reusable launch vehicle services through the NASA Office of the Chief Technologist (OCT)'s Flight Opportunities Program. SMD also solicits investigations as CubeSats and as 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 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.

Experiments using suborbital reusable launch vehicles (Section V(d)), the International Space Station (Section V(e)), and CubeSats (Section V(f)) as platforms are subject to additional requirements.

(i) NASA-provided Sounding Rocket Services

Sounding Rocket Vehicles. 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 SRPO has the final authority in the choice of which vehicle is to be used.

Sounding Rocket Launch Sites. 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. Proposals may be submitted for launches with modest operational requirements from the established non-U.S. launch sites at Andoya, Norway, and Kiruna, Sweden (Esrange).

The Sounding Rocket Program is currently planning to provide launches from Woomera, Australia, in July-September of 2014 and again in April-June of 2016, subject to both the availability of funds and the conclusion of agreements with Australia. Investigators responding to ROSES 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.

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 Sounding Rocket Program Office 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.

Questions concerning sounding rockets may be addressed to:

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

(ii) NASA-provided Balloon Services

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

Balloon Launch Sites. The nominal U.S. launch sites for Balloons are Fort Sumner, New Mexico, and at the Columbia Scientific Balloon Facility in Palestine, Texas. The Balloon Program also conducts launches from established non-U.S. launch sites at McMurdo, Antarctica; Alice Springs, Australia; and Kiruna, Sweden (Esrange).

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 young 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)

Questions concerning balloon services may be addressed to:

David Gregory
Balloon Program Office
Code 820
Wallops Flight Facility
National Aeronautics and Space Administration
Wallops Island, VA 23337
Telephone: (757) 824-2367
Email: David.D.Gregory@nasa.gov

(iii) Suborbital Reusable Launch Vehicles

Suborbital Reusable Launch Vehicles (sRLV) may offer new capabilities for the conduct of NASA scientific research, education, and technology advancement. Platforms are provided by the Office of Chief Technologist's (OCT's) Flight Opportunities Program. Some vehicles are operational, and others are anticipated to be operational by 2012. Further, there may be flight research opportunities as the vehicles are tested and demonstrated. The use of these commercial services may reduce the cost of suborbital flight research by leveraging private investment. The Flight Opportunities Program Office will assist proposers with sRLV vehicle platforms.

Additional constraints and requirements for proposals to use sRLV vehicles may be found in the ROSES Summary of Solicitation, Section V(d). All proposals to use sRLV vehicles must comply with the requirements in Section V(d) of the *ROSES Summary of Solicitation* (see below).

Questions concerning potential sRLV investigations may be addressed to:

LK Kubendran
Flight Opportunities Program
Office of the Chief Technologist
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 include nadir pointing locations. NASA has available annual external launch opportunities after 2012 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).

Additional constraints and requirements for proposals to utilize the International Space Station may be found in the *ROSES Summary of Solicitation*, Section V(e). All proposals to utilize ISS must comply with the requirements in Section V(e) of the *ROSES Summary of Solicitation*.

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

For further information, please contact:

George C. Nelson
ISS Research Integration Office/OZ
NASA Johnson Space Center
Houston, TX 77058
Telephone: 281.244.8514
Email: george.nelson-1@nasa.gov

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

Short duration orbital platforms, such as CubeSats, may offer new capabilities for the conduct of NASA scientific research, education, and technology advancement. A CubeSat is a type of space research nanosatellite. The base CubeSat dimension is 10x10x11 centimeters (one “Cube” or “1U”). CubeSats typically include volumes of 1U, 2U, 3U, and 6U and may weigh no more than 1.33 kilogram per 1U Cube. NASA has initiated a CubeSat Launch Initiative and begun regularly providing launch opportunities for CubeSat as secondary payloads on NASA missions. The

CubeSat Launch Initiative is managed by the NASA Human Exploration and Operations Mission Directorate.

Additional constraints and requirements for proposals to utilize CubeSats may be found in the *ROSES Summary of Solicitation*, Section V(f). All proposals to utilize CubeSats must comply with the requirements in Section V(f) of the *ROSES Summary of Solicitation*.

For further information, please contact:

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

or

Jason C Crusan,
Chief Technologist for Human Exploration and Operations
Phone: 202-358-0635,
Email: jason.c.crusan@nasa.gov

(c) General Guidelines for Suborbital Investigation Proposals

ROSES supports science investigations and/or technology development utilizing payloads flown on sounding rockets, balloons, suborbital reusable launch vehicles, or similar-class payloads flown on the International Space Station or as flights of opportunity. Suborbital 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 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. Unlike most other ROSES investigations where the proposing PI organization must subcontract funding to non-Government investigators, suborbital investigations will sometimes be split into multiple awards depending on circumstances. Please read the individual ROSES Appendix and consult with the POC.

(d) Suborbital Reusable Launch Vehicles

Suborbital reusable launch vehicles (sRLVs) may offer new capabilities for the conduct of NASA scientific research, education, and technology advancement. Some sRLVs are already operational and there may be flight research opportunities as other vehicles are tested and demonstrated. The use of these commercial services may reduce the cost of suborbital flight research by leveraging private investment. Access to these platforms is managed by the Flight

Opportunities Program within the Office of the Chief Technologist. This program office will assist proposers with the use of sRLV platforms.

NASA is presently not considering human-tended payloads to be flown on sRLVs and there will not be any NASA-sponsored participants on sRLV flights. The payloads to be flown on sRLV flights must either be automated or remotely operated. Remote operation capability should be confirmed with the flight operator.

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. Some of this information is available from the Flight Opportunities Program website at http://flightopportunities.nasa.gov, and information about various platforms available through Flight Opportunities is available at http://flightopportunities.nasa.gov/platforms. It is the PI's responsibility to work with the Flight Opportunities Program and/or a potential vendor to develop his/her proposal.

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. Note that the Flight Opportunities Program is available to assist with (i) – (iii).

The cost to SMD for the flight and all other services provided by the sRLV vendor must be clearly stated in the proposal. However, the cost for the flight and all other services provided by the sRLV vendor should not be included in the PI's 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 Flight Opportunities Program and will not be funded through the PI's award.

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 in Système International (SI) traceable units.

Proposals for investigations using sRLVs as platforms must be for complete investigations. Proposals to utilize sRLVs must describe a complete suborbital science investigation, including payload construction, vehicle integration, launch and flight operations, data analysis, and publication of results. The Flight Opportunities Program is available to assist with this process.

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.

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 L. Tomko, Human Research Program and Fundamental Space Biology, NASA Headquarters, Washington, DC 20546; Tel.: 202-358-2211; email: dtomko@nasa.gov.

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 suborbital reusable launch vehicle offers an advantage (e.g., scientific, technical, or cost) over other suborbital 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;
- The quality of the plans for completing the preliminary design prior to the investigation confirmation review; and
- The affordability to SMD of the proposed vehicle vendor cost for the flight and other required services.

Additional information on sRLV vehicles, including general vehicle capabilities and contact information for some vendors, is available at http://flightopportunities.nasa.gov/platforms.

Investigators proposing sRLV payloads are strongly urged to discuss prospective investigations with operations personnel in the Flight Opportunities Program 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, Office of the Chief Technologist, NASA Headquarters, Washington, DC 20546; Tel.: 202-358-2528; E-mail: lk@nasa.gov.

(e) 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). Generally speaking, proposals for investigations that are carried out through development, launch, and operation of am ISS-based project are permitted in any ROSES program element that solicits investigations for use on suborbital platforms, including aircraft, sounding rockets, and scientific balloons. In this sense, an ISS-based investigation is a "suborbital class" investigation even though it will generally be placed into orbit. ISS-based "suborbital class" investigations are subject to the same cost constraints to which traditional suborbital investigations are subject.

Available external attach points include both zenith and nadir pointing locations and internal attach points include nadir pointing locations. NASA has available annual external launch opportunities after 2012 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).

(i) Programmatic and management constraints

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 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 on 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.

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; email: dtomko@nasa.gov.

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.

(ii) Accommodation opportunities

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.

Further 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.

Investigators proposing ISS payloads should contact the International Space Station Payloads Office to discuss constraints, launch opportunities, and other technical matters. For further

information, please contact George C. Nelson, ISS Research Integration Office/OZ, NASA Johnson Space Center, Houston, TX 77058; Telephone: 281.244.8514; Email: george.nelson-1@nasa.gov.

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

Short duration orbital platforms, such as CubeSats, may offer new capabilities for the conduct of NASA scientific research, education, and technology advancement. A CubeSat is a type of space research nanosatellite. The base CubeSat dimension is 10x10x11 centimeters (one "Cube" or "1U"). CubeSats typically include volumes of 1U, 2U, 3U, and 6U and may weigh no more than 1.33 kilogram per 1U Cube. NASA has initiated a CubeSat Launch Initiative and begun regularly providing launch opportunities for CubeSat as secondary payloads on NASA launch vehicles. The CubeSat Launch Initiative is managed by the NASA Human Exploration and Operations Mission Directorate; see http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html.

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, are permitted in any ROSES program element that solicits investigations for use on suborbital platforms, including aircraft, sounding rockets, and scientific balloons. In this sense, a CubeSat-based investigation is a "suborbital class" investigation even though it will generally be placed into orbit. Cube-Sat based "suborbital class" investigations are subject to the same cost constraints and risk tolerance constraints that traditional suborbital investigations are subject to.

The process for manifesting a SMD selected and funded CubeSat for launch is still in development. Currently an Agency-wide selection recommendation committee considers candidate CubeSats for selection from among those proposed from 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.

Proposals for short duration orbital experiments other than CubeSats must include provisions for access to space as part of the proposal.

Proposals for CubeSat-based 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.
- 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 selection consideration. The less stringent the orbital constraints, the more probable it will be that NASA can manifest the CubeSat investigation for launch.

- 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 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; email: dtomko@nasa.gov.

Questions concerning the NASA CubeSat Launch Initiative may be addressed to Anne E. Sweet, Launch Services Program Executive, Phone: 202-358-3784, Email: anne.sweet-1@nasa.gov; or Jason C Crusan, Chief Technologist for Human Exploration and Operations, Phone: 202-358-0635, Email: jason.c.crusan@nasa.gov.

VI. PROPOSAL REVIEW INFORMATION

(a) Evaluation Criteria

Evaluation by peers of the proposing personnel will be used to assess each proposal's intrinsic scientific and technical merit, its relevance to NASA's stated objectives, and its cost realism. See Appendix C.2 of the *NASA Guidebook for Proposers* for further discussion of these criteria and their relative weights. The evaluation criteria include factors evaluated by peer reviewers, as well as programmatic factors evaluated by NASA program personnel. 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.
- As discussed in Section IV(e) above, relevance will be judged in part by the proposal's focus on specific strategic and science objectives for that ROSES Appendix (program element), as given in the call. This focus on relevance to the call, rather than NASA's broader goals, supersedes any instructions in the *Guidebook for Proposers.*
- Cost data for U.S. proposals will 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 Proposer*. 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.
- Cost sharing is not part of the evaluation criteria (see Section III(d) above). However, cost sharing may become a factor at the time of selection when deciding between proposals of otherwise equal scientific and technical merit.

(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. For some of the program elements solicited in this NRA, the desire to achieve a balance of efforts across the solicited program objectives may play a role in the selections, taking into account not only the new proposals of merit that are suitable for selection, but also those that seek an extension of activities initiated through previous but now concluded selections, i.e., "successor" proposals; see Section II(b) above.

Unless otherwise specified, the SMD Division Director responsible for a research program element (or his/her delegate) is its Selection Official. Unless otherwise specified, the SMD Lead for Education and Public Outreach (or his/her delegate) is the Selection Official for the cross-division E/PO program element.

(c) Selection Announcement and Award Dates

SMD's goal is to announce selections within 150 days of the proposal due date and within 56 days after the conclusion of the peer review. Selections are typically announced between 150 days and 220 days after the proposal due date (see http://nasascience.nasa.gov/researchers/sara/grant-stats/). 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).

In order to announce selection decisions as soon as is practical, even in the presence of budget uncertainties, the Selection Official may decide to defer selection decisions on some proposals while making selection decisions on others. If a Selection Official uses this option, then proposals will be selected, not selected, or not selected at this time. Proposals that are not selected at this time will be considered for a supplemental selection when circumstances allow. All proposers whose proposals are not selected at this time will eventually be notified whether their proposal is selected through a supplemental selection or is no longer being considered for a supplemental selection.

Those proposers not selected will be notified via NSPIRES or by postal or electronic mail and offered a debriefing consistent with the policy in Section C.6 of the *NASA Guidebook for Proposers*.

(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 URL of the SARA website is 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 sending an email to sara@nasa.gov. It is good experience for young 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 *Grants Handbook*.

(c) Award Reporting Requirements

The reporting requirements for awards made through this NRA will be consistent with Exhibit G of the *Grants Handbook*. 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
Telephone: (202) 358-0879
Email: sara@nasa.gov

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 of Key Information* subsection that concludes each program element description. 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 email 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 email 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 this 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-12 homepage, which can be found at http://go.nasa.gov/ROSES-12 (or by going to http://nspires.nasaprs.com, selecting "Solicitations"

then “Open Solicitations” then “NNH12ZDA001N”). Also, an RSS feed for amendments, clarifications, and corrections to ROSES can be found at http://nasascience.nasa.gov/researchers/sara/grant-solicitations/roses-2012/. Although 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 at http://nspires.nasaprs.com (select “Solicitations” then “Open Solicitations” then “NNH12ZDA001N” then “List of Program Elements” then the relevant program element). All such clarifications will be posted no later than 30 days before the proposal due date.

(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 email 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 “Email Subscriptions.” Owing to the increasingly multidisciplinary nature of SMD programs, this email 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://nspires.nasaprs.com (select “Solicitations” then “Open Solicitations”) 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 email received from “NSPIRES-help@nasaprs.com” is not identified by any automated email filtering system as unwanted email.

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 investigations selected through previous solicitations (issued after January 1, 2005) are available at http://nspires.nasaprs.com (click “Selected Proposals”, choose the year from the pop-down menu, and click the find button.). Selection statistics and links to winning abstracts can also be found at http://nasascience.nasa.gov/researchers/sara/grant-stats.

(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://www.GeoData.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

Barbara Giles
Director
Heliophysics Division

James L. Green
Director
Planetary Science Division

Paul Hertz
Director (Acting)
Astrophysics Division

John M. Grunsfeld
Associate Administrator
Science Mission Directorate

Table 1: NASA Science Goals, Questions, and Research Objectives[3]

Science Goals	**Science Questions**	**Science Area Objectives**
Earth Science: Advance Earth System Science to meet the challenges of climate and environmental change.	• How is the global Earth system changing? (Characterize) • What are the sources of change in the Earth system and their magnitudes and trends? (Understand) • How will the Earth system change in the future? (Predict) • How can Earth system science improve mitigation of and adaptation to global change? (Apply)	1. Understand and improve predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition 2. Quantify the changing distributions of extreme weather events and enable improved weather prediction 3. Quantify and predict changes in global land cover, biological productivity, ecosystems, and the carbon cycle 4. Quantify the key reservoirs and fluxes in the global water cycle and improve models of water cycle change and fresh water availability 5. Understand the roles of oceans, atmosphere, and ice in the climate system and improve predictive capability for future evolution 6. Characterize and understand Earth surface changes and variability of Earth's gravitational and magnetic fields 7. Enable the broad use of Earth system science observations and results in mitigating and adapting to a changing environment
Heliophysics: Understand the Sun and its interactions with the Earth and the solar system.	• What causes the Sun to vary? • How do the Earth and Heliosphere respond? • What are the impacts on humanity?	1. Understand the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium 2. Understand how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres 3. Maximize the safety and productivity of human and robotic explorers by developing the capability to predict the extreme and dynamic conditions in space

[3] From Appendix 1 of the *2010 Science Plan for NASA's Science Mission Directorate*; see Section I(a) for reference

Science Goals	Science Questions	Science Area Objectives
Planetary Science: Ascertain the content, origin, and history of the solar system, and the potential for life elsewhere.	• What is the inventory of solar system objects and what processes are active in and among them? • How did the Sun's family of planets, satellites, and minor bodies originate and evolve? • What are the characteristics of the solar system that lead to habitable environments? • How and where could life begin and evolve in the solar system? • What are the characteristics of small bodies and planetary environments that pose hazards or provide resources?	1. Inventory solar system objects and identify the processes active in and among them 2. Understand how the Sun's family of planets, satellites, and minor bodies originated and evolved 3. Understand the processes that determine the history and future of habitability of environments on Mars and other solar system bodies 4. Understand the origin and evolution of Earth life and the biosphere to determine if there is or ever has been life elsewhere in the universe 5. Identify and characterize small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources
Astrophysics: Discover how the universe works, explore how the universe began and evolved, and search for Earth-like planets.	• How do matter, energy, space and time behave under the extraordinarily diverse conditions of the cosmos? • How did the universe originate and evolve to produce the galaxies, stars, and planets we see today? • What are the characteristics of planetary systems orbiting other stars, and do they harbor life?	1. Understand the origin and destiny of the universe, and the nature of black holes, dark energy, dark matter, and gravity 2. Understand the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today 3. Generate a census of extra-solar planets and measure their properties

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

Appendix	Program	NOI/Step 1 Due Date [2]	Proposal Due Date
A.11	IceBridge	N/A	05/01/2012
C.10	Cassini Data Analysis and Participating Scientists [3]	03/23/2012 (Step 1)	05/04/2012 (Step 2)
C.2	Cosmochemistry [3] [4]	04/02/2012	05/11/2012
A.41	Making Earth System data records for Use in Research Environments	04/04/2012	05/15/2012
B.4	Heliophysics Research: Solar and Heliospheric Science	03/16/2012 (Step 1)	05/18/2012 (Step 2)
D.2	Astrophysics Data Analysis	03/30/2012	05/18/2012
A.13	Modeling, Analysis, and Prediction	03/23/2012	05/25/2012
C.22	Fellowships for Early Career Researchers (current fellows) (first opportunity) [3]	N/A	05/25/2012
E.3	Origins of Solar Systems [4]	03/23/2012	05/25/2012
A.3	Ocean Biology and Biogeochemistry	03/30/2012	05/30/2012
A.25	Surface Water and Ocean Topography Mission Science Definition Team	03/30/2012	05/30/2012
A.12	Cryospheric Science	N/A	06/01/2012
C.5	Planetary Astronomy [3] [4]	04/06/2012	06/01/2012
C.3	Laboratory Analysis of Returned Samples [4]	04/13/2012	06/08/2012
C.9	Near Earth Object Observations [3] [4]	04/13/2012	06/08/2012
B.3	Heliophysics Research: Geospace Science	04/13/2012 (Step 1)	06/15/2012 (Step 2)
C.6	Planetary Atmospheres [3] [4]	04/27/2012	06/22/2012
A.7	Physical Oceanography	04/30/2012	06/29/2012
A.20	Precipitation Measurement Missions (PMM) Science Team	**04/30/2012**	**06/29/2012**
A.14	Atmospheric Composition: Upper Atmospheric Composition Observations	N/A	07/02/2012

A.30	Earth Science U.S. Participating Investigator	N/A	07/02/2012
C.4	Planetary Geology and Geophysics [3] [4]	04/27/2012	**07/02/2012**
C.13	Mars Fundamental Research [3] [4]	05/04/2012	07/06/2012
D.4	Astrophysics Theory	05/14/2012	07/13/2012
B.8	**Heliophysics Data Environment Enhancements**	05/11/2012	07/20/2012
A.23	CloudSat And CALIPSO Science Team Recompete	05/25/2012	07/25/2012
C.21	**In Space Propulsion: Astrodynamics Research**	**06/11/2012**	**08/20/2012**
A.32	Remote Sensing of Water Quality	06/21/2012	08/22/2012
C.24	Moon and Mars Analog Missions Activities	06/30/2012	08/24/2012
D.10	**Science Investigations as Members of the Euclid Consortium and Euclid Science Team**	**6/15/2012**	**8/31/2012**
C.18	Planetary Protection Research [4]	**06/29/2012**	**09/05/2012**
C.12	Mars Data Analysis [3]	07/13/2012	09/18/2012
A.29	**Airborne Instrument Technology Transition**	**07/23/2012**	**09/24/2012**
D.5	SWIFT Guest Investigator – Cycle 9	N/A	09/26/2012
A.16	Atmospheric Composition: Modeling and Analysis	N/A	**10/01/2012**
A.47	**Development and Testing of Potential Indicators For The National Climate Assessment**	**08/03/2012**	**10/05/2012**
C.11	Planetary Mission Data Analysis [3]	08/17/2012	10/12/2012
C.22	Fellowships for Early Career Researchers (current fellows) (second opportunity) [3]	N/A	10/26/2012
C.19	**Maturation of Instruments for Solar System Exploration [3]**	**08/31/12**	**11/07/2012**
D.9	Nancy Grace Roman Technology Fellowships in Astrophysics	09/07/2012	**11/08/2012**
C.7	Outer Planets Research [3] [4]	08/24/2012	**11/09/2012**
A.48	**In-Space Validation of Earth Science Technologies**	**10/17/2012**	**11/27/2012**
D.11	**Astrophysics Explorer U.S. Participating Investigator**	**10/12/12**	**12/14/2012**

A.4	**Terrestrial Ecology**	**9/18/2012** (Step 1)	**01/08/2013** (Step 2)
D.6	**Fermi Guest Investigator – Cycle 6**	N/A	01/18/2013
D.7	**Kepler Guest Observer – Cycle 5**	**12/07/2012**	**01/18/2013**
A.24	The Soil Moisture Active-Passive Mission Science Team	12/03/2012	02/01/2013
D.12	**Theoretical and Computational Astrophysics Networks**	**N/A**	**02/14/2013 via Fastlane**
A.49	**Studies with ICESat and CryoSat-2**	**12/10/2012**	**02/22/2013**
C.8	Lunar Advanced Science and Exploration Research [3] [4]	12/28/2012	03/01/2013
C.27	**MAVEN Participating Scientist Program**	**01/11/2013**	**03/01/2013**
D.13	**Kepler Participating Scientist Program**	**01/18/2013**	**03/01/2013**
D.3	**Astrophysics Research and Analysis**	01/25/2013	03/22/2013
D.8	**Strategic Astrophysics Technology**	01/25/2013	03/22/2013
C.28	**LADEE Guest Investigator Program**	**02/22/2013**	**03/29/2013**
A.31	**Interdisciplinary Research in Earth Science**	**03/01/2013**	**04/01/2013**
A.36	**Earth Science Applications: Ecological Forecasting Applications Feasibility Projects**	**02/14/2013**	**04/18/2013**
A.2	**Land Cover/Land Use Change**	**11/30/2012** (Step 1)	06/03/2013 (Step 2)
A.26	Rapid Response and Novel Research in Earth Science	N/A	Rolling Submissions through 03/31/2013
E.2	Topical Workshops, Symposia, and Conferences	N/A	Rolling Submissions through 03/31/2013
C.22	Fellowships for Early Career Researchers (new applicants) [3]	See Program of Interest	
C.23	Planetary Major Equipment [4]	See Program of Interest	
A.5	Carbon Cycle Science	Not solicited this year	
A.6	Biodiversity	Solicited with NSF	
A.8	Ocean Salinity Science Team	Not solicited this year	

A.9	Ocean Vector Winds Science Team	Not solicited this year
A.10	Ocean Surface Topography Science Team	Not solicited this year
A.15	Radiation Sciences	Not solicited this year
A.17	Atmospheric Composition: Tropospheric Chemistry	Not solicited this year
A.18	Terrestrial Hydrology	Not solicited this year
A.19	NASA Energy and Water Cycle Study	Not solicited this year
A.21	Weather Focus Area	Not solicited this year
A.22	Earth Surface and Interior	Not solicited this year
A.27	Pre-Aerosol, Clouds, and Ocean Ecosystem Mission Science Team	Not solicited this year
A.28	Space Archaeology	Not solicited this year
A.33	GNSS Remote Sensing Science Team	Not solicited this year
A.34	NASA Data for Operation and Assessment	Not solicited this year
A.35	New (Early Career) Investigator Program in Earth Science	Not solicited this year
A.37	**Earth Science Applications: Water Resources Applied Sciences Team**	**Not solicited this year, moved to ROSES 2013**
A.38	**Earth Science Applications: Health and Air Quality**	**Not solicited this year, moved to ROSES 2013**
A.39	**Earth Science Applications: Cross-cutting Topics**	**Not solicited this year, moved to ROSES 2013**
A.40	Advancing Collaborative Connections for Earth System Science	Not solicited this year
A.42	Earth System Data Records Uncertainty Analysis	Not solicited this year
A.43	Computational Modeling Algorithms and Cyberinfrastructure	Not solicited this year
A.44	Advanced Information Systems Technology	Not solicited this year
A.45	Instrument Incubator Program	Not solicited this year
A.46	Advanced Component Technology	Not solicited this year
B.2	Heliophysics Theory	Not solicited this year

B.5	Heliophysics Guest Investigators	Not solicited this year – see B.3 and B.4
B.6	**Living with a Star Targeted Research and Technology**	**Not solicited this year – see draft 13 text in B.6**
B.7	**Living With a Star Targeted Research and Technology: Strategic Capability**	**Not solicited this year – see draft 13 text in B.6**
C.14	Mars Instrument Development Project	Not solicited this year
C.15	Mars Technology Project	Not solicited this year
C.16	**Planetary Instrument Concepts for the Advancement of Solar System Observations**	**Not solicited this year**
C.17	Astrobiology: Exobiology and Evolutionary Biology [3] [4]	Not solicited this year
C.20	**Astrobiology Science and Technology for Exploring Planets [3] [4]**	**Not solicited this year**
C.25	Mission Concept Development for Astrobiology Small Payloads	Not solicited this year
C.26	**Radio-Isotope Power System Technology Development**	**Not solicited this year**
E.4	Opportunities in Education and Public Outreach for Earth and Space Sciences	Not solicited this year
A.1	Earth Science Overview	N/A
B.1	Heliophysics Research Program Overview	N/A
C.1	Planetary Science Research Program Overview	N/A
D.1	Astrophysics Research Program Overview	N/A
E.1	Cross-Division Overview	N/A

Notes:
[1] Amended due dates and new program elements will be indicated with bold red text as ROSES-2012 is amended through the 2012 calendar year.
[2] See Sections IV(b)(vi) and IV(b)(vii) 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.22) may be submitted only in conjunction with program elements Cosmochemistry (Appendix C.2); Planetary Geology and Geophysics (Appendix C.4); Planetary Astronomy (Appendix C.5); Planetary Atmospheres (Appendix C.6); Outer Planets Research (Appendix C.7); Lunar Advanced Science and Exploration Research (Appendix C.8), Near Earth Object Observations (Appendix C.9); Cassini Data Analysis and Participating Scientists (Appendix C.10); Planetary Mission Data Analysis

(Appendix C.11), Mars Data Analysis (Appendix C.12), Mars Fundamental Research (Appendix C.13); Astrobiology: Exobiology and Evolutionary Biology (Appendix C.17); Maturation of Instruments for Solar System Exploration (Appendix C.19); and Astrobiology Science and Technology for Exploring Planets (Appendix C.20).

[4] The proposals for program element Planetary Major Equipment (C.23) may be submitted only in conjunction with program elements Cosmochemistry (Appendix C.2); Laboratory Analysis of Returned Samples (Appendix C.3); Planetary Geology and Geophysics (Appendix C.4); Planetary Astronomy (Appendix C.5); Planetary Atmospheres (Appendix C.6); Outer Planets Research (Appendix C.7); Lunar Advanced Science and Exploration Research (Appendix C.8), Near Earth Object Observations (Appendix C.9), Mars Fundamental Research (Appendix C.13); Astrobiology: Exobiology and Evolutionary Biology (Appendix C.17); Planetary Protection Research (Appendix C.18); Astrobiology Science and Technology for Exploring Planets (Appendix C.20); and Origins of Solar Systems (Appendix E.3).

ROSES 2012

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 Overview	N/A	
A.2	**Land Cover/Land Use Change**	**11/30/2012** **(Step 1)**	06/03/2013 (Step 2)
A.3	Ocean Biology and Biogeochemistry	03/30/2012	05/30/2012
A.4	**Terrestrial Ecology**	**9/18/2012** **(Step 1)**	**01/08/2013** **(Step 2)**
A.5	Carbon Cycle Science	Not solicited this year	
A.6	Biodiversity	Solicited with NSF	
A.7	Physical Oceanography	04/30/2012	06/29/2012
A.8	Ocean Salinity Science Team	Not solicited this year	
A.9	Ocean Vector Winds Science Team	Not solicited this year	
A.10	Ocean Surface Topography Science Team	Not solicited this year	
A.11	IceBridge	N/A	05/01/2012
A.12	Cryospheric Science	N/A	06/01/2012
A.13	Modeling, Analysis, and Prediction	03/23/2012	05/25/2012
A.14	Atmospheric Composition: Upper Atmospheric Composition Observations	N/A	07/02/2012
A.15	Radiation Sciences	Not solicited this year	
A.16	Atmospheric Composition: Modeling and Analysis	N/A	**10/01/2012**
A.17	Atmospheric Composition: Tropospheric Chemistry	Not solicited this year	
A.18	Terrestrial Hydrology	Not solicited this year	
A.19	NASA Energy and Water Cycle Study	Not solicited this year	
A.20	Precipitation Measurement Missions (PMM) Science Team	**04/30/2012**	**06/29/2012**

A.21	Weather Focus Area	Not solicited this year	
A.22	Earth Surface and Interior	Not solicited this year	
A.23	CloudSat And CALIPSO Science Team Recompete	05/25/2012	07/25/2012
A.24	The Soil Moisture Active-Passive Mission Science Team	12/03/2012	02/01/2013
A.25	Surface Water and Ocean Topography Mission Science Definition Team	03/30/2012	05/30/2012
A.26	Rapid Response and Novel Research in Earth Science	N/A	Rolling Submissions through 03/ 31/2013
A.27	Pre-Aerosol, Clouds, and Ocean Ecosystem Mission Science Team	Not solicited this year	
A.28	Space Archaeology	Not solicited this year	
A.29	**Airborne Instrument Technology Transition**	**07/23/2012**	**09/24/2012**
A.30	Earth Science U.S. Participating Investigator	N/A	07/02/2012
A.31	**Interdisciplinary Research in Earth Science**	**03/01/2013**	**04/01/2013**
A.32	Remote Sensing of Water Quality	06/21/2012	08/22/2012
A.33	GNSS Remote Sensing Science Team	Not solicited this year	
A.34	NASA Data for Operation and Assessment	Not solicited this year	
A.35	New (Early Career) Investigator Program in Earth Science	Not solicited this year	
A.36	**Earth Science Applications: Ecological Forecasting Applications Feasibility Projects**	**02/14/2013**	**04/18/2013**
A.37	**Earth Science Applications: Water Resources Applied Sciences Team**	**Not solicited this year, moved to ROSES 2013**	
A.38	**Earth Science Applications: Health and Air Quality**	**Not solicited this year, moved to ROSES 2013**	
A.39	**Earth Science Applications: Cross-cutting Topics**	**Not solicited this year, moved to ROSES 2013**	
A.40	Advancing Collaborative Connections for Earth System Science	Not solicited this year	
A.41	Making Earth System data records for Use in Research Environments	04/04/2012	05/15/2012
A.42	Earth System Data Records Uncertainty Analysis	Not solicited this year	
A.43	Computational Modeling Algorithms and Cyberinfrastructure	Not solicited this year	

A.44	Advanced Information Systems Technology	Not solicited this year	
A.45	Instrument Incubator Program	Not solicited this year	
A.46	Advanced Component Technology	Not solicited this year	
A.47	**Development and Testing of Potential Indicators For The National Climate Assessment**	**08/03/2012**	**10/05/2012**
A.48	**In-Space Validation of Earth Science Technologies**	**10/17/2012**	**11/27/2012**
A.49	**Studies with ICESat and CryoSat-2**	**12/10/2012**	**02/22/2013**
B.1	Heliophysics Research Program Overview	N/A	
B.2	Heliophysics Theory	Not solicited this year	
B.3	Heliophysics Research: Geospace Science	04/13/2012 (Step 1)	06/15/2012 (Step 2)
B.4	Heliophysics Research: Solar and Heliospheric Science	03/16/2012 (Step 1)	05/18/2012 (Step 2)
B.5	Heliophysics Guest Investigators	Not solicited this year – see B.3 and B.4	
B.6	**Living with a Star Targeted Research and Technology**	**Not solicited this year – see draft 13 text in B.6**	
B.7	**Living With a Star Targeted Research and Technology: Strategic Capability**	**Not solicited this year – see draft 13 text in B.6**	
B.8	**Heliophysics Data Environment Enhancements**	05/11/2012	07/20/2012
C.1	Planetary Science Research Program Overview	N/A	
C.2	Cosmochemistry [3] [4]	04/02/2012	05/11/2012
C.3	Laboratory Analysis of Returned Samples [4]	04/13/2012	06/08/2012
C.4	Planetary Geology and Geophysics [3] [4]	04/27/2012	**07/02/2012**
C.5	Planetary Astronomy [3] [4]	04/06/2012	06/01/2012
C.6	Planetary Atmospheres [3] [4]	04/27/2012	06/22/2012
C.7	Outer Planets Research [3] [4]	08/24/2012	**11/09/2012**
C.8	Lunar Advanced Science and Exploration Research [3] [4]	12/28/2012	03/01/2013
C.9	Near Earth Object Observations [3] [4]	04/13/2012	06/08/2012

C.10	Cassini Data Analysis and Participating Scientists [3]	03/23/2012 (Step 1)	05/04/2012 (Step 2)
C.11	Planetary Mission Data Analysis [3]	08/17/2012	10/12/2012
C.12	Mars Data Analysis [3]	07/13/2012	09/18/2012
C.13	Mars Fundamental Research [3] [4]	05/04/2012	07/06/2012
C.14	Mars Instrument Development Project	Not solicited this year	
C.15	Mars Technology Project	Not solicited this year	
C.16	**Planetary Instrument Concepts for the Advancement of Solar System Observations**	**Not solicited this year**	
C.17	Astrobiology: Exobiology and Evolutionary Biology [3] [4]	Not solicited this year	
C.18	Planetary Protection Research [4]	**06/29/2012**	**09/05/2012**
C.19	**Maturation of Instruments for Solar System Exploration [3]**	**08/31/2012**	**11/07/2012**
C.20	**Astrobiology Science and Technology for Exploring Planets [3] [4]**	**Not solicited this year**	
C.21	**In Space Propulsion: Astrodynamics Research**	**06/11/2012**	**08/20/2012**
C.22	Fellowships for Early Career Researchers (new applicants) [3]	See Program of Interest	
C.22	Fellowships for Early Career Researchers (current fellows) (first opportunity) [3]	N/A	05/25/2012
C.22	Fellowships for Early Career Researchers (current fellows) (second opportunity) [3]	N/A	10/26/2012
C.23	Planetary Major Equipment [4]	See Program of Interest	
C.24	Moon and Mars Analog Missions Activities	06/30/2012	08/24/2012
C.25	Mission Concept Development for Astrobiology Small Payloads	Not solicited this year	
C.26	**Radio-Isotope Power System Technology Development**	**Not solicited this year**	
C.27	**MAVEN Participating Scientist Program**	**01/11/2013**	**03/01/2013**
C.28	**LADEE Guest Investigator Program**	**02/22/2013**	**03/29/2013**
D.1	Astrophysics Research Program Overview	N/A	
D.2	Astrophysics Data Analysis	03/30/2012	05/18/2012

D.3	**Astrophysics Research and Analysis**	01/25/2013	03/22/2013
D.4	Astrophysics Theory	05/14/2012	07/13/2012
D.5	SWIFT Guest Investigator – Cycle 9	N/A	09/26/2012
D.6	**Fermi Guest Investigator – Cycle 6**	N/A	01/18/2013
D.7	**Kepler Guest Observer – Cycle 5**	**12/07/2012**	**01/18/2013**
D.8	**Strategic Astrophysics Technology**	01/25/2013	03/22/2013
D.9	Nancy Grace Roman Technology Fellowships in Astrophysics	09/07/2012	**11/08/2012**
D.10	**Science Investigations as Members of the Euclid Consortium and Euclid Science Team**	**6/15/2012**	**8/31/2012**
D.11	**Astrophysics Explorer U.S. Participating Investigator**	**10/12/12**	**12/14/12**
D.12	**Theoretical and Computational Astrophysics Networks**	**N/A**	**02/14/2013 via Fastlane**
D.13	**Kepler Participating Scientist Program**	**01/18/2013**	**03/01/2013**
E.1	Cross-Division Overview	N/A	
E.2	Topical Workshops, Symposia, and Conferences	N/A	Rolling Submissions through 03/ 31/2013
E.3	Origins of Solar Systems [4]	03/23/2012	05/25/2012
E.4	Opportunities in Education and Public Outreach for Earth and Space Sciences	Not solicited this year	

Notes:
[1] Amended due dates and new program elements will be indicated with bold red text as ROSES-2012 is amended through the 2012 calendar year.
[2] See Sections IV(b)(vi) and IV(b)(vii) 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.22) may be submitted only in conjunction with program elements Cosmochemistry (Appendix C.2); Planetary Geology and Geophysics (Appendix C.4); Planetary Astronomy (Appendix C.5); Planetary Atmospheres (Appendix C.6); Outer Planets Research (Appendix C.7); Lunar Advanced Science and Exploration Research (Appendix C.8), Near Earth Object Observations (Appendix C.9); Cassini Data Analysis and Participating Scientists (Appendix C.10); Planetary Mission Data Analysis (Appendix C.11), Mars Data Analysis (Appendix C.12), Mars Fundamental Research (Appendix C.13); Astrobiology: Exobiology and Evolutionary Biology (Appendix

C.17); Maturation of Instruments for Solar System Exploration (Appendix C.19); and Astrobiology Science and Technology for Exploring Planets (Appendix C.20).
[4] The proposals for program element Planetary Major Equipment (C.23) may be submitted only in conjunction with program elements Cosmochemistry (Appendix C.2); Laboratory Analysis of Returned Samples (Appendix C.3); Planetary Geology and Geophysics (Appendix C.4); Planetary Astronomy (Appendix C.5); Planetary Atmospheres (Appendix C.6); Outer Planets Research (Appendix C.7); Lunar Advanced Science and Exploration Research (Appendix C.8), Near Earth Object Observations (Appendix C.9), Mars Fundamental Research (Appendix C.13); Astrobiology: Exobiology and Evolutionary Biology (Appendix C.17); Planetary Protection Research (Appendix C.18); Astrobiology Science and Technology for Exploring Planets (Appendix C.20); and Origins of Solar Systems (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 Earth Science Research Program is designed to leverage NASA's unique capabilities in the context of related research carried out by other Federal agencies, especially that conducted as part of organized interagency activities (including those coordinated through the Committee on Environment and Natural Resources and Sustainability under the National Science and Technology Council), such as the U.S. Global Change Research Program, the U.S. Group on Earth Observations, the Climate Change Adaptation Task Force, the Ocean Policy Task Force, the EarthScope Program, and NASA-National Oceanic and Atmospheric Administration (NOAA) and NASA-United States Geological Survey (USGS) efforts to support the transition between research and operations.

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*, available at http://www.nasa.gov/news/reports/)**.** In particular, it addresses the more specific Science Outcomes (see the *2010 Science Plan for NASA's Science Mission Directorate* (hereafter the *NASA Science Plan*), available at http://nasascience.nasa.gov/about-us/science-strategy/), which are to achieve:

- Progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition;
- Progress in enabling improved predictive capability for weather and extreme weather events;
- Progress in quantifying global land cover change and terrestrial and marine productivity and in improving carbon cycle and ecosystem models;
- Progress in quantifying the key reservoirs and fluxes in the global water cycle and in improving models of water cycle change and fresh water availability;

- Progress in understanding the role of oceans, atmosphere, and ice in the climate system and in improving predictive capability for its future evolution;
- Progress in characterizing and understanding Earth surface changes and variability of the Earth's gravitational and magnetic fields; and
- Progress in expanding and accelerating the realization of societal benefits from Earth system science.

The most recent comprehensive description of the research goals of NASA's Earth Science Research Program was in the *2003 Earth Science Enterprise Strategy* at http://nasascience.nasa.gov/about-us/science-strategy. The most up-to-date description of the Earth Science Research Program may be found in Chapter 4 of the *NASA Science Plan* at http://nasascience.nasa.gov/about-us/science-strategy (click on link for "SMD Science Plan for 2010"). 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. 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). A 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.

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).

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 sought after, 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; several 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. They involve three science teams as described in the previous sentence (CloudSat/CALIPSO Science Team – Appendix A.23), Soil Moisture Active Passive (SMAP) Science Team – Appendix A.24, Pre-Aerosol, Cloud, Ocean Ecosystem (PACE) Science Team – Appendix A.27), one Science Definition Team (SDT) (Surface Water and Ocean Topography (SWOT) Mission – Appendix A.25); one science team that supports two missions – the Precipitation Measurement Mission

Science Team (Appendix A.20) that supports both the existing Tropical Rainfall Measuring Mission and the planned Global Precipitation Mission; one that solicits for completion of development of new airborne instruments that leverage prior technology development (Airborne Instrument Technology Transition – Appendix A.29); one that solicits U.S. investigators to participate in relevant foreign satellite missions (U.S. Principal Investigators - Appendix A.30); one that solicits interdisciplinary teams to address issues that cross multiple science focus areas (Appendix A.31, Interdisciplinary Research in Earth Science); 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 (Appendix A.26); and one that addresses the remote sensing of water quality (Appendix A.32) which is of interest to ocean biology, terrestrial hydrology, and applied sciences. One additional element that addresses novel use of NASA data and models that does not easily fit into the structure, Space Archaeology (Appendix A.28), is not being solicited this year.

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 goals of the Carbon Cycle and Ecosystems Focus Area are 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 are (* indicates program elements that are or may be soliciting proposals in ROSES-2012):

- Land Cover / Land Use Change* (Appendix A.2);
- Ocean Biology and Biogeochemistry* (Appendix A.3);

- Terrestrial Ecology* (Appendix A.4);
- Carbon Cycle Science (Appendix A.5); and
- Biodiversity (Appendix A.6).

Topics relevant to the Carbon Cycle and Ecosystems Focus Area are included in the following program elements (* indicates program elements that are or may be soliciting proposals in ROSES-2012):

- Rapid Response and Novel Research* (Appendix A.26);
- PACE Science Team* (Appendix A.27);
- Space Archaeology (Appendix A.28);
- Airborne Instrument Technology Transition* (Appendix A.29);
- Earth Science U.S. Participating Investigator (USPI)* (Appendix A.30);
- Interdisciplinary Research in Earth Science* (Appendix A.31);
- Remote Sensing of Water Quality* (Appendix A.32);
- NASA Data for Operation and Assessment* (Appendix A.34);
- New Investigator Program (Appendix A.35);
- Ecological Forecasting: Feasibility to Decision Support* (Appendix A.36);
- Making Earth System data records for Use in Research Environments (MEaSUREs)* (Appendix A.41).

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 are (* indicates program elements that are or may be soliciting proposals in ROSES-2012):

- Physical Oceanography* (Appendix A.7);
- Ocean Salinity Science Team (Appendix A.8);
- Ocean Vector Winds Science Team (Appendix A.9);
- Ocean Surface Topography Science Team (Appendix A.10);
- Cryospheric Science* (Appendix A.12);
- IceBridge * (Appendix A.11); and
- Modeling, Analysis, and Prediction* (Appendix A.13).

Topics relevant to the Climate Variability and Change Focus Area are included in the following program elements (* indicates program elements that are or may be soliciting proposals in ROSES-2012):

- Carbon Cycle Science (Appendix A.5);
- Atmospheric Composition: Modeling and Analysis* (Appendix A.16);
- CloudSat/CALIPSO Science Team* (Appendix A.23);
- SMAP Science Team* (Appendix A.24);
- SWOT Science Definition Team* (Appendix A.25);
- Rapid Response and Novel Research in Earth Science* (Appendix A.26);
- Space Archaeology (Appendix A.28);

- Airborne Instrument Technology Transition* (Appendix A.29);
- Earth Science U.S. Participating Investigator (USPI)* (Appendix A.30);
- Interdisciplinary Research in Earth Science* (Appendix A.31);
- GNSS Remote Sensing Science Team (Appendix A.33);
- NASA Data for Operation and Assessment* (Appendix A.34);
- Ecological Forecasting: Feasibility to Decision Support* (Appendix A.36);
- Making Earth System data records for Use in Research Environments (MEaSUREs)* (Appendix A.41);
- Computational Modeling Algorithms and Cyberinfrastructure (Appendix A.43).

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 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.

The ROSES elements most closely directed towards the Atmospheric Composition Focus Area are (* indicates program elements that are or may be soliciting proposals in ROSES-2012):

- Upper Atmosphere Research Program (UARP) Field Observations* (Appendix A.14);
- Radiation Sciences Program (Appendix A.15);
- Atmospheric Composition: Modeling and Analysis* (Appendix A.16); and
- Atmospheric Composition: Tropospheric Chemistry (Appendix A.17).

Topics relevant to the Atmospheric Composition Focus Area are also included in the following program elements (* indicates program elements that are or may be soliciting proposals in ROSES-2012):

- Carbon Cycle Science (Appendix A.5);
- CloudSat/CALIPSO Science Team* (Appendix A.23);
- Rapid Response and Novel Research in Earth Science* (Appendix A.26);
- PACE Science Team* (Appendix A.27);
- Airborne Instrument Technology Transition* (Appendix A.29);
- Earth Science U.S. Participating Investigator* (Appendix A.30);
- Interdisciplinary Research in Earth Science* (Appendix A.31);
- NASA Data for Operation and Assessment* (Appendix A.34);
- New Investigator Program (Appendix A.35);
- Health and Air Quality Applications* (Appendix A.38); and
- Making Earth System data records for Use in Research Environments (MEaSUREs)* (Appendix A.41).

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 cycle.

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 predication 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 are (* indicates program elements that are or may be soliciting proposals in ROSES-2012):

- Terrestrial Hydrology (Appendix A.18);
- NASA Energy and Water Cycle Study (Appendix A.19); and
- Precipitation Measurement Missions (PMM)* Science Team (Appendix A.20).

Topics relevant to the Water and Energy Cycle Focus Area are included in the following program elements (* indicates program elements that are or may be soliciting proposals in ROSES-2012):

- CloudSat/CALIPSO Science Team* (Appendix A.23);
- SMAP Science Team* (Appendix A.24);
- SWOT Science Definition Team* (Appendix A.25);
- Rapid Response and Novel Research in Earth Science* (Appendix A.26);
- Space Archaeology (Appendix A.28);
- Airborne Instrument Technology Transition* (Appendix A.29);
- Earth Science U.S. Participating Investigator (USPI)* (Appendix A.30);
- Interdisciplinary Research in Earth Science* (Appendix A.31);
- Remote Sensing of Water Quality* (Appendix A.32);
- NASA Data for Operation and Assessment* (Appendix A.34);
- New Investigator Program (Appendix A.35);
- Water Resources Applied Sciences Team* (Appendix A.37); and
- Making Earth System data records for Use in Research Environments (MEaSUREs)* (Appendix A.41).

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 close coordination with other U.S. agencies' programs under the U.S. Weather Research Program (USWRP), and it is guided by the question from the 2003 Earth Science Enterprise Strategy:

- How can weather forecast duration and reliability be improved?

A large effort in this Focus Area is concerned with the detection and quantification of rainfall rate, generally measured using microwave radiation. The first weather radar in space, on board the Tropical Rainfall Measuring Mission (TRMM) satellite, has enabled the global mapping of rainfall in the tropics and has contributed to the increased physical understanding of storm cloud characteristics accompanying various forms and levels of rainfall rates. Future planning involves the extension of the TRMM concept to a global constellation of active and passive sensors in the form of a Global Precipitation Measurement (GPM) mission.

Another key component of the current Weather Focus Area is a set of core efforts to assimilate new NASA satellite data into numerical forecast models and to assess the amount of forecast improvement. Two groups are currently working on this problem, the Joint Center for Satellite Data Assimilation (JCSDA), involving the NASA Goddard Space Flight Center (GSFC) and the National Center for Environmental Prediction (NCEP) at NOAA, and now including other agency participation, and NASA's Short-term Prediction Research and Transition Center (SPoRT). As NASA continues to implement NPP and decadal survey missions, the weather focus area will contribute to the algorithm development to accelerate the use of the relevant decadal survey measurements in operational weather forecast. These centers will allow studies of the most effective ways of assimilating new satellite data into global and regional numerical models.

NASA-funded researchers are working to use the many forms of new data from Earth Observing System sensors related to the atmosphere. The Moderate Resolution Imaging Spectroradiometer (MODIS), Atmospheric Infrared Sounder (AIRS), Multiangle Imaging Spectroradiometer (MISR), and Advanced Microwave Scanning Radiometer (AMSR-E) sensors on the Earth Observing System (EOS) satellites Terra and Aqua all contribute valuable information, such as land and sea surface temperatures, cloud characteristics, bidirectional reflectance for interpreting air pollution concentrations, surface wetness, and polar winds.

The weather forecast area has also contributed to a number of field programs, such as the Genesis and Rapid Intensification Processes (GRIP) and NASA contribution to the Amazon Multidisciplinary Monsoon Analysis (AMMA) that serve to both improve our understanding of atmospheric processes and provide calibration and validation instruments for NASA's Earth-observing satellites. Not all of the satellite and airborne measurements are currently being assimilated into numerical forecast models to determine their potential forecast impacts. Research work will continue for improved modeling and computing, the development of Doppler wind lidars, and the development of geosynchronous and active sounding to meet the future objectives of the Weather Focus Area.

The ROSES element most closely directed towards the Weather Focus Area (which is not being solicited this year) is:

- Weather Focus Area (Appendix A.21).

Topics relevant to the Weather Focus Area are included in the following program elements (* indicates program elements that are or may be soliciting proposals in ROSES-2012):

- Precipitation Measurement Mission Science Team* (Appendix A.20);
- Rapid Response and Novel Research in Earth Science* (Appendix A.26);
- Airborne Instrument Technology Transition* (Appendix A.29);
- Earth Science U.S. Participating Investigator (USPI)* (Appendix A.30);
- Interdisciplinary Science* (Appendix A.31);
- NASA Data for Operation and Assessment* (Appendix A.34);
- New Investigator Program (Appendix A.35);
- Making Earth System data records for Use in Research Environments (MEaSUREs)* (Appendix A.41); and
- Computational Modeling Algorithms and Cyberinfrastructure (Appendix A.43).

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 element most closely directed towards the Earth Surface and Interior Focus Area is (which is not being solicited this year):

- Earth Surface and Interior (Appendix A.22);

Topics relevant to the Earth Surface and Interior Focus Area are included in the following program elements (* indicates program elements that are or may be soliciting proposals in ROSES-2012):

- Rapid Response and Novel Research* (Appendix A.26);
- Airborne Instrument Technology Transition* (Appendix A.29);
- Earth Science U.S. Participating Investigator (USPI)* (Appendix A.30);
- Interdisciplinary Science* (Appendix A.31);
- GNSS Remote Sensing Science Team (Appendix A.33);
- New Investigator Program (Appendix A.35);
- Making Earth System data records for Use in Research Environments (MEaSUREs)* (Appendix A.41).

2.7 Cross-Cutting and Interdisciplinary

There are several cross-cutting and interdisciplinary elements in ROSES-2012, most 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-2012 unless otherwise noted, are:

A major element in Interdisciplinary Science (Appendix A.31: Interdisciplinary Research in Earth Science) is included in this year's. This element is designed to allow scientists to address major Earth Science issues that do not fit neatly into any one of the six focus areas. The number and focus of sub-elements for this call are not yet determined, but will be specified when a revised version of this element is posted no fewer than 90 days before the due date for the element.

Other elements include:

- CloudSat/CALIPSO Science Team (Appendix A.23) - This particular solicitation requests proposals for the consolidated CloudSat/CALIPSO science team. 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.
- SMAP Science Team (Appendix A.24) - The objective of this solicitation is to select a Science Team (ST) to assist with prelaunch and postlaunch science activities of the SMAP mission. The ST will function for the period from October 1, 2013, through the second year of the postlaunch science operations phase (SOP), currently planned to be January 25, 2017, for a total of 40 months;
- SWOT Science Definition Team (Appendix A.25) - The priority of the SDT selection is to address the various challenges the mission planning and development is facing in the coming years before launch, emphasizing the definition of the requirements for meeting the mission's primary goals and the formulation and implementation of a practical approach to meeting the requirements, including calibration and validation;
- Rapid Response and Novel Research in Earth Science (Appendix A.26) – This solicitation allows for two types of proposals not normally solicited through ROSES – (a) research on Earth system events or opportunities to collaborate that occur unpredictably as rare and valuable targets of opportunity and that require rapid provision of resources to enable immediate research activity to take advantage of that target of opportunity, and (b) first-time investigations applying novel and innovative ideas to advance Earth remote sensing in a previously undeveloped area of remote sensing theory, technology utilization, or scientific application;
- PACE Science Team (Appendix A.27) – This solicitation, if finalized, would solicit for a science team for the planned Pre-Aerosol, Cloud, Ocean Ecosystem (PACE) mission, which is intended to include an ocean color sensor and an aerosol/cloud polarimeter, in order to produce data to maintain a time series of critical climate and Earth system variables;
- Airborne Instrument Technology Transition (Appendix A.29) - This solicitation provides an opportunity for the integration of existing instruments, developed under the NASA Instrument Incubator Program (IIP) or similar programs, onto platforms supported by the NASA Airborne Science Program. This solicitation addresses only existing instruments, and does not support the development of new instrumentation;
- Earth Science U.S. Principal Investigator (Appendix A.30) –This solicitation requests proposals for U.S. investigators to participate in space-based missions led by other space agencies (especially, but exclusively, those of non-U.S. agencies);
- Remote Sensing of Water Quality (Appendix A.32) – This solicitation provides an

opportunity for proposers to develop algorithms to remotely sense inland and coastal water quality and to provide the scientific basis for next generation water quality remote sensing.

Additionally, NASA Data for Operation and Assessment (Appendix A.34) may be solicited this year. If it is, an amendment will be issued at least 90 days in advance of the proposal due date.

Two cross-cutting elements, both of which were competed under previous ROSES, are not being solicited this year are included; the status of current plans for future solicitations is indicated as part of the element. These include:

- Space Archaeology (Appendix A.28); and
- GNSS Science Team (Appendix A.33).

Selection information about the elements from ROSES-2011 may be found at http://nspires.nasaprs.com/external/viewrepositorydocument?cmdocumentid=252961&solicitationId=%7BAEF75D0F-2272-7DE7-D52A-295B47C8F5CF%7D&viewSolicitationDocument=1 and clicking on the links for the specific ROSES element and then "selection list").

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 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.

The Applied Sciences Program directly solicits proposals through the following ROSES elements (* indicates program elements that are or may be soliciting proposals in ROSES-2012):

- Ecological Forecasting: Feasibility to Decision Support* (Appendix A.36);
- Water Resources Applied Science Team* (Appendix A.37);
- Health and Air Quality Applications* (Appendix A.38); and
- Applied Sciences Crosscutting Applications* (Appendix A.39).

In addition, topics relevant to the Applied Sciences Program are also included in the following program elements (* indicates program elements that are or may be soliciting proposals in ROSES-2012):

- Atmospheric Composition: Modeling and Analysis* (Appendix A.16);
- SMAP Science Team* (Appendix A.24);
- SWOT Science Definition Team* (Appendix A.25);
- Rapid Response and Novel Research in Earth Science* (Appendix A.26);
- PACE Science Team* (Appendix A.27);
- Airborne Instrument Technology Transition* (Appendix A.29);
- Earth Science U.S. Principal Investigator* (Appendix A.30);
- Interdisciplinary Science * (Appendix A.31);
- Remote Sensing of Water Quality* (Appendix A.32);
- New Investigator Program (Appendix A.35).

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 addition to the education and outreach opportunities that are embedded in and competitively selected as part of the Earth Science flight and research programs, other program announcements are issued periodically to 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 terminal degree, is solicited every two years. It was last solicited as part of ROSES-2011 and thus is not solicited in ROSES-2012. Proposers can address research, applied sciences, data management, computing, and/or technology issues.

4.2 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 volume 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 requires 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.

NASA's data and information management activities are described in NASA's *2003 Earth Science Strategy* at http://nasascience.nasa.gov/about-us/science-strategy/past-strategy-documents/earth-science-enterprise-plans.

Three program elements in the area of data and information management are included in this NRA, only one of which is being solicited this year. The active element is Making Earth System data records for Use in Research Environments (MEaSUREs) (Appendix A.41) This program, most recently competed in 2006 (see http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={F3C433F6-58D9-0D66-2884-78368B3C811F}&path=past for selection information) initiating projects providing Earth science data products and services driven by NASA's Earth science goals, including infusion or deployment of applicable science tools that contribute to data product quality improvement, consistency, merging or fusion, or understanding. The two not being solicited are Advancing Collaborative Connections for Earth System Science (ACCESS; Appendix A.40); and Earth System Data Records Uncertainty Analysis (Appendix A.42).

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 FAQs. 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.

4.3 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-2012 there are no calls specifically targeted in this area. There is one relevant element, Computational Modeling Algorithms and Cyberinfrastructure (Appendix A.43), that 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 assimilation systems, is not being solicited this year because it was solicited late in ROSES 2011.

4.4 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, WB-57F, 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 2012 Call Letter for Flight Requests supporting approved investigations is expected to be released in April 2012. None of the ROSES-2012 calls are specifically focused on airborne field campaigns, but proposals that require the acquisition of new airborne data may be submitted in response to the 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.

4.5 Technology

The Earth Science Technology Program is designed to foster the creation and infusion of new technologies into space missions in order to enable new science observations or reduce the cost of current observations. Needs for advanced technology development are based on Earth science measurement and system requirements articulated in chapter 4 of the *2010 Science Plan for NASA's Science Mission Directorate,* available at http://nasascience.nasa.gov/about-us/science-strategy, and also the National Research Council (NRC) report *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond,* available at http://www.nap.edu/catalog.php?record_id=11820.

The key components of the technology infusion process are dialog among experts and the programs spanning the technology readiness scale for remote sensing, computing, and communications. Open solicitations are used to attract the best ideas from universities, industry, and Government laboratories. Conferences and workshops are held to establish connections between developers of maturing technologies and scientific investigators proposing new observing or modeling approaches. Principal investigators and others responding to mission solicitations can then adopt these technologies, whose maturation and readiness is well documented, in their proposals.

The Earth Science Technology Office (http://esto.nasa.gov/) maintains several program lines through which technology investments are competed and that cover a range of technology readiness levels (TRLs); since all these programs were recently recompeted, none of them are being solicited in ROSES 2012:

- Advanced Information Systems Technology (Appendix A.44);
- Instrument Incubator Program (Appendix A.45); and
- Advanced Component Technology (Appendix A.46).

A.2 LAND-COVER / LAND-USE CHANGE

Amended on May 29, 2012. Two new sections have been added: Section 1.2.1 Social and economic sciences in the NASA LCLUC program and Section 1.2.2 Synthesis in the LCLUC program. In addition, proposers should expect to receive electronic notification no later than fifteen weeks after the submission of their Step-1 proposals, rather than twelve. Finally, the due date for Step-1 proposals is now November 30, 2012. New text is bold, deleted text is struck through.

1. Solicited Research

This program element uses a two-step proposal process (see Section 2.3), with required Step-1 proposals due December 1, 2012. Those invited to submit Step-2 proposals must do so by June 1, 2013. Proposals need to be aligned with the LCLUC program goals and themes (see http://lcluc.hq.nasa.gov).

1.1 Goals and scope

The LCLUC program has a special place in NASA Earth Science in developing interdisciplinary approaches combining aspects of physical, social, and economic sciences, with a high level of societal relevance, while using remote sensing tools, methods, and data.

This solicitation consists of two elements:

1) *Global mapping of industrial forests from Landsat observations.* Emphasis on land-use change is broadening beyond the mapping of forest cover and monitoring deforestation to a more complete understanding of land-use change and the related processes. The LCLUC program is embarking on a strategic initiative to develop a new suite of remote sensing-based, land-use products for use in global integrated assessment and biogeochemical models. For this particular call, we focus on industrial forests. Industrial forestry includes areas, which are intensively managed for productive consumption to produce economically valuable products, and includes plantations, land reclamation, orchards, tree crops, and other similar systems. Industrial forests, as defined here, involve the planting and harvesting of trees for timber, saw logs, veneer, and pulp, or more recently for biofuel and biomaterial feedstock. There is an expectation that with the increasing global demand for wood the industrial forestry sector will increase, particularly in the developing world. The rotation of the industrial forests varies, for example as a function of the tree species and environmental conditions as manifested in the growth rate. Proposals should aim at developing new global-to-continental scale data sets on distribution of industrial forests. An assessment of the accuracy of the data set should be included in the proposal. The program is not interested in regional to local scale mapping projects. Data from LDCM, which will become Landsat-8 after launch, will be available by the time the newly selected projects receive funding. So it is expected that the proposals for this element will rely on the new Landsat data in their mapping procedures.

2) *Synthesis of LCLUC studies in Eurasia*. The geographic area of interest includes Northern Eurasia, Southern Asia, and South East Asia regions. There have been a number of previous studies on land-cover and -use change that have focused on case studies for different subregions. Developing generalized theory or holistic understanding of land transformation from these case studies requires an integrated synthesis of findings and results from previously funded projects in this program. Proposals should aim at enhancing the conceptual underpinning of LCLUC science. This could include: summarizing state-of-the-art knowledge, advancing our understanding of the processes, drivers and impacts of LCLUC with the ultimate goal of developing new understanding, a conceptual framework or generalized theory appropriate to land transformations in the region, or a comprehensive assessment of some specific aspect of land-cover and -use change that could inform future investigations or policy interventions. Studies could include: theory development, hypothesis testing and comparative analyses. The focus would be on integration and synthesis of existing results rather than develop new data, models, or studies. There should be an emphasis on answering outstanding questions in land-change science, rather than framing new questions, except for those questions that are directly derived from the synthesis. Funded synthesis studies would include publishing the synthetic analysis and refined or new conceptual framework. Studies may also lead to identification of new research areas, as well as data and research gaps. Studies could involve small synthesis teams or one to two scientists using workshops funded through TWSC to support broader community participation. Note that ROSES-2012 Appendix E.2, 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.

Proposals studying non-U.S. regions should identify an explicit collaboration with one or more regional partners. The regional partners should provide letters signed by the authorities of the collaborating institution, which would indicate agreement to participate in the project and provide the necessary institutional financial support for research and travel. 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. However, 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. Thus, NASA funding may not be used for research efforts by foreign organizations at any level, including travel expenses by any participant who is not participating while 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).

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 Synthesis in the LCLUC program

With the growth in land-cover and land-use research around the globe in recent years and having accumulated results of many projects, the LCLUC program has embarked on the development of synthesis studies. Synthesis is an essential component of scientific research, which integrates information from previous studies. Synthesis requires developing a new understanding and conceptual framework. This process should enhance the conceptual underpinning of LCLUC science and would summarize the state-of-the-art knowledge to advance our understanding of the processes, drivers, and impacts of changes in land cover and land use over the globe. 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, 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).

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.

Land-use data products proposals, such as mapping of industrial forests, are not required to include social science. However, model requirements endorsed by the respective modeling group need to be outlined in the proposal. A link between model simulations and societal benefits should be identified.

1.2.3 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 encouraged (see, e.g., http://www.digitalglobe.com/ and http://www.geoeye.com/CorpSite/).

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, IRS, CBERS, 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&Itemid=38). Special attention should be given to the dissemination of data and products associated with the proposed research. We 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 https://c3.nasa.gov/nex/.

2. Programmatic Information

2.1 Period of Performance for Selected Proposals

Research awards for the LCLUC Program are typically for three-year periods of performance (or less) with annual funding contingent upon satisfactory progress reporting and available funding.

2.2 Funding Available for Support of Selected Proposals

About $2.5M per year from the NASA LCLUC program is expected to be available for this solicitation. Support can be anticipated for about 10 investigations with the budget around 150-250K per year: two or three selections for the Industrial Forests element and seven or eight selections for the Synthesis element. The Two-Step Proposal Process for this announcement will start in calendar 2012. Pending the availability of funds through the Federal budget process for Fiscal Year 2013, NASA expects to make final selections for this announcement in the fall of 2013. Anticipated starting date for selected projects is late 2013 – early 2014.

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 1.1 on what is and what is not allowed in the budget concerning non-U.S. participation.

2.3 The Two-Step Proposal Procedure

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 procedure (see also Section IV(b)(vii) of the *ROSES Summary of Solicitation*). Step-1 Proposal replaces 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 PI) 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 template is suggested for use. Step-1 Proposals should be provided as a PDF proposal document-upload not to exceed five pages. 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.

The five-page limit for Step 1 Proposals must include all information necessary to evaluate the Step 1 Proposal. It should include any references or citations included in the Step 1 Proposal. One page of the allowed five can be used for a brief CV of PI and research experience.

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 expanded to 15 pages.

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, evaluate any logistical, implementation, cost, and/or management concerns. The funding recommendations will then be forwarded to a Selecting Official for confirmation. NASA then will announce the official selection of proposals for award.

Proposers will receive electronic notification no later than ~~twelve~~ **fifteen** weeks after the submission of their Step-1 proposals, whether they are, or are not, invited to submit Step-2 full

proposals, based on reviews of their Step-1 proposals. Feedback to proposers will be made available electronically to the proposers at the same time as their decision letters, after both Step-1 and Step-2 proposals.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $2.5M
Number of new awards pending adequate proposals of merit	~10
Maximum duration of awards	3 years
Due date for Step-1 Proposals	**November 30, 2012**
Due date for Step-2 Proposals	June 3, 2013
Planning date for start of investigation	December 2013 – early 2014 or when new fiscal year funds become available
Page limit for the central Science-Technical-Management section of proposal	Step-1 proposals: 5 pp; Step-2 proposals: 15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance to NASA	This program is relevant to the Earth science strategic goals and sub-goals 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 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	NNH12ZDA001N-LCLUC

NASA point of contact concerning this program	Garik Gutman Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-0276 Email: ggutman@nasa.gov

A.3 OCEAN BIOLOGY AND BIOGEOCHEMISTRY

1. Scope of Program

NASA's Ocean Biology and Biogeochemistry program focuses on describing, understanding, and predicting the biological 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:

1. 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, including phytoplankton and organisms from other trophic levels;
2. 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;
3. Exploring the development of new biological 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
4. Improving future climate predictions (impacts and feedbacks) by incorporating a dynamic understanding of ocean biology 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):

1. 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?
2. 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?

3. 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?
4. 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. Types of Solicited Investigations

Priorities for new research within NASA's Ocean Biology and Biogeochemistry program are to prepare scientifically for new measurements from the missions recommended by the National Research Council's (NRC) *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (NRC, 2007), as well as the National Academy of Sciences' report on *Assessing Requirements for Sustained Ocean Color Research and Operations (2011)* ; foster continued integrative and synthetic studies to further advance the science from past research projects; improve the availability, accessibility, and scientific utility of existing NASA observational data sets (i.e., satellite data products and related *in situ* measurements used to analyze and/or validate remote sensing data); and address the research agendas of the ecosystem and carbon cycle elements of the U.S. Global Change Research Program (USGCRP), as well as the goals and objectives of the National Ocean Council (NOC). There also is a need to develop new ideas for consideration as future field campaigns or analogous focused projects that require a coordinated, interacting team of researchers (the latter to be hereafter referred to as "related team projects") to address an important science question or set of interrelated questions about ocean biology and biogeochemistry and the Earth System. The NASA Ocean Biology and Biogeochemistry program solicits the following types of research investigations in no priority order:

- New analyses of impacts to and vulnerability of aquatic ecosystems/biological oceanography (e.g., taxa, physiology, phytoplankton physiological properties and plant functional types, etc., not carbon cycle science), to global environmental or climate variability and change.

- Science investigations to advance the development and utilization of new and/or multisensor remote sensing approaches to estimate important ocean biology and biogeochemistry (ecosystem and carbon cycle) properties. Studies using data to evaluate approaches relevant to future satellite missions are of special interest.

- Studies to analyze coastal and open ocean ecosystem impacts of the 2010 Gulf of Mexico oil spill utilizing NASA airborne and *in situ* optical data collected in support of the national response.

- Scoping studies to identify the scientific questions and develop the initial study design

and implementation concept for a new NASA Ocean Biology and Biogeochemistry field campaign or related team project (scale on par with ICESCAPE, SO GasEx, ARC-TAS, SEA4CRS, etc.).

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

2.1 Impacts On and Vulnerability Of Biological Oceanography

Aquatic ecosystems respond to global change in a variety of ways, but systems vary in both their vulnerability (i.e., exposure, sensitivity, resilience) to and impacts from environmental and climate change. Some impacts of global environmental change are major, greatly affecting the sustainability of ecosystem functions or causing large feedbacks to the climate system. Some changes are abrupt while others take much longer (decades or even centuries) to become manifest. Research is needed to identify the most significant of these 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.

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 biological oceanography, 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) why the impacts and/or vulnerabilities to be studied are expected to be highly significant, representing major perturbations to the Earth system and 2) how the remote sensing data and data products to be utilized in the study provide unique and powerful information for addressing the research issues/questions posed.

Characterization of uncertainties will be essential in all analyses of potential 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.

2.2 New and/or Multisensor Data Analyses and Approaches of Ocean Biology and Biogeochemistry Objectives

Continuing research is needed to develop, evaluate, and utilize new data analysis methodologies for extracting biological, ecological and biogeochemical information from space-based observations of the ocean. This applies to new uses of existing sensors as well as to preparatory work in anticipation of new satellite sensors. Multisensor research approaches are especially important and relevant given that abundant, complementary types of satellite observations are now available, several new types of observations will be forthcoming from satellites now in development, and adequate computational resources and analytical tools are available.

Research to apply new combinations of data and/or data products from different satellite sensors and to demonstrate their suitability for answering key ocean biological and biogeochemical science questions is solicited. Exploratory studies and projects that demonstrate new scientific applications are relevant. Studies to actively utilize such data and data products in ocean biological and biogeochemical modeling, synthesis activities, and diagnostic analyses are of interest. This opportunity is not appropriate for the production of major, new Earth System Data Records (ESDR).

Test flights of NASA JPL's Portable Remote Imagine SpectroMeter (PRISM) sensor will begin in spring 2012. Scientists interested in investigating the character and quality of PRISM measurements for ocean biological and biogeochemical applications are invited to submit proposals that address both sensor performance and a relevant ocean science question.

2.3 Ocean Biological and Biogeochemical Impacts of the Gulf of Mexico Oil Spill

The 2010 Deepwater Horizon Oil Spill in the Gulf of Mexico offered a rare opportunity to study the impacts of a large oil spill on open ocean and coastal ecosystems and biogeochemistry. NASA collected a unique and fairly comprehensive set of airborne and satellite remote sensing data in support of the broad national response to this oil spill, and these data are available for scientific research. Many state and Federal agencies also supported research efforts to collect optical and bio-optical observations in and around the oil spill area. The NASA Ocean Biology and Biogeochemistry program is interested in supporting investigations to analyze the airborne remote sensing data NASA collected over U.S. coastal zones and open ocean waters within the Gulf of Mexico before, during, and after the 2010 Deepwater Horizon Oil Spill. Part of the analyses may include existing optical and bio-optical data that would help to analyze the airborne or NASA satellite data. NASA collected much of these data at the request of other U.S. Government agencies in support of the broad national response to the oil spill, but added specific science-focused acquisitions based on the recommendations of scientists familiar with the Gulf region and knowledgeable of the scientific issues that could be addressed using the airborne research sensors deployed. NASA, through the Terrestrial Ecology program, acquired additional airborne data in the Gulf region in 2011, especially over heavily impacted coastal ecosystems, and these data also will be available for research under this program element. Information about the NASA data available can be found at the following Web sites:

http://aviris.jpl.nasa.gov/html/gulfoilspill.html
Other views of the AVIRIS collections can be found at:

http://aviris.jpl.nasa.gov/html/gulfoilspill.html and
http://www.google.com/fusiontables/DataSource?dsrcid=337729);
http://master.jpl.nasa.gov/data/; http://uavsar.jpl.nasa.gov/gulfoilspill.html.

In addition, many other Gulf of Mexico oil spill-related data sets and documents can be found at:

http://hdds.usgs.gov/hdds/ (under "Event/Disaster Response" event selection box, choose: "201004_Oilspill_GulfOfMexico" continue).

The NASA Ocean Biology and Biogeochemistry program requests studies to 1) characterize and understand the effects of the oil spill on the ocean biology, ecology, and biogeochemistry in coastal waters adjacent to the Gulf of Mexico, as well as in the affected open ocean area of the Gulf of Mexico, and/or 2) assess ocean biological, biogeochemical, and ecological responses (i.e., degradation, management, recovery) in the U.S. Gulf coastal environment to the oil spill and clean-up effort. If a strong justification can be made, NASA may be willing to consider analyses that address ecological impacts to areas outside the Gulf of Mexico caused by the oil spill, if NASA satellite data area utilized as a primary research tool and the aforementioned and following criteria for this program subelement are met.

In the studies proposed, NASA airborne data may be analyzed in conjunction with existing *in situ*/field data, other existing airborne data, and satellite data. Collaborations with field research organizations and scientists already working on Gulf oil spill impacts are encouraged. It is anticipated that most Gulf oil spill data analyses can be completed within 1-2 years, exploiting existing, archived airborne, and satellite data and the existing field knowledge and data of Gulf region agencies and researchers. Therefore, proposers submitting in response to this element are encouraged to request award durations of two years or less.

2.4 Field Campaigns

Only recently has NASA's Ocean Biology and Biogeochemistry program successfully mounted its first, dedicated field campaign (ICESCAPE) aimed at exploiting the synergistic benefits of multidisciplinary science focused on a particular science problem or set of problems that can be addressed using satellite remote sensing. The past campaign focused on research to address big questions, enable more effective interpretation and analysis of space-based measurements, foster collaborative (and international) interactions, and provide valuable opportunities for training and educating the next generation of scientists. At NASA, field campaigns produce important results, build new relationships within the scientific community, and leave a legacy integrated data set of great value. In the past, the ideas for the next field campaign have arisen spontaneously from within the research community – often as a result of discussions among current NASA researchers working on related research questions or through the committees and working groups of national and international programs (e.g., USGCRP, NOC committees, IOCCG, etc.). At present, new ideas are needed. NASA is, therefore, requesting scoping studies to (1) identify the scientific questions, and (2) develop the initial study design and/or implementation concept for a new NASA Ocean Biology and Biogeochemistry field campaign or related team project. This solicitation offers resources to facilitate such planning and the opportunity to design a project that matches Ocean Biology and Biogeochemistry research goals and makes use of NASA's unique capacity and flexibility to mount well-coordinated projects with satellite (and airborne, as needed) remote sensing as a central element.

The most important aspect of the scoping study will be the identification of the science

question(s) and issues to be addressed. The current state-of-the-science must be addressed; the potential for a major, significant scientific advancement must be described; and the central, critical role of NASA remote sensing must be explained. Scoping studies must describe 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* observations) and analytical (e.g., models, data, and information system) infrastructure. The study must also assess feasibility, both technical and logistical. The scoping study must make an effort to engage the broader research community in order to seek feedback on the ideas and to assess interest.

While the focus should be on Ocean Biology and Biogeochemistry Program goals and objectives, it is clear that past successful field campaigns and related projects have involved interdisciplinary research questions and scientists trained in a number of different disciplines. Most have also involved interagency and international partnerships. Thus, it would be helpful if the scoping studies could identify the disciplinary skills needed to conduct the study and engage potential partners in their planning activities.

While proposers will be free to develop their own work plan, it is anticipated that a typical scoping study might support the activities of a small planning/writing group and one or more workshops. Scoping studies must produce a written report that provides the scientific rationale and an initial study design concept for a new field campaign or related team project. While this report need not be lengthy, it must include a thorough presentation of science questions, goals, and objectives; the underlying rationale in terms of state-of-the-art, relevance, and expected advances; implementation concepts; and other information to enable NASA to fully evaluate the project. Examples of such reports are the LBA Concise Experimental Plan (http://www.lbaeco.org/lbaeco/invest/docs/LBA_concise_ExPlan.pdf) and the NASA ARC-TAS White Paper (http://www-air.larc.nasa.gov/missions/arctas/arctas.html)

2.4.1 *Additional Requirements*

The maximum duration for proposals under this subelement is 12-18 months.

2.4.2 *Additional Considerations*

NASA will review the scoping study reports submitted from selected investigations and make a decision within six months of that submission as to whether to further develop or implement the field campaign or related team project. NASA reserves the right to suggest a combined field campaign or related team project, if similar or complementary field campaigns or related team projects are proposed. NASA reserves the right to not implement any of the recommended field campaigns or related team projects and to entertain other ideas that may be offered for its consideration through other mechanisms. There are many other factors to be considered besides the excellence of the scoping study report and prospects for a major scientific advance. They include such programmatic considerations as the affordability of the campaign/project, its compatibility with current and near-term future space-based missions, NASA's ability to formalize needed partnerships and agreements, and schedule compatibility with other programs and projects that may be competing for the same resources (e.g., airborne instruments and

platforms).

Proposers are advised that participation on a successful scoping team study does not guarantee participation in the new field campaign or related team project. Proposals for participation in the field campaign or related team project will be solicited when NASA is ready to move it into implementation.

2.5 Successor Studies

This solicitation provides opportunities for integrative research relevant to the goals and objectives of the Ocean Biology and Biogeochemistry program element that will significantly advance the results of prior research toward meaningful answers to NASA's goals and relevant USGCRP carbon cycle and ecosystems and NOC research questions. 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. New studies that cannot cite and demonstrate a relationship to a recent NASA Ocean Biology and Biogeochemistry research award will be considered nonresponsive under this element.

3. Programmatic Information

3.1 Requirements Regarding General Content

All proposals submitted in response to the Ocean Biology and Biogeochemistry program subelements of this solicitation must explain the significant advance in scientific understanding anticipated and its societal relevance. Research supported will be expected to characterize uncertainties and quantify errors associated with data, analytical approaches, model results, and scientific interpretations. 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 and biogeochemical properties from space-based assets beyond traditional ocean color in support of the project objectives.

Coordinated or linked projects should be proposed separately. Individual efforts may be linked with other projects and these linkages must clearly and explicitly be called out by all involved proposals and investigators.

Substantive use of remote sensing data is required in all studies.

Investigators should make clear any special requirements or platform needs, i.e., ship modifications, additional boats, specific sampling requirements, aircraft support (see http://www.nasa.gov/centers/dryden/research/AirSci/), 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

cruises to be undertaken, region, dates, expected stations, measured variables, sampling frequency, platform and instrument, calibration strategy, and co-investigators. Data collected are requested to be submitted to the NASA SeaBASS archive (http://seabass.gsfc.nasa.gov/) within one year of collection.

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 four day trip to the farthest coast once per year, unless specified otherwise).

3.2 Requirements for Proposals to Acquire New Airborne 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. 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.

3.3 Requirements 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 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.

3.4 Proposal Evaluation Criteria

Proposals will be evaluated according to the criteria specified in 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.

4.0 Summary of Key Information

Expected annual program budget for new awards	Up to ~ $3 M
Number of new awards pending adequate proposals of merit	~ 10-20
Maximum duration of awards	Subelements 1, 2, and 5: 3 years; Subelement 3: 2 years; Subelement 4: 12-18 months **[Corrected 2/17/2012]**
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	October 1, 2012
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 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 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	NNH12ZDA001N-OBB
NASA Point of Contact for this Program	Paula Bontempi Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1508 Email: Paula.S.Bontempi@nasa.gov

A.4 TERRESTRIAL ECOLOGY

Amended July 30, 2012. This amendment presents the final text for this Appendix A.4 Terrestrial Ecology, which replaces in its entirety the placeholder text that was released with ROSES 2012. Step-1 proposals are due September 18, 2012, and Step-2 proposals are due January 8, 2013.

Notice: Proposals to this program will be taken via a two-step proposal process. This means that the Notice of Intent is replaced by a required Step-1 proposal and the Title and Principal Investigator are binding. The three-page Step-1 proposal will be used to conduct a preliminary evaluation, which will result in full proposals being either encouraged or discouraged. See Section 4 for details.

1. Scope of Program

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.

2. Types of Proposals

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 (http://www.carboncyclescience.gov/). This solicitation calls for research on specific topics of current, strong scientific interest and programmatic relevance. The NASA Terrestrial Ecology program requests the following types of research investigations:

- Data set development in support of arctic-boreal ecosystem vulnerability research to be conducted in a future Terrestrial Ecology Program-sponsored field campaign.
- Data set development to meet priority needs of the NASA terrestrial ecological community.

- Successor studies in the areas of remote sensing science and remote sensing methods development that offer to significantly advance the results of prior NASA Terrestrial Ecology research.

2.1 Data Sets for Arctic-Boreal Ecosystem Vulnerability Studies

Climate change in the Arctic and Boreal Region (ABR) is unfolding faster than anywhere else on Earth, resulting in receding glaciers, a longer ice-free Arctic Ocean during summer, warming and thawing of permafrost, increases in the frequency and severity of climate-driven disturbances, and widespread changes to surface water extent and vegetation structure and function. Environmental change in this region is increasingly affecting society in a variety of ways, including impacts on forests from insects and fires, erosion of Arctic coastlines, and changes to wildlife habitat and ecosystems that affect subsistence opportunities and economic uses. The impacts of environmental change in the ABR are rapidly becoming the focus of numerous policy discussions.

To more fully understand the evolving ABR environment and provide the information required to develop options for societal responses to the impacts of ABR climate change, the NASA Terrestrial Ecology Program is planning a field campaign based on the Arctic-Boreal Vulnerability Experiment (ABoVE) concept (see http://cce.nasa.gov/terrestrial_ecology/scoping.html#above for the ABoVE Scoping Study report, revised Executive Summary, and other study planning reports). The research to be conducted will involve observations, process-oriented analyses, scientific syntheses, and modeling. The field campaign will emphasize research that integrates and synthesizes geospatial data collected by airborne and spaceborne sensors with information obtained from field studies and ground-based observations. It will address questions that are associated with processes that are critical to understanding the impacts of climate change in the ABR, focusing on society and ecosystem services, land surface processes, and interfaces with the hydrological system, adjacent coastal ocean, and overlying atmosphere. The detailed study design will be developed over the next year, but it is not too early to begin assembling key data sets for the study region. Data sets of obvious importance for arctic-boreal ecosystem vulnerability research and modeling, as well as data sets that would inform study planning and preparation are of interest.

The exact spatial domain of the field campaign and the location of its study sites have not yet been determined. For the purposes of this solicitation, proposers should assume that the study region includes the arctic and boreal zones of Western North America (west of Hudson's Bay), with some degree of concentrated effort in Alaska. For moderate resolution satellite data, geographical coverage over the arctic and boreal zones of the entire Northern Hemisphere is also of interest in support of larger-scale integration and comparative studies with other regions.

NASA requests proposals for investigations to assemble, prepare, develop, refine, and/or integrate data sets for use in preparing for and conducting arctic-boreal ecosystem vulnerability 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; or preparing a

suite of geospatial data sets with consistent formatting, metadata, map projections, etc. suitable for use in relevant ecosystem models.

This opportunity is not for the collection of new surface-based *in situ* data, but rather to access and refine existing data for use in arctic-boreal ecosystem vulnerability field campaign research. Data set development involving new satellite data acquisitions, however, will be responsive. Use of data from limited new airborne data acquisitions over sites in Alaska may also be responsive – if proposed either in association with existing airborne research programs already working in the region or as part of a NASA Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) deployment now under consideration for summer 2013 or 2014 (see section 3.3 for additional information on this proposed deployment and how to budget for it).

Proposals must explain the overall importance of the data set proposed and its anticipated use(s) for the arctic-boreal ecosystem vulnerability field campaign. They must also explain the relevance of the proposed data set to a remote sensing-oriented research program. NASA intends to select only the most obviously important, high priority data sets for "pre-ABoVE" investment.

2.2 Data Sets to Advance NASA Terrestrial Ecology Research Goals

The NASA Terrestrial Ecology Program's Data Working Group and Modeling Working Group identified and prioritized data sets urgently needed to advance Terrestrial Ecology research and modeling goals. The five top-priority data sets are:

- *High spatial and temporal resolution weather data.* One of the fundamental forcings for land process models is surface weather at the land-atmosphere boundary. As land process models move toward higher spatial and temporal resolution and larger spatial domains, a new generation of surface weather boundary conditions is required to meet the needs of these models, with subkilometer resolution, global land coverage, and on the order of hourly temporal resolution. These datasets should include near-surface air temperature, precipitation, humidity, incident short and longwave radiation, and winds over the longest possible historical period, and updated at least annually with the latest observations. The estimation accuracy of these surface weather datasets must be quantified to the fullest possible extent, providing a foundational component for land process model uncertainty quantification.

- *Global gridded data on land-cover, land-use, land-use transitions, and land-cover changes (past, present, future).* The impacts of disturbance and land-cover /land-use change have long been recognized to be a key driver of climate and ecosystem function at local to global scales, yet the incorporation of these impacts in land surface models remains an ongoing challenge. Needed are consistent and comprehensive driver data sets on disturbance and land use change available at the spatial and temporal scales necessary for models to represent their impacts on land-atmosphere interactions. It should be recognized that a comprehensive set of disturbance forcings need to be organized using a consistent approach that can be

readily incorporated into model systems (i.e. a gridded and temporally explicit framework) along with the contributing change agent.

- *In situ validation data sets for Terrestrial Essential Climate Variables.* In support of the United Nations Framework Convention on Climate Change (UNFCCC), the Global Climate Observing System (GCOS) has specified the need to systematically produce and validate a suite of key global satellite-derived parameters that play an important role in understanding land-surface-climate interactions. Among the 50 Essential Climate Variables (ECVs), those relevant to the land remote sensing community include: land cover, fire disturbance, albedo, leaf area index (LAI), the fraction of absorbed photosynthetically active radiation, above ground biomass, snow cover, permafrost, and soil moisture (http://gosic.org/ios/MATRICES/ECV/ecv-matrix.htm). A set of *in situ* terrestrial observations at a diversity of sites is needed for: (a) validation of observations derived from Earth observation satellites; (b) process studies; (c) observations of the fullest possible range of terrestrial ECVs and associated details relevant to their application in model validation; and (d) to address intrinsic limitations in derived products.

- *High spatial resolution soil depth data layer.* A major difficulty with current soils data used for terrestrial biogeochemistry modeling is the representation of soil depth. The current depth limit of 1-m is an insufficient depth for ecohydrological analysis and evaluation for many natural terrestrial systems. While the next generation Global high-resolution soils data (GlobalSoilMap.net) is being compiled, it won't be completed for another five to ten years. In the interim, novel methods to develop high spatial resolution data on soil depth regardless of the distance to bedrock must be developed to advance Terrestrial Ecology modeling.

- *Spectral libraries.* The value of airborne and spaceborne datasets covering the spectral range 0.35-13 μm is enhanced with ground measurements, typically made at high spectral resolution of different vegetation types. In order to maximize the usefulness of these ground measurements, they need to be made under known and documented conditions with well-calibrated instrumentation and made freely available with standardized format and content. These ground datasets are typically referred to as spectral libraries. It is important that the measurements are documented carefully, cover the full optical range used by the airborne and spaceborne sensors, and are made at higher spectral resolutions than the airborne and spaceborne sensors. This information needs to be robust enough to examine between and within species variability.

  A NASA Hyperspectral Infrared Imager (HyspIRI) Ecosystem Spectral Library Working Group is currently conducting a rapid pilot effort to demonstrate a HyspIRI ecosystem spectral library using existing *in situ* observations and basing the approach on a modified copy of the existing Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) spectral library, but with added metadata fields appropriate to hyperspectral data spanning the visible-thermal infrared regions of the spectrum. Their results may be available as soon as September 2012, and follow-on

work to complement or further develop this improved NASA ecosystem spectral library may be proposed.

Additional information about the NASA Terrestrial Ecosystem research community's priorities for new data sets and the HyspIRI ecosystem spectral library can be found at: http://cce.nasa.gov/terrestrial_ecology/WGdata.html and http://hesl.jpl.nasa.gov/.

NASA requests proposals to develop data sets and/or methodologies that meet the above priority needs. Remote sensing approaches are encouraged in such proposals, but these are challenging requirements and, in some cases, it is unlikely the data can be obtained using current remote sensing technologies. Also, new surface-based, *in situ* data collection to create global products is neither feasible nor a core element of NASA's mission. Thus, the NASA Terrestrial Ecology Program is looking for innovative and practical approaches to meeting these data set needs that do not involve the collection of new *in situ* data. For example, it may be possible to combine remotely sensed data or geospatial data products with other data types to create a product of sufficient quality and utility to advance NASA Terrestrial Ecology research goals. Partnerships with organizations responsible for *in situ* data may yield the access and expertise to create a new customized product to advance NASA Terrestrial Ecology research goals and practical options for sustaining its future production.

Efforts to develop these various data sets must be handled with strong attention to issues of data consistency, service, management, and usability, which will require close coordination between the dataset developers and the research and modeling user communities. Successful proposals must have a clear plan for demonstrating how their data set will meet the needs of the broad NASA Terrestrial Ecology community and of how they will interact with that community to ensure those needs are met.

Proposals must 1) explain how the data set proposed addresses one of the high-priority Terrestrial Ecology data sets identified above and 2) describe how they will demonstrate that need is met in the research to be conducted. NASA intends to select only proposals that successfully address both.

NASA does not expect to be able to support research to develop data sets in all five topic areas detailed in this section, but rather is providing an opportunity for promising approaches to assembling these challenging, high-priority data sets to be proposed. NASA intends to select only those projects that demonstrate a high potential for success, are cost effective, and are consistent with the NASA Terrestrial Ecology community's priorities.

2.3 Successor Studies

This solicitation provides opportunities for research relevant to the goals and objectives of the Terrestrial Ecology program element that will significantly advance the results of prior research in the area of remote sensing science and remote sensing methods development toward meaningful results relevant to NASA's and USGCRP's carbon cycle and ecosystems research questions and current and future NASA missions. Successor proposals and follow-on research from past NASA Terrestrial Ecology 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 Terrestrial Ecology Program.

New studies that cannot cite and demonstrate a relationship to a recent NASA Terrestrial Ecology research award will be considered nonresponsive under this element.

Successor studies in Terrestrial Ecology program topic areas other than remote sensing science and remote sensing methods development are not solicited this year.

3. Additional Proposal Requirements

3.1 Requirement Regarding Remote Sensing

For proposals to develop new data sets (i.e., responding to sections 2.1 and 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 Terrestrial Ecology research, use of remote sensing data will not be required. Instead, the proposal must explain how the data set will meet a priority NASA Terrestrial Ecology need and be used in future research to complement satellite remote sensing data analysis.

For successor proposals responding to section 2.3 above, substantive use of remote sensing data is required.

3.2 Requirement Regarding Duration of Study

It is anticipated that many data set development activities that exploit existing data sources can be completed within 1-2 years. Also, some follow-on remote sensing science and remote sensing methods studies 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 Technical Plan 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 sections 2.1 and 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 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.

However, because the Terrestrial Ecology Program is planning an AVIRIS deployment to Alaska for 2013 or 2014, researchers wishing to obtain data for the purposes of data set development in support of arctic-boreal ecosystem vulnerability research may assume the funds for the aircraft and sensor deployment will be covered by the NASA Terrestrial Ecology Program using resources additional to those identified as being available for this competition. Such proposals need only include the costs of the flight hours to acquire their data from a base in Alaska (for planning purposes only, Fairbanks, Alaska, may be assumed). At this time, it is not certain whether the sensor will be AVIRIS-Classic or AVIRISng or whether the aircraft platform will be the NASA ER-2 or a Twin Otter. If it does not matter to the investigation, proposers should plan for use of AVIRIS-Classic on the NASA ER-2. If the other sensor and/or platform are required, the proposal should explain and justify the reasons.

4. Programmatic Information

4.1 The Two-Step Submission Process

To diminish the workload on authors and reviewers of proposals, and in recognition of the tightly focused scope of activities solicited and limited funding available, the Terrestrial Ecology

program is using a two-step proposal submission process in 2012 (see also Section IV(b)(vii) of the *ROSES Summary of Solicitation*). In the two-step process, three-page Step-1 proposals replace the Notice of Intent. These Step-1 proposals are required in order to later submit a normal (i.e., full, 15-page) proposal, which is called the Step-2 proposal. Any Step-2 proposal that was not preceded by a corresponding Step-1 proposal will be rejected without review. The Step-1 Proposal Title and Principal Investigator are considered binding and cannot be adjusted in the full (Step-2) proposal. Step-1 Proposals must be submitted electronically by the Step-1 due date (see Tables 2 and 3 in the *ROSES Summary of Solicitation*). Because of the way the NSPIRES web interface works, the required Step-1 proposal must be submitted by an authorized institutional official at the Principal Investigator's organization. However, submission of the Step-1 proposal does not obligate the offerors to submit a full proposal later.

NSPIRES will be open for the submission of Step-1 proposals starting ~30 days in advance of the Step-1 proposal due date. NASA will review each Step-1 proposal to determine whether submission of a full Step-2 proposal will be encouraged or discouraged. If a Step-2 proposal is discouraged, the letter will include a concise reason as to why a full proposal is discouraged. If a Step-2 proposal is encouraged, no additional feedback will be provided. Responses to the Step-1 proposals will be provided to proposers at least 35 days in advance of the deadline for full Step-2 proposals.

4.2 Proposal Content and Submission

4.2.1 Step 1 Proposals

The NSPIRES system will guide proposers through submission of all required proposal information. The scientific/technical section of Step-1 proposals may be at most three pages in length. 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 detailed budget is not required for Step-1 proposals.

The scientific/technical section of Step-1 proposals should be provided as a PDF document upload not to exceed three pages. It should focus on providing the following:

- A brief description of *what* research is proposed, including identification of what is new, different, and/or a scientific advancement. If it is a proposal to develop a data set, key attributes of the data set should be provided (e.g., planned geographic coverage, time-span covered, temporal/spatial resolutions, accuracy/error characteristics)
- Clear statements as to *why* the work proposed is 1) scientifically and societally important and 2) relevant to this NASA Terrestrial Ecology program element.
- A brief description of *how* the research will be conducted; it should address the overall approach and, as appropriate, data sources, methods, analytical tools, and anticipated scientific outcomes and/or products.

4.2.2 Step-2 Proposals

Step-2 proposals should follow the guidance for full proposals provided in section 2.3 the *NASA Guidebook for Proposers* and section 3 of this solicitation. 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.*

4.3 Proposal Evaluation Criteria

Proposals will be evaluated according to the criteria specified in 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 quality and completeness of the data management plan, including 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 appropriateness of the approach to characterizing uncertainties and quantifying errors.

5. Summary of Key Information

Expected program budget for first year of new awards	~ $1.5M
Number of new awards pending adequate proposals of merit	~7-12
Maximum duration of awards	3 years; but note guidance in section 3.1
Due date for Step-1 proposals	September 18, 2012
Due date for Step-2 Proposals	January 8, 2013
Planning date for start of investigation	April 1, 2013
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 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 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	NNH12ZDA001N-TE
NASA point of contact concerning this program	Diane E. Wickland Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0245 E-mail: Diane.E.Wickland@nasa.gov

A.5 CARBON CYCLE SCIENCE

NOTICE: The carbon cycle science program will not solicit proposals in ROSES-2012. All funds currently available for a dedicated carbon cycle science opportunity are committed to the support of awards selected through the 2010 carbon cycle science solicitation. These carbon cycle science funds will be competed again in ROSES-2013. 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.

The goals of the NASA Earth Science Research Program for carbon cycle science are to improve 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 U.S. Global Change Research Program (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/ and http://www.carboncyclescience.gov/). NASA carbon cycle research also contributes toward the goals of the U.S. Ocean Action Plan (http://www.whitehouse.gov/assets/documents/09_17_09_Interim_Report_of_Task_Force_FINAL2.pdf).

The mission of the NASA Earth Science Applied Sciences Program is to advance the realization of societal and economic benefits from NASA Earth Science by identifying societal needs, conducting applied research and development, and collaborating with application developers and users (http://nasascience.nasa.gov/earth-science/applied-sciences). The program's carbon cycle applications leverage NASA's investments in carbon cycle science to discover and demonstrate applications that inform resource management, policy development, and decision making. Applied sciences carbon cycle research is directed toward enhancing decision making within operational agencies responsible for resource management and policy decisions that affect carbon emissions, sequestration, and fluxes among terrestrial, aquatic, and atmospheric environments.

For further information on this program, contact:

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Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-0245
E-mail: Diane.E.Wickland@nasa.gov

A.6 BIODIVERSITY

NOTICE: NASA does not intend to solicit research proposals under this element in ROSES-2012. However, the Biodiversity call in Calendar 2012 was released as amendment 38 to ROSES-2011. Proposals are due April 10, 2012, *to the National Science Foundation (NSF)*. Please see the following URL for additional information about this joint solicitation and for instructions for NSF proposal submission: http://tinyurl.com/6pwyzzw

1. Scope of Program

Biodiversity is the variety of life on Earth at all levels of organization, from genes to species to ecosystems. In addition, biodiversity incorporates the compositional, structural, and functional aspects of life at these different levels. There is widespread concern about biodiversity declines across all organizational levels, particularly given that human actions may be driving a mass extinction event comparable to those seen in the geologic record. As a result, the research community is seeking tools to understand the condition of biodiversity and how it is changing over time.

2. Types of Proposals Sought

Please refer to the text of ROSES-2011 Appendix A.6 (that can be accessed by linking from http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId=%7B2E1D69D3-9C60-545D-0B03-0E07F736D390%7D&path=open) for the terms of the Biodiversity solicitation released during calendar year 2012. The final text of Appendix A.6 was released as amendment 38 to ROSES-2011.

3. Summary of Key Information

The NASA point of contact concerning this program is

Woody Turner
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NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-1662
E-mail: Woody.Turner@nasa.gov

A.7 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 at the NASA Goddard Space Flight Center Laboratory for Hydrospheric Processes, 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).

- *Exploitation of sea-surface temperature products.* NASA is playing a central role in providing the next generation of data products for sea surface temperature through the Group on High-Resolution Sea Surface Temperature (GHRSST) (http://www.ghrsst-pp.org). Proposals are sought which utilize or exploit these data products for innovative physical oceanographic science. Preference will be given to proposals addressing upper ocean physics and subpixel variability studies. This opportunity is NOT for development or improvement of data products.

2. Programmatic Information

Total funds available for work selected under this solicitation are approximately $2.0M 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 2013
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 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 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	NNH12ZDA001N-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.8 OCEAN SALINITY SCIENCE TEAM

NOTICE: Ocean Salinity Science Team will not be competed in 2012. The Ocean Salinity Science Team is tentatively scheduled to next solicit proposals in ROSES-2013.

The objective of this program element is to select additional members for the U.S. Ocean Salinity Science Team to support and participate in the U.S./CONAE Aquarius/SAC-D mission and joint Aquarius/SAC-D Science Team. The initial Ocean Salinity Science Team was competed in ROSES 2008 and further expanded to encompass exploitation of Aquarius data in ROSES 2011. It is anticipated that proposals will again be solicited in ROSES 2013.

The objective of the Aquarius instrument is to contribute to a better understanding of ocean circulation, the prediction of changes in this circulation, and its impact on Earth's climate and water cycle. Aquarius is described fully at http://aquarius.gsfc.nasa.gov/.

The NASA Ocean Salinity Science Team (OSST) supports basic research and analysis activities associated with the salinity measurement objectives of the Aquarius/SAC-D Mission. 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.

For information on this program, contact:

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A.9 OCEAN VECTOR WINDS SCIENCE TEAM

NOTICE: Ocean Vector Winds Science Team will not be competed in 2012. The OVWST is tentatively scheduled to next solicit proposals in ROSES 2013.

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 2009 and is anticipated to be open again in ROSES 2013.

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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National Aeronautics and Space Administration
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A.10 OCEAN SURFACE TOPOGRAPHY SCIENCE TEAM

NOTICE: Ocean Surface Topography Science Team will not be competed in 2012. The OSTST is tentatively scheduled to next solicit proposals in ROSES 2015.

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, Jason-2/Ocean Surface Topography Mission, and Jason-3) and other ocean altimetry data sets. The team is recompeted every four years. Proposals were last received in March 2012 (under ROSES 2011), and it is anticipated that proposals will be solicited again in ROSES 2015.

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 altimetry Climate Data Record from the Jason series of satellites, which are a cooperative venture between NASA, CNES, the National Oceanic and Atmospheric Administration (NOAA), and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT).

For information on this program, contact:

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A.11 ICEBRIDGE

1. Program Overview

1.1 Background

IceBridge (http://www.espo.nasa.gov/oib/) is a NASA airborne mission making altimetry, radar, and other geophysical measurements to monitor and characterize the Earth's cryosphere. The IceBridge mission began operation in 2009 and will continue until the launch of ICESat-2, currently estimated for early 2016. 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 will improve our knowledge of the contribution of the world's major ice sheets in Greenland and Antarctica to sea level rise. It will also make fundamental contributions to understanding changes occurring in the extent and thickness of the Arctic sea ice cap.

1.2 Scope of Program

This solicitation supports the second phase of IceBridge data collection from FY 2013 through FY 2015. During this period, IceBridge will 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 and one smaller campaign over Arctic sea ice in the northern hemisphere fall near the end of the melt season.

Though other aircraft will be considered, it is anticipated that the NASA P-3, DC-8, and Global Hawk will be the primary observation platforms. The Global Hawk is an Unpiloted Aerial System (UAS), and the mission aims to progressively increase the utilization of it and possibly other UASs with a goal of increasing the collection of altimetry observations in geographic coverage, time, and density. Other aircraft - piloted or unpiloted - may be proposed for any component of the IceBridge program, but must be capable of measurements at comparable scales and costs to the NASA aircraft.

With regards to the geographic foci, this phase of the IceBridge mission shifts land-ice focus to the Antarctic Ice Sheet with a goal of expanding coverage of ice elevation change and collecting ancillary data critical to modeling the AIS's present and future contributions to sea level rise, and understand mass change and dynamic processes of ice loss. This campaign will be conducted during October-January of 2012-2015 primarily using the NASA P-3, DC-8, and potentially the NASA Global Hawk. In conjunction with the Antarctic campaign, operations will be conducted over Antarctic sea ice to continue and improve on freeboard and other measurements.

In addition, the current IceBridge Arctic sea ice observations will continue using the NASA P-3, with a goal of expanding altimetry measurements using the NASA Global Hawk. A smaller program will be continued over the Greenland Ice Sheet, primarily using the NASA P-3, with the goal of maintaining or expanding altimetry observations with the Global Hawk. Surveys of other Arctic glaciers and small ice caps will also be considered as targets-of-opportunity during seasonal planning, though investigators may propose such surveys to this solicitation if designed

to 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 that have applications to polar ice sheets.

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, and it is likely that the Global Hawk will primarily be used for altimetry measurements. Since snow thickness on sea ice has been identified as critical to estimating sea ice thickness from freeboard measurements, this phase of IceBridge will also support the adaptation of snow radar technology to the NASA Global Hawk.

Overall, the specific measurements and science goals for this second phase of IceBridge are summarized 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 predictive models of sea level rise and changes in sea ice cover, especially the following:
    - Snow thickness, especially over Arctic sea ice;
    - Ice thickness and structure;
    - Bed topography 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.

To support these goals, this solicitation calls for two types of proposals:

1) data collection;
2) development of a snow radar for NASA's Global Hawk.

Scientific research with IceBridge data and membership on the IceBridge Science Team is not specifically supported under this solicitation, but will be solicited in a separate solicitation through NASA ROSES-2013.

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 other award vehicles, such as grants. See the *NASA Guidebook for Proposers* and the *Grant and Cooperative Agreement Handbook* for guidance.

2. Proposal Information

Two types of investigations are solicited through this IceBridge program element solicitation:

- Data Collection – collection of altimetry or gridded data; see Section 2.1.
- Development of a snow radar for NASA's Global Hawk; see Section 2.2.

2.1 Data Collection Proposals

2.1.1 Data Collection Campaigns

This phase of the IceBridge data collection program involves two 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. This campaign will primarily utilize the NASA P-3, the NASA DC-8, and the NASA Global Hawk starting in 2013.

b) Collection of critical data to support numerical models of the Antarctic ice sheet. The goal is to measure ice thickness, surface elevation, gravity anomalies within 3 km of the Antarctic Ice Sheet Grounding line and along a second line located 10 km upstream of the grounding line. This campaign will be based around flights by NASA's P-3 and DC-8.

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 between these two components, and 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.

The tentative dates of campaigns and aircraft are as follows:

Dates	**Goal**	**Aircraft**
October 2012 to January 2013	Antarctica and Southern Ocean sea ice, select areas	DC-8
March 2013 to May 2013	Greenland and Arctic sea ice, select areas and gridded datasets	P-3; Global Hawk (tentative)

September 2013	Arctic sea ice	P-3; Global Hawk (tentative)
October 2013 to January 2014	Antarctica and Southern Ocean sea ice, select areas	DC-8 (tentative); P-3 on continent (tentative); Global Hawk (tentative)
March 2014 to May 2014	Greenland and Arctic sea ice, select areas and gridded datasets	NASA P-3, Global Hawk (tentative)
September 2014	Arctic sea ice	NASA P-3 (tentative); Global Hawk (tentative)
October 2014 to January 2015	Antarctica and Southern Ocean sea ice, select areas	NASA P-3 on continent (tentative); NASA Global Hawk (tentative)
March 2014 to May 2014	Greenland and Arctic sea ice, select areas and gridded datasets	NASA P-3, Global Hawk (tentative)
September 2015	Arctic sea ice	NASA P-3 (tentative); Global Hawk (tentative)

Field campaigns to other Arctic glaciers and small ice caps using the NASA aircraft will be developed as targets-of-opportunity during seasonal planning. Investigators may propose some independent programs with other aircraft, but these programs will be considered as a lower priority and must be designed to cover broad geographical areas that are of consequence to understanding systemic impacts of global climate change and sea level change, or help elucidate fundamental processes that control glacier dynamics that have applications to polar ice sheets.

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. 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

Rader 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
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.	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

2.1.2 Proposal 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 campaign, 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/) and NASA Goddard Spaceflight Centers Laser Vegetation Imaging Sensor (LVIS) (http://lvis.gsfc.nasa.gov/), which has been adapted to both the NASA DC-8 and Global Hawk.

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.

2.1.3 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 post-collection 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.

2.1.4 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.

2.1.5 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 three, three-day-long flight planning meetings per year; two at the NASA Goddard Space Flight Center and one at the NASA Jet Propulsion Laboratory.

With regards to aircraft, proposers should initially consider installing their instrument on the NASA DC-8, P-3 and Global Hawk. Details on these aircraft can be found at http://airbornescience.nasa.gov/. These proposals need not consider flight costs. For alternate aircraft, such as those required for detailed surveys over Greenland outlet glaciers, proposers 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 Proposals for Adaptation of a snow radar for NASA's Global Hawk

This element supports the adaptation of a radar to map snow thickness over sea ice via the NASA Global Hawk unmanned aerial system. This subelement is not intended to support the development of new instruments. At the conclusion of the award, instruments must be ready to deploy into the field on the NASA Global Hawk for routine use by March 2014. Proposals to this subelement must include the following: 1) a description of the instrument, 2) details on the measurements to be made, 3) a demonstration that the proposer understands the capabilities and limitations of the Global Hawk, 4) a discussion of the IceBridge science enabled by this measurement, 5) a management plan, 6) a complete plan that takes the instrument through to readiness for deployment, and 7) deployment costs according the Arctic campaigns in 2.1.

For specific details on the Global Hawk see: http://www.nasa.gov/centers/dryden/aircraft/GlobalHawk/index.html and the contact information therein.

In general, instruments must have the following capabilities:

1. Determine snow depth over Arctic sea ice with an uncertainty of 5 cm;
2. Measurements at flight altitudes of 40,000-70,000 feet above sea level;
3. Fully autonomous operation;
4. Continuous operation for flight durations up to 32 hours.

2.3 Other Requirements

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	~ $9M in total for the first year; ~ $7.5M for Element 2.1; ~$1.5M for Element 2.2
Number of new awards pending adequate proposals of merit	~ 8 for Element 2.1; 1 for Element 2.2
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	None
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	October 1, 2012
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 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 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	NNH12ZDA001N-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.12 CRYOSPHERIC SCIENCE

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.

1.2 Scope of Program

This solicitation calls for proposals to understand the mechanisms of change in 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. Field studies are considered if closely tied to remote sensing efforts.

Specific goals of the program are to improve our understanding of the following:

- 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 of remote sensing data to develop, validate, and improve predictive models of the contribution of land-based ice to sea level change, especially in the coming century;
- Mechanisms controlling sea ice cover, including quantification of the connections between sea ice and the ocean and atmosphere, and determining the effects of changing sea ice cover;
- Use of remote sensing data to validate and improve predictive models of changes in sea ice cover, especially in the coming century, and the implications of these changes to the ocean, atmosphere, surrounding land areas, and global system.

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. 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 that have applications 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 Arctic projects to connect with the Study of Environmental Arctic Change (SEARCH; http://www.arcus.org/SEARCH/index.php), the interagency effort to understand the nature, extent, and future development of the system-scale change presently seen in the Arctic.

Use of the extensive data sets collected by NASA and other satellite and airborne remote sensing campaigns is strongly encouraged, 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 is 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 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. Since 1995, NASA's Program for Arctic Regional Climate Assessment (PARCA; http://nsidc.org/data/parca/) has focused a coordinated effort on determining the dynamics and mass balance of the Greenland ice sheet through a combination of targeted field campaigns, satellite data analysis, aircraft observations, and process modeling. 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 between 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 accumulation rates to 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 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 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 — 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 complete an Operational Requirements Worksheet (ORW) as discussed in NSF's Antarctic Science research solicitation (http://www.nsf.gov/div/index.jsp?div=ANT). A copy of the summary ORW must be included with your proposal.

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	~ $1M
Number of new awards pending adequate proposals of merit	~ 10
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*.
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 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 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	NNH12ZDA001N-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.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. The program has a historical and continuing emphasis on climate and weather, but addresses broader Earth system research as well.

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. 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 observationally-based improvements of Earth system model components, leading to 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. An overview of the current program may be found at http://map.nasa.gov/.

1.2 Background

MAP funds two primary projects and/or functional organizations that comprise the core activities of the program. These efforts are:

Goddard Institute for Space Studies (GISS) (http://www.giss.nasa.gov/research/modeling/). GISS engages in research on global climate change occurring 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. GISS has a long-term involvement in the Coupled Model Intercomparison Project (CMIP) that forms the basis of International Panel on Climate Change (IPCC) assessments of climate change. 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 general circulation model (GCM).

NASA Goddard Global Modeling and Assimilation Office (GMAO) (http://gmao.gsfc.nasa.gov). GMAO 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 is focused on developing and maintaining world-class data assimilation systems for purposes associated with maximizing satellite data utility and serving as a centralized 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, from defining an instrument, characterizing its in-flight performance, through to the development of algorithms and forward models for data assimilation, integrating the data into assimilation products, and finally 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/.

MAP also funds several smaller but still substantial projects that further core program interests. These efforts include:

Global Modeling Initiative (GMI) (http://gmi.gsfc.nasa.gov/). GMI develops, maintains, and utilizes a state-of-the-art modular global 3D chemistry and transport model (CTM) that includes full chemistry for both the troposphere and stratosphere, as well as a coupled representation of stratospheric aerosols. The GMI model serves as a testbed for different meteorological fields, emissions, chemical mechanisms, deposition schemes, and other processes determining atmospheric composition, both gas-phase and aerosols. In this role, GMI seeks to understand and constrain the uncertainties in model results through intercomparison of simulations and testing with observations. Since many of these processes are also included in general circulation models (GCMs), GMI is also a tool to expand the parameter space in sensitivity studies and test the parameterizations in GCMs with measurements of atmospheric composition.

NASA Unified Weather Research Forecast Model (NU-WRF). The NU-WRF model is an effort to unify the Weather Research and Forecasting (WRF) model, a next-generation multi-agency supported mesoscale NWP system, with NASA's existing weather models and assimilation systems, such as GEOS-5 and the Land Information System (LIS). Several parameterizations of physical processes developed by NASA scientists have been implemented into NU-WRF to better represent/simulate cloud/aerosol/precipitation/land surface processes. The goals for this effort are to robustly connect the global scale to the regional and mesoscale, and the use of NASA high-resolution satellite data for research into short-term climate and weather.

1.3 Modeling, Analysis, and Prediction Research Themes

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

- Model investigations designed to examine the role of processes within the Earth system and improve their representation in global models. Studies leading to implementable improvements are preferred. This includes representation of the weather-to-climate continuum of high impact events such as tropical systems, floods, droughts, heat waves, and extreme storms. Note that the focus of such an investigation should be on improving model representation of classes of events. Investigations involving case studies should explain the tie to general classes.
- Proposals to develop, implement, and evaluate new parameterizations for global models which would either expand the representation of the Earth system or replace modules which have been shown to have significant deficiencies. Parameterizations should be seamless, that is capable of spanning the weather to climate continuum of time scales. Examples include modules for boundary layer clouds, cloud superparameterizations, ice sheets, sea ice dynamics, dynamic vegetation, carbon cycle, aerosol indirect effects, etc.
- Studies to understand regional and local scale climate change in the context of global climate change: Improved understanding and modeling of the regional and local effects of global climate change is listed as a priority in the draft USGCRP strategic plan for the next decade. The MAP program seeks proposals to understand local and regional responses to global climate forcings and improve their model representation in global models. MAP also seeks proposals addressing the regional and global effects of local and regional climate forcing (such as occurs with aerosol or albedo forcing of climate.)
- Investigations using and/or evaluating the Modern Era Retrospective – analysis for Research and Applications (MERRA) reanalysis data (http://gmao.gsfc.nasa.gov/research/merra/intro.php). MERRA uses state-of-the-art GMAO data assimilation and modeling techniques towards production of a long-term reanalysis data set covering 1979-present and including observations from conventional (ship, aircraft, balloon, surface, etc.) and space-based observations. Investigations should address core MAP goals and objectives.
- Investigations utilizing observations which are aimed at identifying, characterizing, and reducing uncertainties in model predictions of climate change on seasonal to multidecadal time scales. This includes investigation and model representation of feedbacks, and components of the climate system which may provide predictive capability, for instance ocean circulations, the Northern and Southern Annular Modes, the NAO and PDO, etc.
- Constituents in the climate system: Constituents in the atmosphere (aerosols and chemical species) will respond to climate change, and changes in constituent concentrations can have climatic consequences as well. A MAP program goal is to expand our understanding of the role of atmospheric constituents in the context of the climate system, as well as utilization of constituent observations to better understand global processes and their model representation. Proposals are sought to understand the role of climate change on atmospheric constituent distributions and the influences of constituent change on climate. Proposals are sought to conduct hindcasts using

reanalyzed meteorological fields over the past twenty to thirty years to investigate the capability to capture observed characteristics (e.g., secular trends, seasonal and interannual variability) of inert tracers (e.g., N_2O) and radiatively and chemically active species. Proposals are sought to utilize constituent observations to investigate important transport processes within the troposphere and stratosphere, such as the relative roles of large scale vs. convective transport, the role of long range transport on regional and local constituent concentrations, and the influence of the stratosphere on the troposphere. A desirable feature of such investigations would be to understand the implications for the climate system. Proposals are sought to utilize observations to better understand uncertainties in global simulations of atmospheric composition, due to model formulation or process representation, for example of resolution, meteorology, emissions, or deposition. Proposals are also sought to investigate model/measurement comparison methodologies: Evaluating CCMs and CTMs with observations require different approaches due to the fact that the meteorology of the CCM does not correspond to the meteorology of the observations. Studies are, therefore, sought which demonstrate using CTM simulations the validity of the evaluation methodology for CCMs.

- Advanced numerics: The MAP program seeks investigations of grids and fluid dynamical formulations that support high resolution simulation of the Earth's climate. Techniques that contribute to the development of a modeling environment that can be configured in both global and regional applications are of specific interest. Proposals should consider accuracy, physical consistency, nonhydrostatic simulation, computational robustness, and be consistent with component-based model architectures.
- Model-based methods for establishing appropriate measurement requirements for climate monitoring to reduce uncertainties in global climate model projections. Current climate models exhibit a broad range of projections of climate change over the next few centuries, and this wide uncertainty envelope limits the utility of the model projections. Methods to better characterize and reduce this uncertainty are sought, in particular through the use of current observational capabilities and by determining and establishing requirements for key measurements to which the climate projections are most sensitive.

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.

New model components which are proposed should be Earth System Modeling Framework (ESMF) compliant and make use of ESMF utilities where appropriate. 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. Proposals for new or improved model components for NASA MAP supported models and proposals which utilize NASA MAP-supported models or model output will be preferred over those that do not.

2.2 MAP Infrastructure

Adherence to the multiagency ESMF (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 Computational Sciences (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 for 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 a clearly identified subsection of the Scientific/Technical/Management portion of the proposal.

The MAP program maintains a code repository for all code whose development has been funded by MAP.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $9M
Number of new awards pending adequate proposals of merit	~40
Maximum duration of awards	4 years

Due date for Notice of Intent	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, 2013
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 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 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	NNH12ZDA001N-MAP
NASA point of contact concerning this program	David B. Considine Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-2277 Email : david.b.considine@nasa.gov

A.14 ATMOSPHERIC COMPOSITION: UPPER ATMOSPHERIC COMPOSITION OBSERVATIONS

1. Scope of Program

Atmospheric composition determines air quality and affects weather, climate, and critical constituents such as ozone. Exchanges with the atmosphere link 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 chemistry and associated composition are a central aspect of Earth system dynamics, since the ability of the atmosphere to integrate surface emissions globally on time scales from weeks to years 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 constituents and solar radiation are driving global climate?
- How do atmospheric trace constituents respond to and affect global environmental change?
- What are the effects of global atmospheric chemical 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. NASA's research strategy for atmospheric composition encompasses an end-to-end approach for instrument design, data collection, analysis, interpretation, and prognostic studies.

2. Upper Atmosphere Research Observational Support

The principal area of research solicited through this section is for operational support of atmospheric field measurement systems that monitor trace gas composition in the stratosphere and tropical upper troposphere from the ground, aircraft, and balloons. These types of measurements include those associated with (i) the long term monitoring of ozone and ozone- and climate-related trace gases via remote sensing techniques, (ii) support of key observations desired for field missions designed to address chemical and dynamical processes that influence upper tropospheric and stratospheric composition, and (iii) required continuation of validation data products from NASA's Aura satellite and provide a transition to observations from future missions such as National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP). Aura validation observations that are required to understand long-term drift of the Aura observations will be given the highest priority. In this solicitation section, NASA is not seeking proposals for instrumentation designed to make atmospheric boundary layer measurements or measurements of cloud/aerosol radiative or microphysical properties. Proposed investigations may include, but are not limited to:

- Long-term ground-based remote sensing network observations of atmospheric trace gas composition such as those prioritized under the Network for the Detection of Atmospheric Composition Change (http://www.ndacc.org/);
- Airborne *in situ* and remote sensing observations of the tropical upper troposphere and stratosphere that are key to current and potential future airborne campaigns; or
- Small and large balloon observations of atmospheric composition for maintaining continuity of satellite calibration/validation capabilities.

With respect to the balloon-borne measurements, high-altitude/heavy-lift research balloons have been an important component of the Aura validation program over the last few years. While there may be a need for future balloon measurements (such as for support of the SAGE-III instrument on the International Space Station after 2014) to provide continuity and to focus on new issues, we anticipate that this need can be addressed at a much reduced scope and level of effort. Priority will be given to proposals that directly address the science priorities of NASA atmospheric composition focus area, have the potential to be used in planned future airborne field campaigns in the tropical upper troposphere and lower stratosphere (such as the SEAC4RS campaign in 2012), and can be used to enhance data products from the EOS Aura and other atmospheric composition satellites. Due to budget limitations, proposals that enhance and maintain the abilities of existing established measurement techniques and recent observations will be given priority over those proposing development and construction of new instruments and technology or data sets that have not been obtained over the past 3 years.

3. Summary of Key Information

Expected annual program budget for first year of new awards	~ $7.0 M
Number of new awards pending adequate proposals of merit	~ 20 – 30
Maximum duration of awards	4 years

Due date for Notice of Intent to propose (NOI)	None requested
Due date for proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	January 1, 2013
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 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 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	NNH12ZDA001N-UACO
NASA point of contact concerning this program	Kenneth W. Jucks Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0476 E-mail: Kenneth.W.Jucks@nasa.gov

A.15 RADIATION SCIENCES

NOTICE: The Radiation Sciences Program element will not be competed in 2012. All funds available for Radiation Sciences in 2012 are committed to the support of awards already selected. The Radiation Sciences Program is expected to solicit for data analysis and modeling proposals in 2013.

The National Aeronautics and Space Administration (NASA) Earth Science Division supports scientific investigations under the Radiation Sciences Program within the Atmospheric Composition focus area that contribute to the understanding of the sources, transformation, and transport of trace species in the Earth's atmosphere. The research strategy in atmospheric composition encompasses an end-to-end approach for instrument design, data collection, analysis, interpretation, and prognostic studies. NASA expects to provide the necessary monitoring and evaluation tools to assess the effects of climate change, and air quality forecasts that take into account the feedbacks between local, regional and global air quality and global climate change. 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 modeling studies that together with this suite of observations allow us to test our understanding of atmospheric processes.

The Radiation Sciences Program supports scientific investigations that lead to an enhanced understanding of the Earth's radiation budget. In this regard, better quantitative understanding of the optical properties of aerosols and clouds as well as the processes affecting those properties are of interest. In addition, the program supports investigations of the theoretical basis for the interaction of electromagnetic radiation with constituents in the earth's atmosphere.

For further information on this program, contact:

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A.16 ATMOSPHERIC COMPOSITION: MODELING AND ANALYSIS

Amended on March 12, 2012. To give time to proposers the proposal due date for this program has been delayed to October 1, 2012. Notices of Intent are not requested for this program.

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. Atmospheric Composition Modeling and Analysis Program Activities

2.1 Research Areas of Interest

The modeling and analysis effort is generally aimed at the questions of tropospheric air quality and oxidation efficiency, pollution sourced aerosol where they impact cloud properties, stratospheric chemistry and ozone depletion, and chemistry/climate interactions. Studies of long-term trends in atmospheric composition are also of interest to the program, particularly if a governing process can be identified. The program is particularly interested in studies which integrate observations from multiple instruments with models to address attribution and predictions. Use of satellite and suborbital data sets (e.g., DISCOVER-AQ, ARCTAS, INTEX, and AVE field campaigns) and ground-based measurements (ground-based measurements, such as ozonesondes, NDACC, AERONET, and MPLNET) are encouraged for modeling constraints and verification where applicable.

Retrospective studies are also encouraged. Modeling tools can range from primarily conceptual to process-level to regional to fully global, three-dimensional atmospheric composition models. The Atmospheric Composition Modeling and Analysis program (ACMAP) is focused primarily on data analysis, model utilization, and model evaluation, rather than model development. Proposals with a primary focus on model development and only a secondary focus on utilization and data analysis are not encouraged. Therefore, proposals are encouraged in the following areas:

Area A. Research topics in the area of tropospheric air quality and oxidizing capacity include the effects of climate change on tropospheric air quality and air quality on climate. Studies of the attribution of changes in air quality and oxidizing capacity over the past 20 years are encouraged.

Additional topics include upper tropospheric composition, the interaction between the regional and global scale atmosphere, boundary layer processes, convection and long-range transport, and exchange between the stratosphere and troposphere. Studies of the changes in chemically and radiatively active trace gases in the upper troposphere on climate will also be considered.

Area B. Studies of aerosol characteristics with respect to their impacts on actinic fluxes and tropospheric chemical processes are encouraged. In addition, studies that deal with the effects of clouds on atmospheric chemical processes, either by changing the radiative properties of the atmosphere or by providing a place for aqueous chemical reactions to occur, will be considered.

Area C. Stratospheric chemistry and ozone depletion studies of interest to the program include utilizing observations to understand the chemical, dynamical, and radiative processes controlling interaction between the stratosphere and troposphere. The polar regions are of particular interest with respect to chemical and radiative impacts of stratospheric ozone change on the lower atmosphere.

To understand the stratospheric ozone and its response to changes in ozone-depleting substances (ODSs), it is necessary to recognize and attribute the observational signal of ozone response to ODS change in the context of a changing and variable climate. The program, therefore, seeks

studies which will evaluate the potential impacts on future stratospheric ozone concentrations of both climate change and variability and changes in the concentrations of ODSs.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $2.2M
Number of new awards pending adequate proposals of merit	~10-15
Maximum duration of awards	3 years
Due date for Notice of Intent	None requested
Due date for Proposals	**October 1, 2012 [Amended March 12, 2012]**
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 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 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	NNH12ZDA001N-ACMAP

NASA point of contact concerning this program	Richard S. Eckman Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-2567 Email : Richard.S.Eckman@nasa.gov

A. 17 ATMOSPHERIC COMPOSITION: TROPOSPHERIC CHEMISTRY PROGRAM

NOTICE: The Tropospheric Chemistry Program of the Atmospheric Composition Focus Area will not be competed in ROSES 2012. TCP was part of a major solicitation for up to 3 years of activities associated with the SEAC4RS campaign with Element A.13 of ROSES 2010. It is, therefore, anticipated that the next major TCP solicitation will occur in ROSES 2013.

The Tropospheric Chemistry Program (TCP) seeks to improve measurement-based understanding of global tropospheric ozone and aerosol, including their precursors and transformation processes in the atmosphere. Ozone and aerosol 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 programs in the atmospheric composition focus area, the program also sponsors interpretation of these comprehensive but infrequent measurements to improve the continuous monitoring of ozone and aerosols from space and the improvement of prognostic models.

For information on this program, contact:

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A.18 TERRESTRIAL HYDROLOGY

NOTICE: The Terrestrial Hydrology Program will not be competed in ROSES-2012.

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 GRACE, or in formulation, such as SMAP and GPM, or in planning stages, such as SWOT, SCLP, and GRACE-2. THP projects are also extensively using data collected at previously funded field campaigns, such as those focused on soil moisture (SMEX'02, '04, and CLASIC) and/or those focused on snow (CLPX'02, '03, etc.). 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.19 NASA ENERGY AND WATER CYCLE STUDY

NOTICE: The NASA Energy and Water Cycle Study (NEWS) program will not be competed in ROSES-2012.

1. Scope of Program

The U.S. Global Change Research Program established the water cycle goals of the Nation's climate change program (see the strategic plan at http://www.climatescience.gov/Library/stratplan2003/). Accomplishing these goals will require, in part, an accurate accounting of the key reservoirs and fluxes associated with the global water and energy cycle, including their spatial and temporal variability, through integration of all necessary observations and research tools. To this end, in conjunction with NASA's Earth science research strategy (see NASA's Earth science research plan at http://nasascience.nasa.gov/about-us/science-strategy), the overarching long-term 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.

As the Earth's water and energy cycle is central to the mechanics and impacts of climate change, NASA's Earth Science Program seeks to advance and integrate water and energy cycle observation, scientific understanding, and ultimately its prediction to enable society to cope with future climate adversities. Discovery-driven water and energy research projects carried out by individuals or small groups of scientists have yielded significant advances in our understanding of key Earth science processes. To meet the NEWS challenge, the compendium of these water and energy cycle discoveries must be unified and integrated into a comprehensive and coordinated science solution. 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's 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 will be 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.

While no proposals to NEWS are sought for 2012, the program is always seeking collaboration with other projects and/or programs to make greater progress on broad water and energy cycle questions. Potential collaborators are strongly encouraged to review on-line documentation of existing NEWS projects, available at http://nasa-news.org. NEWS investigations are expected to interact proactively with the entire NEWS team, other NASA projects, and related national and international projects and programs to optimize progress toward integrating Earth Science resources (e.g. satellite data products, model and computational resources, ongoing research activities, etc.) to make decisive progress toward the NEWS grand challenge. This may require some modification of existing activities to optimize integration (e.g., by eliminating areas of potential overlap) but that has been deemed acceptable because of the challenging problems to be addressed that certainly cannot be solved by NEWS alone.

2. Point of Contact for Further Information

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A.20 PRECIPITATION MEASUREMENT MISSIONS (PMM) SCIENCE TEAM

Amended on March 12, 2012. The due dates for this program element have been changed. Notices of Intent are due April 30, 2012, and proposals are due June 29, 2012.

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) launched in November 1997, and investigations related to future precipitation missions, such as the next generation constellation-based Global Precipitation Measurement (GPM) Mission to be launched in 2014. 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 application 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 Multi-Frequency Microwave Scanning Radiometer (MADRAS) and 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 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. Proposers should identify the category (only one) under which they are submitting the proposal.

2. Research Categories

2.1. Algorithm/Product validation and enhancement

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 enhancements of facility algorithms for the GPM core and constellation, physical-based retrieval algorithms over-land that make use of the full range of microwave frequencies, and surface emissivity characterizations that can improve the utility of microwave channels over land and over coastlines. Important topics include:

- 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;
- Development, testing, and validation 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;
- Development, testing, and validation 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;

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) in such a way that they can be more readily implemented by the algorithms will receive priority consideration. Close collaboration between the analysis effort and GPM algorithm development is expected for proposals in this category:

- Development 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; and
- Development of innovative methods to improve the fusion of precipitation information from multiinstrument and multisatellite platforms within the general framework of statistical estimation.

2.2 Utilization of satellite/GV products for process studies and model development

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 studies of climate (global and regional variability, ENSO, etc.) and weather (tropical convection, hurricanes, midlatitude weather systems).

2.3. Methodology development for improved applications of satellite products

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.

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. 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)	**April 30, 2012 [Amended March 12, 2012]**
Due date for proposals	**June 29, 2012 [Amended March 12, 2012]**
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 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 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	NNH12ZDA001N-PMM
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A.21 WEATHER FOCUS AREA

NOTICE: The Weather Focus Area programs will not be competed in 2012. The Weather Focus Area is tentatively scheduled to next solicit proposals in ROSES-2013.

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. The main aim of this focus area as articulated in the NASA 2010 Science Plan is

- To enable improved predictive capability for weather and extreme weather events.

A large effort in this Focus Area is concerned with the detection and quantification of rainfall rate, generally measured using microwave radiation. The first weather radar in space, on board the Tropical Rainfall Measuring Mission (TRMM) satellite, has enabled the global mapping of rainfall in the tropics and has contributed to the increased physical understanding of storm cloud characteristics accompanying various forms and levels of rainfall rates. Future planning involves the extension of the TRMM concept to a global constellation of active and passive sensors in the form of a Global Precipitation Measurement (GPM) mission.

Another key component of the current Weather Focus Area is a set of core efforts to assimilate new NASA satellite data into numerical forecast models and to assess the amount of forecast improvement. Two groups are currently working on this problem: the Joint Center for Satellite Data Assimilation (JCSDA), involving the NASA Goddard Space Flight Center (GSFC) and the National Center for Environmental Prediction (NCEP) at NOAA, and now including other agency participation; and NASA's Short-term Prediction Research and Transition Center (SPoRT). As NASA continues to implement NPP and decadal survey missions, the weather focus area will contribute to the algorithm development to accelerate the use of the relevant decadal survey measurements in operational weather forecasting. These centers will allow studies of the most effective ways of assimilating new satellite data into global and regional numerical models.

NASA-funded researchers are working to use the many forms of new data from Earth Observing System sensors related to the atmosphere. The Moderate Resolution Imaging Spectroradiometer (MODIS), Atmospheric Infrared Sounder (AIRS), Multiangle Imaging Spectroradiometer (MISR), and Advanced Microwave Scanning Radiometer (AMSR-E) sensors on the Earth Observing System (EOS) satellites Terra and Aqua all contribute valuable information, such as

land and sea surface temperatures, cloud characteristics, bidirectional reflectance for interpreting air pollution concentrations, surface wetness, and polar winds.

The weather forecast area has also contributed to a number of field programs, such as the Genesis and Rapid Intensification Processes (GRIP), the NASA contribution to the African Monsoon Multidisciplinary Analyses (NAMMA), and Tropospheric Cloud System and Processes (TCSP) field experiments that serve to both improve our understanding of atmospheric processes and provide calibration and validation instruments and techniques for NASA's Earth-observing satellites. Not all of the satellite and airborne measurements are currently being assimilated into numerical forecast models to determine their potential forecast impacts. Research work will continue for improved modeling and computing, the development of Doppler wind lidars, and the development of geosynchronous and active sounding to meet the future objectives of the Weather Focus Area.

2. Point of Contact for Further Information

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A.22 EARTH SURFACE AND INTERIOR

NOTICE: The Earth Surface and Interior program will not be competed in ROSES 2012. The Earth Surface and Interior program is tentatively scheduled to next solicit proposals in ROSES-2013.

1. Scope of Program

1.1 Thematic Areas and Research Questions

The Earth Surface and Interior (ESI) focus area can be divided into three thematic areas,

- Land Surface Change and associated Natural Hazards;
- Space Geodesy; and
- Earth's Planetary Interior- its structure and dynamics,

that address the following four research questions within the Earth Science Division:

1) Prediction: How can knowledge of the Earth's surface change be used to predict and mitigate natural hazards?

The overarching goal of the ESI focus area is to assess, mitigate, and forecast the natural hazards that affect society, including such phenomena as earthquakes, landslides, coastal and land surface erosion, floods, and volcanic eruptions.

Near term predictions of volcanic eruptions are moderately successful for certain, limited, and well studied, volcanic areas. These near term predictions can be improved through better remote sensing utilizing optical and geodetic imaging and enhanced predictive modeling. During the past year, significant success has been achieved in the application of stochastic techniques to identify with significant spatial resolution areas at high risk of significant earthquakes. NASA has also made available significant new high resolution Shuttle Radar and LIDAR Topographic maps and InSAR data from strain maps to study volcanic inflation and inundation dynamics from lahars and floods. NASA is collaborating with its national and international partners to develop an expanded access to remote data sets for research in the mitigation of geohazards within defined natural laboratories such as the EarthScope and Asia-Pacific Natural Laboratories.

2) Variability: How is the Earth's surface being transformed by naturally occurring tectonic and climatic processes?

Space geodetic techniques are revealing a seismic precursory and stress transfer events that appear to be important components of the earthquake cycle. The integration of geodetic and seismic models is leading to better estimates of crustal strength and dynamics within seismic zones. High resolution topography from the Shuttle Radar Mission and satellite and airborne LIDAR coupled with hyperspectral and multispectral optical imaging are providing detailed structural and lithologic models for the resolution of tectonic and climatic influences upon an evolving terrain. Geodetic imaging, utilizing InSAR, LIDAR, and optical mapping techniques, constitutes the highest priority for new investments within the ESI focus area. Other

electromagnetic techniques such as ELF/ULF network measurements are also being studied to gain a better understanding of the physics of the earthquake cycle.

3) Forcing: What are the dynamics of the Earth's interior and how do these forces drive change at the Earth's surface?

Space geodetic research is making enormous strides in defining the dynamics of the crust, mantle, and core through measurements of surface deformation, the Earth's angular momentum. Likewise, the wonderful progress of gravity and geomagnetic satellite missions such as GRACE, Oersted, SAC-C, CHAMP, and soon COSMIC, GOCE and SWARM, during the International Decade of Geopotential Field Research, is providing high resolution long term data to model the geodynamo and provide high resolution information on the structure, composition, and dynamics of the Earth's mantle, lithosphere, oceanic, and atmospheric envelope. The combined analysis of satellite gravity, geomagnetic, and space geodetic measurements will likely lead to a better understanding of the state of stress in crust and mantle and ultimately to improved prediction capabilities for geohazards. Also of importance to the ESI program are better macroscopic observations and models for ionospheric and magnetospheric dynamics. These areas are being studied for the improvement in the separation of sources in geomagnetic modeling and for the detection of subtle surface disturbances such as surface seismic waves and tsunami's and the sounding of the deep interior of the Earth.

4) Response: How is global sea level affected by natural variability and human induced change in the Earth System?

The rate of sea-level change is estimated to be 1-2 mm per year measured within the terrestrial reference frame; a critical component of these estimates is the response of the solid Earth, including subsidence and erosion in coastal zones and crustal warping beneath the deepening oceans and thinning ice sheets.

Of critical importance in the broad range of ESI and related climate change studies is the definition of a stable and accurate terrestrial reference frame and the interpretation of associated changes in the Earth's shape, gravity field, and angular momentum. The program is seeking to improve the performance of the global geodetic observing and analysis capability through the design of new observing strategies, technologies, and analysis capability.

1.2 The ESI Program Plan

The strategic plan of the Earth Surface and Interior focus area is entitled *Living on a Restless Planet* and is available at http://solidearth.jpl.nasa.gov/seswg.html. The program plan is a 25-year vision drafted by the Solid Earth Sciences Working Group (SESWG) in close consultation with the solid Earth science community and the Federal agencies. The SESWG report was adopted as the ESI focus area's strategic plan following the review and endorsement by the National Research Council (NRC) in 2004. The NRC review entitled *Review of NASA's Solid-Earth Science Strategy* (http://books.nap.edu/catalog/11084.html).

The SESWG recognized that understanding the solid Earth and moving toward predictive capabilities, where appropriate, requires a broad observational strategy, incorporating numerous methodologies (including space-borne, airborne, and ground measurements), technological advances, and complementarity among observations. The SESWG recommended the following six observational strategies to address the fundamental solid Earth questions:

- Surface Deformation;
- High-resolution Topography;
- Variability of Earth's Magnetic Field;
- Variability of Earth's Gravity Field;
- Imaging Spectroscopy of Earth's Changing Surface; and
- Space Geodetic Networks and the International Terrestrial Reference Frame.

2. Point of Contact for Further Information

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A.23 CLOUDSAT AND CALIPSO SCIENCE TEAM RECOMPETE

1. Scope of the Program

1.1 Overview

Nearing six 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. 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 A-train sensors is encouraged. 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	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 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 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	NNH12ZDA001N-CCST
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.24 THE SOIL MOISTURE ACTIVE-PASSIVE MISSION SCIENCE TEAM

NOTICE: A number of changes have been made to this call. We have increased the length of accepted proposed activity length from 40 months to 52, which better aligns project activity with the life time of SMAP. We have increased the available monetary resources to $2M/year (up from 1.6M) and have indicated that this is to be used to select ~15 US members. New language emphasizes role of selected PIs in engaging the project strongly during the cal/val phase of SMAP (including the expectation of travel to JPL during that period). In addition, instructions for non-US proposers has been made available on the web, and web links are provided for the SMAP Algorithm Theoretical Basis Documents and a FAQ web page. New text is in bold and deleted text is struck through. The due date for proposals remains unchanged at February 1, 2013.

1. Scope of Program

Proposals are solicited for participation in the Science Team (ST) for the Soil Moisture Active-Passive (SMAP) mission.

The Soil Moisture Active-Passive mission will 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 and is currently scheduled for launch in October 2014.

The objective of this solicitation is to select a Science Team to assist with prelaunch and postlaunch science activities of the SMAP mission. The ST will function for the period from October 1, 2013, through the ~~second~~ **third** year of the postlaunch science operations phase (SOP), currently planned to be January 25, 201~~7~~**8**, for a total of ~~40~~ **52** months. The ST role will primarily be to provide expert guidance and contributions to the SMAP project in the areas of preparation for science and applications utilization of SMAP science data products, calibration, and validation (Cal/Val) of the Level 1 through Level 4 science data products, assessments of accuracies of the science data products, utilization demonstrations of SMAP science data products for research and applications, and liaison with the broader science and applications communities.

As stated in the Decadal Survey, there are numerous priorities for the SMAP mission. The first is enabling advances in the study of the water, carbon, and energy cycles, especially on those topics

that deal with the intersections of these cycles. Soil moisture serves as 'memory' for the land surface, much as sea surface temperature does for the ocean. The SMAP mission will thus make a significant contribution to weather forecasting and short-term (seasonal) climate predictions. The SMAP mission will also contribute significantly to climate and environmental science and applications in areas such as flood prediction, drought prediction and assessment, agricultural productivity, and public health related concerns, such as heat waves and vector borne diseases.

This solicitation is open to U.S. and non-U.S. applicants. Non-U.S. applicants will be selected on a no-exchange-of-funds basis only. Instructions for non-U.S. participants to submit proposals in response to this solicitation are provided in Section 3.

2. Science Team for the SMAP Mission

The Science Team (ST) is expected to consist of approximately 15 **U.S.** members, **plus a smaller number of** non-U.S. team members, whose expertise span the areas of:

- Soil moisture retrieval algorithms, using passive, active, and combined active-passive approaches, and associated physical theory;
- Freeze/thaw algorithms, and associated physical theory;
- Soil moisture data assimilation (primarily with off-line land surface models);
- Use of soil moisture to initialize weather and climate model simulations;
- Carbon cycle science, as influenced by freeze/thaw transitions;
- Flood and drought forecasting and assessment;
- Postlaunch calibration of antenna and brightness temperatures including assessment of external effects (e.g., sun, galaxy, ionosphere) on L-band antenna temperatures;
- Postlaunch calibration of radar backscatter and removal of drifts and processing artifacts;
- Detection and removal of RFI in radar and radiometer science data;
- Field activities (data acquisition, processing and analysis) for soil moisture and freeze/thaw product calibration and validation.

Members of the ST will attend approximately three meetings per year in person and will provide expert guidance on issues related to SMAP science. Between ST meetings, **especially during the first year of the post-launch science mission**, members will be ~~available~~ **expected to travel to Jet Propulsion Laboratory, CA and attend and actively contribute to special Cal/Val analysis and assessment meetings and to participate in frequen**t teleconferences as needed. Members are expected to contribute towards achieving the required science objectives stated in the Decadal Survey ~~and SMAP Workshop Report.~~ **SMAP science data products and the algorithms used to generate them are described in Algorithm Theoretical Basis Documents (ATBDs) that are available at the URL http://smap.jpl.nasa.gov/science/dataproducts/ATBD/.** A particular role of the Science Team is in carrying out the Cal/Val Plan for the Level 1 through Level 4 mission science data products. The SMAP **Science Data** Cal/Val Plan is available at the URL http://smap.jpl.nasa.gov/science/Validation/. The Cal/Val Plan provides details of the planned field campaigns and validation data acquisitions and processing for the SMAP mission. An additional role of the Science Team is to foster early utilization of SMAP data products in

addressing objectives of the SMAP Science Applications Plan. The SMAP Science Applications Plan is available at the URL http://smap.jpl.nasa.gov/science/wgroups/applicWG/.

Specifically, the Science Team members will:

- Provide guidance to the SMAP Project in implementation of the Cal/Val Plan for the mission;
- Participate directly in carrying out Cal/Val activities specified in the Cal/Val Plan;
- Through implementation of the Cal/Val Plan, assess the accuracies of the instrument data products (Level 1) and geophysical data products (Level 2 – Level 4) generated by the mission and the performance of the algorithms used to create these products;
- Identify necessary actions to be taken by the Project in improving the quality of the data products generated by the mission;
- Provide guidance on improvements to the Science Data System (SDS) necessary to support the mission data processing; and
- Provide guidance for the entrainment of SMAP mission data in application users' models, processes, and decision support systems.

The basis for the expert guidance on the topics listed above will be the proposer's knowledge and experience in the relevant scientific topic, in particular the use of L-band radar and radiometer data for studies of soil moisture and freeze/thaw state and their hydrologic applications. Direct experience with previous and current satellite instruments for soil moisture and freeze/thaw data production is desirable but not required. Proposers ~~should~~ **may** consider how concurrent satellite data and land-surface modeling activities could contribute to their studies. Activities of the ST related to Cal/Val are expected to focus on items specifically contained within the SMAP Cal/Val Plan. However, innovative activities beyond those identified within the SMAP Cal/Val Plan that contribute to the assessment of SMAP product quality will also be entertained.

Team member proposals should include a description of the proposed contribution, including a description of the expertise to be contributed to the ST. Proposals should address the following topics:

- Statement of interest that makes the link to one or more of the specific ST roles and responsibilities listed above,
- Description of key deliverables to the project and their anticipated time-line,
- Synopsis of the expertise to be contributed to the ST that includes relevant past experience, and
- Outline of time-commitments in the period covering the ST activities and statement on readiness to commit time to project.

Proposals will be evaluated on the basis of proven capabilities of the principal investigators, as well as the approaches and activities proposed to address topics that will help assess the quality of the SMAP science data products and the use of SMAP data for hydrologic applications. **Proposals will be expected to reflect the capability of the proposer to be cognizant of, and responsive to, project milestones and deliverables, including critical analyses, documentation and reports, as described in the Cal/Val Plan.**

The Science Team leadership will be provided by Dara Entekhabi (MIT) as overall Team Leader, together with the Project Scientist Eni Njoku (JPL) and Deputy Project Scientist Peggy O'Neill (GSFC). The Team Leader will organize, plan, and chair the team meetings, integrate the input of the various team members, and work to achieve consensus on the overall science objective and requirements. The three mission science leaders (listed above) and the Science Team will act in close association with the NASA Programmatic Mission Office and Program Scientist to achieve these goals.

3. Instructions for International Team Member Proposal Submission

Proposals for scientists employed at non-U.S. institutions are encouraged and 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 at the SMAP web page http://smap.jpl.nasa.gov/science/team/STInfo/. Proposers are encouraged to include a letter of commitment promising financial support for the investigation activities. ~~Instructions and requirements for submitting a proposal as an International team member will be available on the SMAP website at least ninety days before the due date. Please look under 'science team' when viewing the website (http://smap.jpl.nasa.gov).~~

4. Frequently Asked Questions

A Frequently Asked Questions (FAQ) web page has been set up to provide responses to questions concerning the SMAP Science Team solicitation. The FAQ web page can be accessed at the URL http://smap.jpl.nasa.gov/science/team/STInfo/.

5. Summary of Key Information

Expected annual program budget for new awards	~ $~~1600~~ **2000K**
Number of new U.S. investigator awards pending adequate proposals of merit	~ ~~10~~ **15**
Maximum duration of awards	~~40~~ **52** months
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	12 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal or research objectives from Table 1 in the *ROSES Summary of Solicitation*. See also Sections I(a) and IV(e) of the *ROSES Summary of Solicitation*.
General information and	See the *ROSES Summary of Solicitation*.

overview of this 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	NNH12ZDA001N-SMAP
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.25 SURFACE WATER AND OCEAN TOPOGRAPHY MISSION SCIENCE DEFINITION TEAM

1. Scope of Program

Proposals are solicited for participation in the prelaunch Science Definition Team for the Surface Water and Ocean Topography (SWOT) satellite mission.

The SWOT mission will use 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.

SWOT was recommended by a survey conducted by the National Research Council on NASA's Earth Science Program. The survey was documented in *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 SWOT mission and its capability to fulfill the objectives laid out for it in the Decadal Survey can be found at the SWOT web site (http://swot.jpl.nasa.gov/). SWOT is 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 is currently scheduled for launch in 2019.

The objective of this solicitation is to select a Science Definition Team (SDT) to assist with prelaunch planning for the SWOT mission. The selection will be conducted in coordination with CNES and CSA. The SDT will function for the period between now and 2018, which is one year prior to the currently planned launch date. Its role will primarily 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.

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 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 priority of the SDT selection is to address the various challenges the mission planning and development is facing in the coming years before launch. The emphasis is placed on the definition of the requirements for meeting the mission's primary goals and the formulation and implementation of a practical approach to meeting the requirements, including calibration and validation. In addition to the primary goals in land surface hydrology and mesoscale/submesoscale oceanography, the SWOT mission will also address other topics including sea ice, ice sheets, estuarine processes, ocean bathymetry, etc. These additional goals and objectives will be considered in mission planning without stressing the mission resources. These considerations will also be part of the duties of the SDT.

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 SDT will provide advice and guidance for AirSWOT activities.

2. Science Definition Team for the SWOT Mission

The SDT is expected to consist of approximately 10-20 investigators with the ability to provide expert advice and serve in an advisory capacity on the following mission objectives:

2.1 Oceanographic mission objectives

- Mesoscale/submesoscale processes - defining and quantifying the spatial/temporal variability of sea surface height at wavelengths from 10-300 km from observations (including AirSWOT) and high-resolution ocean general circulation models (OGCM), for evaluation of mission science requirements.
- Coastal tides – developing state-of-the-art models for ocean tides around the world's coasts, leading to algorithms for correcting the SWOT ocean measurements.
- Internal tides – developing state-of-the-art models for global ocean internal tides, leading to algorithms for correcting the SWOT ocean measurements.
- Modeling/data assimilation – conducting numerical experiments with high-resolution OGCM for evaluating the performance of data assimilation in estimating the 4-dimensional state of the ocean from the SWOT measurements.
- Effects of ocean waves – investigating the effects of ocean waves and surface roughness on the SWOT measurement of sea surface height and develop correction algorithms.
- Synergy of high-resolution imagery – exploring synergy from using multiple sensors (sea surface temperature, ocean color, backscatter intensity from SWOT, etc.) for estimating ocean surface velocity at the SWOT resolution.

- Calibration/validation – developing techniques for calibration and validation of SWOT measurements (including the use of AirSWOT) as well as selection of Cal/Val sites and validation strategies for the initial cal/val phase of the mission.
- High-level products – exploring methods for producing multiscale global maps of sea surface height by merging SWOT observations with other types of data through statistical as well as modeling/assimilation approaches, leading to algorithms for high-level data products.
- Wet-tropospheric correction – investigating the characteristics of atmospheric water vapor content over the ocean at wavelengths of 10- 300 km and their effects on SWOT measurements, leading to measurement approaches and correction algorithms assuming the presence of nadir radiometer.

2.2 Hydrological mission objectives

- Discharge algorithms – quantifying the expected accuracy of river discharge derived from SWOT measurements demonstrating trade-offs between measurement accuracy and errors in derived discharge. Because SWOT will collect locally instantaneous measurements from a single overpass as well as provide basin-wide measurements from multiple overpasses, algorithms are expected to vary in accuracy and complexity especially as fluvial geomorphology varies from single channels to complex multi-channel flow paths and as hydroclimatology varies geographically from tropical to arctic zones.
- Water and energy balance modeling – quantifying the expected improvements in regional to global water and energy budgets from having SWOT measurements and derived products, e.g., changes in discharge and storage.
- Calibration and validation – Validating SWOT water surface elevations and derived products includes *in situ* and AirSWOT measurements of water surface elevations and resulting estimates of bathymetry, discharge, and storage change.
- Classification of SWOT measurements – Because SWOT is an active, Ka-band synthetic aperture radar operating at near-nadir incidence, the signal-to-noise of returned radar energy is expected to be strong. Developing classification methods to ensure delineation of water and nonwater returns at the highest possible spatial resolutions and hence trade-offs regarding river channel widths (i.e., for discharge) and lake areas (i.e., for storage changes). Classification methods are also needed to determine the impact of vegetation in flooded environments.
- Geophysical uncertainties – Height errors over terrestrial water surfaces resulting from atmospheric water vapor are not expected to be as significant as those over oceans; nevertheless, errors might vary with hyroclimatology warranting assessment of potential uncertainties and corrections.

2.3 Additional synergistic objectives

- Sea ice – defining the utility of SWOT for observing sea-ice properties, in particular, the free board height, as well as the performance of sea surface height measurement in the midst of sea ice floes, leading to sea-ice algorithms and data products and associated requirements.

- Ice sheet topography – defining the utility of SWOT for measuring the topography of land ice sheets, leading to ice-sheet algorithms and data products and associated requirements.
- Estuarine processes – defining the utility of SWOT for the study of processes in estuarine zones, develop models for utilizing the water height measurements to estimate key parameters underlying the processes.
- Practical applications – exploring the utility of SWOT data for societal applications and develop future requirements for operational applications to hydrological and oceanographic problems: flood forecast, water resources management, coastal tides and currents, offshore operations and navigations, etc.

Members of the SDT must address expertise related to the objectives noted in Sections 2.1, 2.2, and 2.3. Specifically, it is expected that the SDT members will work together as a team to further refine the mission design. This requires sharing of measurements, data, and models amongst the SWOT project and team members. Therefore team members are expected to work in an open and communicative manner. The SDT members will attend approximately three meetings per year in person and will provide expert guidance on issues related to SWOT science. Between SDT meetings, members will be available for teleconferences, as needed. Proposers should budget for these travel and communication costs. The following is a summary of the SDT tasks:

- Provide advice regarding the refinement of measurement requirements and accuracies for meeting the science objectives;
- Provide guidance for the development of calibration and validation plans for the mission;
- Define the geophysical products and data sets to be provided by the mission and the algorithm development work required to create these products and data sets;
- Identify necessary prelaunch studies to meet the science objectives and evaluate such studies when completed;
- Provide guidance on the development of the science data processing system necessary to support the mission scientific goals; and
- Provide guidance for the eventual entrainment of SWOT mission data in application users' models, processes, and decision support systems.

The basis for the expert guidance on the topics listed above will be the proposer's knowledge and experience in the relevant scientific topic, in particular the merits in addressing the specific needs of the project development. Direct experience with previous and current satellite instruments for oceanographic and hydrological studies is desirable but not required. Proposers should consider how previous and current satellite data and modeling activities could contribute to their guidance. Examples of the types of contributions from members of the SDT might include, but are not limited to: assessment of science trade-offs for spatial resolution, temporal sampling, instrument accuracy and correction algorithms, data latency as impacting enabling applications (such as coastal and flood forecasts), etc.

Team member proposals should include a 10-15-page description of interest, including a description of the expertise to be contributed to the SDT. Proposals will be evaluated on the basis of proven capabilities of the principal investigators, as well as the approaches and activities proposed to address topics that will define the SWOT scientific measurement and objectives and the use of SWOT data for oceanographic and hydrologic applications.

The Science Definition Team leadership will be provided jointly by the NASA and CNES. They will organize, plan, and chair the team meetings, integrate the inputs of the various team members, and work to achieve consensus on the overall science objective and requirements. The Project Scientists, Team Leaders, and the Science Definition Team will act in close association with the programmatic mission offices and Program Scientists at NASA and CNES, in coordination with CSA, to achieve these goals.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $1M
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)	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 2013
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 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 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	NNH12ZDA001N-SWOT
NASA point of contact concerning this program	Eric Lindstrom Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-4540 Email: eric.j.lindstrom@nasa.gov

A.26 RAPID RESPONSE AND NOVEL RESEARCH IN EARTH SCIENCE

1. Introduction

In order to address its strategic goals and objectives (see Section I of the *ROSES Summary of Solicitation*), the Earth Science Division (ESD) of the Science Mission Directorate (SMD) acknowledges that there are important and highly relevant research topics and opportunities that cannot be anticipated in annual disciplinary and cross-disciplinary ROSES elements. In particular, it is usually not possible to solicit the following two types of activities:

- research on Earth system events or opportunities to collaborate that occur unpredictably as rare and valuable targets of opportunity and that require rapid provision of resources to enable immediate research activity to take advantage of that target of opportunity, and
- first-time investigations applying novel and innovative ideas to advance Earth remote sensing in a previously undeveloped area of remote sensing theory, technology utilization, or scientific application.

In the past, SMD has supported such research through unsolicited proposals and/or the former Innovative Research Program. Beginning with the issuance of this solicitation, SMD Earth Science will no longer consider such unsolicited proposals and instead is calling for them in response to this program element. ESD has not reserved any funds to dedicate to this solicitation, but anticipates that each of its individual programs will be able to consider meritorious proposals at approximately the same levels that unsolicited proposals were considered in the past – that is, only a very small number of proposals can be funded 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 Targets of Opportunity: Rapid Response to Earth System Events and Opportunities to Collaborate (Rapid Response)

This topic is focused on research proposals having great urgency for action 1) involving quick-response research on natural or anthropogenic extreme events, disasters, and/or similar unanticipated or unpredictable events, and 2) requiring a quick funding decision to take advantage of an opportunity for research collaboration that is only available for a short time. Examples of unanticipated or unpredictable events 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. Examples of opportunities for collaboration that can be short notice and time critical are major airborne campaigns sponsored by international partners that have unexpected capacity to host additional instruments or support NASA satellite calibration/validation activities, and single-

season field studies or ocean cruises sponsored by other agencies that with short notice offer collaborations that can be exploited to address NASA objectives.

The research activities proposed must require rapid, near-term data acquisition, field work, and/or other such research activities. 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 why the proposed research is of an urgent nature and why this ROSES program element is the only feasible mechanism to request NASA support for the proposed work. Requests submitted under this solicitation to take advantage of an opportunity for collaborative research must explain why a rapid response is essential.

Opportunities to collaborate that were known well in advance and could have been pursued through other ROSES program elements may not be proposed here because of a failure to engage in timely planning.

2.2 First-Time Development of Innovative, Novel Ideas in Earth Remote Sensing (Novel Earth Science)

This topic is intended to provide an open, systematic, competitive process for NASA's ESD to consider proposals to conduct highly novel scientific research that cannot be considered as relevant under any other NASA solicitations. ESD believes it is vital to its future that such proposals come forward and have an opportunity to be considered for funding. While research on any such novel topic area might not be considered a high priority for near-term investment in NASA ESD's mainstream program elements focused on accomplishing specific objectives, ESD also recognizes that such proposals offer the possibility for major scientific breakthroughs and brand-new remote sensing approaches. A vital research and analysis program must provide a mechanism for researchers with novel ideas to develop those ideas and to make their case as to why near-term investment is warranted and could lead to an important new capability or scientific application that will advance ESD goals and objectives.

This solicitation is focused on innovative, fundamental scientific research to advance Earth remote sensing. It does not include instrument or technology development, data and information systems research, or educational activities. This solicitation emphasizes research that is new and different, for example, the initial exploration of a novel idea or a first demonstration of new scientific use of remote sensing data or technology.

Where other ESD ROSES program elements specifically solicit for proposals in a particular topic area, and where such proposals would be considered responsive, proposals must be submitted in response to those solicitations instead of this one.

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-2009 – ROSES-2011, NASA Announcements of Opportunity, etc.).

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

4.1.1 *Proposals for Rapid Response*

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. 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. 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). If available in time, feasibility and cost estimates should be submitted as part of the budget justification; if not available in time, the budget justification should include a statement explaining what has been done and which facility managers have been contacted.

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 conduct an expedited peer review of each rapid response proposal, and, depending on the nature of the proposal and the time available before the opportunity to act is lost, the process may involve only internal review, external review, or a combination of the two.

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 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. 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 Earth Science*

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. It is anticipated that most such studies could be conducted in less than three years and at modest cost (e.g., ~$75-150K per year). It is the responsibility of the proposer to specify and justify the requested funding and duration of award. However, the requested duration should not exceed three years.

NASA will 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 benefitting ESD program. 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.

Potential proposers are strongly encouraged to contact the appropriate ESD Program Officer to investigate the availability of funds in that specific program for funding meritorious proposals. 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 midnight on March 31, 2013 **[Changed March 1, 2012]**
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	NNH12ZDA001N-RRNE
NASA point of contact concerning this program	Diane E. Wickland Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0245 E-mail: Diane.E.Wickland@nasa.gov

A.27 PRE-AEROSOL, CLOUDS, AND OCEAN ECOSYSTEM MISSION SCIENCE TEAM

NOTICE: On release of the ROSES 2012 Solicitation in mid February, the placeholder for Appendix A.27 PACE Science Team program element included a notice that it might be solicited in ROSES 2012. We regret to inform potential proposers that Appendix A.27 will not be solicited this year. [Changed April 10, 2012]

1. Scope of the Program

The Pre-Aerosol, Clouds, and ocean Ecosystem (PACE) mission is a strategic Climate Continuity mission and is included in NASA's new plan: *Responding to the Challenge of Climate and Environmental Change: NASA's Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space* (hereafter referred to as the "Climate Initiative") sponsored by NASA's Earth Science Division. The Climate Initiative can be found at http://science.nasa.gov/earth-science/. This plan contains an approach for implementation of the National Research Council's (NRC) Decadal Survey of Earth Science at NASA, NOAA, and USGS, entitled "Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond" (the NRC's Earth Science Decadal Survey, is available at http://www.nap.edu/catalog.php?record_id=11820).

PACE will be a polar-orbiting mission with an ocean color sensor and an aerosol-cloud polarimeter. The mission will be capable of performing radiometric and polarimetric ocean and atmosphere surveys, returning a range of geophysical data from which properties of the ocean and atmosphere can be produced to maintain a time series of critical climate and Earth system variables. The Pre-Aerosol, Clouds, and ocean Ecosystem (PACE) mission has multiple scientific goals, including making climate-quality global ocean color measurements, essential for understanding the carbon cycle and global ocean ecology, and how the ocean's role in global biogeochemical (carbon) cycling and ocean ecology both affects and is affected by climate change. Polarimetry measurements would provide extended data records on clouds and aerosols. The President's FY2012 budget request enables the development for launch in 2019 of these critical climate measurements. The PACE mission will extend key ocean biogeochemical and aerosol climate data records whose future was in jeopardy prior to the FY2012 budget request.

2. Science Team for the PACE Mission

The subject of this solicitation may be identified in an amendment during Spring 2012.

3. Programmatic Information

Questions or comments may be directed to the PACE Program Scientist at the address given below:

Paula Bontempi
Earth Science Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone: (202) 358-1508
E-mail: Paula.Bontempi@nasa.gov

A.28 SPACE ARCHAEOLOGY

NOTICE: The Space Archaeology Program will not be competed in ROSES-2012. Space Archaeology was competed in ROSES-2011 and it is expected that the next solicitation will occur in ROSES-2013.

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 spaceborne 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 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.

For more information on this program, contact:

Craig Dobson
Earth Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-0254
E-mail: craig.dobson@nasa.gov

A.29 AIRBORNE INSTRUMENT TECHNOLOGY TRANSITION

Amended on June 26, 2012. On release ROSES 2012 on February 14, 2012, the NASA Research Announcement included a draft version of Appendix A.29. This Amendment presents the final text of this appendix, which replaces the draft version in its entirety. Notices of Intent to propose are requested by July 23, 2012. Proposals are due on September 24, 2012.

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.

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 relevance to the goals and activities of NASA's Applied Science Program.[2] Examples of previous field campaigns can be found at the Airborne Science Website.[3]

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[1] http://airbornescience.nasa.gov/platforms/platforms.html
[2] http://appliedsciences.nasa.gov/
[3] http://airbornescience.nasa.gov/

The following documents identify the relevant missions and programs for this solicitation:

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. Program Requirements

Proposals submitted in response to this solicitation will be processed, reviewed, and selected according to the guidelines specified in the *NASA Guidebook for Proposers Responding to a NASA Research Announcement or Cooperative Agreement Notice* January 2012 edition (hereinafter called the *Guidebook for Proposers*).

2.1 Additional Solicitation Requirements

Proposals must provide a description of the existing instrument and a clear assessment of what it will take to make the instrument suitable for reliable and regular airborne operation. This means the instrument will perform under a wide variety of airborne-deployment scenarios, with high reliability, including in "campaign" mode in which multiple flights would be made over short duration periods, potentially from remote locations with limited time and resources available to make modifications and/or repairs between flights. Moreover, flights sometimes take place under challenging weather conditions (extreme cold, turbulence, etc.) and Airborne Instrument Technology Transition (AITT) instruments must withstand the rigor of regular airborne operations and should allow accommodation as part of multiinstrument payloads without interfering with other instrument systems.

Besides clearly stating its relevance to one or more of the Earth Science Focus Areas, the proposal's narrative must provide one or more scenarios for potential use of the instrument including objectives, location(s), duration, candidate platform(s), other synergistic instruments that could be constructively co-manifested; and, other information that illustrates how the proposed instrument operations would further NASA objectives.

NASA supports a data policy of open access to scientific data. Scientific advancement is generally enhanced by broad access to and use of scientific data. Therefore, proposers should specify how the instrument and its products would be made available for use by, or in concert with, a broad community of Principal Investigators (PI), and address any issues concerning data access.

All proposals must include a description of the process that will be followed to be in compliance with Chapter 2 of NPR 7900.3C[4] *Aircraft Operations Management, Airworthiness and Maintenance.*

2.2 Available Funding and Period of Performance

Yearly funding guidance is given in the "Summary of Key Information" (section 3) of this announcement. Funding for subsequent use, maintenance, repair, and/or upgrading of AITT graduates should be requested by proposing to future ROSES elements for research and analysis programs and/or calibration/validation activities. No funding is provided for such activities under this solicitation. Since it is expected that the AITT program element will support the full transition of airborne instruments into the regular research and analysis program(s), successor proposals to the AITT for those funded once are strongly discouraged unless there will have been significantly enhanced technical development to the underlying instrument concept in the period since completion of the AITT-funded work (e.g., through additional support under IIP or other technology development activities). Under no circumstances are "consecutive" proposals to AITT contemplated.

Proposals for two-year projects are strongly encouraged, but proposers may request up to a 30-month period. Proposals requesting more than 24 months (but not exceeding 30 months) should provide a strong rationale for the need and advantage gained by the additional project duration. In all cases, it is expected that at project conclusion the instrument will be complete and ready for campaign deployments.

2.3 Technical Reporting Requirements

The Earth Science Technology Office (ESTO) will provide assistance in managing performance of the awards made under this solicitation. Therefore, all status information, presentation materials, and reports deliverable for this solicitation shall be submitted through the ESTO web-based AITT-12 Award Administration e-Book (herein after called e-Books). Reporting submissions to e-Books shall be made in Microsoft PowerPoint (preferred), Adobe PDF (unlocked, searchable pdf files are required), Microsoft Word, or Microsoft Excel. User accounts for e-Books will be provided to the Principal Investigator (PI) upon award.

The following deliverables are required of awarded proposals:

- Initial plans and Reports;
- Quarterly Technical Reports;
- Interim Reviews, Annual Reviews, and a Final Review; and
- Final Report (a ~20 page narrative paper)

More information on these reporting requirements can be found at

http://esto.nasa.gov/AITT_reportingRequirements.html.

[4] http://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=7900&s=3C

In cases where Co-Investigators (Co-I), partnerships, or subcontract arrangements exist in a Project Team the submission of consolidated reports is the responsibility of the PI. The proposed budget should provide for these reporting requirements.

2.4 Proposal Content

Proposal style formats shall be in accordance with Section 2.2 of the *Guidebook for Proposers*. The "Scientific/Technical/Management Section" of the proposal shall be limited to 15 nonreduced, single-spaced typewritten pages. Scientific/Technical/Management Section write-ups that exceed this limit will be truncated at 15 pages prior to the Proposal's review.

For consistency of the evaluation process, proposals shall include the content described here (section 2.4.x) formatted in sections that follow the outline and titles used below. Failure to provide any of this material may be a cause for the proposal being judged as noncompliant and returned without further review.

2.4.1 Proposal Summary

The proposal summary is an abstract that provides an overview of the proposed investigation that is suitable for release to the public should the proposal be selected. The proposal summary should be concise, should not exceed 301 words in length, and should not contain any special characters or formatting. The proposal abstract shall discuss the:

- Relevant Earth Science Focus Area(s), *Climate Centric Architecture* mission(s) or other NASA mission(s);
- Proposed work and methodology; and,
- Proposed period of performance.

2.4.2 Scientific/Technical/Management Section

This section completely replaces Section 2.3.5 of the *Guidebook for Proposers*.

1. Relevance to Earth Science Measurements in the Reference Documents - Clearly state the relevance to one or more of the Earth Science Focus Areas and to NASA's Earth science missions. The proposal narrative must provide one or more scenarios for potential use of the instrument including objectives, location(s), duration, candidate platform, other synergistic instruments that could be constructively co-manifested, and other information that would illustrate how the proposed instrument would further NASA objectives. Also, describe possible benefits to future Earth science missions that can leverage the instrument's products. Finally, discuss any potential commercial benefits. Proposals that fail to include a relevancy scenario will be considered noncompliant and will be returned without review.

NASA supports a data policy of open access to scientific data. Scientific advancement is generally enhanced by broad access to and use of scientific data. Proposals should specify how the instrument would be made available for use by or in concert with other interested PIs and address associated issues of data access.

2. Description of Proposed Development - Describe the work to be performed. Include a description of the instrument, a description of its current status, and a clear assessment of what it will take to make it suitable for reliable, regular airborne use by research and analysis programs and/or satellite calibration/validation activities.

3. Aircraft Operations Maintenance Compliance **-** Include a description of the process that will be followed to comply with Chapter 2 of NPR 7900.3C.

4. Comparative Technology Assessment – Describe the anticipated advantages of the upgraded instrument 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). Review the current state of the art and relate it to the proposed work.

5. Research Management Plan – Provide a statement of work that concisely describes each task or 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 project activities and critical milestones. At least two milestones per twelve-month period must be defined.

Subcontracting portions of the project is acceptable and is the responsibility of the Principal Investigator and the sponsoring organization.

6. Personnel – Include a list of key personnel and identify experience related to the proposed activity. Proposers should be sure to demonstrate science, technology development, and instrument development skills on the team. The key personnel list is included in the overall page count and must include, as a minimum, the PI. Optionally, one-page resumes for Key Personnel may be supplied; these resumes are not included in the overall page count.

7. Facilities and Equipment – Describe significant procurements, facilities, and equipment required to complete the work. Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative.

8. Special Matters – Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal.

2.5 Proposal Evaluation

Proposals submitted to NASA in response to this solicitation will be evaluated with respect to the criteria specified below. These criteria supersede and replace the criteria specified in the *Guidebook for Proposers*.

Factor 1: Relevance to NASA's objectives includes the applicability of the proposed investigation to Earth Science Focus Area(s), Decadal Survey, Climate-Centric Architecture, and

other science measurements and technology needs and specifically includes the following factors:

- The degree to which the proposed investigation specifically supports the objectives of at least one of the Earth Science Focus Areas (see Appendix A.1 for a description of the Earth science Focus Areas
- The potential for the upgraded instrument to provide improved data products, or to reduce the risk; cost; size; or potential development time of Earth science airborne investigations.
- The degree to which the proposed investigation is relevant to one or more of the recommended Decadal Survey, Climate-Centric Architecture, or to other NASA missions identified in the Reference Documents.
- The degree to which the proposed investigation specifically supports the objectives of at least one of the Earth Science Focus Areas.

Factor 2: Intrinsic merit includes the following factors:

- Overall scientific or technical merit of the proposal and/or unique and innovative methods, approaches, concepts, or advanced capabilities offered by the proposal.
- The feasibility of the proposed technical effort for integration onto the proposed airborne platform(s) and the adequacy of proposed flight tests or demonstrations.
- Evaluation of the proposal against the state-of-the-art, including existing instruments and sources for collecting the data proposed from this instrument.
- Offeror's capabilities, related experience, facilities, techniques, or unique combination of these that are integral factors for achieving the proposal's objectives.
- 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 science, technology, and instrument integration skills.

Factor 3: Cost and programmatic realism specifically includes the following factors:

- Adequacy and realism of proposed milestones and associated success criteria.
- Realism and reasonableness of proposed costs.
- Use of sound and consistent management practices.
- 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.

3. Summary of Key Information

Expected program budget for new awards	~ $2.5M/year for first two years and ~ $1M for year 3
Number of awards anticipated	~ 4 to 7
Maximum duration of awards	30 months
Due date for Notice of Intent to propose (NOI)	July 23, 2012
Due date for proposals	September 24, 2012
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 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 *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 *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	NNH12ZDA001N-AITT
NASA point of contact concerning this program	Jared Entin Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0275 E-mail: Jared.K.Entin@nasa.gov

Technical points of contact concerning this program	For Airborne Science Program information: Randy Albertson NASA Dryden Flight Research Center P. O. Box 273 Edwards, CA 93523-0273 Telephone: (661) 276-7540 E-mail: Randal.T.Albertson@nasa.gov For Earth Science Technology information: Eduardo Torres-Martinez Code 407 Goddard Space Flight Center Greenbelt, MD 20771 Telephone: (301) 286-7166 E-Mail: Eduardo.Torres-Martinez-1@nasa.gov

A.30 EARTH SCIENCE U.S. PARTICIPATING INVESTIGATOR

March 30, 2012: Sections 1.2 and 2.2.1 of this call have been changed to clarify the types and phases of missions appropriate for this call and present the alternative opportunities available for investigations that don't fit the constraints of Appendix A.30.

1. Scope of Program

1.1 Background

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 Earth Science Research Program is designed to leverage NASA's unique capabilities in the context of related research carried out by other Federal agencies, especially that conducted as part of organized interagency activities (including those coordinated through the Committee on Environment and Natural Resources and Sustainability under the National Science and Technology Council), such as the U.S. Global Change Research Program, the U.S. Group on Earth Observations, the Climate Change Adaptation Task Force, the Ocean Policy Task Force, the EarthScope Program, and NASA-National Oceanic and Atmospheric Administration (NOAA) and NASA-United States Geological Survey (USGS) efforts to support the transition between research and operations.

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, available at http://www.nasa.gov/news/reports/). In particular, it addresses the more specific Science Outcomes (see the 2010 Science Plan for NASA's Science Mission Directorate (hereafter the NASA Science Plan), available at http://nasascience.nasa.gov/about-us/science-strategy/), which are to achieve:

- Progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition;
- Progress in enabling improved predictive capability for weather and extreme weather events;

- Progress in quantifying global land cover change and terrestrial and marine productivity and in improving carbon cycle and ecosystem models;
- Progress in quantifying the key reservoirs and fluxes in the global water cycle and in improving models of water cycle change and fresh water availability;
- Progress in understanding the role of oceans, atmosphere, and ice in the climate system and in improving predictive capability for its future evolution;
- Progress in characterizing and understanding Earth surface changes and variability of the Earth's gravitational and magnetic fields; and
- Progress in expanding and accelerating the realization of societal benefits from Earth system science.

The most recent comprehensive description of the research goals of NASA's Earth Science Research Program was in the 2003 Earth Science Enterprise Strategy at http://nasascience.nasa.gov/about-us/science-strategy. The most up-to-date description of the Earth Science Research Program may be found in Chapter 4 of the NASA Science Plan at http://nasascience.nasa.gov/about-us/science-strategy (click on link for "SMD Science Plan for 2010"). 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. 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). A 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.

In addressing these questions, NASA makes use of space-based, surface-based, airborne, and balloon-based measurements, as well as a broad suite of observations (both space-based and other) made by our interagency and international partners. Particular interest is given to having close connections with the satellite observations of international partners, especially as coordinated through the Committee on Earth Observation Satellites (http://www.ceos.org/) as well as other large international coordinating organizations, such as the World Meteorological Organization (http://www.wmo.int/pages/prog/sat/).

1.2 Science and Program Objectives

NASA solicits proposals for U.S. Participating Investigator (USPI) investigations **on a non-NASA space mission** that address the Earth Science Research Program objectives listed in the *NASA Science Plan*. This solicitation is for Earth science investigations that address the science questions listed in the *NASA Science Plan* and that contribute and facilitate access to foreign space agencies' assets. **[Clarified March 30, 2012]**

2. Programmatic Considerations

2.1 Proposal Opportunity Period and Schedule

The schedule that applies to this Earth Science USPI program element is given in Section 3.

2.2 Proposal Requirements and Constraints

2.2.1 *Type of Investigation*

A proposed investigation as a USPI on a non-NASA space mission may be 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, scientific analysis and/or research of the data returned, 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 some meaningful data analysis component, archiving of the set of data products generated by the USPI as part of his/her task, and the publication of science results in the peer reviewed literature. All aspects of the investigation through publication must be within the proposed cost.

Investigations requiring the provision of flight hardware are not solicited through this USPI solicitation.

A proposed investigation as a USPI on a non-NASA space mission may take any form that clearly and demonstrably enhances the scientific output of the mission, benefits the U.S. scientific community, and enables the U.S. Earth science community access to a highly valued scientific data set.

The proposed investigations can vary in duration, to include just the prime science mission phase, or to begin at the post confirmation development phase (e.g., for calibration analysis) through the prime mission operational phase, depending on the science requirements of the investigation. All investigations shall include one year for archiving of data products resulting from this effort following the conclusion of the prime mission phase. The emphasis of the investigations proposed should be on supporting the development and validation of Earth science data products that will be distributed promptly to the Earth science research community. **Involvement in the mission in the development phase is preferred, although proposals for missions that have recently launched (i.e., 2011 or beyond) are also appropriate for consideration.** Investigations focused on analysis and interpretation of the data products produced by this effort should be proposed separately through the annual ROSES call in response to an appropriate element**, e.g., Land Cover/Land Use Change (Appendix A.2), Ocean Biology and Biogeochemistry (Appendix A.3), Physical Oceanography (Appendix**

A.7), Cryospheric Science (Appendix A.12), or Atmospheric Composition: Modeling and Analysis (Appendix A.16). [Clarified March 30, 2012]

This program element solicits new investigations only. Proposals whose intent or purpose is to extend or directly supplement existing investigations already funded for approved space flight missions or other Earth Science Division research programs are not appropriate for this program element. 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 proposed research is distinct from their existing efforts.

2.2.2 *Cost Considerations*

For individual investigators, the cost for proposals should be between $125K and $150K per selected investigation per year through the prime science mission phase, plus one year for additional data archiving for the baseline scientific investigation. NASA plans to distribute $750K per year for this solicitation.

NASA reserves the right to make no selection if there are no proposals of appropriate merit.

2.2.3 *Duration of Award*

Proposals should be for the entire duration of the proposed investigation. This may be no more than through the prime science mission, plus one year for additional data archiving for the baseline scientific investigation. The budget justification in the body of the proposal should cover this entire period.

Awards will be for a maximum of five years. If the proposed investigation is for more than five years, then a continuation proposal may be submitted for a new award covering a period of up to five additional years. The progress and accomplishments of the initial five years of the investigation will be reviewed as part of the decision making process for the continuation award.

The budget for only the first five years of the investigation should be entered into the NSPIRES budget forms.

2.2.4 *Technical Requirements and Constraints*

In addition to the requirements given in ROSES, all proposed investigations must also demonstrate:

1. their formal relationship with the sponsoring agency's mission (e.g., selected participant, invited participant, or proposed participant);
2. the status of the mission within the sponsoring agency (i.e., Pre-Phase A, Phase A, Phase B, etc.), including the level of commitment that the sponsoring agency has made to complete development;
3. a description of the type and the characteristics of the data from this investigation, as well as any ancillary science data that will be archived as part of this investigation and a clear

statement of the data policy for the mission that documents the process and schedule by which the data will be made available to the Earth science community; and

4. a detailed explanation of how the U.S. Earth science community benefits from this participation.

2.3 Proposal Evaluation Factors

Proposers are reminded that the evaluation criteria for this solicitation are given in the *NASA Guidebook for Proposers* (see below for reference). These criteria are intrinsic merit, relevance to NASA's strategic goals and objectives, and cost realism and reasonableness. In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion "intrinsic merit" specifically includes the following factors:

- The benefits to the U.S. Earth science community from this investigation; and
- The demonstrated scientific merit that this investigation's archived data adds to the U.S. Earth science community.

2.4 Award Management

Awards will likely be executed directly from NASA Headquarters, although NASA reserves the right to implement them through a NASA Center (or the Jet Propulsion Laboratory) in order to facilitate coordination with related flight projects that the Center may be carrying out.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $750K
Number of new awards pending adequate proposals of merit	~5-6
Maximum duration of awards	Through the end of the Prime Mission plus one year for data analysis and archiving (see Section 2.2.3).
Due date for Notice of Intent	None requested
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 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 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	NNH12ZDA001N-ESUSPI
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A.31 INTERDISCIPLINARY RESEARCH IN EARTH SCIENCE

Amended December 13, 2012. This amendment releases final text for Appendix A.31. The draft text released with ROSES in February 2012 has been replaced entirely. Notices of intent are requested by March 1, 2013 and proposals are due by April 1, 2013.

1.0 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 five specific themes listed in this solicitation:

- 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 Climate 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. Overall, it responds to the directives on science and technology priorities

in the U.S. Government's Fiscal Year 2014 Budget (*http://www.whitehouse.gov/sites/default/files/m-12-15.pdf*), which states:

> "Particular emphasis should be given to research that advances understanding of vulnerabilities in human and biogeophysical systems and their relationships to climate extremes, thresholds, and tipping points."

2.0 Interdisciplinary Research Themes, Proposal Details, and Review information

The specific scientific topics and questions identified by the subelements below are the priorities for this solicitation. These topics and questions are the complete set of scientific research topics solicited by the IDS program, and no priority should be construed from their relative order below. 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 five specific subelements listed below.

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 these 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.

2.1 Subelement 1: Understanding Earth System Vulnerabilities to Climate Extremes

In recent years, severe flooding, drought, and extreme weather-related events have caused major impacts in regions with significant human populations, built-up infrastructure, and changing land uses. Human-dominated and extensively managed systems, as well as certain natural or less-intensively managed ecosystems, can be extremely vulnerable to the impacts of these events. Global change scenarios and projections suggest that such events may become more frequent and/or intense in the future as a direct result of changing climate, as well as changing human uses and management, or interactions among them. Fundamental research on the aforementioned

topics is needed to understand the integrated, full system impacts of and vulnerabilities to extreme climatic events; the actions humans take to recover from past events and/or mitigate the effects of future similar events; and how these responses interact and feed back to further affect integrated physical-biological-human Earth system functioning. Holistic, multidisciplinary studies of recent extreme events that could serve as models for study of the possible impacts of future more extreme and intense events are urgently needed. They will provide scientific information about likely future outcomes and the efficacy of options currently being considered for adaptation and mitigation that will be of significant value for society.

In ROSES-2009 (http://tinyurl.com/IDS2009) NASA solicited research on Integrated Earth System Responses to Extreme Disturbances and expressed particular interest in holistic studies addressing severe weather events (e.g., major hurricanes, devastating wind and ice storms), intense and extensive fires, “hundred-year” floods, and extreme drought. Seven studies were funded; four addressed fires and one each addressed extreme dust deposition, extreme heat in urban ecosystems, and landslide hazards. These studies are breaking new ground in the integrative study of how coupled natural-human systems respond to extreme events and global climate change, and it is highly desirable to encourage complementary research focused on other types of extreme events. Such studies should respond to new scientific and societal interests in the vulnerabilities of human and biogeophysical systems to climate extremes and in the potential for extreme events to move these ecosystems toward thresholds or tipping points.

Thus, integrated Earth System responses to extreme events are of continuing interest and increasing priority for NASA Earth Science and U.S. Global Change Research Program (USGCRP) research (see http://www.whitehouse.gov/sites/default/files/m-12-15.pdf). Such research will, in the words of the USGCRP priorities memo, "require integrated cross-sectoral, biogeophysical, and socioeconomic observations as well as improved simulation and modeling." Specific areas where progress is needed include "observations to detect trends in extremes, integration of observations into models, attribution of change to human or natural causes, integrated research on Earth and human systems; simulation and prediction at spatial and temporal scale conducive to decision making; and adaptation responses to changing frequency and intensity of extreme events."

NASA is well positioned to address this set of global change research priorities with its satellite data, airborne remote sensing data, extensive archives of data products, and modeling capabilities, in combination with its ability to support integrative Earth system research through the Interdisciplinary Science Program solicited here.

Extreme climatic events of interest for this solicitation are:

- Extreme drought and/or
- Extreme flooding, including that caused by extreme precipitation, storms, or sea level rise

Drought is an extended period of time when a region suffers a deficiency in its water supply, usually because it receives consistently below average precipitation. Droughts can be short and intense or they can persist for several years or decades. Drought can be characterized according to its biophysical manifestations as meteorological drought (period of time with less than average precipitation), agricultural drought (reduced crop production and impacts on range ecology), and

hydrological drought (water supply available in aquifers, lakes, streams, and other reservoirs falls below the statistical average). Drought can also be characterized in socioeconomic terms, as when demand for an economic good exceeds supply as a result of a shortfall in water supply. For the purposes of this solicitation, extreme drought is defined as a situation where all four of these characterizations (meteorological, agricultural, hydrological, and socioeconomic drought) apply and the impacts are major and widespread with severe consequences for humans and/or the environment. Economic, environmental, and social impacts of and responses to extreme drought are of interest. Time scales of interest for drought impacts and responses range from seasons to years to decades. Examples of drought-related phenomena and consequences that could be addressed under this solicitation include, but are not limited to: losses in agricultural productivity; reductions in water supplies; impacts to fish and wildlife; ecosystem susceptibility to fire, pests, and pathogens; land cover and land use change; soil erosion and deposition; alterations to the regional carbon balance and/or biogeochemical cycling; alterations in urban microclimate; feedbacks to regional and global climate; increases in the cost of food, water, and other ecosystem services; water use restrictions; and impacts to human livelihoods and industries.

Flooding is the inundation of a normally or periodically dry area caused by rising water in an existing waterway or water body. It may be caused by excessive precipitation or rapid snow and ice melt. In coastal areas, flooding also may be caused by storm surges and sea level rise. Often, extreme floods cause large economic damage to society and loss of life. Some flooding events cover large areas with the gradual inundation of the land surface being the major concern; others influence only small areas, where intensities can be extremely high and destruction of infrastructure and erosion may be the major problems. For the purposes of this solicitation, extreme floods are floods that far exceed the normal situation for a particular area (e.g., hundred-year flood) and have severe consequences for humans and/or the environment. Research on extreme precipitation and the storms that produce it, when tied to the floods that result, is of interest under this solicitation. Economic, environmental, and social impacts of and responses to extreme flooding are of interest. Time scales of interest for flooding impacts and responses range from months to seasons to years. Examples of flooding-related phenomena and consequences that could be addressed under this solicitation include, but are not limited to: losses in agricultural productivity; impacts to water supplies; impacts to fish and wildlife; soil erosion and deposition; alterations in regional biogeochemical cycling; loss of or damage to important buffering ecosystems (e.g., coastal marshes and riparian zones) damage to infrastructure and loss of property; the cost of clean-up and rebuilding; challenges for urban/regional planning; release/dispersion of environmental contaminants; development and spread of diseases; nutrient and sediment loading in coastal ecosystems, including sensitive systems like coral reefs; and impacts to human livelihoods and industries.

Flooding and drought are not unrelated phenomena. The climatic conditions that cause extreme drought in one region can cause storms, excessive precipitation, and flooding in other regions. The impacts of drought may affect the severity/impact of future flooding events, and vice versa. For example, excessive rainfall following a drought may yield greater runoff causing more extensive flooding and erosion because drought-impacted vegetation and dried-out soils are unable to absorb as much rainfall as could an ecosystem not impacted by drought. The resilience of human systems to withstand the impacts of an extreme event may be significantly affected by

the impacts of and their response to a prior extreme event. Research proposals that address the interactions between extreme drought and extreme flooding are also encouraged.

Extreme droughts and flooding events are the focus of this subelement because they can serve as models for the types of events that are expected to be more common in the future. NASA's interdisciplinary science objectives are not just to characterize and understand the impacts of these events, but also to gain new insights through observationally-driven studies into both the trends and trajectories of extreme events and their impacts and the societal options that may be available for responding to and/or mitigating their effects. A holistic, end-to-end approach might include the following types of research activities:

- Characterizing the nature, magnitude, and distinguishing attributes of the extreme event(s) being investigated;
- Assessing the full impact of the extreme event (near-term and long-term) and recovery processes in both natural (e.g., ecological, hydrological, biogeochemical, climatic, biogeographic) and human (e.g., agricultural, forestry, conservation, urban, socio-economic) elements of the system;
- Identifying trends in occurrences of these extremes in regions of high human and biogeophysical ecosystem vulnerability;
- Analyzing the ramifications of human actions to recover from and/or mitigate the impacts of extreme events (i.e., both efficacy and unintended consequences are of interest);
- Assessing the potential for thresholds, tipping points, and major feedbacks to Earth system functions and investigating how their behavior may be affected by multiple stressors in coupled human and biogeophysical ecosystems; and/or
- Incorporating findings into decision support systems used by relevant stakeholders.

In order to be fully responsive to this element, a proposal must offer a holistic approach that includes several of the above research activities. It may not be feasible to comprehensively address all aspects of Earth system vulnerability and response to extreme drought or flooding, but it is expected that each proposal will address how the proposed research fits into the larger context and takes into account components of the system that may only be assumed, prescribed, or in other ways less fully addressed. A key factor for evaluating relevance of the proposed research will be the degree to which the study offers to produce scientific understanding of how extreme drought or flooding affect the coupled, physical-biological-human Earth system through an observationally-driven approach.

Successful studies are expected to involve a multidisciplinary team of scientists with expertise appropriate to the topics and activities to be pursued. At a minimum, a broad mix of natural sciences disciplinary experts (e.g., ecologists, hydrologists, climate scientists, biogeochemists, atmospheric scientists) will be required. Studies that offer substantive scientific analysis of human system vulnerabilities and responses or offer to inform decision making will require social science (e.g., economists, human geographers, sociologists, political scientists) and/or applied science expertise within the team.

Successful studies will demonstrate regional- or global-scale relevance. Some human system vulnerabilities or management/mitigation options may require study at relatively small spatial scales. If this is the case, then it will be expected that local-scale analyses will be placed in an

appropriate regional context and the potential of extending the research approach or results to other places or situations will be explained in the proposal.

Research proposed in response to this subelement must make substantive use of remotely sensed data and data products. Preference will be given to proposals with strong ties to NASA data and data products. Many NASA satellites provide data relevant to the types of solicited studies; as does NASA airborne data (from existing archives or proposed for acquisition through this solicitation), which may be particularly useful for intensively managed systems (e.g., urban areas, agricultural systems, transportation networks, etc.).

2.2 Subelement 2: Impacts of Changing Polar Ice Cover

A major impact of climate change has been the changing amount and character of ice in the Earth's polar regions. In this subelement, NASA requests proposals that move beyond study of the ice itself and into the impacts of that change on other components of the Earth system.

Changes in the polar ice sheets are especially evident in the reduction of Arctic sea ice, the continued loss of mass from the Greenland ice sheet, and the collapse of Antarctic ice shelves, but also involve some expansion of Antarctic sea ice. Space-based remote sensing has provided critical insight into these changes, which take place in areas that are otherwise difficult to assess quantitatively because of their remote nature and inaccessibility. Significant advances have been made in quantifying the amount and character of ice cover and mass change during recent years with satellites and sensors, as well as data from Interferometric Synthetic Aperture Radar (InSAR) instruments and NASA's Operation IceBridge aircraft mission. These and the many other sensors in near-polar orbits also offer detailed yet underutilized observations of other components of the Earth system. Combined, they offer the possibility to connect the observed changes in ice with the Earth system.

In this subelement, NASA requests proposals that move beyond study of the ice itself and into the impacts of ice change on other components of the Earth system. Previous NASA support for such work resulted in major advances such as the massive phytoplankton bloom discovered under the Arctic sea ice during the 2011 NASA ICESCAPE cruise (http://www.sciencemag.org/content/336/6087/1408.abstract?sid=ea7cfcde-db2c-4ec5-b986-103694789477). This subelement, therefore, addresses a specific set of impacts of ice change on other components of the Earth system, as follows:

- Changes to physical and biological characteristics of the Arctic ocean due to diminished sea ice cover
- Atmospheric impacts of diminished Arctic sea ice cover, including impacts to North American and global weather patterns
- Oceanographic, atmospheric, and biological impacts of the growing Antarctic sea ice
- Any impacts from the 2012 surface melt event that covered the Greenland Ice Sheet

Potential areas of consideration include, but are not limited to:

- Implications of reduced sea ice cover for ocean productivity, ecology, and biodiversity in areas with greater spatial and temporal extent of open water, and the effects of such

changes on broader ocean biogeochemical properties, including studies that build on the results of the ICESCAPE cruises;

- Implications of reduced sea ice cover to ocean circulation, heat budget, salinity, ocean atmosphere exchange, and other fundamental ocean characteristics and processes;
- Impacts of diminished sea ice cover on the polar atmosphere, cloud cover, and weather, including determination and characterization of current impacts and future impacts, especially on North American precipitation patterns and their relationship to water resources;
- Characterization of the 2012 surface melt event in Greenland, including the impacts of the melt water on the surrounding ocean.

In addressing this subelement, proposals are expected to have the following characteristics:

- Make significant use of space-based remote sensing data - with preference given to NASA-produced data sets - and NASA modeling resources.
- Go beyond correlation of datasets and, wherever possible, use models to connect the changes in ice and the impact and gain new insight into the physical and biological processes and underlying causality
- The space-based data may be combined with data from airborne sensors and/or surface-based measurements and models of sufficient scope to address the coupled aspects of the problem.
- Proposals are expected to be interdisciplinary in scope and to specifically address the connections addressed in this subelement. Proposals that address only a single component (e.g., changes in ice cover or ice dynamics) will be considered unresponsive to this subelement.
- Proposed work should be at least at the regional scale to increase understanding of the global connections of the Earth system and should not be limited to specific, local areas.

Proposals that build on their new insights into Earth system science to address the societal impacts of their results (e.g., impacts of changes in Arctic sea ice cover on North American water resources) will also be considered, but should employ models and other methods to rigorously connect ice change to specific impacts

2.3 Subelement 3: The Water and Energy Cycle Impacts of Biomass Burning

Biomass burning continues to be recognized as one of the major drivers of global change. Much research has focused on the impact of biomass burning on the global carbon cycle. Recently, however, the importance of biomass burning has been recognized in a wide range of scientific disciplines. These areas include lasting changes to the land-atmosphere energy cycle, as well as the gas and aerosol particle composition of the troposphere, which affect regional and global weather and climate. Indeed, much is still unknown about how changes in the physical and biological features of the land surface due to burning impact energy, hydrological, and biogeochemical cycles.

In this subelement, NASA solicits proposals that address the impacts of biomass burning on regional and global weather and climate. More specifically, proposals to investigate:

- changes in the energy and water cycle caused by biomass burning within regions of burning,
- implications of these changes on the land-atmosphere energy cycle, and
- impact of biomass burning on gas and aerosol particle composition of the troposphere.

Potential areas of interest include, but are not limited to:

- Impacts of burning on the energy balance between the surface and the atmosphere (including, but not limited to, sensible heat flux, latent heat flux, surface radiative fluxes, and aerosol radiative forcing, such as that associated with biomass-burning generated smoke);
- Changed mechanical resistance (e.g., affecting momentum flux and eddy diffusivity) of the affected area to surface-level winds and subsequent boundary layer features;
- Transformations of regional gas and aerosol particle emissions characteristics after burning or land-cover change;
- Altered precipitation patterns and other meteorological features related to biomass burning emissions and/or surface changes;
- Changes in surface runoff associated with altered surface physical and biological characteristics;
- Interactions of land-use practices and atmospheric processes on the above; and
- The possible feedback between biomass burning induced alterations to the environment back onto the future prevalence of burning activity and subsequent impacts.

In addressing this element, proposers are expected to link several of the above topics through the significant use of space-based remote sensing data (with preference given to NASA-produced data sets). Space-based data may be used, together with data from airborne sensors, surface-based instruments, and/or models of sufficient scope to address the coupled aspects of the problem. Proposed projects are expected to include primarily data analysis and modeling. However, some modest additional airborne and/or surface-based measurements are allowed. All costs for these measurements (e.g., flight hour costs, travel, etc.) must be included in the proposal budget. Proposals are expected to be interdisciplinary in scope and to specifically address the connections addressed in this subelement. Proposals that address only a single component (e.g., changes in land cover due to biomass burning or changes in aerosol distributions associated with biomass burning, etc.) will be considered unresponsive to this subelement. Proposed investigations must be at least regional in scope and address extreme events and/or regional scale phenomena such as wide spread agricultural burning; projects may not be limited to specific local areas or particular local events.

2.4 Subelement 4: Impacts Of Population Growth on Watersheds and Coastal Ecology

One challenge facing Earth System Science is to understand and quantify the impacts and feedbacks of human influences on hydrology and downstream waterways on coastal zone biology and ecology. This collective system has important interplay with human population and economics, especially in regions of high population density (e.g., megacities). An important objective is to understand the specific effects of humans on hydrology and on ecological structure, composition (e.g., biodiversity), and function, following the biological impact(s) and feedback(s) of human populations to the coastal zone.

NASA seeks projects that combine the following four components: (1) satellite observations, (2) field observations, (3) ecological models, and (4) hydrological models to explore the dynamics of human population centers, watersheds, and coastal marine ecosystems in order to determine how centers of population density can affect a watershed from its upper reaches to the continental shelf. Projects should delineate the scientific basis for an ecosystem approach to the stewardship of our terrestrial and marine resources within terrestrial, hydrological, coastal ocean, and open ocean ecosystems. The goal of this is to provide an understanding of and predictive capability for ecosystem organization and management, especially accounting for the dual drivers of anthropogenic pressure and climate (both variability and change). Responsive teams will have the expertise in the required disciplinary areas for the aforementioned four components.

Topics of specific interest include, but are not limited to:

- Interdisciplinary approaches that investigate the impacts and feedbacks of human population centers on waterways and the resulting impacts on coastal ocean ecological structure, composition, and function (e.g., fisheries, invasive species) with a focus on utilizing or synthesizing existing satellite data sets, field observations, and models to achieve an integrated study of these regional systems through integrated processes;

- Interdisciplinary studies that assess and quantify the feedbacks of coastal ecosystem change resulting from human practices, decision-making, and regional economics.

Research proposed in response to this subelement must make substantive use of remotely sensed data and NASA-produced data products and address uncertainties and errors associated with each aspect of the study, observations, or model estimates employed.

2.5 Subelement 5: The Role of Permafrost in a Changing Climate

Climate change in the permafrost-dominated systems of northern latitudes (hereafter to be referred to as “permafrost systems”) is unfolding rapidly – the leading edge of global warming is widely recognized as occurring in this region. Yet the functioning of permafrost systems and their integrated response to changes in climate over time are still poorly understood. In the past few years we have learned that the recent rate of sea ice loss in the Arctic has far exceeded any climate model’s historical recreations. This is a powerful indicator of a significant discrepancy between the real-world manifestations of climate change and our understanding and conceptualization of it in models. The terrestrial analog of sea ice is permafrost. In the case of permafrost, we lack even a robust long-term data record of in-ground and surface temperatures to assess how good or poor our understanding and modeling are in capturing, let alone predicting, real-world changes. We know our models do not adequately capture permafrost, especially the spatial and temporal variability in permafrost systems. But as with sea ice, remote sensing may hold a key to unlocking some of the mystery about permafrost and its role in the Earth system (i.e., both in its changes as a result of climate forcing and its potential impact on further environmental change).

Permafrost systems are defined simply by the temperature of the soil (i.e., being at/below zero degrees Celsius for extended periods of time), but this belies a much more complicated system

with a host of properties and interactions that are pertinent to understanding system change and the possible implications of permafrost thawing and loss. Although the spatial coverage of permafrost has been estimated, there is little certainty about the amount of water and biogeochemical compounds that are captured in the soil and might be released should the permafrost thaw. Similarly, we have little understanding of how the landscape would be altered thereafter, including changes in topography, local hydrology, and ecosystems. Of particular concern, because of anticipated large feedbacks to the climate system, are releases of methane and carbon dioxide to the atmosphere associated with permafrost thawing, soil warming, increased burning, and changes in surface hydrological conditions and redox status.

In permafrost-dominated regions, the hydrological, ecological, biogeochemical, and climatological components of the system are tightly coupled and strongly interdependent. Permafrost systems and processes are heterogeneous and highly variable at very fine spatial and temporal scales (e.g., thermokarst processes and features, methane fluxes, surface inundation). This tight coupling and heterogeneity can yield nonlinear responses and emergent behaviors. Thresholds and potential tipping points, some with potential large feedbacks to the climate system, are major concerns. All of this poses significant challenges for understanding cross-scale interactions, in scaling up to larger regional or global scales, and for predictive modeling of changes and feedbacks in permafrost systems. It may be that our best chance for advancing understanding of permafrost systems lies in interdisciplinary approaches that bring together data and knowledge from a variety of disciplinary sources and of differing spatial/temporal scales to fill or bridge gaps and to better understand and characterize the interactions among components of the system. Therefore, this solicitation calls for synthesis through interdisciplinary research, integrating existing data, process understanding, and/or models to yield new scientific knowledge, as well as to assess what is missing and in need of further research in pursuit of integrated, whole-system understanding.

Results from the International Polar Year (IPY) and other recent and ongoing national and international investments in observations and research in permafrost systems provide new opportunities for evaluating permafrost system dynamics from a variety of functional perspectives and across spatial and temporal scales. A wide variety of data are available or becoming available from diverse field campaigns in which NASA researchers have participated over the years, such as the Arctic Research of the Composition of the Troposphere from Aircraft and Satellites (ARCTAS), Impacts of Climate change on the Eco-Systems and Chemistry of the Arctic Pacific Environment (ICESCAPE), Carbon in Arctic Reservoirs Vulnerability Experiment (CARVE), Airborne Microwave Observatory of Subcanopy and Subsurface (AirMOSS) mission, and earlier campaigns such as the Boreal Ecosystem-Atmosphere Study (BOREAS) and several Atmospheric Boundary Layer Experiment (ABLE) campaigns). Of course, data from past and current spaceborne sensors have much to offer, and new near-future satellite data and custom satellite data products (e.g., surface freeze-thaw, global wetlands, phenology, and snow cover from the NASA MEaSUREs program) will become available in the timeframe of the investigations to be selected under this solicitation. A substantial body of data has also been acquired by many non-NASA sources, such as the air composition flask samples coordinated by NOAA and observations from international satellite platforms.

Studies that offer to explore, combine, and/or integrate data from several of these sources (new

and old) to address key questions about changes in permafrost systems associated with climate change are of strong interest. It may now be possible to analyze multiple satellite data products and/or satellite time series records of recently thawed areas of permafrost to identify and document change in surface topography and alterations in local hydrology, surface energy balance and partitioning, and/or greenhouse gas fluxes. These changes in turn drive alterations in the physical structure, composition (e.g., biodiversity), and functioning of permafrost ecosystems with further ramifications for the climate system, as well as the sustainable management of these systems.

NASA seeks synthesizing, interdisciplinary research proposals to develop improved understanding of the effects of global change in permafrost systems. Topics of interest include, but are not limited to:

- Changes in the spatial and temporal domains and/or scales of key permafrost system processes and subsequent impacts on entire permafrost system functioning.
- Drivers of permafrost thaw, including connections to the Arctic ocean;
- Permafrost thaw and feedbacks to climate;
- Effects of permafrost thaw and thermokarst processes on topography, surface water, and landscape structure;
- Effects on permafrost changes on emissions of methane and carbon dioxide to the atmosphere;
- Effects of permafrost thaw and degradation on ecosystems and the distribution and abundance of species;
- Effects of permafrost changes on amount and characteristics of runoff to the coastal ocean and resultant effects in the coastal ocean; and
- Spatial and temporal dynamics of changes in local hydrology, surface energy balance and partitioning (including albedo and soil thermal properties), vegetation, and/or greenhouse gas fluxes.

To be fully responsive, proposed studies must:

- Address more than one disciplinary aspect of permafrost systems (i.e., hydrology, ecology, biogeochemistry, and climatology);
- Make critical use of multiple types and sources of remotely sensed information; the proposal must provide evidence that the remote sensing data to be used has appropriate time and space sampling and is of sufficient quality to address the scientific problem(s) to be investigated; and
- Place permafrost, and its possible changes, in the context of its receipt of outside forcing and response that in turn impacts the coupled hydrological-ecological-

biogeochemical-climatological components of the permafrost system. Proposals that only address one aspect, for example, past and/or future temperature, will not be considered of sufficient relevance;

Proposers are encouraged to consider offering investigations that:

- Yield guidance on the important factors to be considered when monitoring with remote sensing (and *in situ*) techniques;
- Yield guidance on how global and regional models may need to be enhanced to incorporate permafrost and its role in local, regional, and global environmental evolution;
- Offer key indicators that would be amenable to investigation by single-time short duration monitoring (e.g. field campaign style observation strategy); and/or
- Better inform programs such as the U.S. Global Change Research Program (USGCRP) and its National Climate Assessment (NCA) that are interested in better understanding tipping points in important environmental regimes, such as permafrost systems, and the societal implications of a changing climate.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $12M per year total, subdivided as follows: Subelements 2.1 and 2.2 $3M each; Subelements 2.3,2.4,and 2.5 $2M each.
Number of new awards pending adequate proposals of merit	~ 24
Maximum duration of awards	3 years
Due Date for Notice of Intent to Propose (NOI)	March 1, 2013
Due date for delivery of proposals	April 1, 2013
Planning date for start of investigation	November 1, 2013
Page length for the Science-Technical-Management section of proposal	15 pages; see also Chapter 2 of the *NASA Guidebook for Proposers*.
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 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	NNH12ZDA001N-IDS
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 IDS Program should be directed to the point of contact above. Questions about specific Subelements should be directed to those listed below, all of whom share the same mailing address, listed below.

Earth Science Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001

NAME	PROGRAM RESPONSIBILITY	TELEPHONE	E-MAIL
Diane Wickland	Subelement 1	(202) 358-0245	Diane.E.Wickland@nasa.gov
Thomas Wagner	Subelement 2	(202) 358-4682	Thomas.wagner@nasa.gov
Hal Maring	Subelement 3	(202) 358-1679	Hal.Maring@nasa.gov
Paula Bontempi	Subelement 4	(202) 358-1508	Paula.Bontempi@nasa.gov
Jared Entin	Subelement 5	(202) 358-0275	Jared.K.Entin@nasa.gov

A.32 REMOTE SENSING OF WATER QUALITY

1. Scope of Program

The Terrestrial Hydrology and Ocean Biology and Biogeochemistry Programs support this program element. Both programs support Presidential mandates and associated Federal research objectives, *e.g.*, the U.S. Climate Change Science Program (http://www.globalchange.gov) and its strategic plan, *The National Ocean Policy Draft Implementation Plan* (http://www.whitehouse.gov/administration/eop/oceans/implementationplan).

NASA's Ocean Biology and Biogeochemistry program focuses on describing, understanding, and predicting the biological 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.

NASA's Terrestrial Hydrology program focuses use of 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.

2. Description of Solicited Research

2.1 Overview

Water is the foundation of life on Earth. Water supply is a critical aspect of human society, enabling a wide range of recreational, social, and economic activities. Entrained in these activities is water quality: that the water to be used by human beings, society, ecosystems, etc., is of an appropriate characteristic or property for use. Threatening the aquatic environment are global climatic changes and episodic environmental events that have significant impacts on water quality and availability.

Anthropogenic factors can influence water availability and quality along with natural environmental processes. Electric power generation can raise the temperature of water in streams. Deforestation and loss of topsoil can affect the amount of sediment deposited in rivers and streams, which empty in to coastal regions, and eventually to the open ocean. Treatment of agricultural crops and changes in land cover/land use practices can also lead to chemical constituents being added to waters of rivers, lakes, and oceans. An increasing proportion of the global population lives within the coastal zones of all major continents, requiring increasing attention to agricultural, industrial, and other human-related effects on coastal water quality, and thus water quality impacts on ecological dynamics, ecosystem health, and biological diversity. Clearly linked to coastal water quality are the rivers and streams and materials contained in them that flow to the coasts, which are areas subject to environmental variability and change. Eventually coastal waters undergo exchange with open ocean waters. Satellite observations of rivers, streams, and coastal and global ocean, as well as terrestrial and atmospheric processes are needed to understand what Earth System processes impact water quality. It is critical to identify event-scale phenomena (e.g., hurricanes, their frequency and intensity) and their impact on water availability and quality.

As water supplies become more constrained and strained, it is important to have an ability to assess both water's quantity and quality in environmental stores. In accordance with Federal Government priorities and advice found in reports of the National Research Council concerning Earth science, satellite observations, and/or water sciences - NASA would like to further the use of remote sensing to assess the quality of water of inland aquatic environments (e.g., rivers and lakes) and coastal regions. NASA is also interested in proposals that address the impact to ecosystem dynamics and habitat health.

To improve remote sensing capability of water quality, NASA solicits projects that have either of the following objectives. While proposed "field campaigns" are acceptable, proposers are encouraged to keep their efforts small and targeted to the specific work proposed. NASA may seek to leverage all the funded investigations and investigators to help generate a plan for a larger field campaign that would collect a much larger set of environmental descriptors.

2.2 Techniques to improve remote sensing of water quality

2.2.1 *Atmospheric corrections*

Research is solicited that addresses the reduction of interference that the atmosphere generates by existing between a satellite (or airborne) remote sensing device and the water of lakes, rivers, and coastal ocean. By addressing this problem, improvements should be possible with current and near-future satellite observations. Research in this topic may also target optimal remote sensing design of future systems so as to maximize the return of the coupled sensor design and radiative transfer algorithm. If this goal is proposed, then explicit connection must be drawn between the approach and goals of the study and potential NASA satellites and or remote sensing approaches – as either defined by the Decadal Survey and/or NASA sponsored working groups.

2.2.2 *Shallow water*

Optically shallow water environments may also confound remote sensing algorithms because of the extra information that is sent to the sensor because of the signal reflected off the bottom.

2.3 Improving description of the link between optical and biogeochemical properties

Research is solicited to better understand how the biogeochemical properties of a water body may influence its optical properties. This work should also be put into context of how remote sensing can be used to make backward inferences, i.e. using the remotely sensed signal of optical properties to accurately describe the biogeochemical state of the water.

3. Programmatic Information

3.1 Funding

It is anticipated that approximately $1.0M per year may be available to support approximately five – six new investigations. Periods of performance of up to three years may be proposed.

Funds for this solicitation will be pending the Federal budget process for the Fiscal Year 2013. NASA expects to make selections in October 2012. Proposal start dates should be no earlier than January 1, 2013.

3.2 Evaluation of Proposals

Proposals will be evaluated according to the criteria specified in section C.2 of the *NASA Guidebook for Proposers*. In addition, the determination of a proposal's intrinsic merit shall also include the following factor:

- The significance of the scientific and/or water and coastal management uses of the specific water quality variable(s) to be made retrievable via remote sensing if the study is successful.

4. Summary of Key Information

Expected program budget for first year of new awards	~$1.0M
Number of new awards pending adequate proposals of merit	~5 - 6
Maximum duration of awards	3 years
Due date for Notice of Intent	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	No earlier than January 1, 2013
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 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 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	NNH12ZDA001N-WATER
NASA point of contact concerning this program	Jared K. Entin Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0275 E-mail: Jared.K.Entin@nasa.gov Paula Bontempi Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1508 E-mail: Paula.S.Bontempi@nasa.gov

A.33 GNSS REMOTE SENSING SCIENCE TEAM

NOTICE: The GNSS Remote Sensing Team will not be competed in ROSES-2012. The next GNSS Remote Sensing Team competition is tentatively scheduled to next solicit proposals in ROSES-2014.

1. Introduction

This announcement seeks innovative approaches to the development of Global Navigation Satellite System (GNSS) remote sensing techniques and algorithms to study the Earth's environment from the ionosphere to Earth's interior. The coming decade will see a dramatic change both in the number of GNSS satellite constellations and the expansion of signals and frequencies available to civil applications. The changes include the rejuvenation of GLONASS, new GPS III signals, the deployment of QZSS, GALILEO, COMPASS, and GAGAN satellite constellations are among the changes to be expected. These new signals structure will provide a dramatic new opportunity for remote sensing of the Earth system with relatively simple and robust space borne GNSS receivers.

The utilization of the GNSS signals for Earth observation has long been an objective of NASA's Earth Science Research Program. NASA, through the Jet Propulsion Laboratory (JPL), has invested significantly in the development of algorithms, ground networks, and high-performance Global Positioning System (GPS) receivers capable of ground-based, airborne, and space-based science applications. Remote sensing versions of the spaceborne receivers were placed aboard several satellites including:

- GPS/Met (http://genesis.jpl.nasa.gov/zope/GENESIS/Missions/GPSMET),
- Oersted (http://web.dmi.dk/fsweb/projects/oersted),
- SunSat (http://www.sunspace.co.za/),
- Fedsat (www.ips.gov.au/IPSHosted/NCRS/wars/wars2000/invited/fraser.pdf),
- CHAMP (http://op.gfz-potsdam.de/champ/),
- SAC-C (http://www.conae.gov.ar/satelites/sac-c.html),
- GRACE (http://www.csr.utexas.edu/grace/),
- C/NOFS (http://www.kirtland.af.mil/shared/media/document/AFD-070404-094.pdf), and
- COSMIC (http://www.cosmic.ucar.edu/about.html)

These spaceborne receivers perform various aspects of remote sensing, including precision orbit determination, gravity field measurement, ionospheric and atmospheric limb sounding or occultation, and bistatic reflection sounding. The National Research Council's Decadal Survey recommended that NOAA launch a new constellation of radio occultation satellites –COSMIC II- and recommended to NASA that it include GNSS radio occultation aboard its recommended Decadal Survey missions including CLARREO.

In response to the NRC's Decadal Survey recommendations, NASA in collaboration with NOAA, is developing a new space-borne TriG GNSS receiver to enable the use of these new GNSS signals and to insure operation beyond 2020 when the current codeless operation will no-longer be guaranteed by the US.

The advantages of the GNSS remote sensing approach include a precision multi-frequency signal structure, vibrant Government and commercial investment strategies for navigation, availability of commercial-off-the-shelf components, application of bistatic radar processing techniques, application of geodetic science algorithms, robust observing strategies aboard microsatellite constellations, and the low-cost, low power, low mass of the required instrumentation. Many of these advantages have been demonstrated in the GNSS remote sensing missions listed above.

NASA has also invested significantly in the ground infrastructure needed to provide precision orbits and accurate clock references for the various GPS remote sensing algorithms. JPL operates a global high data rate real time GPS reference network (GDGPS) as well as providing support to the International GNSS Service in the production of high accuracy precision orbits and clocks for the GPS constellation and other related GPS activities essential to the development of GPS remote sensing. NASA's GENESIS data system (http://genesis.jpl.nasa.gov/zope/GENESIS) provides multi-sensor analysis support that focuses upon the applications of GPS remote sensing. NASA's Crustal Dynamics Data Information System (http://cddis.gsfc.nasa.gov/) is one of three global IGS data systems for access to GPS data analysis products.

2. Programmatic Information

This announcement seeks innovative approaches to the development of GNSS remote sensing techniques and algorithms to study the Earth's environment from the ionosphere to Earth's interior in accord with NASA's strategic goals and objectives. In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion "relevance to NASA's strategic goals and objectives" specifically includes the following factor: The value to NASA strategic objectives in Earth Science including multidisciplinary science objectives in space geodesy, geohazards mitigation, gravity, and geomagnetic field dynamics as articulated in the Earth Surface and Interior's strategic plan entitled "Living on a Restless Planet" http://solidearth.jpl.nasa.gov. Proposals should focus upon the enhancement of our understanding of the dynamics of the Earth's surface, atmosphere, and ionosphere through the development of GNSS remote sensing techniques.

The dramatic increase in open GNSS signal structures will significantly increase measurement accuracy and utility. Current applications of GNSS remote sensing focus upon the utilization of refracted GNSS signals via occultation measurement schemes for the characterization of the atmosphere and ionosphere. We seek further development of occultation techniques with a focus upon the broader utilization of existing GNSS signals such as GPS (L1 C/A, L2C and L5) and the GLONASS frequency division multiple access (FDMA) signals in preparation for new spaceborne receiver capabilities. We also seek stronger emphasis on the use of reflected GNSS signals for the characterization of the Earth surface. The reception of GPS reflected signals on airborne and space-borne receivers has been demonstrated using both low and high incident angle reflections. This call seeks proposals to develop and demonstrate algorithms for the recovery surface characteristics including ocean and land elevation, soil moisture, wind stress etc. We also note that combined analysis of reflected and refracted signals have been suggested as a technique for atmospheric tomography, a technique of significant potential benefit to weather and climate studies.

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	~7
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	Not solicited this year.
Due date for proposals	Not solicited this year.
Planning date for start of investigation	Not solicited this year.
Page limit for the central Science-Technical-Management section of proposal	15 pp for SDT member proposals and 20 pp for SDT co-lead proposals; see also Chapter 2 of the *NASA Guidebook for Proposers*
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 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	Not solicited this year
Web site for submission of proposal via Grants.gov	Not solicited this year
Funding opportunity number for downloading an application package from Grants.gov	Not solicited this year
NASA point of contact concerning this program	John LaBrecque Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1373 E-mail: John.LaBrecque@nasa.gov

A.34 NASA Data for Operation and Assessment

NOTICE: On release of the ROSES 2012 Solicitation in mid February, the placeholder for Appendix A.36 NASA Data for Operation and Assessment included a notice that it might be solicited in ROSES 2012. We regret to inform potential proposers that Appendix A.36 will not be solicited this year. [Changed April 10, 2012]

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. Point of Contact for Further Information

Tsengdar Lee
Earth Science Division
Science Mission Directorate
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A.35 NEW (EARLY CAREER) INVESTIGATOR PROGRAM IN EARTH SCIENCE

NOTICE: The New Investigator Program (NIP) in Earth Science will not be competed in 2012. NIP is scheduled to next solicit proposals in ROSES-2013.

1. Scope of Program

1.1 Introduction

The New (Early Career) Investigator Program (NIP) in Earth Science is designed to encourage the integration of Earth system research and education/outreach by scientists and engineers at the early stage of their professional careers. The program encourages scientists and engineers at academic and/or research institutions to develop a broader sense of responsibility for effectively contributing to the improvement of science education and public science literacy; it provides an opportunity for the investigators to develop partnerships and/or enhance their skills, knowledge, and ability to communicate the excitement, challenge, methods, and results of their work to teachers, students, and the public. The Earth Science Division places particular emphasis on the investigators' ability to promote and increase the use of space-based remote sensing through the proposed research and education projects.

All NIP proposals must contain both a research element that addresses one of the topical areas identified below, as well as a significant program of education, communication, or outreach activities, including interdisciplinary endeavors (e.g., reaching out to practitioners in disciplines beyond physical sciences and engineering, such as social sciences). The research Focus Areas appropriate for the NIP are (see Appendix A.1 for a description of the Focus Areas and related high priority research topics):

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

The proposed research project must be led by a single, eligible (see further below for eligibility) Principal Investigator (PI); however, the research project itself may be collaborative. In particular, scientific, interdisciplinary, or educational collaborations with partners from institutions other than the submitting institution are encouraged. International collaborations are also encouraged, although funds from NASA may not be used to fund research carried out under the auspices of a non-U.S. institution. Access to unique research equipment, facilities, and/or geographical locations and the opportunity to collaborate with outstanding foreign researchers and educators may provide substantial benefits to the research proposed.

This early-career program, NIP in Earth Science, was established in 1996. The frequency of solicitation is currently every two years.

1.2 Eligibility

An 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, 2007).

Institutions and organizations are encouraged to submit proposals under the NIP on behalf of their outstanding new faculty members or employees who intend to develop academic careers involving research and education 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 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. Note that individuals who have interrupted their careers for substantive reasons, such as family leave or serious health problems, and are more than five years beyond the receipt of their Ph.D. degrees may also be eligible. In such cases, prior concurrence from the NASA Program Officer is encouraged before proposal submission. 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 awards have an approximate upper cap of $120K per year for a period of up to three years, subject to satisfactory progress and availability of funds.

2.2 Relationship of NIP to PECASE Awards

Each year, NASA selects its 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-year duration. The nominations are made by program officers at NASA Headquarters; NASA does not issue a special announcement for the PECASE award. The awardees of the New Investigator Program constitute a primary, but not the only, source of nominations for the PECASE by the Earth Science Division. If an NIP 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 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* (see further below), with the following exceptions:

- The Science/Technical/Management section of the proposal should contain a detailed statement of both the proposed Research, as well as the proposed Education/Outreach activities. In order to accommodate this expanded purview, the length of this section of the proposal is expanded to 20 single-spaced pages including figures and tables. All other characteristics of the proposal, as given in the *NASA Guidebook for Proposers,* are the same.

- The Education/Outreach Plan should be a section distinct from the Research Plan, describing the specific role played by the PI in the proposed educational or outreach activities.

  If education is proposed as the focus, the plan should address the educational objectives and evaluation criteria laid out in the NASA Education Strategic Coordination Framework, available at http://education.nasa.gov/about/strategy/. The focus of the plan should be a significant degree of participation by the PI in an existing, systemic, and sustainable educational system or framework, whereby scientific and technological research, as a *process* and a *product*, contributes to substantive teaching or learning by the targeted groups. The plan should address a real educational need and does *NOT* have to address all aspects of higher, elementary/secondary, and informal education, as outlined in the NASA Education Strategic Coordination Framework. The proposed PI is encouraged to incorporate her/his own talent, interest, and/or expertise, as well as the

need of their institutional environment. She/he is encouraged to partner with educators or educational organizations/entities whose primary mission is in education, science communication, or interpretation; she/he is also encouraged to partner with programs or entities focused on promoting the participation of underrepresented groups in Earth science. Stand-alone educational efforts and/or development of educational resources without a clear plan for evaluation and dissemination are not acceptable for the NIP. The PI is encouraged to exploit resources already developed in Earth science education (see http://science.nasa.gov/educators/nasa-reviewed-collection-dlese/). If course development is proposed for higher education, it should be highly innovative and be beyond the normal duties of the proposed PI.

If interdisciplinary endeavor is proposed as the focus, the plan should describe the nature of the collaboration and address the needs of the other discipline(s) the PI intends to reach. Note that the interdisciplinary endeavor for the Education/Outreach Plan refers to collaboration and involvement of expertise beyond the physical sciences or disciplines related to Earth system sciences, such as social sciences (communication, economics, political science, etc.)

Expenditures to enable the participation of the PI in an education, communication, or outreach endeavor may command up to 25% of the total proposed budget. Student support to graduate and/or undergraduate students and/or research assistants proposed under the Research Plan is considered as such, and will *NOT* accrue merit under the education/outreach evaluation.

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. Funds may be used for support by students (undergraduate or graduate) and/or postdoctoral fellows who are involved in the proposed research; for support of the education/outreach activities; 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, an NIP award may not include expenses for personnel or activities at collaborating institutions, nor salary costs for senior personnel, consultants, or subcontractors unless in support of the proposed education/outreach activities accompanied by appropriate justification.

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 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 exceptions:

- 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.
- For the Education/Outreach Plan, the specific factors for the evaluation criteria (Intrinsic Merit, Relevance to NASA's Objectives, Intrinsic Merit, and Cost) are described at http://science.nasa.gov/researchers/education-public-outreach/explanatory-guide-to-smd-e-po-evaluation-factors/ (see Version 3.1) and are based on the NASA Education Program Operation Principles.
- The evaluation of the two Plans will be combined for the final selection, and the Research Plan will carry approximately double the weight of the Education/Outreach Plan.

3. NASA Point of Contact concerning this Program

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A.36 EARTH SCIENCE APPLICATIONS: ECOLOGICAL FORECASTING FOR CONSERVATION AND NATURAL RESOURCE MANAGEMENT

Amended on December 21, 2012. This amendment presents the final text for this Appendix and replaces the prior text in its entirety. The entire document has been substantially revised and expanded. This program element will be implemented in two stages. One-year Stage 1 Feasibility Study Projects will be awarded with an option for a three-year Stage 2 Decision Support Project to be awarded at the end of Stage 1. Proposals to this solicitation are only for the Stage 1 portion of this enterprise. Notices of Intent are requested by February 14, 2013 and Proposals are due April 18, 2013.

1. Scope of Program

1.1 Overview

The NASA Earth Science Division Applied Sciences Program solicits proposals that develop and demonstrate innovative and practical applications of Earth observations, models, visualizations, and other Earth science and geospatial products in decision-support activities related to ecological forecasting for conservation and natural resource management.

This solicitation will initially support one-year feasibility studies of potential applications. NASA will then down-select and continue support for a subset of these applications in subsequent, three-year projects.[1] The three-year projects will continue to develop the application with and then transition the application to a public or private organization for sustained use in decision making and services to end-users.

Proposals to this solicitation are only for the Stage 1 portion of this enterprise. Plans for Stage 2 are also addressed in the text of this solicitation.

1.2 Applied Sciences Program Objectives

The Applied Sciences Program promotes the discovery and demonstration of innovative and practical uses of Earth observations for decision making. 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 within practitioners' decision-making, and transition the applications to sustained use by partner organizations. Projects are carried out in partnership with public and private organizations (e.g., government agencies, private companies, regional associations, international organizations, multinational financial institutions, tribal organizations, and not-for-profit organizations). The goal is for these partner

[1] In the past, the NASA Applied Sciences Program has called directly for multiyear applications-development projects, which were referred to colloquially as "Decisions" solicitations or projects. The reader should NOT assume that past descriptions of "Decisions" solicitations are valid for this solicitation. Please read this solicitation thoroughly.

organizations to achieve sustained use of and benefits from the Earth observations. For more information visit the Applied Sciences Program website at http://AppliedSciences.NASA.gov/.

For the purposes of this solicitation, the Program considers "Earth observations" to include a broad range of products and capabilities: Earth-observing satellite measurements from NASA on-orbit and planned satellites, as well as from foreign, commercial, and other U.S. Government satellites (the use of other satellite products is welcome though proposals should include specific NASA satellite products in the mix of data products proposed); outputs and predictive capabilities from models associated with NASA products; algorithms; visualizations; and other geospatial products.

The Applied Sciences Program is organized around Applications themes and Capacity Building elements. The Applications themes are currently focused on four of the nine Societal Benefit Areas of the interagency U.S. Group on Earth Observations (USGEO): Health (including Air Quality), Disasters, Ecological Forecasting, and Water Resources.[2] The Program includes climate-related influences and impacts within each of these themes. The Capacity Building elements focus on foreign and domestic activities to build skills and capabilities in uses of Earth observations, including international and economic development.

This solicitation is for applied projects focused specifically on the integration of Earth observations and related products into decision-making activities. Proposals that aim to conduct only fundamental Earth science research will be considered noncompliant. For research pursuits, the reader is referred to other Earth Science appendices in the ROSES solicitation.

2. Scope of Ecological Forecasting Program Element

The Ecological Forecasting program element of the Applied Sciences Program supports the integration of Earth observations and associated models to enable better conservation and more sustainable natural resource management through the development, improvement, and application of predictive tools, with associated uncertainties, for assessing alternative approaches and designing effective management strategies. The program element applies current scientific understanding and modeling capabilities of how ecosystems and their components (e.g., species, genes) are changing and likely to change over time. The program element focuses on the areas of conservation biology, natural resource management, and sustainable development.

3. Scope of Solicitation

3.1 Context: The Needs

Ecological forecasting applications require the integration of both observations and modeling. This integration can improve predictive tools used in decision making activities for assessing scenarios, analyzing options, and designing effective management strategies.

[2] The nine USGEO SBAs are: Agriculture, Climate, Disasters, Ecological Forecasting, Energy, Health, Oceans, Water Resources, and Weather.

Satellite observations provide a synoptic view of the patterns of many ecosystems and their components, along with vital information on a number of the processes driving ecological change. At times, satellite observations alone may be insufficient to capture the full range of patterns and processes necessary for the whole ecosystem understanding required to make the ecological forecasts sought by managers. *In situ* observations, especially biological observations at finer spatial scales, can complete the full suite of observations essential to initiate ecological forecasting models and provide managers with useful outputs from these models in their decision analysis. So, if they are to address the requirements for various applications, NASA ecological forecasting projects must integrate NASA Earth observations with *in situ* biological observations of ecosystems, their species, and even their genetic components. These important *in situ* observations can frequently be a limiting factor in assembling observation and modeling-based frameworks for ecological forecasting applications. Consistent time series of both biological and environmental observations are critical needs for addressing management requirements for ecological forecasting tools.

One means of enhancing *in situ* biological observations for ecological forecasting is to harness the capabilities of numerous amateur observers who are already making observations of the natural world around them. The rise of technologies for collecting timestamped and georeferenced images and sound recordings (i.e., observations) and the concomitant development of Internet-based tools to interpret, organize, and share these observations promotes crowdsourcing of *in situ* biological observations that can then be brought to bear with satellite imagery for ecological forecasting.

Along with more observations, the development of predictive tools for ecological forecasting applications also requires modeling. A major challenge for the modeling component of ecological forecasting is that generating forecasts usually necessitates linking different types of models to get to ecological outcomes. For example, a manager might want to understand the impacts of changing temperatures and precipitation patterns on the habitat suitability for a species of concern (e.g., its distribution and abundance). This might be a threatened species or perhaps an invasive species, both subject to management. Alternately, another user might be interested in determining the impacts of human actions on a nearby reserve and need to know both the likelihood of the actions in question, as well as their impact on the living systems of the reserve. Addressing needs like these and a myriad others depends upon our ability to link and sometimes couple different types of models, e.g.: physical climate models, habitat models, and socioeconomic models. Thus, ecological forecasting applications drive a need for improved model interoperability, and improved interoperability can enhance the robustness of the decision analysis and management strategies.

3.2 Topic Solicited

To address these applications needs, this solicitation seeks feasibility proposals for Ecological Forecasting projects that improve conservation and/or natural resource management in terrestrial, freshwater, and marine ecosystems.

Proposals must include the following elements:

- Products from Earth observations, as described in Section 1.2 above

- Biological observations of ecosystems, species, and/or genetic components derived, at least in part, from a crowdsourcing initiative(s)

- Ecological models (e.g., physiological and/or niche-based distribution models, population/abundance models, spatially-explicit individual-based models) and another type of model (e.g., climate, weather, socioeconomic, hydrological, financial, land use, etc.) coming together in a framework that enables model interoperability

Applicants should propose concepts that will:

- Enhance the performance of *existing* decision-making activities through the use and integration of the three elements listed above (the decision making activity(-ies) must be clearly defined, the practitioners clearly identified, and the transition of the application to the user community must be possible within four years); or

- Develop new capabilities for decision-making applications through the use and integration of the three elements listed above (the need for the decision making application must be clearly defined, the practitioners clearly identified, and the transition of the application to the user community must be possible within four years), these capabilities may include (but are by no means limited to) the generation of apps for the delivery of applications information or the engagement of a wider community in applications activities.

Proposals must also include significant participation in the project from its conception by representatives of the partner (i.e., user or end-user) organization(s) that would ultimately host the ecological forecasting products or outputs developed through the life of the project.

The solicitation allows projects at any level – multinational, national, regional, tribal, U.S. states, and substate (e.g., county, local). However, proposals at U.S. state and substate levels must include elements to enable and deliver impact beyond that specific, limited location so that project results accrue broadly. Proposal teams wishing to work internationally must involve an established public or private organization with an international mandate (e.g., a U.S. Government organization with a foreign-service mandate and appropriation, nongovernmental organization, international financial institution, or philanthropic foundation). Proposals involving international participants should also follow the guidance in Subsection 1.6.1 of the *NASA Guidebook for Proposers* on "Proposals Involving Non-U.S. Organizations." The Program allows and strongly encourages private sector companies (and teams of companies) to submit proposals and/or be involved in project teams.

3.3 Scope and Stages of Projects

The solicitation will initially support feasibility study projects of potential applications. NASA will select and continue support for a subset of these projects to develop and transition their

applications fully. The shorthand name for this two-stage approach is Feasibility-to-Decision-Support projects.

The objective of the two-stage approach is to identify, prioritize, and implement high-reward applications ideas with committed partners. Initial awards are one year in duration (Stage 1-Feasibility Study Project). *Based on an evaluation at the end of year one, the grantee MAY be selected to continue work for up to an additional three years (Stage 2-Decision Support Project).* An assessment of Stage 1 results, partner commitment, and in-person presentations will be used to assess Stage 2 award continuations.

3.3.1 Stage 1: Feasibility Study Project

This stage of the solicitation is specifically for studies to develop and test preliminary ideas for applications of Earth observations to the decision-making activity. In this stage, projects will test, refine, and demonstrate the feasibility of the approach. Projects will determine the potential value of the application to the partner organizations. Projects will scope efforts for the in depth application development and transition phase (i.e., Stage 2) if the application is to be adopted and operated by the partner organization. The first stage also allows the project team to characterize the decision-making activity in depth to establish a baseline performance level and fully engage the partner organization(s).

By the end of Stage 1 the project should, at a minimum:

- Describe comprehensively the specific conservation and/or natural resource management challenge(s) and its importance;
- Describe the decision-making activity and actions, including reasons to improve the decision-making (or create the new decision support capability);
- Articulate and quantify the baseline performance of the preexisting decision-making activity;
- Assess/substantiate the potential impact of applying Earth observations products to support the conservation and/or natural resource management challenge(s) (assuming the feasibility proves positive);
- Deepen the partnership with the partner organization(s), which is able and willing to commit resources to the further development of the project's product(s);
- Establish a plan to implement the identified, feasible improvements to the conservation and/or natural resource management decision-making activity;
- (And this is the most important!) Determine and state the feasibility of the proposed application(s).

Section 5.3 provides guidance and specific information to include in the Stage 1-Feasibility Study proposal. Section 5.4 provides the Evaluation Criteria used to evaluate the Stage 1 proposals to this solicitation. Section 5.5 provides the reporting requirements for Stage 1. Section 5.6 provides the general criteria used for selection of Stage 2.

3.3.2 Stage 2: Decision Support Project

For those projects selected to continue, this stage of the award will pursue implementation of the application and enhancements to the decision-making activity and actions. The objective of Stage 2 is to develop the application, address implementation issues, transition the application into sustained use by the partner organization(s), and document and quantify the improved performance.

At the initiation of Stage 2, continuing teams will develop a thorough plan for the project implementation phase, including key project milestones. The Program will articulate the details of a full Stage 2 plan following determination of which projects will continue.

3.3.3 Partner Organization Involvement

Commitment from end-users and practitioners is critical to the eventual success of the project and the transition and adoption of its products for sustained use. Stage 1 Feasibility Study Projects need to involve end-users and practitioners at the onset of the project and to the fullest extent possible, particularly to describe the conservation and/or natural resource management challenge(s) and decision-making improvements necessary. The project team must show a clear path for further developing the partnerships and opportunities for transfer throughout the course of the project. The organizations that will ultimately adopt the application in their decision-making activities should demonstrate a strong interest and commitment and they must be involved in both Stages 1 and 2. As the application matures and the likelihood of success increases, the commitment of the partner organization is expected to grow, including resource commitments to incorporate and maintain the use of Earth observations in their decision-making activities.

For example, this table is a notional transition of resource responsibility to the partner.

Project	Stage	Activity	NASA Share	Partner Share
Stage 1 Year 1	Feasibility	Prove out application potential	100%	Optional
Stage 2 Year 2	Decision Support	Develop application	~80-85%	~15-20%
Stage 2 Year 3	Decision Support	Continue development	~60-70%	~30-40%

Stage 2 Year 4	Decision Support	Complete application and transition	~30-40%	~60-70%
Subsequent Years	Following the Stage-2 project phase, the partner organization(s) is responsible for the operational costs to run its decision support system using the Earth observations.[3] If additional activities are needed to assist in the sustained use of the Earth observations, NASA will support additional efforts with in-kind support, as possible. NASA will continue to provide appropriate Earth observations through the NASA data centers for use by the partner organization(s), as possible.			

The final project year should include transition activities and an end-of-project event to announce results.

3.4 Specific Suggestions and Considerations

The Applied Sciences Program strongly encourages projects to use an array of Earth observations and Earth science resources. The Program encourages project teams to consider and use products from recently-launched NASA missions, as well as simulated products from upcoming, planned missions such as SMAP and GPM. Proposals can include data products from non-NASA satellites, including foreign and commercial satellites, if used in conjunction with some NASA observations.

The Program strongly encourages multiorganizational, multidisciplinary, and multisectoral teams. Projects are strongly encouraged to have team members familiar with conservation and/or natural resource management or policymaking activities and the needs of end-users in these areas. The Program encourages early interaction with personnel knowledgeable of NASA Earth science, models, and sensors (e.g., NASA science team and instrument scientists) to understand capabilities and limitations of these NASA tools.

Project teams might consider having the Principal Investigator (PI) be someone who is very familiar with the needs of the practitioners and decision-making organization(s).

Projects should engage and involve existing agency, state, and intergovernmental structures already in place addressing conservation and/or natural resource management to determine priority, tractable topics to address. Project teams should provide statements from the practitioners describing the problem and how the Earth observations can be included in the decision-making activity.

[3] The ongoing costs to incorporate and maintain the application of the Earth observations in the decision-making activities will likely be much less than the costs to develop, test, and transition the application.

4. Program Information

Total Amount of NASA Funding (FY 2013-2016)	$8M total (Stage 1: $2M; Stage 2: $6M or $2M per Year for 3 Years)
Anticipated Number of Stage 1 Awards	10 to 20 projects
Expected Funding Range of Stage 1 Awards per project	$100K to $200K
Period of Performance (Stage 1)	1 Year
Contributions from Partner Organizations (Stage 1)	While strongly encouraged, partner funding does not count toward funding level guidelines.
Anticipated Number of Stage 2 Awards	5 to 10 projects
Expected Funding Range of Stage 2 Awards per project	$200K to $400K (per annum funding scenarios depend on partnerships/cost sharing levels; per section 3.3.3, Stage 2 projects expect resource contributions from partners)
Period of Performance (Stage 2)	3 Years
Contributions from Partner Organizations (Stage 2)	Transition plan with resource commitments from partner organizations is expected

5. Alterations and Modifications to the *Summary of Solicitation* for ROSES 2012

The following information provides, for this call, alterations and modifications to some of the rules in the *Summary of Solicitation* of this NRA. The information below supersedes direction provided in the respective sections of the *Summary of Solicitation*. Projects involving private sector organizations and/or proprietary products and services are strongly encouraged to read NASA guidelines on cooperative agreements.

5.1 Award Period of Performance: Changes to Section II(c) of the *Summary of Solicitation*

The period of performance for a Stage 1-Feasibility Study Projects is one year. A progress review will be held in compliance with the *NASA Guidebook for Proposers* and *NASA Grants and Cooperative Agreement Handbook* (14 CFR 1260). Proposals to this A.36 solicitation must define clear, measurable milestones to be achieved in order to warrant consideration and continuation (to a Stage 2-Decision Support Project) of the award for no more than 36 additional months. Stage 1 awards DO NOT guarantee approval of a Stage 2 award continuation.

5.2 Cost Sharing or Matching: Changes to Section III(d) of the *Summary of Solicitation*

Cost-sharing and partner resource commitments for Stage 1-Feasibility Study Project proposals are encouraged, but optional. Cost-sharing and partner resource commitments for Stage 2 project continuations are required. While the solicitation accepts in-kind contributions during the course of the project as cost sharing, financial contributions are preferred, especially in Stage 2. Relevant past work, prior results, or previous support and accomplishments can be described, but

the Program does not consider these as cost sharing or in-kind contributions for proposals to this solicitation.

5.3 Proposal Format and Contents: Changes to Subsection 2.3 of the *NASA Guidebook for Proposers*

Proposals are for Stage 1-Feasibility Study Projects only. Proposals should provide sufficient detail to allow reviewers to assess viability and potential for success. Proposals should adhere to the following page guidelines and order. Content descriptions, if specified below, modify Section 2.3 of the *NASA Guidebook for Proposers*.

Proposal Cover Page..... As found on NSPIRES site
..... (includes budget summary)
Proposal Summary.....300 words (on cover page)
Table of Contents..... 1 page
Decision-Making Activity ..... 1 page
Earth Observations..... 1 page
Science-Technical (including figures/tables) .....10 pages
- Figures and Tables (as appropriate; integrated into text if possible)
Feasibility Criteria ..... ½ page
Anticipated Results/Improvements.....½ - 1 page
Project Management .....½ - 1 page
Schedule with Milestones for Stage 1-Feasibility ..... 1 page
Letters from End-User Organizations..... one-page letters
Budget Justification: Narrative and Details..... as needed
Facilities and Equipment (if applicable)..... 1 page
Resume/Curriculum Vitae: Principal Investigator(s)……..... 2 pages
Each Co-Investigator ..... 1 page
Current/Pending Support ..... as needed
References and citations ..... as needed

Proposal Summary

As a summary, this section should briefly describe the project concept. This section should state why the project should be done and how the project relates to the topics identified in Section 3.2 of this appendix. The section must include and briefly state the proposition to be tested in the Feasibility Study Project of the application.

Decision-Making Activity

This section explicitly identifies and describes the decision-making activity/action to be addressed, created, and/or enhanced in the project. The description should describe the management, business, policy topic, or other issue that it serves, including any quantitative information regarding its use. This section must identify and describe the partner/end-user organization(s) and their responsibility and/or mandate to address the topic/issue. This section must provide statement(s) from the practitioner(s) describing the conservation and/or natural resource management challenge and the need and opportunity to improve the decision-making activity.

Earth Observations

This section identifies and describes the Earth observations, derived products and/or models (see Section 1.2 of this appendix) that the proposal seeks to apply to improve the decision-making activity. This section should include any non-NASA data sets that are expected to play an important role in the application.

Science and Technical

As the main body of the proposal, this section should cover the following material:

- How the project responds and relates to the priority topic identified in Section 3.2;
- Application of the Earth observations to the decision-making activity, including rationale;
- The proposition to be tested or addressed in the Feasibility Study Project of the application;
- Methodology to be employed in the application, including discussion of the innovative aspects;
- Approach to assess the feasibility of the application, including technical, scientific, and management aspects;
- Estimate of the Applications Readiness Level (ARL, per Section 6 of this appendix) of the application, including any expected improvements from beginning to end of Stage 1;
- Challenges and risks affecting project success (technical, policy, operations, management, etc.) and the approach to address the challenges and risks; and
- Relevant tables/figures that demonstrate key points of the proposal.

Feasibility Criteria

This section states and describes the measures (both quantitative and qualitative) the team will use to assess and judge the feasibility of the application.

Anticipated Results/Improvements

This section describes the expected results and improvements to the decision-making activity from the application, should the feasibility study prove positive.

Project Management

This section should articulate the management approach and structure; plan of work; partnership arrangements; and the expected contribution, roles, and responsibilities of the team members. Project schedule and milestones must be included. Note: Meetings (number of, frequency of, etc.) do not qualify as project management milestones.

Letters of Support from End-User Organizations (optional)

This section may include up to four, one-page letters from the end-user organizations that will benefit from the proposed project. The letters may include input from the community and beneficiaries served by the end-user organizations. All letters must be addressed to the PI and included in the proposal.

5.4 Evaluation Criteria: Subfactors for Subsection VI(a) of the Summary of Solicitation and Subsection C.2 of the *NASA Guidebook for Proposers*

In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion "relevance to NASA's strategic goals and objectives" specifically includes the following factors:

- Intent and ability to demonstrate the applicability of Earth observations to address a topic of importance;
- Intent and ability to determine the utility of Earth observations for potentially substantive improvements to a conservation and/or natural resource management challenge(s) and decision-making activities;
- Cross-cutting nature of the project; and,
- Potential impact of the project (given its level of risk).

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 and test the feasibility of the proposed concept;
- Approach, methodology, and ability to apply Earth observations and related products;
- Ability to characterize the decision-making activities and needs for improvement; and,
- Quality of teaming across appropriate sectors and areas of expertise and the involvement of the end-user organization(s) in the project.

In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion "cost" specifically includes the following factors:

- Overall approach to manage the project and achieve stated objectives, and
- Ability and appropriate levels of effort to cost-effectively meet the identified Stage 1 needs.

Cost sharing is not part of the Stage 1-Feasibility Study Project proposal evaluation criteria. At the time of project selection, when deciding between proposals of otherwise equal merit, NASA will consider the extent to which the proposed project includes funds or in-kind contributions from non-Federal sources and Federal agencies, consistent with Section 5.2 of this appendix and Section III(d) of the *Summary of Solicitation.*

5.5 Award Reporting Requirements: Consistent with Subsection VII(c) of *the Summary of Solicitation*

Each awarded project will be responsible for timely maintenance (via an on-line system) of project information, status updates, highlights, and milestone achievements. NASA will coordinate with each PI at award to provide the necessary information for the on-line system.

The following reports will be required of awarded proposals. In cases where teams of organizations or subcontracts 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.

Stage 1-Feasibility Study Projects will have a Progress Report due at six-months and a Final Report due no later than twelve months after the project start date.

Progress Report: The progress report involve two items. One item is a brief (one page), written summary of the progress in the project to date; it should identify key milestones (met or upcoming) and highlight changes. The second item is a one-page project "quad-chart" (format provided at award) with Purpose and Objectives, Approach, a Figure, and Key Milestones and ARL; quad charts are updated as needed.

Final Report: The Final Report summarizes the feasibility study and clearly, explicitly states the conclusions of the study. Part 1 of this report should articulate the conservation and natural resource management challenge(s) and decision-making activity(-ies), application of Earth observations, proposition tested in the study, starting and ending ARLs, and results of the study. 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 for a Stage 2 award, Part 2 of the report should provide a *preliminary* plan for Stage 2 activities. Part 2 should articulate the approach to implement the application, the baseline performance of the decision-making activity, potential impact of the application, the composition of the Stage 2 team, estimated cost, preliminary transition approach, key milestones and final ARL, and key challenges to address. Please note that after selection of Stage 2 awards, project teams will revise their preliminary plan and develop a formal project plan and budget for the implementation phase.

The Applied Sciences Program will hold in-person presentations for consideration of Stage 2 awards. Project teams should budget for a two-day trip to the Washington, DC metropolitan area.

For Stage 2-Decision Support Projects, the Program will articulate reporting requirements upon continuation award.

5.6 Evaluation Criteria for Selection of Stage 2 Proposals

The Applied Sciences Program will determine and award Stage 2-Decision Support project continuations and budgets upon review of Stage 1 results. The assessment will include information in the Progress and Final Reports (including Preliminary Plan), Stage 1-Feasibility Study Project results, partner commitment, and in-person presentations.

The Program will include the following factors in its determination of projects to continue:

- Applicability of Earth observations to address the conservation and/or natural resource management topic
- Measurable, potential impact to decision-making activity
- Partner interest, involvement, and commitment
- Viability of necessary science and technology
- PI and team expertise, influence, and experience
- Quality of preliminary Stage 2 Plan, including a transition approach with clear objectives to develop and transfer the application into sustained use
- Viability of partnership agreements and financial plan

6. Application Readiness Levels

The Applied Sciences Program developed a nine-step Applications Readiness Level (ARL) index to track the development of applications and integration of Earth observations into partner organizations' decision-making 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 to the technology-based TRL, the operational decision-making activity of the practitioner organization is the applications analog to space.

The ARL reflects three main tiers in applications 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' systems and transition.

The following are the nine levels of the ARL:
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 decision-making activity.
3. Proof of Application Concept - Feasibility studies to assess the potential viability of the application. More complete characterization of the decision-making 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 decision-making 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 so application can be tested in a simulated decision-making environment.
6. Demonstration in Relevant Environment - Major increase in the application's demonstrated readiness. Prototype system demonstration in a relevant environment or simulated operational decision-making environment
7. Application Prototype in Partners' Decision Making - Prototype near or at planned operational system. A major advance from TRL 6, requiring prototype system demonstration of an actual system prototype in an operational environment, such as partners' decision-making activity.
8. Application Completed and Qualified - Actual system completed and 'qualified' through test and demonstration for partners' decision-making 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 decision-making activities.

7. Summary of Key Information

Expected program budget	$8M total for 4 years
Expected total per year program budget for new awards	$2M in Stage 1 (one year) $6M in Stage 2 ($2M per year for three years)
Number of new awards pending adequate proposals of merit	10 to 20 – Stage 1 5 to 10 – Stage 2
Maximum duration of awards	4 years (Stage 1 and Stage 2)
Due date for Notice of Intent to propose (NOI)	02/14/2013
Due date for proposals	04/18/2013
Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	10 pp; see Subsection 5.3 of this document and also Chapter 2 of the *NASA Guidebook for Proposers*
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 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	NNH12ZDA001N-ECOF
NASA point of contact concerning this program	Woody Turner Applied Sciences Program Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1662 E-mail: Woody.Turner@nasa.gov

A.37 EARTH SCIENCE APPLICATIONS: WATER RESOURCES APPLIED SCIENCES TEAM

NOTICE: Amended December 19, 2013. This call will not be solicited as part of ROSES 2012. Instead it will be a part of ROSES 2013, which will be released in mid February, 2013.

~~**NOTICE: NASA plans to solicit for this program element in ROSES-2012. NASA will issue an amendment to ROSES to provide specific information about the element. The proposal due date will be at least 90 days following the announcement of the amendment.**~~

1. Program Objectives

The 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 organizations to achieve sustained use and sustained benefits from the Earth observations. For more information visit the Applied Sciences Program website at http://AppliedSciences.NASA.gov/.

The Applied Sciences 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.

The Applied Sciences Program is organized around Applications themes and Capacity Building elements. The Applications themes are currently focused on four of the nine Societal Benefit Areas of the interagency U.S. Group on Earth Observations (USGEO): Health (including Air Quality), Disasters, Ecological Forecasting, and Water Resources.[1] The Program includes climate-related influences and impacts within each of these themes. The Capacity Building elements focus on foreign and domestic activities to build skills and capabilities in uses of Earth observations, including international and economic development.

2. Scope of Program Element

The NASA Applied Sciences' Water Resources program promotes the routine integration of NASA Earth science into water resource management for sustainable use of water. The Water Resources Applications area primarily focuses on drought, streamflow and flood forecasting, water supply and irrigation, water quality, and climate impacts on water resources.

[1] The nine USGEO SBAs are: Agriculture, Climate, Disasters, Ecological Forecasting, Energy, Health, Oceans, Water Resources, and Weather.

The objective of this solicitation is to select a Water Resources Applied Sciences Team. This team will focus on specific applied research topics required to advance the water resources management community's use and application of NASA Earth science observations and models in decision making. The team will span all relevant NASA satellite mission observations and can include data products from non-NASA satellites, including foreign satellites. The team will coordinate with the competitively-selected projects within the Water Resources Program. The team will likely interact with the Research Science Focus Areas, especially the Water-Energy Cycle Focus Area, and appropriate mission Science Teams.

In this solicitation, the program will request applications that require a sustained, coordinated, and targeted applied research investment and will identify specific data products and provide applications-oriented feedback to Earth science research. The Applied Sciences Teams are analogous to the mission Science Teams. The Applied Sciences Teams will involve research scientists, data center representatives, applied scientists, and end users; the teams will include scientists sponsored by interested Government agencies and water resources community associations.

In general, these teams will contribute to the fundamental understanding of how Earth science can be scaled and applied to serve society. These teams will contribute to the body of knowledge on methods to enable institutions to apply new types of data and information in traditional processes and decision-making activities.

The Water Resources program website is available through the URL listed above.

3. Programmatic Information

For further information about this program, contact:

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A.38 EARTH SCIENCE APPLICATIONS: HEALTH AND AIR QUALITY

NOTICE: Amended December 19, 2013. This call will not be solicited as part of ROSES 2012. Instead it will be a part of ROSES 2013, which will be released in mid February, 2013.

~~**NOTICE: NASA plans to solicit for this program element in ROSES-2012. NASA will issue an amendment to ROSES to provide specific information about the element. The proposal due date will be at least 90 days following the announcement of the amendment.**~~

1. Program Objectives

The Applied Sciences Program supports efforts to discover and demonstrate innovative and practical uses of NASA Earth science data, knowledge, and technology. 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 in 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 allows and encourages private sector companies to submit proposals and/or be involved in project teams. For more information visit the Applied Sciences Program website at http://AppliedSciences.NASA.gov.

2. Scope of Program Element

NASA's Health and Air Quality Applications 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 objective of this solicitation is to select applied research and applications projects in the area of Health and Air Quality. Successful projects will advance organizations' use and application of Earth science observations and models in decision making associated with Health and Air Quality. The projects can include all relevant NASA satellite mission observations and can include data products from non-NASA satellites, including foreign satellites and commercial products, if used in conjunction with some NASA capabilities. Projects are encouraged to include modeling capabilities and predictions, data fusion and interoperability techniques, visualizations, or other Earth science products and capabilities to complement use of an array of Earth observations.

The amendment to this program element will articulate specific themes of priority for the solicitation. The amendment to this program element will also describe proposed project period of performance and required elements and objectives.

The Health and Air Quality program website is available through the website listed above.

3. Programmatic Information

For further information about this program, contact:

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A.39 EARTH SCIENCE APPLICATIONS: CROSS-CUTTING TOPICS

NOTICE: Amended December 19, 2013. This call will not be solicited as part of ROSES 2012. Instead it will be a part of ROSES 2013, which will be released in mid February, 2013.

~~**NOTICE: NASA plans to solicit for this program element in ROSES-2012. NASA will issue an amendment to ROSES to provide specific information about the element. The proposal due date will be at least 90 days following the announcement of the amendment.**~~

1. Program Objectives

The 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 organizations to achieve sustained use and sustained benefits from the Earth observations. For more information visit the Applied Sciences Program website at http://AppliedSciences.NASA.gov/.

The Applied Sciences 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.

The Applied Sciences Program is organized around Applications themes and Capacity Building elements. The Applications themes are currently focused on four of the nine Societal Benefit Areas of the interagency U.S. Group on Earth Observations (USGEO): Health (including Air Quality), Disasters, Ecological Forecasting, and Water Resources.[1] The Program includes climate-related influences and impacts within each of these themes. The Capacity Building elements focus on foreign and domestic activities to build skills and capabilities in uses of Earth observations, including international and economic development.

2. Scope of Program Element

In this solicitation, the Program will select applications projects on topic(s) that span and involve many of the Applications themes. The amendment will articulate one or more topics that are cross-cutting and multi-disciplinary in nature.

The Applied Sciences Program will use a two-stage approach to applications projects in this

[1] The nine USGEO SBAs are: Agriculture, Climate, Disasters, Ecological Forecasting, Energy, Health, Oceans, Water Resources, and Weather.

appendix. The solicitation will initially support feasibility studies of potential applications. These studies will generate and test preliminary ideas for applications, determine the potential value to the end users, and scope efforts for an in-depth application development and transition. The Program will then select and continue support of a subset of these applications in subsequent projects to develop the application fully and transition the application to public or private organization(s) for sustained use in decision making and services to end users.

The amendment to this program element will describe this two-stage, feasibility-to-decision support project arrangement more fully. Proposals to the solicitation will only be for the initial stage of this enterprise (i.e., feasibility study). The amendment will provide information on the format and content for an applications-style proposal as well as specific information for the feasibility stage proposal.

3. Programmatic Information

For further information about this program, contact:

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A.40 ADVANCING COLLABORATIVE CONNECTIONS FOR EARTH SYSTEM SCIENCE

NOTICE: The Advancing Collaborative Connections for Earth System Science (ACCESS) program will not be competed in 2012. NASA expects to continue to solicit improvements to NASA's Earth science data systems through future ACCESS solicitations. However, currently all funds available for these activities are committed to the support of awards selected through prior year solicitations.

1. Scope of Program

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 utilization of tools to aid in measurable improvements of Earth science data access and data usability. Awarded projects are expected to augment NASA's heterogeneous data system components by leveraging these proven information technologies in order to rapidly deploy data system services that bridge specific gaps within the agency's Earth science information systems.

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 ACCESS program encourages targeted solutions to current data access and data usability issues by supplying new tools or services to our Earth science research community.

2. Point of Contact for Further Information

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National Aeronautics and Space Administration
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A.41 MAKING EARTH SYSTEM DATA RECORDS FOR USE IN RESEARCH ENVIRONMENTS

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.

1.1 Overview

The Earth Science Division (ESD) uses NASA's unique capabilities in space to study the fundamental Earth processes that power climate, weather, and natural hazards, and the impact of those processes on the quality of life. In pursuit of its objectives in Earth science research, NASA is generating Earth system data of unprecedented quality and quantity and developing data processing and modeling capabilities to transform these data into products, information, and, ultimately, new knowledge of our planet. NASA Earth science data, data products and data processing algorithms are stored in archives at centers across the United States and linked by the Internet for data access and distribution.

A major need stated by the NASA Earth science research strategy is to develop long-term, consistent, and calibrated data and products that are valid across multiple missions and satellite sensors.

Data products created from multiple instruments, and from "data fusion," remain a challenge, and full utilization of complementary satellite data remains an elusive goal. NASA synergistic packages intended for creation of products, e.g, AIRS/AMSU, provide a guide for further innovative data products to be introduced. Here "data fusion" could be Low level fusion, the combining of several sources of raw data to produce new raw data, or data integration, the combining of diverse data sets into a unified data set which includes all of the data points and time steps from the input data sets. Sophisticated understanding of the contributing instruments' characterization and correct application of the various contributing data must be performed for such records to achieve the expectation that fused data is more informative and synthetic than the original inputs.

NASA is currently developing new missions to be launched in this decade. Records that provide precursor products that begin to baseline geophysical parameters that will be produced from these satellites would be valuable to NASA's Earth science research strategy.

NASA's Earth Science Division has an unprecedented number of missions currently flying. Data product developers have matured mission instrument products through refinement of instrument cal/val and algorithms. Accordingly, ESD is increasingly able to focus research and data production on measurement-based products, beyond single mission instrument products. For creating these basic records, a science measurement focus brings together expertise in multiple instrument characterization and calibration, data processing, science-based product generation and distribution, science tools and interactive relationships with the broader science community.

Projects selected through this solicitation will work to afford a solution for utilization of NASA assets and capabilities by the following:

- providing or adding to mature data records needed for NASA Earth System research, and potentially product science tools and services capabilities;
- applying ESD principles regarding community involvement, product life cycle planning, and standards and interfaces for interoperability and exchange of data and information;
- supporting ongoing data system evolution efforts through participation in one or more Earth Science Working Groups, which include Standards and Interfaces, Technology Infusion, Architecture and Reuse, and Metrics Planning and Reporting.

1.2. Types of Proposals

This MEaSUREs call continues the 2006 MEaSUREs Program focus on these particular Earth science research measurement needs, and the creation of Earth System Data Records (ESDRs), including Climate Data Records (CDRs). An ESDR is defined as a unified and coherent set of observations of a given parameter of the Earth system, which is optimized to meet specific requirements in addressing science questions. These data records are critical to understanding Earth System processes, are critical to assessing variability, long-term trends, and change in the Earth System and provide input and validation means to modeling efforts.

Selected MEaSUREs projects will be focused on product generation, availability, and utility. Maturity of algorithm and cal/val activity research is a prerequisite for selection as a MEaSUREs project to embark on large-scale data production.

2. Programmatic Information

Awards will commence with Fiscal Year 2013 funds.

2.1 Proposal Submission and Evaluation

In addition to the evaluation criteria given in *NASA Guidebook for Proposers*, these MEaSUREs proposals must address these additional factors:

• Identify the Earth Science research need or use for the ESDR/CDR. Proposers should cite documentation of key measurement needs found in NASA or NASA-participating (e.g. U.S. Global Change Research Program, Group on Earth Observations (GEO) Reports) related strategic plans, documents, roadmaps, or other materials.

• Document ESDR/CDR community establishment and maturity level, citing established cal/val, peer reviewed publications for algorithms, and product quality and usage summaries.

• Identify all challenges in the development and production of the proposed ESDR/CDR and describe the effort required. Characterize uncertainties and quantify errors associated with the proposed ESDRs.

• The period of award for these projects is up to five years. Proposal plans and deliverables described must state the length of effort and provide milestones and deliverables within the timeline. Five year proposals must be fully justified.

2.2 Other Requirements

All MEaSUREs projects will meet the following requirements:

• Maintain a public WWW-compliant presence.

• Data and information shall be publicly available, preferably via Internet transfer. A tailored, alternate *Data Rights* section will be applied to resultant Cooperative Agreement (CA), under which scientific data and scientific software (software used for processing raw Earth Observation remote sensing instrument data into scientific data and products) will be exchanged without restriction as to its disclosure, use, or duplication.

• Cooperative Agreement project management will seek community scrutiny and review of product quality and acceptability.

In addition, proposals selected by the MEaSUREs Program will be asked to have representation on one or more Earth Science Data System Working Groups (DSWGs). MEaSUREs proposals must include to which DSWG(s) they wish to have representation. Proposers should budget a quarter time (0.25) FTE and adequate travel budget for these activities (see http://earthdata.nasa.gov/our-community/esdswg for additional information).

2.3 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 other vehicles such as grants. See NASA's *Guidebook for Proposers* for guidance.

2.4 Relationship to Other NASA Program Elements

NASA will not consider any proposal to include data from the NPP satellite instruments in response to this 2012 MEaSUREs solicitation, given the current state of evaluation of NPP instruments. Research on evaluation of NPP instruments and use of those instruments' data to continue NASA ESDRs from EOS instruments is being conducted by the NASA NPP Science Team. All interested parties are encouraged to participate in NASA community evaluation through this effort.

Two recent solicitations have resulted in NASA investigations that have bearing to the selection of future MEaSUREs ESDR development and production. These are Projects selected under Earth Science Data Records Uncertainty Analysis (ROSES-10) and Satellite Calibration Interconsistency Studies (ROSES-11). Proposers are advised to review the available abstracts and results where available of these selected Projects, as well as the MEaSUREs Projects

awarded under ROSES-06, to ensure awareness of all ongoing as well as completing work done in this area (http://earthdata.nasa.gov/our-community/community-data-system-programs).

Any proposer whose project would require 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 the MEaSUREs program to apply for computing time on either of two NASA computing facilities, at NASA Goddard Space Flight Center's Computational and Information Sciences and Technology Office or at Ames Research Center's Advanced Supercomputing Division.

MEaSUREs does not solicit proposals for systems and information technology. Information technology 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 products algorithm development or refinement or for cal/val activities. These research activities are solicited through other Earth Science Research Program opportunities, most recently ROSES-09, The Science of TERRA and AQUA.

3. Summary of Key Information

Expected total program budget for new awards	~ $12M
Number of new awards pending adequate proposals of merit	~ 12 - 20
Maximum duration of awards	5 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 new investigation	January 1, 2013
Page limit for the central Science-Technical-Management section of proposal	20 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
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 *Summary of Solicitation* of this NRA. See the Alternate Data Rights to be used in Cooperative Agreements for this Program at:

	http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/data-rights-related-issues/
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers Responding to a NASA Research Announcement* 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 *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 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	NNH12ZDA001N-MEASURES
Point of contact concerning this program	Martha Maiden Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1078 E-mail: martha.e.maiden@nasa.gov

A.42 EARTH SYSTEM DATA RECORDS UNCERTAINTY ANALYSIS

NOTICE: The Earth System Data Records Uncertainty Analysis program will not be competed in 2012. NASA expects to continue to solicit uncertainty analysis research, and will use the first set of projects underway to determine how best to proceed in the future. Currently all funds available for these activities are committed to the support of awards selected through the 2010 solicitation.

The Earth Science Division (ESD) uses NASA's unique capabilities in space to study the fundamental Earth processes that power climate, weather, and natural hazards, and the impact of those processes on the quality of life. In pursuit of its objectives in Earth system science research, NASA is generating Earth system data of unprecedented quality and quantity and developing data processing and modeling capabilities to transform these data into products, information, and, ultimately, new knowledge of our planet. NASA Earth science data, data products and data processing algorithms are stored in archives at centers across the United States and linked by the Internet for data access and distribution.

A major need stated in the NASA Earth science research strategy is to develop long-term, consistent, and calibrated data and products that are valid across multiple missions and satellite sensors.

NASA has invested in the creation of consistent time series satellite data sets over decades, through both mission science team-based and measurement-based data product reprocessing and through solicitations for merged data products. The Earth Science Division has focused on data sets creation for particular Earth science research measurement needs, and has defined a term for data sets to be used for these needs: Earth System Data Records (ESDRs), including Climate Data Records (CDRs). An ESDR is defined as a unified and coherent set of observations of a given parameter of the Earth system, which is optimized to meet specific requirements in addressing science questions. These data records are critical to understanding Earth System processes, are critical to assessing variability, long-term trends and change in the Earth System, and provide input and validation means to modeling efforts.

The Earth System Data Records Uncertainty Analysis program seeks to extend and enhance the use of Earth System Data Records, including Climate Data Records, through rigorous estimation of error in Earth System Data Records used by NASA communities. Earth System Data Records Uncertainty Analysis projects increase the science value of Earth System science measurements by identifying and validating systematic errors, and improving error estimations. The Earth System Data Records Uncertainty Analysis program contributes to supporting agency research and applied science goals and objectives.

The Earth System Data Records Uncertainty Analysis program provides support for in-depth analysis of the properties of long-term data sets, with a focus on detecting systematic error, better quantifying error, and properly attributing uncertainty sources. A second focus is to resolve known issues of such data sets. In so doing, projects may orchestrate correct (and appropriate) methodologies, and may utilize advanced algorithms, techniques, and technologies that advance

the understanding of uncertainties in Earth system science measurements. Resultant tool development is a third focus of the program.

The scope of problems that Earth System Data Records Uncertainty Analysis projects address include:

- Estimating, validating, and conveying measurement differences between sensors or between sensors, validation measurements and/or models;
- Estimating, validating, and conveying measurement errors in merged data products;
- Estimating, validating, and conveying systematic errors in long-term Earth system science data records; and
- Other contributions to the determination, validation, and conveyance of Earth science measurement quality and quantification of uncertainties.

The data methodologies or techniques employed by Earth System Data Records Uncertainty Analysis projects and their applicability to the problems being solved must be scientifically rigorous, peer-recognized, and substantiated.

To minimize project risk, any technologies employed by Earth System Data Records Uncertainty Analysis projects for disseminating new capabilities must have high technology readiness levels (TRL), 6 or higher, and it must be made clear how the technologies will improve community understanding of the data records, broaden data use or increase data usability, and support research science or applied science goals.

Any resultant software tool development shall fall under the scientific software of Earth Science Alternate Data Rights, which will be incorporated into the Cooperative Agreement, which shall be the award instrument for NASA and selected Projects. (See the *Other Documents* section on the NSPIRES index page for this program element appendix.)

For information on this program, contact:

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A.43 COMPUTATIONAL MODELING ALGORITHMS AND CYBERINFRASTRUCTURE

NOTICE: Computational Modeling Algorithms and Cyberinfrastructure (CMAC) will not be competed in 2012. The CMAC was competed in ROSES-2011 and is anticipated to be open again in ROSES-2013.

NASA's primary role in Earth Science is to innovate in global observations of the Earth system from space. The Science Mission Directorate (SMD) pioneers the scientific use of these satellite measurements to improve understanding of the Earth system and to advance benefits to society. NASA's weather and climate models codify our understanding, gleaned from the satellite observations, of the many processes that make up the complex Earth system. They help to quantify the interactions and the balances between the various components acting on a wide variety of scales in both space and time.

Models and assimilation systems are the tools that synthesize the diverse array of information from many satellites and bring that information to bear on improving prediction of weather and air quality; future climate change and its impacts; changes in atmospheric composition and terrestrial and marine ecosystems; and important phenomena that contribute to climate variability, such as changes in the water cycle, ocean circulation, and El Niño and its impacts. As a result, improvements in the accuracy of Earth science models are some of the end products of NASA research that most directly impact human society. Examples include narrowing the uncertainty of global warming and sea-level rise expected this century; predicting the likelihood of rapid changes in climate due to the catastrophic collapse of the major ice sheets; forecasting the likelihood of changes in water availability or extreme weather events with changes in climate; predicting the rainfall impact of an El Niño event expected to arrive a year from now; or improving the accuracy of the timing, location, and strength of hurricane landfall next week. NASA considers the use of data driven models to be central to our approach to these problems.

As the temporal and spatial resolutions of the models are increased, these models require more computational resources. It is desirable that the efficiency of the computational models can be gained from the advances in computational technology, including hardware, software, networks, and tools. These needs were documented in *NASA Science Mission Directorate Computational Modeling Capabilities Workshop Final Report (2008)* and may be accessed on the web at http://www.hec.nasa.gov/workshop08/workshop08.html.

Data from satellite observations are typically used for initializing the models, constraining the model external forcings, or calibrating the model parameters. Data-model intercomparison provides an effective way to verify and validate (V&V) model performance. Considerable data regarding the environment are available through the myriad of remote-sensing programs, however, this data is not directly compatible with the models. It has been observed that scientists and engineers spend more than 60% of their time just preparing the data for model input or data-model intercomparison. This is an inefficient use of the precious time of NASA scientists and engineers. This program provides funding to build and enhance a common infrastructure which will dramatically reduce the time and energy spent by NASA scientists and engineers in the preparation of data for data-model intercomparison, model V&V, and model utilization.

The current Earth system models codify the accumulation of more than 40 years of scientific discovery and knowledge. As the knowledge grows, their size also grows. A typical Earth system model consists of more than a million lines of code. It becomes increasingly difficult for small research groups to develop, enhance, operate, and maintain the code. The development and maintenance of an Earth system model has thus become the job of a large laboratory or research consortia. As both the complexity and societal importance of Earth system models continues to grow, the quality of the underlying software implementation is too often not keeping up with modern software engineering methodology, leading to inadequate software infrastructure, and opening development and testing gaps that raise risk and significantly limit return on the science research investment. Examples include:

- Loss of science productivity due to
    - Excessive difficulty in adapting or extending existing model implementations to more complex science problems.
    - Disproportionate effort for routine modifications and maintenance of software.
    - Deficient and/or erroneous software documentation.
    - Idiosyncratic code that is not robust to personnel changes.
- Potential for erroneous conclusions, wasted resources, and institutional embarrassment due to insufficient software testing, verification, and quality control.
- Limited accessibility to models by external researchers and collaborators due to impenetrable source code, sparse documentation, and limited portability.

In order to enable distributed model development and to provide a mean to encourage open and rapid contribution, modern software engineering methodologies must be practiced to develop modular, agile, easily maintainable, and extensible code.

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.

Questions or comments may be directed to the Computational Modeling Algorithms and Cyberinfrastructure Program Manager at the address given below:

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

A.44 ADVANCED INFORMATION SYSTEMS TECHNOLOGY

NOTICE: The Advanced Information Systems Technology program will not be competed in 2012. The Advanced Information Systems Technology program is expected to be competed again in 2014.

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.

ESTO'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 S. Seablom
Earth Science Technology Office
NASA Headquarters
Telephone: (202) 358-0442
E-mail: Michael.S.Seablom@nasa.gov

A.45 INSTRUMENT INCUBATOR

NOTICE: The Instrument Incubator Program will not be competed in ROSES-2012. 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-2013.

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
Earth Science Technology Office
Telephone: (301) 286-8001
Email: p.ghuman@nasa.gov

A.46 ADVANCED COMPONENT TECHNOLOGY

NOTICE: The Advanced Component Technology Program will not be competed in ROSES-2012. 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-2014.

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:

- Reduce the risk, cost, size, volume, mass, and development time of Earth observing instruments and platforms; and
- Enable new Earth observation measurements.

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

Joseph Famiglietti
ACT Program Manager
Earth Science Technology Office
NASA Earth Science Division
Telephone: (301) 286-1833
Email: Joseph.Famiglietti-1@nasa.gov

A.47 DEVELOPMENT AND TESTING OF POTENTIAL INDICATORS FOR THE NATIONAL CLIMATE ASSESSMENT

Amended on July 2, 2012. This Amendment presents a new opportunity in Appendix A.47 entitled Development and Testing of Potential Indicators For The National Climate Assessment. Notices of Intent are requested by August 3, 2012, and proposals are due by October 5, 2012.

1. Scope of Program

NASA is a major contributor to global climate and related environmental assessment activities, such as the Intergovernmental Panel on Climate Change (IPCC), Climate Assessments and the World Meteorological Organization/United Nations Environment Programme (WMO/UNEP) Ozone Assessment Reports. NASA has made a similarly significant contribution to the U.S. National Climate Assessment (NCA), a central component of the 2012-2022 U.S. Global Change Research Program's Strategic Plan, and intends to continue supporting the NCA.

Indicators are anticipated to be an important component of future NCAs. These indicators are intended to provide a clear and concise way of communicating to the NCA audiences about not only status and trends of physical drivers of the climate system, but also the ecological and socioeconomic impacts, vulnerabilities, and responses to those drivers. This ROSES element solicits contributions to enhance NASA's participation in future NCAs by encouraging the developing and testing of potential indicators that address the needs expressed in the NCA vision for a national system of indicators and that largely draw from NASA -produced data and/or modeling products.

1.1 The National Climate Assessment

The Global Change Research Act of 1990 requires that the Nation conduct periodic scientific assessments of global change, especially for the effects of global change on specific sectors (http://www.globalchange.gov/about/program-structure/global-change-research-act). The assessments analyze current trends in global change and project major trends for the subsequent 25 to 100 years. Each National Climate Assessment (NCA) acts as a national snapshot or status report on advances in the underlying physical, chemical, biological, and social sciences. Additionally, it provides integrated analyses of impacts and vulnerability to climate change, addressing both specific sectors (i.e., natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity) and geographical regions. The process serves to integrate scientific information from multiple sources, highlight key findings and significant gaps in our knowledge, and provides a basis for prioritizing Federal climate science investments. The NCAs provide the scientific underpinnings that can be used by communities and the nation to create sustainable and environmentally-sound development paths and identify economic opportunities that may arise as the climate changes.

The Office of Science and Technology Policy (OSTP) leads the overall NCA effort, with coordination accomplished through the U.S. Global Change Research Program (USGCRP). The next NCAs, including the report scheduled to be released in 2013, are focused on evaluating the

nation's progress towards meeting adaptation and mitigation goals and on building a long-term, consistent process for the evaluation of climate-related risks and opportunities. Additional information on the objectives of the NCA can be found at http://www.globalchange.gov/what-we-do/assessment/nca-overview/objectives.

The long-term NCA process fits within Goal 3 of the new USGCRP Strategic Plan for 2012-2022, which focuses on conducting sustained assessments, both international (e.g. IPCC) and national (NCA). The NCA approach is to create and implement a long-term, consistent, and ongoing process for evaluation of climate risks and opportunities and to inform decision making processes within regions and sectors. An essential component of this vision is to establish sustained assessment activity both inside and outside of the Federal Government that both draws upon and sustains the work of stakeholders and scientists across the country. A sustained assessment process allows for an effective, planned, and potentially phased response to the four-year reporting requirement of the Global Change Research Act. It will also be more focused on evaluating the current state of scientific knowledge relative to climate impacts and trends and on supporting the Nation's activities in adaptation and mitigation.

One element that will be incorporated into future NCAs is that of "indicators" that would provide a clear and concise way of communicating to the NCA audiences about not only status and trends of physical drivers of the climate system, but also the ecological and socioeconomic impacts, vulnerabilities, and responses to those drivers. To help lay the groundwork for the development of such indicators, the NCA held workshops on ecological, physical, and societal indicators in 2010 (ecological) and 2011 (physical, societal). Links to these workshop reports and other NCA workshops may be found on the NCA website http://www.globalchange.gov/what-we-do/assessment/nca-activities/workshop-and-meeting-reports. Although indicators will not be included in the 2013 NCA report, there are plans to include them in the 2017 and subsequent NCA reports.

The strategic vision for the NCA indicators can be found at http://www.globalchange.gov/images/NCA/Indicator-Framework_2011-11-16.pdf, and a Technical Information Report on indicators that was provided as input to the NCA can be found at http://downloads.usgcrp.gov/NCA/Guidance/NCA-Indicators-Background-Development-Examples-Feb-2012.pdf. Proposers should consult these documents to align with the expected national approach of the NCA indicator development. (To assist NASA with this alignment, this solicitation also includes the opportunity for the Principal Investigator to serve as liaison to the indicators effort of the NCA: see 3A1.2.3).

1.2 NASA and the National Climate Assessment

NASA supports a range of global climate and related environmental assessment activities through its data records, models, and model-produced data sets, as well as through involvement of agency personnel. These assessments provide important information on climate change and are used by policymakers, especially with the recent increased interest in climate vulnerability, impacts, and adaptation. NASA intends to make a similarly significant contribution to the NCA – both the upcoming 2013 report and subsequent assessment activities.

NASA currently supports the NCA in numerous ways, although its main approach is to provide funding to investigators who will advance assessment-relevant science that may be published in

the peer-reviewed literature and thus be available for inclusions in future assessments. For instance, in FY 2011, NASA issued a call to investigators at NASA centers to begin assessment activities, with interest in both directly supporting the 2013 assessment, while also advancing assessment science, developing capabilities and products, and enhancing the development of assessment-enabling tools that will be useful for future assessments. A total of 14 proposals were selected in response to this call. Information concerning these ongoing projects can be accessed at http://www.weather.msfc.nasa.gov/NASA_NCA/. Additionally, NASA played a leadership role for several NCA workshops, including the physical and societal indicators workshops described above. NASA helped organize these workshops through the active participation of NASA scientists on the organizing committees and took the lead in the development of several of the workshop reports. NASA scientists also contributed in their capacity as workshop participants and by working on other technical documents that were submitted to the 2013 NCA Report author teams. Finally, NASA provides general support to the NCA office (part of the USGCRP National Coordinating Office) that includes funding, personnel support, and representation on the Interagency National Climate Assessment Working group.

2. Solicitation Goals

This ROSES element solicits contributions to enhance NASA's participation in future NCAs by encouraging the developing and testing of potential indicators that best address the needs expressed in the NCA indicator vision and that leverage NASA's capabilities. Such indicators should draw significantly, but not necessarily exclusively, from NASA -produced data and/or modeling products. Given the multiple audiences of the NCA, the potential indicators of greatest interest for this solicitation are those that can be expected to be useful by those who will be drawing on the NCA to make decisions related to impacts, adaptation, vulnerability, and mitigation associated with climate and global change (e.g., Federal agencies engaged in place-based or sector-based decision-making). Both lagging (based on current information) and leading (based on projections) indicators are envisioned as components of the NCA indicator suite. Indicators must be able to be tracked over time using data currently available and/or data expected to be available in the future. Indicators may be related to a single environmental variable, or could consist of several aggregated variables, each of which is weighted in some consistent way to contribute to the overall metric (e.g. IGBP Climate-Change Index) (http://www.igbp.net/globalchange/climatechangeindex.html). Of less interest for this solicitation are indicators that are solely of primary interest to the research community addressing climate and global change.

2.1 Indicator System Research Activities

Proposals submitted in response to this ROSES element should address the following issues:

- Motivation for the proposed indicator(s), including traceability to the ideas presented in the reports from the three indicator workshops (ecological, physical, societal indicators), noted above and available on the National Climate Assessment web page, as well as other NCA documents and any other indicator-related activity that is documented in widely available and accepted publications.
- General vision for the proposed indicator(s), i.e. primary climate issue addressed, general approach to be employed, spatial and temporal properties, and the sources of data (non-NASA and NASA) and/or model inputs used. The geographic scope of a proposed indicator can be at

a subnational scale if sufficient data are not available for a national analysis, but should be relevant nationally (e.g. sea-ice or high altitude range shifts).

- If indicators are proposed that could be prepared at multiple scales, the proposal need only focus on a single potential scale, but an explanation of how the indicator might be prepared and used at other scales should be included.
- Description of how the indicator(s) might be visually displayed, including the spatial and temporal scales at which information may be presented.
- Description of potential users of the indicator(s), especially in the context of existing and/or proposed decision support systems of Federal, regional, state, or local governments, nongovernmental organizations, and/or the private sector. Potential indicators may be directed towards either a specific user or multiple users. However, if indicators are expected to be useful to multiple audiences, the proposal need only focus on a single potential audience, but should include an explanation of how the indicator might be prepared and visualized for other audiences.
- Preparation during the course of the proposed work of a "demonstration set" of the indicator, over some subset of the spatial and temporal resolutions identified earlier, that would illustrate that the time-evolution of the indicator can be observed in a way that relates to climate and global change rather than shorter-term variability.
- Documentation regarding the expected future availability of the data (and any model output) required to produce the proposed indicator(s).

All data and models used in the development and testing of these indicators should be publicly available and documented consistently to allow their use in any future National Climate Assessments. To facilitate data transparency, the proposer shall provide a data-sharing and archiving plan, implementation of which will assure broad availability to the NCA community of the indicators developed in response to this ROSES element, see Section 4.2 of Appendix A.1 of this solicitation. Information used in the NCA must meet the highest standard set by the Information Quality Act as a highly influential scientific assessment (http://www.cio.noaa.gov/Policy_Programs/IQ_Guidelines_110606.html).

Data underlying the indicators can draw upon any relevant sources, but are expected to heavily rely on NASA -produced data and/or modeling products. Although most of the data and modeling products produced by NASA focus on physical, chemical, and biological sciences, proposers are encouraged to make appropriate ties between these data and those more closely associated with societal issues. As such, proposers are particularly encouraged to consider data found in NASA's Socioeconomic Data and Applications Center (SEDAC) (http://sedac.ciesin.org/), one of the centers under NASA's Earth Observing System Data and Information System (http://earthdata.nasa.gov/).

This solicitation is intended to facilitate the broadest possible participation of the Earth Science research and applications communities, including those from academia, industry, nongovernmental organizations, and all levels of government. However, since one goal of the USGCRP, and the NCA, is to expand the number of researchers with interest and/or experience in doing assessment-relevant science and contributing to the development of future assessments, NASA is particularly interested in proposals that involve the funding of early career scientists (most notably, graduate students and/or postdoctoral fellows) to increase the pool of "assessment-capable" scientists. Proposers should, therefore, specifically address how their proposals may contribute in this area.

As noted above, this solicitation is clearly focused on the development and testing of potential indicators for use in future NCAs. However, there is no guarantee that any indicators developed under funding from this solicitation will be used in future NCAs. Also, no commitment by NASA is given to provide future support of these indicators. If any future indicator-related solicitation is to be issued by NASA, there need not be any relationship between the indicators developed and tested here and future indicators.

2.2 Indicator System Team Membership

Principal Investigators selected under this solicitation will be considered members of the NASA Indicator System Team (IST) through the duration of the award. Each IST Member will be responsible for coordinating their NASA-funded indicator research to align with the NCA's strategic vision for a system of national indicators. In conducting their own indicator work, IST members will explore approaches and/or alternative products that best conform to aspects of that vision. The IST Members will assist in making connections to ongoing and newly developing activities with similar and/or complementary objectives being undertaken by other entities, especially other U.S. Federal agencies. The IST is expected to be led by an IST Leader (Section 3A1.2.3), and will conduct its business through periodic meetings with more frequent interactions through teleconference calls and email.

Funded investigators may be requested to participate in NCA-related indicator workshops during the award period or asked to provide expert input to, or serve as, reviewers for NCA-related indicator activities. Principal Investigators (PIs) should, therefore, include funds in their proposal budget for one trip to the Washington, DC, area for a potential meeting of investigators selected in response to this call or another NCA meeting to which NASA would request the PI's presence. Federal agency personnel submitting proposals should verify that they have management approval to carry out this travel with the funds requested in this proposal.

2.3 Indicator System Team Leader

Proposals are also requested for a NASA Indicator System Team Leader. The IST Leader will be responsible for providing scientific leadership and direction to help the IST align with the NCA indicator vision. In coordination with NASA staff, the Leader will be responsible for organizing appropriate IST meetings and related activities. He/she will be responsible for organizing and delivering to NASA a final report summarizing the IST findings and products. Additionally, the IST Leader will actively work with, and align and represent NASA's interests on, the NCA Indicator Working Group as they develop a national approach to climate change indicators.

Achieving the role of IST Leader depends on a successful science proposal for the IST: those wishing to serve as Team Leader should include a separate section of up to three additional pages that describes only those activities to be undertaken as IST Leader and addresses the following aspects of team leadership;

- The qualifications and leadership skills of the proposing Team Leader to serve in this capacity;
- A clear understanding of the overall NCA Indicator System strategic vision, and articulation of the proposed Team Leader's vision of NASA's role;
- The ability of the proposing Team Leader to represent NASA's and the NCA's overall goals and objectives for indicators to the broader community; and

- A detailed management plan that describes interactions with the IST and NASA management and how science team business and meetings will be organized and conducted.

In addition, the Budget Justification section of the proposal must include a detailed budget, narrative, and justification for the Team Leader activities that is separate from those for the individual research activities. This section should also include a budget for proposed IST meetings and Team Leader participation on the NCA Working Group (attending Working Group meetings, document preparation, teleconferences etc.).

For Team Leader Proposals, in addition to the factors given in the Guidebook for Proposers, the determination of a proposal's intrinsic merit shall take into account the qualifications and leadership abilities of the proposed IST Leader, to include his/her ability to fairly represent the broader indicator community, to effectively communicate with indicator stakeholders, to effectively engage a large and diverse group of researchers, and to communicate with NASA management.

NASA reserves the option to select a Team Leader from among the IST members should proposals of adequate merit and suitability not be received for the Team Leader role. NASA also reserves the right to not choose a team leader.

Those wishing to propose serving as Team Leader should consult with the NASA contact for this solicitation.

3. Summary of Key Information

Expected program budget	~ $2M total for the full duration of all awards
Number of new awards pending adequate proposals of merit	~ 10-15
Maximum duration of awards	12-18 months
Due date for Notice of Intent	August 3, 2012
Due date for Proposals	October 5, 2012
Planning date for start of investigation	No earlier than January 1, 2013
Page limit for the central Science-Technical-Management section of proposal	10 pp; (13 pp for IST Leader proposals); see also Chapter 2 of the *Guidebook for Proposers*
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 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	NNH12ZDA001N- INCA
Technical point of contact concerning this program	Fred Lipschultz Senior Scientist, National Climate Assessment U.S. Global Change Research Program Telephone: (202) 419-3463 Email: flipschultz@usgcrp.gov
NASA point of contact concerning this program	Jack A. Kaye Associate Director for Research Earth Science Division Science Mission Directorate NASA Headquarters Telephone (202) 358-2559 Email: Jack.A.Kaye@nasa.gov

A.48 IN-SPACE VALIDATION OF EARTH SCIENCE TECHNOLOGIES

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 measurements and operational requirements. ESTO technology investments attempt to address the full science measurement process: from instruments needed to make observations to data systems and information products that make those observations useful.

There has been and continues to be a need for some new technologies 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. This program seeks to advance the readiness of existing Earth Science-related technology and reduce risks to future missions through space flight validation. The details of this program are described below.

This ESTO solicitation is focused on in-space, orbital technology validation only. Airborne, balloon or sounding rocket flight validations are expressly excluded. Selected technologies will only be those that require validation in space. Proposers are responsible to provide their own access to space. Proposals that require procurement of launch services from foreign suppliers will not be considered for funding. Only instrument subsystems or instruments that can make or advance the technology to enable relevant Earth science measurements will be accepted; components are specifically excluded from this call.

Technologies must be ready for launch within two years after award. 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 is permitted if it is required to validate the technology. Science investigations are expressly excluded and will not be funded.

This solicitation is exclusively targeted towards the demonstration of future Earth science measurements from small satellites. These small satellites are restricted to those that comply with Cal Poly CubeSat Developer's specifications, found at http://cubesat.calpoly.edu/index.php/documents/developers. Concepts that do not comply with the Cal Poly CubeSat and Poly Picosat Orbital Deployer (P-POD) standards will be determined to be nonresponsive.

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, Table 1 for TRL definitions) and indicate completion of increasingly demanding proof-of-performance criteria at various stages of a technology development.

Figure 1 shows the progression of TRL goals for current ESTO programs and for flight validation under this solicitation.

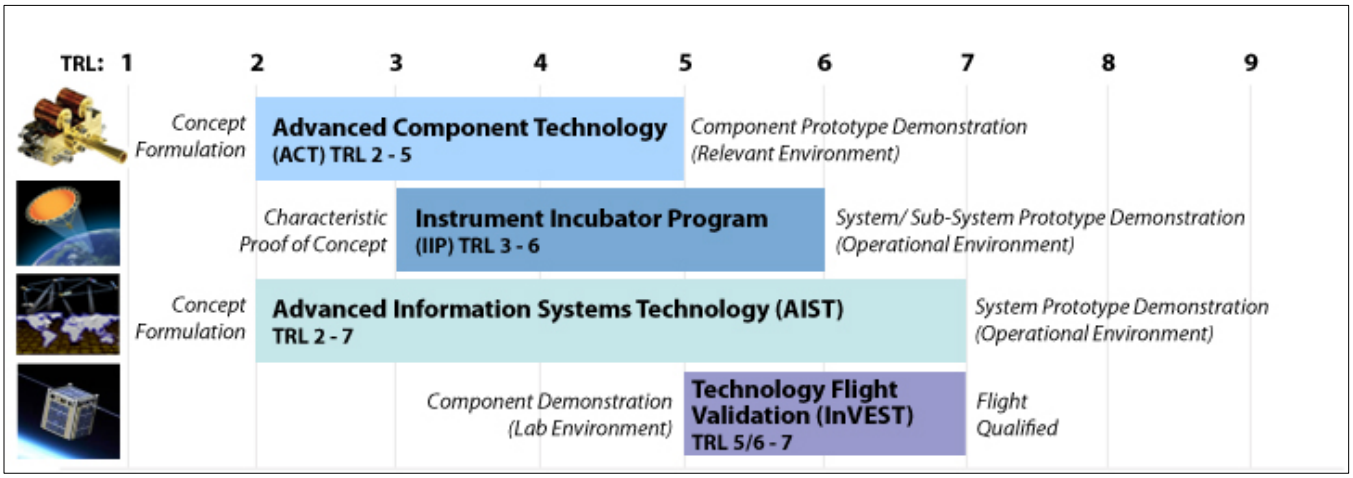

Figure 1. TRL Ranges for Technology Development Programs

Proposer's instrument subsystems or small instruments must be at a TRL 5 or 6 upon entry to the InVEST program. 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 instrument 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 new 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 and the Climate-Centric Architecture and helping to reduce the cost 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 instrument subsystems and small instruments using CubeSats to ensure the greatest benefit from NASA's technology development funds.

1.3 Proposal Research Topics

The Decadal Survey and Climate-Centric Architecture recommend an integrated strategy for Earth science and applications from space. This InVEST Program solicitation focuses on flight validation of instrument subsystems and small instruments to enable the science measurements that are described by the Decadal Survey and Climate-Centric Architecture. The measurements called out in these two documents 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 Decadal Survey and Climate-Centric Architecture for clarification of the exact measurements desired. Priority will be given to those proposals that most clearly address technology validation for one or more of these science measurements and their associated missions.

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 (NRA) or Cooperative Agreement (CAN)* and incorporated by reference into this ROSES solicitation. This document is hereafter 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/.

2.1 Proposal Content and Submission

2.1.1 Notice of Intent to Propose

A Notice of Intent (NOI) to propose is encouraged, but not required, for the submission of proposals to this 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 request that NOIs be submitted electronically via NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) by the due date given in SECTION 3.

However, since NOIs submitted after the deadline may still be useful to NASA, late NOIs, as well as indications of intent NOT to propose on an earlier NOI submission, may be submitted by email to the point of contact for this solicitation (see Section 3).

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 completely replaces 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 being 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 instrument 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. Describe your plan for the spacecraft for the period after which you have completed the build and when the launch provider is willing to accept delivery of your 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 or 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. Table 1 provides high-level definitions for instrument system TRLs. More detailed 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 will be considered noncompliant and will be returned without review.

TRL	Definition
1	Basic principles observed and reported
2	Technology concept and/or application formulated
3	Analytical and experimental critical function and/or characteristic proof-of-concept
4	Component and/or breadboard validation in laboratory environment
5	Component and/or breadboard validation in relevant environment
6	System/subsystem model or prototyping demonstration in a operational environment
7	System prototyping demonstration in a operational environment
8	Actual system completed and "flight qualified" through test and demonstration
9	Actual system flight proven through successful mission operations

Table 1. TRL Definitions Summary

6. Research 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. Personnel – Provide a list of key personnel and identify experience related to the proposed activity. Proposers should be sure to include science, instrument subsystem or instrument development, CubeSat, and spaceflight experience on the team. The key personnel list is included in the overall page count and must include, as a minimum, the Principal Investigator (PI). Optionally, one-page resumes for Key Personnel may be supplied; these resumes are not included in the overall page count.

8. 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.

9. Special Matters – Include a brief description of the organization, its facilities, and previous work experience in the field of the proposal.

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 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

Funds are not currently available for awards under this solicitation. 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 or fee to commercial firms under grant awards (see Section 2.2.3).

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 1 to 3 proposals will be selected. The ESTO anticipates funding of approximately $3 to $4 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 12 months. The total proposed period of performance must not exceed 36 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, 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;
- Degree of innovation of the proposed technology validation concepts and approach;
- 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; 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.
- 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

The second 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 to NASA's strategic goals and objectives" specifically includes the following factors:

- The proposal's relevance and potential contribution to NASA's scientific and technical areas of emphasis, including the potential to contribute to future Earth science instruments to make measurements which are part of the Decadal Survey measurements concepts or support other compelling Earth science measurements.
- The potential for the subsystem or instrument technology development 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 or instrument technology to be integrated, once matured, into future NASA Earth Science missions.

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;
- Past performance and related experience in the proposed area of technology development;
- 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 become a factor at the time of selection when deciding between proposals of otherwise equal scientific and technical merit.

2.4 Technical Reporting Requirements

Once awarded, all status information, presentation material, and report deliverables applicable to this InVEST solicitation shall be submitted to the web-based ESTO InVEST-12 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. All submissions to e-Book shall be made in PDF (preferred), Microsoft Word, Microsoft Excel, or Microsoft PowerPoint.

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 15 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 shall contain the following information:

- Upper Left Quadrant: "Description and Objectives"
- Lower Left Quadrant: "Approach" and "Co-Is/Partners"
- Upper Right Quadrant: A visual, graphic, or other pertinent information
- Lower Right Quadrant: "Milestone Schedule" and "Entry TRL."

The Quad Chart shall be updated at least annually and more often if appropriate. A template is available in the ESTO e-Book under "Information" and "File Templates."

An initial TRL assessment, and the basis for that assessment, shall be provided within 15 days of award for the critical technology developments of the activity. The TRL Assessment Spreadsheet is available in the ESTO e-book under "Information" and "File Templates." 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:

- 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.), 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.

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:

- Describe the primary findings, technology development results, and technical status, e.g., status of proto-flight, or flight systems, results of tests (e.g.; shock, vibe), etc.;
- 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;
- 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 JPL projects only, obligated and costed, along with a graphical representation of the project cost profile to completion (a template is provided in the ESTO e-book under “Information” and “File Templates”);
- Provide a summary of anticipated results at the end of the task; and
- 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:

- The review is held at the PI's facility or a mutually agreed to location.
- The review is attended by an independent technical reviewer from an organization separately funded by ESTO.
- Hardcopy handouts shall be provided by the PI at the review.
- The PI may provide a laboratory demonstration, if appropriate, to show technical results and status.
- 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 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.
- 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 Spreadsheet shall also be uploaded separately to their respective locations 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 Spreadsheet;
5. A final Accomplishments Chart which contains the following information (a template is available in the e-Book):
    a. Upper Left: "Description and Objectives."
    b. Middle: "Accomplishments."
    c. Upper Right: A visual, graphic, or other pertinent information.
    d. 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 Spreadsheet shall be uploaded 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

The awardee is encouraged to participate in the annual Earth Science Technology Forum (ESTF). The ESTF is 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.

Travel expenses will be provided for non-Government awardees selected to participate in the ESTF. A travel charge number will be provided to NASA awardees selected to participate; an invitational travel order will be issued to other (non-NASA) Government awardees selected to participate. Therefore, no travel costs for participation in ESTF should be included in the proposal. If selected for participation in the ESTF, 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.

3. Summary of Key Information

Expected program budget for first year of new awards	Up to $3M
Number of new awards pending adequate proposals of merit	1-3
Maximum duration of awards	Minimum 1-year / Maximum 3-year awards (subject to launch availability)
Due Date for Notice of Intent to Propose (NOI)	October 17, 2012
Due date for delivery of proposals	November 27, 2012
Planning date for start of investigation	May 1, 2013
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	This program is relevant to the Earth science strategic goals and sub-goals in NASA's *Strategic Plan*; see Table 1 in ROSES-12 and the references therein. Proposals that are relevant to this program are, by definition, relevant to NASA. See Section 2.1.2.2 of this appendix.
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	NNH12ZDA001N-InVEST
NASA point of contact concerning this program	Michael Pasciuto Earth Science Technology Office Science Mission Directorate NASA Headquarters Telephone: (301) 286-0006 E-mail: Michael.P.Pasciuto@nasa.gov

A.49 STUDIES WITH ICESAT AND CRYOSAT-2

Amended on February 13, 2013. The due date for proposals for this program element has been delayed because of wide spread loss of power in the northeast without power. Proposals are now due February 22, 2013.

1. Background

NASA solicits investigations to derive geophysical information from NASA's Ice, Cloud, and land Elevation Satellite (ICESat) and the European Space Agency's CryoSat-2. These altimetry missions were optimized to characterize changes in the continental ice sheets of Antarctica and Greenland and the sea ice of the Arctic and Southern Oceans. The missions' primary goals are to understand the contributions of polar ice to current and future sea level rise and the coupling of changes in polar sea ice cover to the Earth system. Investigations are encouraged that:

- create long term, integrated records of change in the polar ice sheets;
- characterize processes of change in polar ice, especially couplings to climate forcings and insight into physical processes that improves predictive models; and
- any other innovative investigations using ICESat and CryoSat-2 observations for Earth science research.

1.1. ICESat, ICESat-2, and IceBridge

The NASA Ice, Cloud, and land Elevation Satellite (ICESat) was launched in January 2003 and ceased operations in 2009. The primary instrument on ICESat was the Geoscience Laser Altimetry System (GLAS) with precise ranging capability. With an orbital inclination of 94 degrees, ICESat observations provided critical insight into the thinning of the Arctic sea ice cover, the ice loss from the continental ice sheets of Greenland and Antarctica, and the global distribution of above-ground biomass. Limitations of the laser lifetime led to a revised measurement strategy from the originally intended continuous operation in a 91-day repeat orbit to a set of discrete campaigns. These were based on a 33-day near-repeat subcycle of the 91-day orbit that was surveyed twice a year at six-month intervals. Details of the mission are at http://icesat.gsfc.nasa.gov/ and the data can be accessed from the NASA Distributed Active Archive Center (DAAC) at http://nsidc.org/data/icesat/.

ICESat's planned successor is ICESat-2, which is currently under development and expected to launch in 2016. ICESat-2 will have a multibeam, photon counting instrument. It makes measurements at higher resolution and over broader swaths that enable direct measurement of both surface elevation and slope. The gap in observations is being bridged by NASA's IceBridge Mission (http://www.nasa.gov/mission_pages/icebridge/index.html), a series of aircraft campaigns over land and sea ice in both polar regions. The instrument suite and flights plans are based on lidar measurements that extend the record of ICESat and offer calibration and validation of CryoSat-2. The aircraft also have radars for mapping snow cover and the underlying bed, as well as gravimeters and other instruments. Data and instrument descriptions can be accessed from the NASA DAAC at http://nsidc.org/data/icebridge/.

1.2. CryoSat-2

CryoSat-2, launched in April 2010, is a radar altimetry mission of the European Space Agency (ESA). It is designed primarily to measure sea ice thickness with sophisticated radar processing techniques. Its measurements of sea ice freeboard complement those of ICESat, and have been validated with IceBridge observations. CryoSat-2 also has the potential to measure ice sheet elevation and make other geophysical measurements. CryoSat-2 has a design life of three years. Details on the Cryosat-2 mission are at http://www.esa.int/esaMI/Operations/SEM36Z8L6VE_0.html.

1.3. Scope of Program

The primary goal of this program is to continue the use of satellite altimetry for the study of polar ice sheets with a focus on extending the time series begun by ICESat and continuing through CryoSat-2.

These measurements are expected to improve knowledge of the contribution of Greenland and Antarctica's ice sheets to current and future sea level rise and to determine the coupling of changes in polar sea ice to the Earth system. Investigations must be based on observations made by ICESat and CryoSat-2, as well as exploit the complementary nature of these missions to produce extended records. Proposers are also encouraged to use IceBridge measurements to connect and fill gaps between ICESat and CryoSat-2 and establish pathways to link these time series to ICESat-2.

Scientific studies based on ICESat and CryoSat-2 observations outside of the polar ice sheets are encouraged, but will also be considered at a lower priority.

Specific goals of the program are as follows:

For the Greenland and Antarctic ice sheets, the program seeks to:

- Measure and understand elevation change in the context of improved mass balance to understand couplings to the Earth system and contributions to sea level rise
- Gain insight into the surface mass balance, especially to improve models of polar precipitation and surface melting
- Characterize the dynamic processes controlling ice flow and related changes in ice sheet elevation and mass balance, especially to improve ice sheet models useful for prediction of sea level rise
- Use satellite altimetry to determine any other properties of the ice sheets critical to improved models of their contributions to current and future sea level rise

For the sea ice of the Arctic and Southern oceans, the program seeks to:

- Measure and understand changes in the thickness of sea ice cover as derived from measurements of sea ice freeboard
- Characterize the physical processes controlling Arctic sea ice loss and Antarctic sea ice expansion, especially to improve sea ice models for hind and forecasting
- Gain insight into surface melting, snow accumulation, age and flooding of sea ice, especially to improve models of polar precipitation and surface melting
- Use satellite altimetry to determine any properties of polar sea ice to understand the physical processes that control their growth and retreat, especially their connections to climate forcings and couplings to the Earth system.

Other areas of research based on ICESat and CryoSat-2 satellite altimetry will also be considered at a lower priority. Proposals are welcome on any topic, but studies should be at a global scale with a specific effort at improving understanding of the Earth system. Potential topics include, but are not limited to the following:

- Change in the major glacial systems of the North America, South America, and Asia. Note: these studies should be scoped to be of significance to global sea level rise or couplings of these glacial systems to the Earth system.
- Vegetation structure and estimation of global biomass
- Atmospheric processes, especially precipitation and cloud properties relevant to interpretation of polar processes and affecting interpretation of ICESat and ICESat 2 observations
- Land surface studies, snow volume estimates, and hydrologic information derived from water surface heights

2. Programmatic Information

Results from investigations supported under this ROSES element 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, such as the National Ocean Policy(http://www.whitehouse.gov/administration/eop/oceans/policy) emphasis on Arctic change and the U.S. Global Change Research Program (http://www.globalchange.gov/) and its strategic plan (http://globalchange.gov/what-we-do/strategic-planning), 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	$2.0M

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)	December 10, 2012
Due date for delivery of proposals	**February 22, 2013 [Amended February 13, 2013]**
Planning date for start of investigation	6 months after proposal due date.
Page length for the Science-Technical-Management section of proposal	15 pages; see also Chapter 2 of the *NASA Guidebook for Proposers*.
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 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	NNH12ZDA001N-ICESAT2
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

APPENDIX B. HELIOPHYSICS RESEARCH PROGRAM

B.1 HELIOPHYSICS RESEARCH PROGRAM OVERVIEW

1. Overview

NASA's Heliophysics Research Program supports research activities that address understanding of the Sun and planetary space environments, including the origin, evolution, and interactions of space plasmas and electromagnetic fields throughout the heliosphere and in connection with the galaxy. Understanding the origin and nature of solar activity and its interaction with the space environment of the Earth is a particular focus. 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.

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 also supports investigations of the physics of magnetospheres, including their formation and fundamental interactions with plasmas, fields, and particles; and the physics of the terrestrial mesosphere, thermosphere, ionosphere, and auroras, including the coupling of these phenomena to the lower atmosphere and magnetosphere.

The Heliophysics Research Program of 2012 represents a strategic commitment to system science — emphasizing the understanding of fundamental processes and interconnections across the traditional science disciplines. 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 documentation underlying the Heliophysics Research Program provides the needed background for proposals addressing its objectives. The science carried out must directly address NASA's Strategic Goal 2.2, to study the Sun and its interactions with the Earth and the Solar System (see Section I(a) and Table 1 in the *ROSES Summary of Solicitation*). In particular, proposals must address the more specific Science Outcomes (see Section I(a) and Table 1 in the *ROSES Summary of Solicitation*), which are to achieve:

- Progress in understanding the fundamental physical processes of the space environment—from the Sun to Earth, to other planets, and beyond to the interstellar medium;
- Progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres; and
- Progress in maximizing the safety and productivity of human and robotic explorers by developing the capability to predict the extreme and dynamic conditions in space.

A brief description of each program element offered in the Heliophysics Research Program is given below. The intent of these summaries is to give the prospective proposer insight into the element's purpose within the context of the overall program structure. Detailed descriptions of each element are to be found in Appendices B.2 through B.8.

It is the overall objective of each of these 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.

2. Program Elements

Heliophysics Theory:
Theoretical investigations are funded as parts of a number of Heliophysics programs, but the Heliophysics Theory Program is the only Heliophysics program that is dedicated solely to theoretical efforts. It also differs from the theoretical investigations funded by other Heliophysics program elements in that it addresses only physical processes that have sufficient breadth and complexity to require the efforts of a critical mass of expertise. Theory Program awards are commensurately larger than typical SR&T awards. The Heliophysics Theory program, which is competed only once every three years, is fully subscribed for Fiscal Years 2011-2013 and will not be competed again until ROSES 2013. The Heliophysics Theory program element is described in Appendix B.2.

Supporting Research and Technology (SR&T):
The main function of SR&T awards is to support planning for future NASA mission. This element supports focused individual research tasks that employ a variety of research techniques, e.g., theory, numerical simulation, and modeling; analysis and interpretation of space data; development of new measurement concepts; laboratory measurements of atomic and plasma parameters, and laboratory simulations of Heliophysical phenomena. Geospace-related SR&T tasks are solicited as part of the Geospace Science element described in Appendix B.3, while solar and heliospheric-related SR&T tasks are solicited as part of the Solar and Heliospheric Science program element described in Appendix B.4.

Low Cost Access to Space (LCAS):
LCAS investigations have as their objective science investigations that require access to space as provided by sounding rockets, research balloons, the International Space Station, and/or CubeSats. LCAS investigations may be science investigations in and of themselves or proof -of-concept experiments for techniques/detectors that enable new Heliophysics science. Geospace-related LCAS investigations are solicited as part of the Geospace Science program element described in Appendix B.3, while solar and heliospheric-related LCAS investigations are solicited as part of the Solar and Heliospheric Science element described in Appendix B.4.

Instrument Development:
Instrument development 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. Geospace-related instrument development investigations are solicited as part of the Geospace Science program element described in Appendix B.3, while solar and heliospheric-related instrument development investigations are solicited as part of the Solar and Heliospheric Science element described in Appendix B.4.

Guest Investigators (GI):
Guest Investigators (GI) programs are intended to maximize the scientific output of currently operating Heliophysics missions through support of individual investigations that draw extensively upon the data sets from the missions of the Heliophysics System Observatory. The focus of the selected research continuously evolves to ensure that the most important questions identified by the operating mission senior reviews are addressed. Geospace-related GI investigations are solicited as part of the Geospace Science program element described in Appendix B.3, while solar and heliospheric-related GI investigations are solicited as part of the Solar and Heliospheric Science element described in Appendix B.4.

LWS Targeted Research and Technology (TR&T):
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 TR&T 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 (terrestrial upper atmosphere?). In addition, TR&T supports the Sun-Climate objective whose goal is 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. Development of Tools and Methods that are needed to achieve the LWS goals are also supported. A draft version of the LWS TR&T program element is described in Appendix B.6 with the release of ROSES-2012. An amendment will subsequently provide the final text.

LWS Targeted Research and Technology (TR&T) Strategic Capability:
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 for enabling 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. A draft version of the LWS Strategic Capability program element is described in Appendix B.7 with the release of ROSES-2012. An amendment will subsequently provide the final text.

Heliophysics Data Environment Enhancements:
Progress in space science is sparked by space observations. It is essential that observations be properly recorded, analyzed, released, documented, and rapidly turned into scientific results. Heliophysics Data Environment Enhancement investigations support and extend data services necessary for the conduct of heliophysics research. Holders of heliophysics data propose for small grants to continue resident archives of data from previously operating missions and to participate in one of the several virtual observatories either in existence or proposed. Aspects to be taken into account are 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. The data environment enhancement program element is described in Appendix B.8.

B.2 HELIOPHYSICS THEORY

NOTICE: The Heliophysics Theory program will not be competed in 2012. The Heliophysics Theory program is fully subscribed for Fiscal Years 2011-2013 and will not be competed again until ROSES 2013.

1. Scope of Program

The Heliophysics Research Program of the Science Mission Directorate (see Appendix B.1) supports investigations of the Sun and planetary space environments, including the origin, evolution, and interactions of space plasmas and electromagnetic fields in the heliosphere and in connection with the galaxy. Understanding the origin and nature of solar activity and its effect on the space environment of the Earth is a particular focus.

The Heliophysics Theory Program (HTP) is specifically designed to support theory and modeling investigations of problems that fall within the general realm of Heliophysics, but are of sufficient breadth that their successful completion requires the efforts of a synergistically interacting group of investigators led by a single Principal Investigator.

Theory investigations are the foundation of the Heliophysics Research Program. They integrate previous experiments and observations into a common theoretical foundation and lead the way to the formulation of new scientific hypotheses, thereby defining experimental concepts for future strategic missions. The ultimate goal of such investigations is to provide a complete chain of reasoning extending from the basic laws of nature to comparison with observation to the identification of future quantitative tests of the behavior of the environment.

HTP investigations are carried out in support of the NASA strategic goal to "Understand the Sun and its interactions with the Earth and the Solar System" and the NASA specific research objective to "Understand the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium" (see Section I(a) and Table 1 of the *ROSES Summary of Solicitation*). Competed once every three years, theory investigations will be solicited next in 2013 for three-year awards.

Proposals to the HTP are expected to present clear descriptions of (1) a specific scientific problem, (2) the importance of the problem, (3) the relevance of the problem to NASA's heliophysics strategic objectives, and (4) a complete method of attack on this problem. As any method of scientific inquiry must be based on observable evidence, (5) a clear description of the data comparisons that will be used to verify assumptions and results is also required. The descriptions should be presented concisely in the Proposal Summary and they should be discussed more thoroughly within the proposal scientific/technical/management section.

Proposals that serve only as an umbrella for a variety of separate research tasks, even though they each may be related by a common theme and may each be of high scientific merit, are not appropriate for the HTP. Proposals for focused smaller-scope theoretical efforts should be submitted to the Heliophysics Research Geospace Science program (Appendix B.3 of this ROSES NRA) or Heliophysics Research Solar and Heliospheric Science program (Appendix B.4 of this ROSES NRA). Efforts focused on those aspects of the Sun-Solar System that directly affect life and society are not appropriate for the HTP, but may be appropriate for the Living With a Star Targeted Research and Technology Strategic Capability program (Appendix B.7 of this ROSES NRA).

2. Programmatic Information

Selections for the HTP are for three-year periods of performance with annual funding contingent upon the submission of satisfactory progress reports and available funding. The total annual budget for this program element is about $4 M with average annual funding per group at $400K.

For further information on this program, contact:

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Science Mission Directorate
NASA Headquarters
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B.3 HELIOPHYSICS RESEARCH: GEOSPACE SCIENCE

Notice: The proposal submission for this program element is now a two-step process in which a Notice of Intent is replaced by a Step-1 proposal, which is required, and the Title and Team are binding. See section 2.1 for details. The Geospace related portion of the Heliophysics Guest Investigator Program has now been imbedded here, and its scope has changed. See section 1.3 for details.

1. Scope of Program

The Geospace Science (G/Science) 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 NRA.

1.1 Overview

The goal of the G/Science program is to understand the space that surrounds the Earth and how it is influenced by the various solar system bodies. These studies range over regions that begin with the Earth's upper atmosphere, including the mesosphere and thermosphere, and extend outward through the ionosphere, into and beyond the magnetosphere. The G/Science program also supports studies of the space *plasma* environments of other solar system bodies. These studies are carried out in support of NASA Strategic Subgoal 2.2: "Understand the Sun and its interactions with Earth and the solar system" from the *Science Mission Directorate Science Plan for 2010* (http://nasascience.nasa.gov/about-us/science-strategy). The recommended priorities of the Heliophysics community are also discussed in the Heliophysics Roadmap for Science and Technology 2009-2030, *Heliophysics, the Solar and Space Physics of a new era*, (http://science.nasa.gov/heliophysics/working-groups/).

The G/Science program now has four components. Brief descriptions of the elements of the G/Science program follow below, while specific information can be found in the individual program element descriptions. Proposers are encouraged to select the program that is most appropriate for their intended proposal.

- The G/Supporting Research (G/SR) program supports the most important Geospace science investigations not addressed by other programs and designed as individual research tasks employing a variety of research techniques. (Section 1.2 and further note below).
- The G/Guest Investigator program (G/GIP) is intended to maximize the return from currently operating Heliophysics missions by supporting studies that address the current science goals of these missions; the analysis of data from these mission(s) plays a primary role (Section 1.3).
- The G/Instrument Development and Enabling Science (G/IDES) program supports the development of instrument technologies, new instrument concepts, and new observing techniques, as well as laboratory measurements of relevant atomic and plasma

parameters, new models, and/or new data analysis techniques. Proposals must be clearly motivated by science questions important to the program (Section 1.4).

- The G/Low Cost Access to Space (G/LCAS) program supports science investigations or instrument development that must be completed through suborbital flights (Section 1.5).

Further note on G/SR – in addition to the programs listed above, proposals that are outside the scope of G/SR and should not be proposed include the following.

- The most recent Living With a Star Targeted Research and Technology (LWS TR&T) Focus Topics and Initiatives are not appropriate for G/SR (see ROSES 2011 Appendix B.6);
- The G/SR program does not support the routine, long-term gathering of observational data (see HDEE Appendix B.8).

1.2 Geospace Supporting Research Program

The G/SR program supports the most important Geospace science investigations not addressed by other programs in this or other ROSES elements; individual research tasks employ a variety of research techniques in pursuit of Geospace program goals. Specifically, the G/SR&T program supports theoretical research, the exercise of models and simulations, and the analysis and interpretation of data for the purposes of identifying and understanding the physical processes important to geospace structure and dynamics. All proposals must provide an explanation of the relationship of the proposed effort to G/Science goals.

1.3 Geospace Guest Investigator Program

The Heliophysics Guest Investigators program (GIP) is intended to maximize the return from currently operating Heliophysics missions by supporting studies of the current science goals of these missions. Guest Investigators proposals are expected to be for investigations in which the analysis of data from currently operating Heliophysics mission(s) data plays a primary role. Information on the current science goals for these missions is available in the report of the Senior Review 2010 of the Mission and Data Analysis Program for the Heliophysics Operating Missions (http://science.nasa.gov/heliophysics/senior-review/.)

Emphasis is on NASA space Heliophysics data that are archived in the public domain. 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. Most Heliophysics data may be found in one or more of the NASA active archives and Virtual Observatories (VOs). These include:

- Space Physics Data Facility (SPDF) (http://spdf.gsfc.nasa.gov)
- Virtual Space Physics Observatory (VSPO) (http://vspo.gsfc.nasa.gov/websearch/dispatcher)
- Virtual Magnetospheric Observatory (VMO) (http://vmo.nasa.gov, and http://vmo.igpp.ucla.edu)
- 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)

Proposers should also be aware that considerable research has already been done using these archival data sets by the original mission science teams, as well as by previously selected participants in the HGIP. Therefore, proposals must demonstrate how the proposed research clearly extends the frontier of existing knowledge in a fundamental and important manner rather than merely repeating a type of analysis on heretofore unstudied class or type of phenomena. 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 significant results from it.

1.4 Geospace Instrument Development and Enabling Science Program

The G/IDES program supports the development of instrument technologies, new instrument concepts, and new observing techniques, as well as laboratory measurements of relevant atomic and plasma parameters, new models, and/or new data analysis techniques.

The G/IDES supports the development of instrument technologies that show promise for use in scientific investigations on future Geospace Science missions, including the development of laboratory instrument prototypes, but not of flight hardware. 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. It is anticipated that the scientific payloads on most future Geospace Science missions will be limited to small, low mass, low power consumption, and low cost instruments. Therefore, proposals for instrument definition and development satisfying these general specifications are especially solicited.

Proposals to the G/IDES must demonstrate that there are specific scientific problem(s) for which the development is a necessary precursor. 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.

1.5 Geospace Low Cost Access to Space Program

The G/LCAS program supports research in magnetospheric, ionospheric, thermospheric, and mesospheric physics that requires the space flight of instrumentation. The program offers a variety of methods for providing low cost access to space, including standard and long-duration balloons, sounding rockets, and sounding rocket-class payloads flown as secondary payloads or on other flights of opportunity. Proposals to the G/LCAS program are expected to describe a complete suborbital science investigation, including payload construction, launch phase, data analysis, and publication of results.

Proposals to the G/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, payload mass, trajectory requirements, launch site, telemetry requirements, attitude control or pointing requirements, and any plans for payload

recovery and reuse. This information will be requested on G/LCAS proposal cover pages, and cost estimates based on this data will be used in proposal selection.

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.

Proposals to the G/LCAS program include costs primarily for payload development, however, the total expense associated with a suborbital investigation also includes costs for launch services - elements that support getting the carrier (i.e., the rocket/payload) into the space environment. Examples include provision of the vehicle, payload support systems, tracking radars, telemetry stations, uplink command systems, launchers, and logistics.

1.5.1 Export Control Laws

Export licenses are required for all foreign nationals accessing sounding rocket hardware. G/LCAS program 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 rocket hardware. Questions concerning sounding rockets and U.S. Export Control Laws and Regulations may be addressed to the Sounding Rocket Program Office.

1.5.2 Launch vehicle services

Detailed information has moved to the *ROSES Summary of Solicitation, Section V.*

2. Programmatic Information

2.1 Step 1 Proposals

A Step-1 Proposal replaces the previous Notice of Intent (NOI); the length and content remain the same as an NOI, but the submission process has changed. To streamline the proposal process (submission, evaluation, and administration), the Geospace program will be using a two-step proposal submission process starting in ROSES 2012 (see the overall description of a two step process in the *Summary of Solicitation Section IV (b) vii*).

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, including any LCAS Co-investigators who will be submitting Step-2 proposals (see Section 2.3). 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 are considered binding and cannot be adjusted in the full proposal. This two step procedure will be implemented without a downselect evaluation of the Step-1 proposal for ROSES 2012 and all proposers who submitted a Step-1 proposal will receive an invitation to submit the Step-2 proposal. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2

(full) proposal later. Please see the Step-1 Submission Clarification PDF file that can be downloaded from the embedded link in the line above or via NSPIRES web page for this program element. **[Added 3/1/2012]**

2.2 Available Funds

It is expected that there will be approximately $2.5M available next fiscal year to support new G/SR investigations selected through this solicitation. Annual funding in past G/SR programs has averaged $110K per investigation.

It is expected that there will be approximately $1.0M available next fiscal year to support new G/GIP investigations selected through this solicitation. Annual funding in past G/GIP programs has averaged $110K per investigation.

It is expected that there will be approximately $300K available next fiscal year to support new G/IDES investigations selected through this solicitation. Annual funding in past G/ID programs has averaged $150K per investigation.

It is expected that there will be approximately $1.2M available next fiscal year to support new G/LCAS investigations selected through this solicitation. As a rule, new investigations are awarded definition-level funding in their first year, full funding for development in their second year, leading to flight early in their third year, which concludes with data analysis. Recent G/LCAS awards have averaged $320K, $450K, and $350K for, respectively, the first, second, and third years of the investigation. **[Corrected 2/17/2012]**

2.3 Evaluation Criteria

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.

In order to demonstrate intrinsic scientific and technical merit 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. 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 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.

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.

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. G/GIP proposals must demonstrate their contribution to the achievement of the current science goals of currently operating Heliophysics missions, which include changes resulting from Senior Review.

2.4 G/Science Proposals from Multiple Institutions

The G/SR, G/GIP, and G/IDES programs do not make separate grants to the Principal and Co-Investigators 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).

The G/LCAS program allows but does not demand separate proposals as described below.

Proposals for suborbital investigations often involve the development of payloads that require major hardware collaborations amongst several organizations. In such cases, lead Principal Investigators (PIs) may propose a direct subcontracting arrangement between his/her organization and the Co-Investigator (Co-I) institution(s), in which case all the nominal instructions in the *NASA Guidebook for Proposers* (see further below) apply.

Alternatively, NASA recognizes that some cost savings may be achieved by providing separate awards to each collaborating institution, where the lead investigator from each Co-Investigator institution serves as the "Institutional PI" for the award to his/her institution (see Section 1.4.2 in the *NASA Guidebook for Proposers*). In order to provide for such multiple-award flexibility, the following instructions should be followed for proposals that involve major hardware contributions from multiple institutions:

- 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 only the summary of the budget requested by the lead organization.
  - The PI's work statement and budget justification (narrative and details), plus appended *Task Statements* and the budget justifications (narrative and details) from all other collaborating Co-I institutions (see further below) as part of its budget justification.

- A table in the budget details that shows the costs for the lead organization, plus those for each Co-I institution, which together must add to the total yearly requests for the entire, integrated investigation for its complete period of performance.

- Each collaborating Co-I institution proposal must:
  - Have submitted a Step-1 proposal as described in Section 2.1.
  - Have a *Proposal Title* that is identical to the title of the lead proposal, except that "[Institution 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 institution and the role of the Co-I(s) to the overall investigation. In the case of multiple Co-Is from the same institution, a single Co-I serving as the "Institutional PI" must be identified.
  - Include a full institutional budget covering the Co-I institution's proposed activities.
  - Be submitted electronically through the institution's Authorized Organizational Representative (AOR), with the Co-I (Institutional PI) from that institution listed as the PI.

3. Summary of Key Information

Expected program budget for first year of new awards	G/SR: $2.5M G/GIP: $1.0M G/IDES: $300K G/LCAS: $1.2M
Number of new awards pending adequate proposals of merit	G/SR: 21 G/GIP: 8 G/IDES: 2 G/LCAS: 3
Maximum duration of awards	G/SR: 3 years G/GIP: 3 years G/IDES: 3 years G/LCAS: 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 except for G/LCAS proposals where the page limit is 20 pp.; see also Chapter 2 of the *NASA Guidebook for Proposers*

Relevance	This program is relevant to the Heliophysics 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 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 (Step-1 only) 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	NNH12ZDA001N-GEO
NASA point of contact concerning this program	Mona Kessel Heliophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0064 E-mail: mona.kessel@nasa.gov

B.4 HELIOPHYSICS RESEARCH: SOLAR AND HELIOSPHERIC SCIENCE

Notice: The proposal submission for this program element is now a two-step process in which a Notice of Intent is replaced by a Step-1 proposal, which is required, and the Title and Team are binding. See section 2.1 for details. The Solar and Heliosphere related portion of the Heliophysics Guest Investigator Program has now been imbedded here, and its scope has changed. See section 1.3 for details.

1. Scope of Program

1.1 Overview

Proposers to this program element are encouraged to read Appendix B.1 for an overview of the Heliophysics Research Program in the NASA Science Mission Directorate.

The Solar and Heliospheric Physics (SHP) program has as its objective the comprehensive study of all five solar and heliospheric research areas, namely:

- Solar interior;
- Solar photosphere;
- Solar chromosphere, transition region, and corona;
- Inner heliosphere; and
- Outer heliosphere and the interstellar boundary

This program has four main research thrusts, nonflight Supporting Research (SR, Section 1.2 below), a Guest Investigator Program (see Section 1.3 below), Instrument and Technology Development (ITD) that may be carried out in the laboratory and/or observatory (see Section 1.4 below), and payloads on balloons, sounding rockets, or as secondary, rocket-class payloads on flights of opportunity that is generically referred to as Low Cost Access to Space (LCAS; see Section 1.5 below). These studies support NASA's strategic goal to understand the Sun and its interaction with Earth and the Solar System (see Section I(a) and Table 1 of the *ROSES Summary of Solicitation*) as discussed in the *Science Plan for NASA's Science Mission Directorate (2010-2019)* (available at http://nasascience.nasa.gov/about-us/science-strategy). Proposals in interdisciplinary research areas (e.g., solar-stellar connections) are appropriate for this program if the proposed research has clear application to Heliophysics program goals.

Objectives that are outside the scope of the SHP program and should not be proposed include:

- Currently solicited Living With a Star Targeted Research and Technology (LWS TR&T) Focus Topics and Initiatives are not appropriate for SH SR (see ROSES 2011 Appendix B.6);
- Proposals with the intent of extending or directly supplementing investigations selected for current, approved space flight missions are not appropriate for this solicitation. Investigators who are members of the science teams of ongoing missions and who propose to use data from these missions in SR efforts proposed through this solicitation must clearly delineate between their mission responsibilities and the proposed efforts.

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.

1.2 Solar and Heliospheric Physics Supporting Research (SR)

For purposes of program balance, the NASA SHP SR program element is organized into a matrix of four techniques, viz,

- Space-based observations;
- Theory and/or modeling;
- Data analysis; and
- Ancillary laboratory research (e.g., derivation of atomic constants, photometric calibrations, or simulation of solar and heliospheric phenomena),

for each of the five solar and heliospheric research areas noted in Section 1.1 above. Supporting research investigations in all matrix categories are invited (e.g., Solar Photosphere/Data Analysis, Outer Heliosphere/Theory-Modeling, etc.).

The SR program supports individual research tasks that employ a single or variety of research techniques in pursuit of SHP program goals. For example, the SR program supports theoretical research, the development and exercise of models and simulations, the analysis and interpretation of data for the purposes of identifying and understanding the physical processes important to solar and heliospheric physics, laboratory measurements of relevant atomic and plasma parameters, and, in special cases, the development or coordination of solar and heliospheric ground-based observing capabilities that support NASA SHP flight programs. The exploration of new instrument concepts, new observing techniques, new models, and/or new data analysis techniques are also supported, but must be clearly motivated by science questions important to the program. All proposals must provide an explanation of the relationship of the proposed effort to SH goals.

The SHP SR program also supports investigations involving analyses of existing NASA space mission data, but only if such data reside or will be placed in research-quality data bases in the public domain. For non-NASA missions, such as, for example, the National Oceanic and Atmospheric Administration's (NOAA's) Solar X-Ray Imager (SXI), etc., preference will be given to those proposals intending to utilize open databases. For investigations using restricted data, the proposer must submit a letter from the experiment Principal Investigator confirming that the data will be made available for the proposed SR work in a timely manner, which NASA reserves the right to confirm.

Similarly, if the proposed effort involves software that is not in the public domain or available to the public for purchase, the proposal should include a letter from the software copyright holder confirming that the software will be made available for the proposed SR work.

1.3 Guest Investigator Program (SHP GIP)

The Solar and Heliosphere Guest Investigators program (SH GIP) is intended to maximize the return from currently operating Heliophysics missions by supporting studies that address the current science goals of these missions. SH GIP proposals are defined as those whose dominant emphasis is the analysis and interpretation of NASA space heliophysics data that are archived in the public domain at the time of proposal submission. Information on the current science goals for these missions is available in the report of the Senior Review 2010 of the Mission and Data Analysis Program for the Heliophysics Operating Missions (http://science.nasa.gov/heliophysics/senior-review/.)

Information about the Heliophysics missions, key personnel, and data sets can be found at the SMD/Heliophysics web site: http://science.nasa.gov/heliophysics/missions/. Most of the observational data have undergone considerable reduction and refinement by way of calibrations and ordering, and extensive data analysis software tools often exist for these data. Virtual observatories can assist investigators in finding and accessing Heliophysics data. A list of virtual observatories pointing to Heliophysics data is at: http://science.nasa.gov/heliophysics/heliophysics-data-centers/. These include:

- Solar Data Analysis Center (SDAC) (http://umbra.nascom.nasa.gov)
- Virtual Solar Observatory (VSO) (http://sdac.virtualsolar.org/)
- Space Physics Data Facility (SPDF) (http://spdf.gsfc.nasa.gov)
- Virtual Space Physics Observatory (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)

Prospective submitters should also be aware that considerable research has already been done using these archival data sets by the original mission science teams, as well as by previously selected participants in the HGIP. Therefore, proposals must demonstrate how the proposed research clearly extends the frontier of existing knowledge in a fundamental and important manner rather than merely repeating a type of analysis on heretofore unstudied class or type of phenomena.

1.4 Solar and Heliospheric Physics Instrument and Technology Development (ITD)

The SHP ITD Program supports the development of instrument concepts that show promise for use in scientific investigations on, or give rise to future Heliophysics/Solar and Heliospheric Physics 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 SHP. ITD 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.

Especially welcomed 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 National Research Council decadal survey for space physics, *The Sun to the Earth — and Beyond: A Decadal Research Strategy in Solar and Space Physics* (available at http://www.nap.edu/catalog/10477.html).

1.5 Low Cost Access to Space Program in Solar and Heliospheric Physics (SHP LCAS)

The SHP Low Cost Access to Space (LCAS) program is expected to continue to lead the way in the development of a large fraction of instrument concepts for future solar and heliospheric missions using a variety of methods for providing low cost access to space. These methods include standard and long-duration balloons, sounding rockets, commercial reusable suborbital research rockets, and sounding rocket-class payloads flown as secondary payloads or on other flights of opportunity. Proposals for the SHP LCAS program must be for a complete science investigation, including clearly defined scientific goals appropriate for SHP, payload construction, launch phase, data analysis, and publication of results.

Suborbital 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 suborbital 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 leadership roles on future NASA space flight missions.

Proposals which do not sufficiently tie LCAS and instrument development efforts to SHP science goals will receive lower priority.

The Sounding Rocket Program is currently planning to provide launches from Woomera, Australia in July-September of 2014 and again in April-June of 2016, subject to the availability of funds. . Investigators responding to this 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 (increased performance) launch vehicles. Proposals must present a strong justification for this selection of launch site. For more information, potential proposers are encouraged to contact Philip Eberspeaker of the Sounding Rocket Program office, whose contact information is given in the *ROSES Summary of Solicitation, Section V*.

Please note, the NASA Balloon program is varying the future availability of launch sites so for more information, potential proposers are encouraged to contact Mr. David Gregory of the

Balloon Program office, whose contact information is given in the *ROSES Summary of Solicitation, Section V*.

1.5.1 *LCAS Page Limit*

Owing to the larger scope of SHP 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.

1.5.2 *Export Control Laws*

Export licenses are required for all foreign nationals accessing sounding rocket hardware. SH/LCAS program 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 rocket hardware. Questions concerning sounding rockets and U.S. Export Control Laws and Regulations may be addressed to the Sounding Rocket Program Office.

1.5.3 *Launch vehicle services*

Detailed information has moved to the *ROSES Summary of Solicitation, Section V*.

2. Programmatic Information

2.1 Step 1 Proposals

A Step-1 Proposal replaces the previous Notice of Intent (NOI); the length and content remain the same as an NOI, but the submission process has changed. To streamline the proposal process (submission, evaluation, and administration), the SHP program will be using a two-step proposal submission process starting in ROSES 2012 (see the overall description of a two step process in the *Summary of Solicitation Section IV.(b) vii*).

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 Proposals must contain the same scientific goals proposed in the Step-1 Proposal. The Step-1 Proposal Title, Principal Investigator, and all co-investigators are considered binding and cannot be adjusted in the full proposal. This two step procedure will be implemented without a downselect evaluation of the Step-1 proposal for ROSES 2012 and all proposers who submitted a Step-1 proposal will receive an invitation to submit the Step-2 proposal. Submission of the Step-1 proposal does not obligate the offerors to submit a Step-2 (full) proposal later. Please see the Step-1 Submission Clarification PDF file that can be downloaded from the embedded link in the line above or via NSPIRES web page for this program element. **[Added 3/1/2012]**

2.2 Available Funds

A total of about $6M SHP program funds next fiscal year will allow the selection of about 38 new awards from proposals for SR, ITD, GIP, and LCAS. Proposals of exceptional scientific merit requesting annual funding for up to that maximum amount will be considered for funding.

It is anticipated that approximately $2.8M will be made available to support new selections for SR. It is expected that about 22-25 new selections will be made with next fiscal year funds.

It is anticipated that approximately $0.5M will be made available to support new selections for ITD. It is expected that about –one to three new selections will be made with next fiscal year funds.

It is anticipated that approximately $1.0M will be made available to support new selections for GIP. It is expected that about 8 new selections will be made with next fiscal year funds.

As part of total SHP funding, the LCAS Program has approximately $1.7M available for a selection made through this solicitation of perhaps three LCAS investigations of up to four years duration will be made with next fiscal year funds. **[Corrected 2/17/2012]**

2.3 Maximum Duration of Awards

Typical duration of awards for SHP program is three years. Duration of proposed work up to four years can be requested for SR, ITD, and GIP proposals. However, a strong justification must be provided to support the extension of funding into the fourth year. Although most LCAS awards are for three years' duration, a four-year proposal may be accepted to develop a completely new, highly meritorious investigation through its first flight.

2.4 Additional Instructions for the Cover Page

To aid in the identification of peer reviewers, it is essential that the electronically submitted proposal *Cover Page* (in NSPIRES) for SHP proposals include a single choice of descriptor (e.g., Theory or Modeling/Solar Chromosphere, Transition Region, and Corona; Ground-based Observations/Solar Interior; Data Analysis/Inner heliosphere; etc.) as the "Technique/Research Area" designation that will appear on the Web site format.

3. Evaluation Criteria

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.

In order to demonstrate intrinsic merit proposals should present within their Scientific/Technical/Management section clear descriptions of 1) Compelling nature and scientific priority of the proposed investigation's science goals and objectives, 2) Appropriateness and feasibility of the methodology, 3) Potential science impact and probable success of the investigation, and 4) Relevance to Heliophysics science objectives.

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.

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. SH GIP proposals must demonstrate their contribution to the achievement of the current science goals of currently operating Heliophysics missions which includes any changes resulting from the Senior Review.

4. Summary of Key Information

Expected program budget for first year of new awards	~ $6M Total, $2.8M SR, $1.7M LCAS, 0.5 ITD, $1M SH GIP
Number of new awards pending adequate proposals of merit	~ 27 for SR and ITD combined, ~3 for LCAS, ~8 SH GIP.
Maximum duration of awards	SR, ITD, and SH GIP - 4 years; LCAS – 4 years; shorter-term proposals are welcome.
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	November 1, 2012
Page limit for the central Science-Technical-Management section of proposal	15 pp; except for LCAS where the page limit is 20 pp.; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the heliophysics 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 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 (Step-1 only) 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	NNH12ZDA001N-SHP
NASA point of contact concerning this program	Dr. Jeffrey Newmark Heliophysics Division Science Mission Directorate NASA Headquarters Washington DC 20546-0001 Telephone: (202) 358-0684. E-mail: Jeffrey.Newmark@nasa.gov or hq-shp-ps@nasa.gov Dr. Arik Posner Heliophysics Division Science Mission Directorate NASA Headquarters Washington DC 20546-0001 Telephone: (202) 358-0727 E-mail: Arik.Posner@nasa.gov

B.5 HELIOPHYSICS GUEST INVESTIGATORS

1. Scope of Program

The Heliophysics Guest Investigators program (GIP) is not being offered as a stand-alone element of the ROSES 2012 NRA, but has been subsumed as a part of elements B.3 (Heliophysics Research: Geospace Science) and B.4 (Heliophysics Research: Solar and Heliospheric Science) of the ROSES 2012 NRA.

B.6 HELIOPHYSICS LIVING WITH A STAR SCIENCE

Notice: The Heliophysics Living With a Star (LWS) programs in Appendix B.6, Targeted Research and Technology (TR&T), and Appendix B.7, Targeted Research and Technology strategic capability, which were presented as placeholders on release of ROSES 2012 in mid-February, will not be solicited this year. They will be solicited together as a single call, entitled Heliophysics Living With a Star Science, which will be Appendix B.6 of ROSES-13. Draft text for next year's version of Appendix B.6 is presented with this Amendment in ROSES 2012 as a courtesy to potential proposers. NASA anticipates that selections will still be announced near the end of fiscal year 2013.

The Strategic Capabilities element and the Sun-Climate Theme element will not be competed in ROSES 2013.

Notice: Proposal submission to all Heliophysics calls in ROSES 2013 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 team members cannot be changed between the Step-1 and Step-2 proposals. See section 2 for details.

1. Scope of Program

1.1 Overview

The goal of NASA's Living With a Star (LWS) Program is to develop the scientific understanding needed for the United States to effectively address those aspects of Heliophysics science that may affect life and society. The LWS Targeted Research and Technology (TR&T) program element solicits proposals leading 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. The TR&T program's objectives can be achieved by data analysis, theory, and modeling, and the development of tools and methods (e.g., software for data handling). TR&T is a crosscutting initiative that addresses the following LWS strategic goals (in no priority order):

1. Solar energetic particles and galactic cosmic rays pose major radiation hazards for space hardware and astronauts. Penetrating particle radiation adversely affects aircraft avionics and potentially the health of airline crews and passengers on polar flights. Communication and navigation systems are directly affected by impulsive changes in the solar particle and electromagnetic output leading to rerouted polar flights and GPS outages. In support of NASA's vision for space exploration and the national communication, navigation, and transportation infrastructure, the TR&T program needs 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. One of the major challenges facing humanity is global climate change. In order to gauge the response of the terrestrial climate system to natural and anthropogenic forcings, NASA through the TR&T program and the Earth Science Division, in conjunction with other national agencies such as National Oceanic and Atmospheric Administration (NOAA) and National Science Foundation (NSF), needs 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. National infrastructures are increasingly dependent on satellites orbiting Earth. With increasing miniaturization, these systems are ever more sensitive to variations in the near-Earth space environment. To protect these assets, the TR&T program needs to deliver the understanding and modeling required for effective forecasting/specification of magnetospheric radiation and plasma environments.

4. The upper atmosphere and ionosphere is central to a host of space weather effects, including anomalous satellite drag, GPS position error, radio blackouts, radar clutter, and geomagnetically induced currents. In order to mitigate space weather's impact on life and society, NASA through the TR&T program, in conjunction with other national agencies such as NSF and Department of Defense (DoD), needs 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 provided the basis for the selection of focused science topics for this solicitation. The primary goal of the LWS Program is to make progress in understanding this complex system, focusing on the most critical interconnections.

The *Final Report of the LWS TR&T Science Definition Team (SDT)* (December 2003), located on the LWS TR&T homepage at http://lws-trt.gsfc.nasa.gov/trt_resources.htm, identified TR&T as a systematic, goal-oriented research program. The TR&T component of the LWS Program provides the theory, modeling, and data analysis necessary to enable an integrated system-wide picture of Heliophysics science with emphasis on societal relevance.

Significant progress toward quantitative understanding and predictive capability with respect to these problems will require large-scale, integrated modeling activities. Recognizing the need for activities that would be broader and more sustained than those that can be supported by a traditional NASA grants program, the *Final Report of the LWS TR&T Science Definition Team* recommended that "…large modeling activities that address coupling across traditional science domains in the Sun-Earth chain specifically be included as strategic capabilities." The TR&T SDT also recommended the formation of a TR&T Steering Committee in order to update periodically the designated strategic capabilities for future solicitations. The most recent report of this Steering Committee is available on the LWS TR&T homepage at http://lws-trt.gsfc.nasa.gov.

As a result of these studies and recommendations, the LWS TR&T program has defined a strategy with three program elements, namely, Strategic Capabilities, Targeted Investigations, and Cross-Disciplinary Infrastructure Building programs.

Further background material concerning relevant research objectives can be found in the following documents:

- The National Academy of Sciences Web tutorial, entitled "*Space Weather: A Research Perspective*" (http://www7.national-academies.org/ssb/SSB_Space_weather97.pdf);
- The Sun Earth Connection LWS web site (http://lws.gsfc.nasa.gov/);
- The LWS Science Architecture Team report to SECAS (http://lws.gsfc.nasa.gov/documents/sat/sat_report2.pdf);
- *The Sun-Earth Connection Roadmap Report* (http://sec.gsfc.nasa.gov/sec_2002_roadmap.pdf);
- The National Research Council Decadal Survey Report *The Sun to the Earth and Beyond* (http://www.nap.edu/books/0309089727/html/);
- *The Heliophysics Roadmap* (http://heliophysics.gsfc.nasa.gov/sec_roadmap.htm);
- *The TR&T Science Definition Team Report* (http://lws-trt.gsfc.nasa.gov/TRT_SDT_Report.pdf); and
- *The latest TR&T Steering Committee Team Report* (http://lws-trt.gsfc.nasa.gov/trt_steeringcom.htm).

1.2 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-2014 at the earliest.

A primary goal of NASA's Living With a Star (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 for enabling exploration of outer space and testing new mission concepts. To begin the process of developing and integrating models for all the components of the Sun-Earth and Sun-Solar System chain, the LWS Targeted Research and Technology (TR&T) Science Definition Team (SDT) identified these models and their integration as strategic capabilities that are critical for the TR&T program.

The objective of a Strategic Capability (SC) within the LWS Program is development of one or more deliverables that address a significant and specific need for achieving the LWS and National Space Weather Program (NSWP) goals. It is expected that SCs will

incorporate the latest scientific results from LWS Focus Science Teams, as well as other research.

All proposed Strategic Capabilities must address the goals of the LWS and NSWP programs described above and must demonstrate that they constitute a major advance from previous Strategic Capabilities. Within these broad goals, proposers are responsible for specifying science focus of their proposed Strategic Capability, justifying the transformative nature of the project, and showing how it will make a unique contribution to LWS and NSWP.

Given the unique nature of the LWS SCs, proposal reviewers will include both scientific peers and knowledgeable representatives from the LWS/Space Weather user community. Proposals will be evaluated on the basis of their relevance, feasibility, intrinsic scientific merit, and compliance with requirements to provide public access to the models, tools, and value-added products developed.

1.3 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 TR&T program. First, the TR&T program must tackle large-scale problems that cross discipline and technique boundaries (e.g., data analysis, theory, modeling, etc.); and second, the TR&T program must identify how this new understanding will have a direct impact on life and society.

This Targeted Investigations program element is typically subdivided into the three components described below: (1) Focused Science Topics (FSTs), (2) The Sun-Climate Theme, (3) Tools & Methods. The maximum duration of these awards are four years, three years, and two years, respectively. Element (2), the Sun-Climate Theme will not be soliciting open proposals this year; instead there is a Sun-Climate centric FST. Element (3), Tools and Methods will not be solicited this year, and has been replaced by a call for science topics focusing on the LWS Program's first mission, Solar Dynamics Observatory (SDO; see section 1.3.4 below). The FST sections are expanded this year by the new concept of TR&T Targeted Science Teams (TSTs; see section 1.3.2 below). Read the following sections carefully; there are significant changes, especially as related to compliance.

Proposals will be judged non-compliant and will not be reviewed if the Evaluation Criteria found in section 2.2 below and detailed in section 1.3.1 are not met.

1.3.1. Focused Science Topics

A set of four Focused Science Topics has been chosen for this solicitation, which is listed below. The maximum duration of these awards is four years. NASA desires a balance of research investigation techniques for each Topic, including theory, modeling, data analysis, observations, and simulations. Any individual proposal does not need to include

all techniques. Given the submission of proposals of adequate number and merit, up to eight selections will be made for each Focused Science Topic. Once selected, these investigators will form a team in order to coordinate their research programs. 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 TR&T Focus Team Members and Leaders at (http://lws-trt.gsfc.nasa.gov/trt_focusteams.htm) for full details of responsibilities.

While the primary evaluation criteria remain unchanged (see *ROSES Summary of Solicitation*, Section VI(a), and the *NASA Guidebook for Proposers*, Appendix C.2), the criterion for relevance includes relevance to one of the five Focused Science Topics (see (a)-(e) below) as an essential requirement for selection within this component. As such, NASA has instituted a compliance check as follows:

In order to be compliant to this ROSES element, each proposal submitted must contain a section, entitled "Proposed Contributions to the Focus Team Effort" and 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.

Since each Focused Science Team has to produce a joint statement of work specifying its deliverables, success criteria, and milestones, the mandatory section described here can serve as a starting point for this SOW.

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.” LWS further emphasizes that Focused Science Teams will be formed from individual proposals selected in a Focus Topic. Therefore, individual proposals do not need to tackle the whole problem, but can instead seek to solve a piece of the problem.

The Focused Science Topics (FST) permitted as the objectives for proposals to this LWS TR&T solicitation are as follows:

(a) Short term solar/atmospheric variability and climate

Target Description:

Both observations and models demonstrate that short-term solar variations can produce significant effects in Earth's upper, middle, and lower atmosphere. Impulsive solar events, such as x-ray flares and solar energetic particles, occur on times scales of minutes to days that is very short compared to climatological time scales. Despite their short duration, these phenomena produce intensity changes at short wavelengths and in the energetic particle populations of several orders of magnitude, leading to dramatic changes in atmospheric response, often localized in space, time, or both.

As elucidated in "The Effects of Solar Variability on Earth's Climate: A Workshop Report" (NAP press, publication 13519, ISBN-10: 0-309-26564-9), a key question remains, namely, where does the role of short-term solar variability (both at short wavelength and in energetic particle populations) fit into the larger effort to understand the influence of the Sun on climate? Although total solar irradiance is the main solar driver of climate variability, whether, and by what mechanisms shorter-time-scale variations have an impact on climate are presently unclear.

The goal of this Focused Science Topic is to develop understanding of the complex response of the atmosphere to these short-term solar variations in order to know how these effects translate into the historical records of solar variability and their long-term impacts on climate. We presently have unprecedented observations of these nonvisible elements of solar variability (short wavelength solar photons and solar energetic particles) and of the atmosphere, which responds to these highly-variable solar drivers. We also now have modeling capabilities to explore the complex interactions and responses throughout the affected portions of the atmosphere to the inputs. If we can quantify these short-term responses through combined model development and data validation, then this knowledge can be used to address the more subtle, but potentially important, slow variation of these same drivers, and the atmosphere's response occurring on climatological timescales.

Goals and Measures of Success:

The goal of this Focused Science Team is to advance our understanding of the short-term responses of the atmosphere to impulsive solar events,, such as flares and solar particles by:

- Progress in quantifying the range and sensitivity of the atmosphere's complex response to rapid inputs of energy in the form of x-ray flares and solar particles.

- Progress in understanding what aspects of the flares and solar energetic particles (intensity, duration, spectral shape, etc.) control the atmosphere's response and what other factors might control the response (such as prior condition of the atmosphere).

- Use of modern observations to validate and calibrate models, which in turn can be used to explore recent historical trends of these drivers and their predicted responses.

- Progress on how to extend our knowledge on the short-time scale, to address the slower variability of these same mechanisms occurring on climatological time scales.

Types of Investigations:

- Numerical models of atmospheric responses to a full range of impulsive solar energetic particles and flare photon 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.

- Validated models to explore and to quantify whether longer-term variations in these rapid-timescale phenomena contribute to climate variability.

(b) Magnetic Flux Ropes from the Sun to the Heliosphere

Target Description:

Magnetic flux ropes are widely believed to play a central role in space weather. Essentially all models for the magnetic field that emerges from below the photosphere to form active regions assume a flux rope structure. Observations of coronal cavities, prominences and active region sigmoids suggest a flux rope structure for the preeruption field, and coronagraph observations invariably show a flux rope for the eruption itself. Furthermore, many models for the preeruption coronal magnetic field of CMEs/eruptive flares invoke a twisted flux rope topology, and all CME models predict a highly twisted flux rope for the eruption, irrespective of the preeruption structure. Ground truth is provided by in situ measurements of the field in the heliosphere. These generally show a twisted flux rope. Hence, flux ropes are a unifying theme across Heliophysics, and understanding the mechanisms of their formation, evolution, and propagation is critical to predicting space weather.

Despite their central importance to space weather, many basic questions on flux ropes remain. For example, where, when, and how flux ropes are formed on the Sun remains highly controversial. Some observations and models support emergence of fully or partially formed flux ropes from the convection zone, while others support local formation in the corona due to magnetic reconnection preceding or during eruptions. We also do not understood how a flux rope, once formed, evolves and eventually erupts. Finally, the posteruption transport and evolution of flux ropes through the heliosphere remain unclear. Even though all current eruption and propagation models predict a flux rope at 1 AU, in situ measurements frequently appear to show a nonrope structure for ICMEs. We are also far from understanding how the observed fields at the Sun determine the IMF at Earth, which is critical to space weather prediction.

It is timely to undertake investigations that unify the observation of flux ropes at the Sun by SDO and Hinode, as well as propagation in the heliosphere by LASCO and STEREO, and their *in-situ* measurement by ACE, Wind, and STEREO. In addition, a growing network of ground-based instrumentation, including interplanetary scintillation arrays, muon detectors, and low-frequency radio telescopes, has been deployed that has the potential to detect the propagation of heliospheric structures as they travel through interplanetary space. As flux-rope related activity increases over the current solar cycle, we now have new observational, numerical, and theoretical capabilities with the potential to make great progress. For example, SDO and Hinode have provided unprecedented high-resolution (spatial and temporal) observations of coronal cavities, prominences/filaments, and sigmoids and early development of CMEs in active regions. SDO/HMI and Hinode/SOT also provide vector magnetic field observations that are critical to determining the magnetic roots of flux ropes in the photosphere. Such observations, in combination with those from STEREO and ACE, can now monitor flux ropes continuously from the Sun to the heliosphere. Meanwhile, 3D MHD models covering a wide domain ranging from the convection zone to the corona and heliosphere can now simulate flux ropes that can be directly compared with new observations. These numerical efforts are being complemented by parallel theoretical/analytical modeling of relevant elementary processes, such as those leading to prominence formation in flux ropes.

Goals and measures of success:

The overall objective of this Focused Science Team is to advance our observation and understanding of the "life cycle" of a magnetic flux rope, from its birth in the Sun, through its evolution and growth phase in the corona, to its eruption and transport through the heliosphere. Measures of success will, in all cases, be sought to reconcile observations/measurements and predictions with model-based simulations and/or theoretical investigations, as well as the elimination of theoretical ideas demonstrably not supported by observations. The primary goals are fourfold:

• Identify the formation mechanisms of flux ropes in the solar atmosphere
• Understand the evolutionary processes leading to eruptions
• Understand the evolution of flux ropes in the interplanetary medium, and in particular, relate the flux rope IMF at 1 AU to solar observations
• Determine the role of flux rope eruptions in the magnetic flux budget of the heliosphere

Types of solicited investigations:

This FST seeks broad interdisciplinary studies that tie together the heliospheric and solar observations. Possible studies include:

• Observational studies of flux rope formation and evolution, such as vector field data from SDO or from the ground and high-resolution coronal imaging/spectroscopy from SDO, Hinode, and STEREO
• Observational studies of flux rope propagation through the heliosphere, such as those from coronagraphs, heliospheric imagers, and ground-based networks

• Studies of *in-situ* measurements of flux rope magnetic and plasma structure, especially plasma properties that can be related to the solar observations, such those from STEREO, ACE, and Wind
• Theoretical/modeling studies of flux rope formation/emergence, evolution and propagation in the heliosphere

(c) Connection between Solar Interplanetary Structures and the response of Earth's radiation belts

Target Description:

We have learned over the last two decades that the response of Earth's hazardous MeV-class outer Radiation Belts to such interplanetary structures as Coronal Mass Ejections (CME's), Corotating Interactions Regions (CIR's), high-speed streams and other structures, is highly unpredictable. An interdisciplinary team is needed to resolve the outstanding issues. There has been much discussion in the literature about the controlling parameters, whether they are pressure, density, velocity, magnetic field magnitude and orientation, and energetic particles that can find their ways into the magnetosphere. But the response to interplanetary structures clearly also depends on the space-time structures of these interplanetary features and the consequential hysteresis of responses of the magnetosphere to those structures. Mechanisms that might communicate the influences of interplanetary structures on the radiation belts could include: 1) ULF waves (that drive RB radial diffusion) generated by external variations and magnetopause K-H wave generation; 2) The relative stimulations of storms and substorms as each has their respective roles in the dynamics of the radiation belts; 3) Global magnetospheric response to external pressure disturbances; 4) Past history (hysteresis, seeding, existing boundary structures) and the consequences on wave generation (e. g. whistlers). Our objective is to sort out the factors associated with the interplanetary structures on the radiation belts and to move towards an understanding of the mechanisms by which those factors exert their influences.

Goals and Measures of Success:

The goal of this Focus Science Team topic is to determine and quantify the relationships between specific solar and interplanetary structures, Coronal Mass Ejections (CME's), Corotating Interaction Regions (CIR's) and other structures, and the dynamic responses of hazardous radiation conditions near and inside the geosynchronous orbit. Success will be achieved when we: 1) Understand the phenomenological connections between the different space-time parametric structures of interplanetary events and the responses of the >MeV outer radiation belt: whether the intensities increase or decrease, whether they move inward or outward, whether they lose their outer layers; 2) Demonstrate the ability to correlate interplanetary structure characteristics and radiation belt responses and develop a scheme for characterizing radiation belt responses; 3) Identify the most important mechanisms by which these interplanetary states regulate the radiation belt responses: generation of storms and substorms, generation of ULF waves; role of seeding, past history, and existing boundaries; global magnetospheric responses to pressure

disturbances; and 4) Move towards an understanding about how these mechanisms influence and regulate the >MeV radiation belts.

Types of investigations:

The FST participants will address the structure and evolution of interplanetary structures, and the interaction of such structures with the dynamics of Earth's radiation belts. Possible investigations include:

• Observational studies correlating characterize the detailed space-time structures of interplanetary features impinging on Earth's magnetosphere (CME's CIR's, high speed streams, etc.) with observations (e. g. SAMPEX and RBSP, etc.) of the response of the radiation belts.
• Global simulations of the magnetospheric response to Solar Wind structures that provide the plasma and fields in the inner magnetosphere. These results will be compared to the in situ observations of RB probes, and provide the context for wave studies.
• Observational and theoretical studies of wave generation and damping (ULF, Chorus, EMIC, etc.), and the resulting wave-particle scattering.

(d) Thermospheric wind dynamics during geomagnetic storms and their influence on the coupled magnetosphere-ionosphere-thermosphere system

Target Description:

The role of winds in modifying the ionosphere during geomagnetic disturbances, and how this varies with disturbance magnitude, remains an important unsolved problem in upper atmosphere science. An improved understanding of the global thermospheric wind system and the sources of its variability is essential for improving our ability to develop useful predictive models of satellite drag and ionospheric electron density variations during geomagnetic storms. Thermospheric winds, both horizontal and vertical, are excited in complex ways by magnetospheric energy and momentum inputs at high latitudes, affecting global circulation patterns and electrodynamics. The winds modify thermospheric density and composition, and strongly impact the ionosphere both directly, through ion transport, and indirectly, through influences on the production and loss of plasma and the generation of dynamo electric fields.

Recent observations and modeling developments now permit substantial progress on this question. New global observations from GPS-equipped satellites such as the COSMIC/FORMOSAT-3 constellation, CHAMP and GRACE, from CINDI observations onboard C/NOFS, and expanding ground-based networks, are providing unprecedented global coverage needed to understand the role of neutral wind dynamics. Recent developments in modeling, such as first-principles and empirically based disturbance time wind models, and the development of assimilative models that can derive winds, are useful new resources that permit substantial progress.

Goals and Measures of Success:

The primary goals of this focused science topic are to improve modeling and characterization of thermospheric wind processes during disturbed periods and to improve understanding of the role of winds in ionospheric storm time dynamics. Measures of success include improved predictive capability of thermospheric winds based on solar wind inputs; development and application of new direct and indirect wind observations that measure storm-time wind dynamics on global scales; new coordinated data sets of ionospheric electron density, electric fields, and thermospheric properties; and new insights into the spatial/temporal scales of storm-time thermospheric variations that affect terrestrial space weather.

Types of Investigations:

Substantial progress on this Focused Science Topic is possible with the following investigations:
• New observation and characterization of global wind field dynamics using direct and indirect measurements from ground and satellite
• New methods for obtaining global wind fields using data assimilative techniques
• Analyses of thermospheric wind responses to solar and magnetospheric energy inputs
• Analyses that elucidate the role of thermospheric dynamics in ionospheric storm-time variability, taking into account transport, electrodynamics, and thermospheric composition
• Developing and/or using first-principles and empirical models to characterize winds and the relationship between winds and ionospheric storm time response
• Theoretical and modeling studies that elucidate the role of winds in causing thermospheric and ionospheric variability
• Improved use of past data sets in light of current understanding.

1.3.2 Targeted Science Teams (TSTs)

During the past ten years, the TR&T FST and SC programs have brought about a revolution in both LWS science and infrastructure. As a result of the TR&T, many of the most basic science issues important to LWS have been identified and addressed. Our understanding of a number of LWS science problems has advanced to the point that the remaining issues are ripe for a concerted team effort, where the attributes of the required team can be clearly defined. Furthermore, collaborations between traditionally different subdisciplines have been fostered to the point that we now have a robust interdisciplinary community, which is capable of supporting such predefined science teams. Consequently it is now timely to attack some of the TR&T science targets with predefined dedicated Teams.

The difference between these Targeted Science Teams TSTs and the traditional FSTs is that the TSTs will form *prior* to selection under a single PI and submit a single TST proposal that attacks the TR&T target. The advantages of this approach are obvious and address some of the major community concerns with regard to the teaming aspects of the present FST program. First, in order to be selected, the TST will necessarily have all the

expertise required to attack the specified Science Target rather than rely on random chance to form a complete Team. Second, the Team Leader, the PI, will again be preselected and will necessarily be a likely, effective leader in order for the proposal to be selected rather than again rely on "the luck of the draw."

A key aspect of the TST program is that the expertise required for a particular Target will be specified in advance by the TR&T program as part of the Target description. One of the main criteria for evaluating TST proposals will be the extent to which individual members of the Team satisfy the expertise requirement. This will encourage the TSTs to be strongly interdisciplinary and to involve the best people in the field, rather than simply co-located groups.

Proposers are encouraged to propose to FST (b) "Magnetic Flux Ropes from the Sun to the Heliosphere" as a TST, and strongly encouraged to propose to FST (a) "Short term solar/ atmospheric variability and climate" as a TST. However, proposers may propose to address any of the FSTs listed in section 1.3.1 above by means of a TST. A proposal with an annual budget in excess of $200k will implicitly be taken to be a TST proposal and will be evaluated accordingly. All of the FST compliance and relevance requirements are still valid and mandatory when proposing as a TST.

1.3.3 The Sun-Climate Theme

Notice: The Sun-Climate Theme element will not be solicited in 2013 except those of the "Short term solar/atmospheric variability and climate" FST, see section 1.3.1(a), above.

The LWS Sun-Climate strategic objective is 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."* The new Sun-Climate Theme is established to address this objective. The maximum duration of these awards is three years. This theme represents a new opportunity to foster cross-disciplinary investigations of connections between solar forcing and climate. Particular emphasis is placed on 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. Only investigations of sun-climate issues will be considered compliant with this theme; climate investigations that are not directly relevant to solar forcing are not being solicited. Atmospheric responses on time scales of seasons to millennia are of primary interest.

Rather than aiming science contributions at a focused science team, proposers will submit individual investigations that must explicitly describe how the proposed work will lead to progress in achieving the prioritized goal quoted above. Contributions from a solar and upper atmosphere perspective will likely be on equal footing with those from a lower atmosphere climate dynamics and chemistry perspective. Exchange among diverse research foci within the Sun-Climate Theme is expected to grow through regular meetings (initially once a year) and individual collaborations are strongly encouraged.

Thematic Description: Proposals submitted to the new Sun-Climate Theme will target processes by which solar influence particulate forcing can impact the Earth's climate. Solar activity variations clearly influence the upper atmosphere, but signals diminish toward the surface. Nevertheless, in some locations climate-related parameters, such as the historical surface temperature or moisture records, exhibit variations that appear to be related to the solar cycle. Two key issues must be addressed to make progress in quantifying the solar contribution to climate variability and change: (1) Observed decadal to centennial-scale climate signals throughout the atmosphere and at the surface must be categorized as either systematically related to solar activity changes or as spurious because of internal climate system variations on similar time scales. (2) The emphasis of solar impact studies in climate research must be broadened beyond mean radiative forcing to include both direct and indirect atmospheric impacts of spectral irradiance and particle precipitation variations over the full range of spatial and temporal scales.

The intent of this Sun-Climate Theme is to initiate cross-disciplinary research that will develop a more solid mechanistic understanding of pathways by which solar variability affects the various levels of the atmosphere, and how these effects are communicated toward the troposphere and surface where they modulate global and regional climate. It also targets the pathways by which ongoing climate change influences the atmospheric response to solar forcing, both directly and via upward coupling. Investigations that identify these processes and analyze variations over a wide range of time scales are necessary to reconcile observations and understanding of the natural modulation of climate by the Sun, and to delineate the Sun's role in regional climate variability and current climate change. This information is crucial for testing climate models that are used for regional climate change prediction. Thus, this program component solicits investigations that seek to define and quantify the solar-induced changes in a "whole atmosphere" approach, emphasizing downward and upward coupling between the upper and lower atmosphere.

Objectives and Metrics: The overall objective is to predict the climate response to solar variability (in many different forms) on regional as well as global scales. Metrics will be gauged for a number of tasks: (1) Identifying and quantifying the relevant pathways by which solar forcing causes variability in climate parameters such as atmospheric temperature, circulation, and wave activity over a broad range of time scales; (2) Isolating the regional and global climate response to variations in these pathways with data that have enough sample (record length); (3) Assessing the sensitivity of these pathways to long-term change in the troposphere and atmospheric composition; (4) Incorporating solar forcing effects into coupled chemistry climate models (CCMs) to produce verifiable simulations of these effects on atmospheric processes; (5) Testing and improving the predictive capabilities of the CCMs and Earth System Models with regard to solar-induced forcing. Also of interest is identifying the minimum specifications of vertical extent, resolution and process complexity that a lower atmosphere model would need in order to adequately simulate solar effects on surface climate and variability.

It is expected that numerical modeling, theory, data analysis, and assimilation investigations will contribute to the Sun-Climate Theme, with studies addressing seasonal

to millennial time scales. The following topics are examples of relevant areas of investigation; these are meant only to be illustrative, and are not all-inclusive:

- Quantify wintertime constituent transport from the thermosphere to the stratosphere, and any subsequent effects on the troposphere, to investigate the influence on these processes of solar particle variability.
- Improved understanding of dynamo processes and solar theory as it relates to long-term climate evolution and change.
- Interpreting cosmic nuclide data in terms of solar activity including accurate estimates of the history of Earth's magnetic field.
- Cyclic and secular changes in Sun-like stars: implications for solar variability and climate change.
- Quantify stratospheric ozone variations caused by solar irradiance variability, and the impacts of these variations on atmospheric circulation patterns.
- Explore the sensitivity of planetary-wave propagation and of large-scale circulation processes, such as the Brewer Dobson circulation, to solar variability.
- Develop and apply statistical procedures to climate data in order to quantify solar-variability signals on various time scales, tying these signals to radiative, chemical or dynamical processes.
- Determine what regional climate variability is systematically influenced by solar variability.
- Develop an assimilation of meteorological data from the troposphere up to the lower thermosphere to identify the impact of solar variations.
- Investigate the sensitivity of interhemispheric coupling to wave activity variations induced by solar variability.
- Evaluate the spectral detail necessary for proper treatment of the radiative and photochemical response to solar spectral variability.
- Identify the dominant processes by which galactic cosmic rays can influence climate, including impacts on cloud condensation nuclei and thus cloud cover and cloud radiative forcing, as well as impacts on the global atmospheric electric circuit.
- Assess the influence of climate change on any of the above.

Note that this theme is not soliciting proposals for the development of solar irradiance proxies, unless they are specifically focused on improving the treatment of atmospheric coupling. Furthermore, this theme does not address day-to-day weather variability, unless it is connected to longer-term changes in tropospheric and stratospheric climate.

1.3.4 Science Analysis for the Solar Dynamics Observatory (SDO)

NOTICE: The solicitation of proposals for Section 1.3.4 is contingent on sufficient funds being made available to the LWS Program budget for FY 2014.

This topic challenges proposers to use the data from the Solar Dynamics Observatory (SDO) to characterize the properties, evolution, and terrestrial consequences of the solar

magnetic field. SDO produces images of the Sun at wavelengths from the visible to the extreme ultraviolet and soft X-ray, full-disk Dopplergrams, as well as full-disk vector magnetograms at an unprecedented cadence and spatial resolution that span scales from the arcsecond resolution to the full diameter of the Sun. Data during the initial part of the SDO mission has shown the Sun at solar minimum has many interesting phenomena that require additional analysis to understand. Fast wave-like processes, distant interactions between solar regions, the thermal fine structure of the corona, and the sources of irradiance variations over a wide range of X-ray and (E)UV wavelengths are now routinely made. These observations can tell us more about the origins of solar variability and space weather. Below are some topics of interest.

Types of investigations:

- Investigate the linkage of subsurface features with magnetic fields above the surface;
- Investigate the physics and diagnostic potential of coronal wave-like phenomena made accessible by AIA's high cadence, high signal-to-noise ratio, or large field of view;
- Determine the impact of small events on larger-scale processes through the coupling of scales, including, for example, destabilazation of large filaments by ephemeral-region emergence, active-region evolution on the formation on coronal holes, or flaring triggered by processes external to the flaring active region;
- Determine the relationship between EUV radiance and the plasma properties of the corona; including how filaments evolve (takeoff velocity, twisting, non-'free-fall' velocities, failed escape/eruptions); why do coronal loops on one side of the erupting filament/active region stay intact and just move out of the way during, then move back after an eruption or flare;
- Analyses of flare energetics by modeling the radiative cooling of small flares to understand the late phase seen in EVE irradiances and creating an understanding of the heating of the solar chromosphere and transition region during the impulsive phase of a flare,
- Use of observations to predict future solar activity, from short timescales to forecast of the properties of Solar Cycle 24.

This proposal opportunity is open to all interested parties, including Co-Investigators of SDO Science Investigations. A Co-I must show that the proposed research does not overlap with research currently funded by the SDO mission. Also, proposers should get a letter of acknowledgement from the PI/PIs to ensure that the latest data product described in the proposal will be available to them.

1.4. Cross-Discipline Infrastructure Building Programs

One of the major challenges facing the LWS Program is the development of a research community that can cross traditional discipline boundaries and attack the system-wide problems that are central to understanding and modeling the Sun-Solar System connection. In order to address this challenge, proposals to this LWS TR&T program may include one or more of the following infrastructure-building elements: cross-disciplinary workshops, summer schools, and postdoctoral fellowships programs. Most of these

activities will be supported through formal proposals to the TR&T program as part of the regular proposal cycle. In all cases, two extra pages will be allowed to the page limit for the science/technical/management section of the proposal (see Section 3 below) for each of these activities.

(a) Support of LWS Workshops/Campaigns: Given the goals of the Infrastructure Building Program, there are several guidelines that successful requests for workshop/campaign support must satisfy:

- The workshop must address a science or technology topic that is both timely and important to the goals of the LWS program.
- Workshops must focus on comparing and validating tools that have already been developed. Examples of possible workshops include 1) predicting all clear forecasting, 2) comparison of helioseismic techniques, and 3) velocity estimation methods.
- Other workshop topics must be cross-disciplinary in nature and bring together researchers from different disciplines encompassed by the LWS program.
- Although there are no restrictions as to where the workshop will be held, preference should be given to locations that are convenient and cost-effective for LWS researchers and students.
- Workshops that encourage the training of new researchers in LWS system science are strongly encouraged.
- Workshops that leverage funding from other institutions and agencies are strongly encouraged.

(b) Directed Topic Workshops: To address science topics that are both timely and important to the goals of the LWS program, but whose scope is not sufficient for the level of support of an FST, proposals for workshops that will address the following two topics are strongly encouraged:

i. Critical Assessment of Dynamo Models; and
ii. Maximizing Science Return from Solar Wind Composition Data.

In addition to describing the location, objectives, and tentative agenda/schedule of the workshops, proposals should provide a list of likely invited participants. In this regard, the Directed Topic Workshops may be viewed as TSTs, bringing together a predefined team to attack the science problem in an interactive, intimate, workshop format. Parallels may be drawn with the ISSI workshops (http://www.issibern.ch/) and the CEDAR/GEM challenges (http://cedarweb.hao.ucar.edu/wiki/index.php/2012_Workshop:CEDAR_ETI_Modeling_Challenge/). Proposals should thus include plans for team websites and publication of results in (special issues of) peer-reviewed Journals.

(i) Critical Assessment of Dynamo Models
The origin of solar activity lies below the photosphere in the internal flows that generate the magnetic field and determine the properties of the dynamo. Between these causative

flows and the effects in the solar atmosphere and heliosphere lies a chain of physical processes and interfaces that are complex and far from understood. Many such processes have been studied in detail, but the connections between them are largely unexplored. We must advance our understanding of these couplings and incorporate them in improved physics-based models in order to make reliable forecasts of the solar activity cycle.

Subsurface magnetic field can be generated in the tachocline at the base of the convection zone, in the body of the convection zone, near the surface in a shear layer, and by turbulence. In kinematic dynamo models, the interplay between the large-scale internal flows of differential rotation, meridional circulation, kinetic helicity, and turbulent magnetic diffusion results in the transport of magnetic flux and helicity within the convection zone and subsequent concentration of the field to the point that it becomes buoyant and emerges at the surface. Kinematic dynamo models have achieved significant success, but some critical ingredients are poorly constrained below the surface and incompletely understood even at the surface. Questions that need to be investigated include:

• What is the nature of interior flows, and how do they determine the sunspot cycle period?
• Are subsurface flows from helioseismology consistent with observed flows in the photosphere?
• How is magnetic helicity generated and transported throughout the convection zone?
• How does the generation of kinetic and magnetic helicity below the photosphere affect the emergence and evolution of active regions and dynamo itself?
• Do observed poloidal fields arise only from the surface transport of active-region fields?
• Are models of photospheric flux transport measurably improved by including subsurface flows or different models of turbulent magnetic diffusion?
• How do additional mechanisms of flux transport (for example turbulent magnetic pumping) affect the observed properties of the dynamo?
• Can critical elements of the kinematic dynamo picture be constrained through observations of other stars?

The goal of this Directed Workshop is to bring researchers in the various subfields of solar physics together to better understand the coupled magnetic and kinematic processes in the solar interior, photosphere, and corona and to use this knowledge to improve the predictive potential of dynamo models. Metrics of success include improved agreement between observed and modeled surface magnetic flux that better incorporate helioseismically determined subsurface properties and, therefore, have fewer free parameters, and the ability to account for the observed range of cyclic behavior in solar-type stars.

The Solar Dynamics Observatory produces a wealth of pertinent data necessary to address this topic; for example, HMI will provide high-degree helioseismology and simultaneous high-cadence vector magnetic field observations in the photosphere. The broad and systemic nature of the proposed research requires a coordinated approach that spans multiple areas of expertise but retains a focus matching observations at and above the photosphere with the picture of an underlying dynamo.

Likely participants to increase the probability of workshop success should offer:

• Studies of the relationship between helioseismic inferences of internal flows and observed vector magnetic fields in the photosphere, including detailed analysis of polar field measurements,
• High resolution MHD models of convective turbulence at various depths in the convection zone, including surface effects such as supergranular flows, to yield better estimates of turbulent magnetic diffusion for inclusion in flux transport models and the generation and transport of magnetic helicity at various depths in the convection zone.
• Global MHD studies of various flux generation and transport mechanisms within the convection zone.
• Kinematic dynamo models that can explore a wide range of parameters using both solar and stellar observations as constraints.
• Stellar observations focused on measurable properties that can constrain the solar kinematic dynamo picture—e.g., cycle period, rotation rate, differential rotation, latitude distribution of activity, and asteroseismic properties.

(ii) Maximizing Science Return from Solar Wind Composition Data

The heliosphere is filled with solar wind, with speeds ranging from below 400 km/s to above 700 km/s. The fastest solar wind (>700 km/s) is primarily associated with large regions of predominantly unipolar magnetic field – coronal holes. Near solar minimum the fast solar wind is usually confined to the two polar coronal holes. The slow solar wind (~400 km/s), on the other hand, is usually confined within a band associated with the heliospheric current sheet that separates the two polarities. Fast solar wind is characterized by ionic charge states that are indicative of relatively cool conditions in the corona. The slow wind exhibits ionic charge states indicative of hotter conditions in the corona and also has an elemental composition that is fractionated with respect to the photosphere, favoring ions with low first-ionization-potential (FIP), a phenomenon not strongly observed in the fast wind.

It is timely, given the wide variation in the continuous solar wind composition measurements in the past two solar cycles, and the nonselection of an Ion Composition Experiment for Solar Probe+, to call for a series of Workshops to maximize the science returns from *existing* Solar Wind Composition data: *ACE*/SWICS, *Ulysses*/SWICS, *STEREO*/PLASTIC, *Wind*/SMS, and *SOHO*/CELIAS data, so as to develop a coherent mechanism for fractionation of solar wind composition, heating and acceleration of solar wind ions, and its temporal and spatial variations. To explain the origins of the differentiated solar wind completely, it is key to characterize and understand the bulk flow and elemental/ion composition *simultaneously*. This is a quintessential System Science investigation: given that the energy that heats the corona and drives the wind derives from photospheric motions and is channeled, stored, and dissipated by the magnetic fields that emerge from the photosphere and structure the coronal plasma, changes in solar wind properties must ultimately stem from processes in, or below, the photosphere. Therefore. it is also key to combine observations of different layers of the solar atmosphere that

manifest these (sub-)photospheric processes for interpreting and understanding the variations in solar wind composition.

Likely participants to increase the probability of workshop success should offer:

- Self-consistent models of coronal heating, solar wind acceleration, and ion-neutral fractionation that are consistent with solar wind composition data and associated solar observations.
    - Are the fast wind and slow wind driven by radically different processes, or is a continuous range of bulk flow properties possible?
    - To understand the causes for variations in solar wind composition.
- Models and techniques to prepare for, and that will enhance the science return of, the *Solar Orbiter* and *Solar Probe+* missions. Explaining the solar wind ion composition by means of physics-based models of coronal heating and acceleration of the nascent solar wind. For example:
    - Is solar wind acceleration decoupled from coronal heating?
    - What processes/characteristics in the solar atmosphere determine the variations in the solar wind ion composition?
- Explanations of the solar wind elemental composition in the solar wind by means of physics-based models for ion–neutral fractionation.
- Solar observations (e.g. magnetic, spectroscopic, or dynamic properties) or empirical models that can relate to and interpret the spatial or temporal variations in the solar wind composition.
- Explanations of the long-term variations in composition/velocity dependence signatures over the solar cycle, and, in particular, in the recent unusual solar minimum.
- Explanations of the short-term variations in composition over individual solar wind streams (down to flux tubes/instrument cadence limit). This may include *ACE-STEREO* correlation studies.
- Models of solar wind thermal and suprathermal elemental/ion composition properties and ion VDFs in the inner heliosphere, so as to prepare for the upcoming launch of *Solar Orbiter*, and to mitigate the lack of an Ion Composition Experiment on *Solar Probe+*.

1.5 <u>Types and Duration of Investigations</u>

This program element contains three components described in section 1.3: (1) Focused Science Topics, (2) Sun-Climate Theme, and (3) Tools and Methods. The maximum duration of these awards are four years, three years, and two years, respectively. In addition there are Cross-Discipline Infrastructure Building Programs described in section 1.4. The duration of these awards are one to five years. Finally, the Strategic Capabilities awards, described in section 1.2 but not solicited this year, are of five years duration.

Read the preceding sections carefully; there are significant changes this year, especially as related to compliance. Proposals may be judged noncompliant and not be reviewed if certain criteria are not met. Highlights are listed in section 2.2.2 below.

2. Submission and Evaluation Process

2.1 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*).

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 proposals must contain the same scientific goals proposed in the Step-1 proposal. The Step-1 proposal title, Principal Investigator, and all team members 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.

2.1.1 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 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 “Proposal Attachment” which should be the Step-1 proposal.

2.1.2 Step-1 Evaluation Criteria

Step-1 proposals may be declared noncompliant based on the compliance requirements listed in Section 1.3.1. PIs of noncompliant proposals will not be eligible to submit the associated Step-2 proposal, and will receive a letter to this effect.

2.2. 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 team members 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.

2.2.1 Step-2 Proposal Format

Guidelines for submitting Step-2 full proposals are specified in the *NASA Guidebook for Proposers*.

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. 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 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.

2.2.2 Step-2 Evaluation Criteria

Step-2 proposals that are not complaint with format requirements in Section IV (b) ii of the *ROSES-13 Summary of Solicitation* and the *NASA Guidebook for Proposers* may be rejected without review. (1) If applicable for this solicitation, proposers must select the component that is appropriate for their intended proposal; proposals that are not appropriate for the chosen component 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 the NASA's objectives and those of the FST, which includes cost realism/reasonableness.

For Focus Science Topics (only) described in section 1.3.1, in addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion for relevance specifically includes the following factor:

- 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. See section 1.3.1 for more details.

Relevance is dependent on the particular Focus Science Topic. Each proposal must demonstrate that the investigation is appropriate for the FST selected.

For the Sun-Climate Theme component, described in section 1.3.3, and the Cross-Discipline Infrastructure Building Program described in section 1.4, there are no additional evaluation criteria, other than those given in the *NASA Guidebook for Proposers*.

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.

3. Summary of Key Information

Expected annual program budget for new awards	~ $3.5 M
Number of new awards pending adequate proposals of merit	~ 30
Maximum duration of awards	Tools & Methods: 2 years Sun-Climate Theme: 3 years Focused Science Topics: 4 years Cross-Discipline Infrastructure: 1-5 years Strategic Capability: 5 years
Due date for Notice of Intent to propose (NOI)	March 1, 2013
Due date for proposals	May 1, 2013
Date for start of investigation	No earlier than October 1, 2013.
Page limit for the central Science-Technical-Management section of proposal	15 pp; extra page permitted for proposals to be Team Leader of Focused Science see also Chapter 2 of the *NASA Guidebook for Proposers*
File size limit for the proposal	10MB; this limit applies to the combined size of all PDF files that are uploaded for a single proposal.
Relevance	This program is relevant to the Heliophysics 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 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 *2013 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	NNH13ZDA001N-LWS
NASA point of contact concerning this program	Dr. Madhulika Guhathakurta Heliophysics Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1992 E-mail: mailto:lws.trt@nasa.gov

B.7 LIVING WITH A STAR TARGETED RESEARCH AND TECHNOLOGY: STRATEGIC CAPABILITY

Notice: The Heliophysics Living With a Star (LWS) programs in Appendix B.6, Targeted Research and Technology (TR&T), and Appendix B.7, Targeted Research and Technology strategic capability, which were presented as placeholders on release of ROSES 2012 in mid-February, will not be solicited this year. They will be solicited together as a single call entitled Heliophysics Living With a Star Science, which will be Appendix B.6 of ROSES-13.

Draft text for next year's version of Appendix B.6 is presented in ROSES 2012 Appendix B.6 with this Amendment as a courtesy to potential proposers.

Notice: Proposal submission to all Heliophysics calls in ROSES 2013 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 team members cannot be changed between the Step-1 and Step-2 proposals. See section 2 for details.

NASA point of contact concerning this program

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Heliophysics Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone: (202) 358-1992
E-mail: lws.trt@nasa.gov

B.8 HELIOPHYSICS DATA ENVIRONMENT ENHANCEMENTS

Amended on April 18, 2012. This amendment presents final text for Appendix B.8, Heliophysics Data Environment Enhancements, which replaces the previous text in its entirety. The due dates have not changed. Please Note: a call for Value Added Services, similar to that in previous HDEE calls, and for Virtual Observatories will be issued later this year as a separate call.

1. Scope of Program

1.1 Introduction

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 will 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 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, although the specific archiving arrangements are currently being dealt with on a case-by-case basis. Proposers should expect to work with SDAC, the HP Data and Model Consortium (HDMC), and NASA HQ on a long-term plan. (The HDMC oversees work under the HDEE 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 "SPASE" Data Model (see http://www.spase-group.org/ for information on SPASE and http://vspo.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 ("VxOs") are expert in the use of SPASE and are expected to provide descriptions for providers, as needed. Thus, people undertaking data projects under this call should identify a VxO 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 VxOs.)

A frequent problem with past data is that they have 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 FITS, and for space physics data CDF is generally the format of choice. Some 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, improving metadata, and otherwise improving the interface of the data service to an existing VO. 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).

Note: a call for Value Added Services, similar to that in previous HDEE calls, and for Virtual Observatories will be issued later this year as a separate call.

2. 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 VOs and 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 in FY 2013, 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.

2.1 Data Services Upgrades Proposals

Funding in this area is intended to support small, short-term (one year) awards to improve the quality, utility, and accessibility of datasets relevant to heliophysics research. Note that 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 discussion* of each of the following points (explicitly note if not applicable):

- 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).
- 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.
- 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.
- The current status of the data and a demonstration that the data can still be retrieved from their current storage medium.
- A statement of the current data volume, the expected data volume after processing, and the fraction of the data expected to be recovered.
- 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 VxO, should be included.

- A clear discussion of how the resource will be used by VOs or placed in an HP Data Center for general access.
- A discussion that demonstrates that the requested resources are necessary and sufficient for success in achieving the proposed upgrade.

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 should be no more than five pages.

2.2 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 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 original 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.
- A statement of the relationship of the RA to one or more of the VOs 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 10 pages.

3. Summary of Key Information

Expected program budget for first year of new awards	$500k
Number of new awards pending adequate proposals of merit	10-12
Maximum duration of awards	See Section 2.
Due date for Notice of Intent to propose (NOI)	May 11, 2012
Due date for proposals	July 20, 2012
Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	See Sections 2.1, and 2.2. See also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Heliophysics 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 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	NNH12ZDA001N-HDEE
NASA point of contact concerning this program	D. Aaron Roberts Heliophysics 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

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, and 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. Furthermore, proposals that include analysis of data from planetary division 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 division space flight missions, in any amount, that is not yet publicly available on the PDS will *not* be considered.

Changes in the Planetary Science Research Program for the ROSES-2012 solicitation are summarized below:

1. The Planetary Data System has defined the level of "certified data" to indicate that data products are ready for scientific use in such programs as Planetary Geology and Geophysics (C.4), Planetary Astronomy (C.5), Planetary Atmospheres (C.6), Outer Planets (C.7), Lunar Advanced Science and Exploration Research (C.8), Near Earth Object Observations (C.9), Cassini Data Analysis and Participating Scientist (C.10), Planetary Mission Data Analysis (C.11), and Mars Data Analysis (C.12) programs. The definition of certified data is available at http://pdsmgmt.gsfc.nasa.gov/documents.html.
2. C.6, Planetary Atmospheres has been clarified to clearly state that investigations that primarily involve making ground-based observations of extrasolar planets also should be submitted to the Origins of Solar Systems program (appendix E.3).
3. C.10, the Cassini Data Analysis and Participating Scientist call this year will use a two-step submission process in which in place of an NOI the submission of Step-1 proposal is required in order to be able to submit the Step-2 (full 15 page) proposal. Please see Section 4.1 of C.10 for details.
4. C.17, the Exobiology and Evolutionary Biology program will not be solicited in ROSES-2012. This program will be solicited in ROSES-2013.
5. The call for Radioisotope Power System Technology Development proposals is expected later in the year. If so, the final text will be added by Amendment at least 90 days prior to the due date.

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.

The Cosmochemistry program supports investigations of a variety of extraterrestrial materials (meteorites, cosmic dust, and lunar samples) that are aimed at understanding the geochemistry of the Solar System bodies (planets, satellites, including the Earth's Moon, and small Solar System bodies). (Appendix C.2)

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. (Appendix C.3)

The Planetary Geology and Geophysics (PGG) program supports scientific investigations of the planetary surfaces and interiors, satellites (including the Moon), satellite and ring systems, and smaller Solar System bodies such as asteroids and comets. (Appendix C.4)

The NASA Planetary Astronomy (PAST) program will continue to support both ground-based astronomical observations and suborbital investigations involving sounding rockets, balloons or reusable sub-orbital vehicles. Proposals are solicited for observations over the entire range of wavelengths from the ultraviolet to radio that contribute to the understanding of the general properties and evolution of the Solar System, its planets, their satellites, and of asteroids and comets. (Appendix C.5)

The Planetary Atmospheres (PATM) program supports scientific investigations that contribute to the understanding of the origins and evolution of the atmospheres of planets and their satellites and of comets. Its broad objectives include the determination of compositions, dynamics, energetics, and chemical behaviors of planetary atmospheres. (Appendix C.6)

The Outer Planets Research (OPR) program supports diverse scientific investigations that contribute to the understanding of the giant planets in the outer Solar System, as well as the smaller solid bodies including comets, asteroids, and the Kuiper Belt. This now also includes what was in the Jupiter Data Analysis program: Jupiter science data obtained by the New Horizons spacecraft, as well as the Voyager, Galileo, and Cassini spacecraft. (Appendix C.7)

The goal of the Lunar Advanced Science and Exploration Research (LASER) program is to support and enhance lunar basic science and lunar exploration science as part of the Vision for Space Exploration's return to the Moon initiative. (Appendix C.8)

The Near Earth Object Observation (NEOO) program supports investigations whose primary objectives are to inventory and characterize the population of NEOs, which may represent a hazard for impacting the Earth with the potential to significantly affect its climate and biosphere. (Appendix C.9)

The objective of the Cassini Data Analysis and Participating Scientist (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 to this program will be taken via a two-step proposal process. This means that the Notice of Intent is replaced by a required Step-1 proposal and the Title and Team are binding. The three page Step-1 proposal be used to conduct a preliminary evaluation, which will result in full proposals being either encouraged or discouraged. See Section 4.1 for details. (Appendix C.10)

The objective of the Planetary Mission Data Analysis Program (PMDAP) is to enhance the scientific return of completed Planetary Science Division missions by broadening the scientific participation in the analysis of data and samples collected by those missions. The PMDAP is intended to complement and not to overlap other active data analysis programs, e.g., Mars Data Analysis program (MDAP), CDAP, and OPR. (Appendix C.11)

The objective of the Mars Data Analysis Program (MDAP) is to enhance the scientific return from the Mars Pathfinder, Mars Global Surveyor, Mars Odyssey, and Mars Exploration Rover 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. (Appendix C.12)

The Mars Fundamental Research Program (MFRP) seeks to sponsor the best and most innovative scientific research concerning atmospheric, climatological, and geologic processes on Mars and offers opportunities for Mars research beyond that available from analysis of spacecraft data alone. (Appendix C.13)

The Mars Instrument Development Project (MIDP) will not be solicited in 2012. (Appendix C.14)

The Mars Technology Project (MTP) will not be solicited in 2012. (Appendix C.15)

The Planetary Instrument Definition and Development program (PIDDP) supports the advancement of spacecraft-based instrument technology that shows promise for use in scientific investigations on future planetary missions. (Appendix C.16)

The goal of NASA's Astrobiology: Exobiology and Evolutionary Biology program 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. (Appendix C.17)

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. (Appendix C.18)

The Astrobiology Science and Technology Instrument Development (ASTID) program element requests proposals to develop instrumentation capabilities that will help meet Astrobiology science requirements on future space flight missions, as well as unique Astrobiology science objectives on Earth. (Appendix C.19)

The Astrobiology Science and Technology for Exploring Planets (ASTEP) program solicits proposals for investigations to explore the Earth's extreme environments in order to develop a sound technical and scientific basis to search for life on other planets. (Appendix C.20)

The In-Space Propulsion (ISP) will not be solicited in 2012. (Appendix C.21)

The Moon and Mars Analog Missions Activities (MMAMA) program addresses the need for integrated interdisciplinary field experiments as an integral part of preparation for planned human and robotic missions to the Moon and Mars. The focus will be 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 of the Moon, Mars, and other planetary bodies with both robots and humans. (Appendix C.24)

Mission Concept Development for Astrobiology Small Payloads will not be solicited in 2012. (Appendix C.25)

The Radioisotope Power Systems (RPS) Program is a multicenter, multiagency (with the Department of Energy (DOE)) program whose purpose is to manage the Science Mission Directorate's investments in radioisotope power systems and their deployment to future missions. The final text for this program will be added by Amendment at least 90 days prior to the due date. (Appendix C.26)

The Origins of Solar Systems program solicits basic research proposals to conduct scientific investigations related to understanding the formation and early evolution of planetary systems and to provide the fundamental research and analysis necessary to detect and characterize other planetary systems. These investigations may involve analytical and numerical modeling, laboratory research, and observational studies in the following areas: star formation and the relationship to planetary system formation, solar nebula processes, accumulation and dynamical evolution, analysis of primitive materials, and the detection and characterization of other planetary systems. This program is shared with the Astrophysics Division, which takes responsibility for proposals involving the detection of extra solar planets. (Appendix E.3)

The Fellowships for Early Career Researchers have been established to facilitate the integration of new Planetary Science Division researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (*i.e.*, tenure-track, civil servant, or equivalent) position. (Appendix C.22) Participation is limited to proposers to the following Planetary Science Division science research programs offered in this solicitation:

- Cosmochemistry (Appendix C.2);
- Planetary Geology and Geophysics (Appendix C.4);
- Planetary Astronomy (Appendix C.5);
- Planetary Atmospheres (Appendix C.6);
- Outer Planets Research (Appendix C.7);
- Lunar Advanced Science and Exploration Research (Appendix C.8);
- Near Earth Object Observations (Appendix C.9);
- Planetary Mission Data Analysis (Appendix C.11);
- Mars Data Analysis (Appendix C.12);
- Mars Fundamental Research (Appendix C.13);
- Astrobiology: Exobiology and Evolutionary Biology (Appendix C.17);
- Astrobiology Science and Technology for Instrument Development (Appendix C.19); and
- Astrobiology Science and Technology for Exploring Planets (Appendix C.20).

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's science research programs offered in this solicitation:

- Cosmochemistry (Appendix C.2);
- Laboratory Analysis of Returned Samples (Appendix C.3);
- Planetary Geology and Geophysics (Appendix C.4);
- Planetary Astronomy (Appendix C.5);
- Planetary Atmospheres (Appendix C.6);
- Outer Planets Research (Appendix C.7);
- Lunar Advanced Science and Exploration Research (Appendix C.8);
- Near Earth Object Observations (Appendix C.9);
- Mars Fundamental Research (Appendix C.13);
- Astrobiology: Exobiology and Evolutionary Biology (Appendix C.17);
- Planetary Protection Research (Appendix C.18);
- Astrobiology Science and Technology for Exploring Planets (Appendix C.20); and
- Origins of Solar Systems (Appendix 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. (Appendix C.23).

C.2 COSMOCHEMISTRY

1. Scope of Program

The Cosmochemistry Program supports investigations of extraterrestrial materials that are aimed at understanding the geochemistry of bodies (planets, satellites, including the Earth's Moon, and small bodies) and dust in the Solar System. The goal of this program is to support research projects that increase the understanding of the chemical origin of the Solar System and the processes by which its planets and small bodies have evolved to their present states. NASA is particularly interested in proposals for sample-focused research projects that closely support its missions for exploring the Solar System or that contribute to the development of future missions. Individual investigations may contribute new data, analyze and synthesize existing data, or combine both kinds of activities.

Examples of the kinds of research supported by this program include:

- Measurements of mineral compositions, major and trace element chemistry, isotopic compositions, radiometric ages, magnetism, or radiation exposure effects;
- Petrologic studies of extraterrestrial materials;
- Laboratory studies of phase stability, chemical partitioning, and other processes necessary to interpret planetary data; and
- Synthesis of previously obtained cosmochemical data.

Although no priorities are imposed on the general kinds of investigations, an ideal program is envisaged as a balance among them, consistent with the quality of submitted proposals and their relevance to the current Cosmochemistry Program.

This program might also support certain types of research on terrestrial analog samples, when such efforts contribute to overall program goals in cosmochemistry. 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 for this program.

Proposals for topical conferences, workshops, or symposia related to the Cosmochemistry program are no longer solicited by this program element. Instead, such proposals may now be submitted in response to Appendix E.2, "Topical Workshops, Symposia, and Conferences," of this NRA. Proposers should specifically identify the Cosmochemistry program as the relevant SMD program element and refer to the goals and objectives of the Cosmochemistry program in demonstrating relevance.

An important goal of the Planetary Science Research Program is to facilitate access to data and extraterrestrial sample material for scientific and educational purposes, in addition to NASA-supported research projects. NASA's Johnson Space Center, Houston, Texas, is responsible for

the security of and access to all returned extraterrestrial samples, as well as the interplanetary dust particles collected by high-altitude aircraft and the meteorites collected in the Antarctic by field parties supported by the National Science Foundation (NSF). 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

2. Programmatic Considerations

2.1 Instrumentation: Construction or Upgrade

The Planetary Major Equipment (PME) program described in Appendix C.23 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 Research 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 Appendix C.23. Two types of instrumentation requests are permitted. (1) A PME request may be made as a special section that is appended to a new research proposal to the Cosmochemistry 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. (2) A stand-alone PME proposal may be prepared and submitted to the Cosmochemistry program. Such a stand-alone proposal must be explicitly affiliated with an existing “parent” award in the program in order to be considered for selection. See Appendix C.23 for details on how to prepare both types of PME requests.

2.2 Early Career Researchers

Early career researchers are encouraged to apply for the Early Career Fellowships (see Appendix C.22 in this NRA) by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program was established to facilitate the integration of new Planetary Science discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (i.e., tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Early Career Fellowships.

2.3 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 the Cosmochemistry 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.

3. Preparation of Proposals

This is a reminder that all proposals to the Cosmochemistry program must strictly conform to the formatting rules in Chapter IV of this ROSES announcement and Chapter 2 of the *NASA Guidebook for Proposers*, some of which are further qualified below. Those that violate the rules may be rejected without review. These rules are designed to facilitate the evaluation process. However, the rules also assure that no proposer can gain an unfair competitive advantage. The following rules for formatting the Scientific/Technical/Management section of the proposal apply:

- Length: 15 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: Cosmochemistry 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: Your 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	~ $4 M
Number of new awards pending adequate proposals of merit	~ 23
Maximum duration of awards	4 years (or 5 years for programs of exceptional merit and breadth where 4 years is demonstrated to be insufficient)
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, 2013
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 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 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	NNH12ZDA001N-COS
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 E-mail (Preferred): HQ-Cosmo@mail.nasa.gov

C.3 LABORATORY ANALYSIS OF RETURNED SAMPLES

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 beginning with this solicitation, 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 between 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 LASER (Appendix C.8) and Cosmochemistry (Appendix C.2). Also excluded from LARS, but included in the Cosmochemistry 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 Johnson Space Center after approval by 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 will bring a representative set of particles, comprising 10% of the total sample mass, to the Astromaterials Curation facility at Johnson Space Center by late 2011. 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 described in Appendix C.23 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 Research Program, including this one. All new analytical instrumentation requests not already covered by

the LARS program, as well as requests for upgrades to existing instruments, costing more than $40,000, may be identified and requested according to the PME guidelines in Appendix C.23. Two types of PME instrumentation requests are permitted. (1) A PME request may be made as a special section that is appended to a new research proposal to the LARS 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. (2) A stand-alone PME proposal may be prepared and submitted to the LARS program. Such a stand-alone proposal must be explicitly affiliated with an existing “parent” award in the program in order to be considered for selection. See Appendix C.23 for details on how to prepare both types of PME requests.

4. Preparation of Proposals

This is a reminder that all proposals to the LARS program must strictly conform to the formatting rules in Chapter IV of this ROSES announcement and Chapter 2 of the *NASA Guidebook for Proposers*, some of which are further qualified below. Those that violate the rules may be rejected without review. These rules are designed to facilitate the evaluation process. However, the rules also assure that no proposer can gain an unfair competitive advantage. The following rules for formatting the Scientific/Technical/Management section of the proposal apply:

- Length: 15 pages
- Margins: 1 inch on all sides, with a standard page size of 8.5 × 11 inches.
- Font: LARS 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: Your 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	~$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 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, 2013
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 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 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	NNH12ZDA001N-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.4 PLANETARY GEOLOGY AND GEOPHYSICS

Amended on May 11, 2012. The due date for proposals to the Planetary Geology and Geophysics (PGG) Program has been delayed to July 2, 2012, to permit those who recently received notification of the decision on their PGG ROSES 2011 proposals additional time to prepare for this solicitation.

1. Scope of Program

The Planetary Geology and Geophysics (PGG) program supports scientific investigations of planetary surfaces and interiors, satellites (including the Moon), satellite and ring systems, and smaller Solar System bodies, such as asteroids and comets. The goals of the PGG program are to foster the synthesis, analysis, and comparative study of data that will improve the understanding of the extent and influence of planetary geological and geophysical processes on the bodies of the Solar System.

Planetary spacecraft mission data to be used in proposed investigations must be available in the Planetary Data System (PDS) or similar publicly accessible archive at least 30 days prior to the PGG proposal submission date. Spacecraft data that have not been obtained (i.e., future mission data), or those that have not been placed in approved archives may not be proposed for use in PGG investigations. Data products accessible in the PDS must designated "certified" (ready for scientific use) in order to be eligible for the PGG program (see Appendix C.1). Data products accessible in archives other than the PDS that are still in liens resolution are not considered archived and their analysis will not be supported by the PGG program.

Supported research projects involve analysis and synthesis of existing data to investigate geological and geophysical processes and phenomena observed on natural objects within the Solar System. Types of research solicited by this program include, but are not limited to:

- Use of reduced, calibrated, publicly available data from planetary missions or ground-based observational databases to address geological or geophysical questions on specific Solar System objects;
- Photogeologic analysis and geologic interpretation of planetary surfaces;
- Mineralogical, lithological, and geologic mapping of planetary surfaces;
- Theoretical and dynamical modeling applied to geologic and geophysical processes on specific Solar System objects;
- Development and production of cartographic products from planetary datasets;
- Generation of new data in a laboratory or field environment;
- Experimental studies of materials under conditions relevant to specific objects in the Solar System;
- Dynamical evolution of specific planets, satellites, small bodies, or ring systems in our Solar System;
- Geologic field studies of terrestrial analogs to planetary features or phenomena in the context of providing a better understanding of those planetary features or phenomena; and/or
- Combinations of the activities listed above.

Examples of the type of research supported by this program and abstracts for currently funded investigations are available online at http://nspires.nasaprs.com/. Proposals to study or develop flight instruments, to study future planetary missions, to perform ground-based observations, to perform astrometric measurements and models, or to study extra-solar objects are not solicited by this program.

Investigators funded by spacecraft missions who wish to apply to the PGG Program must clearly demonstrate that their proposed investigation will use only released and publicly available data. Such investigators must scrupulously comply with the 30-days-prior-to-submission rule (above). Additionally, mission-funded investigators must demonstrate clearly how the proposed PGG research does not overlap and is not redundant with data analysis, duties or responsibilities already funded by their respective mission(s). Lunar investigations are appropriate for PGG, if it is demonstrated that they have general application to comparative planetology or study of processes common to terrestrial bodies. For purely lunar science, consider submitting to the Lunar Advanced Science and Exploration Research (LASER) program (Appendix C.8).

Proposed investigations of any planetary or satellite surface that are intended, as a by-product of the scientific research, to produce 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. Information on geologic maps that have been produced or are currently in production may be obtained from Kenneth Tanaka of the USGS at ktanaka@usgs.gov, or at http://astrogeology.usgs.gov/DataAndInformation/ImagesAndMaps/. Investigators who choose to produce a geologic map as a USGS product will be required to follow newly implemented guidelines for the production and submission of digital products, including the generation of maps that are compatible with Geographic Information System (GIS) software packages, and by providing graphical files compatible with Adobe Illustrator for review and edit (effective January 2011). To support this requirement, in 2009, the USGS began providing mapping base materials in GIS project form which contain the projected, geographically rectified, and scaled mapping base or mosaic, other useful spatially registered datasets; and released image footprints with web links, if available. Investigators selected to publish USGS geologic maps will be expected to review geologic maps generated by other planetary mappers. Investigators proposing to produce a map may request support to perform two planetary geologic map reviews and for GIS training courses.

Investigations that produce new data may be of wide scientific interest. Therefore, it is expected that these data sets would, after a reasonable amount of time, be archived within the NASA Planetary Data System (PDS). Contact R. E. Arvidson (PDS Geoscience Node) for further information regarding the types of data sets that might be of interest for archiving purposes (email: arvidson@wunder.wustl.edu, or telephone: (314) 935-5609).

2. Experimental Facilities Available for the PGG Program

The following facilities are available to investigators supported by the PGG program. 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, to meet the requirements in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support will be required from any facility necessary for the proposed effort.

- Planetary Aeolian Facility. The Planetary Aeolian Facility at the NASA Ames Research Center consists of wind tunnels to simulate atmosphere-surface interactions on Earth and Mars.

  For more information contact:

  Department of Geology
  Box 871404
  Arizona State University
  Tempe, AZ 85287-1404
  Telephone: (480) 965-7045

- Reflectance Experiment Laboratory (RELAB). The RELAB facility at Brown University provides a mechanism for researchers to obtain laboratory spectra of geologic materials for use in compositional and/or geologic applications. NASA supports the RELAB as a multiuser spectroscopy facility. Laboratory time can be made available at no charge to investigators funded by NASA programs. If the proposed research requires new spectra in the VIS/NIR or mid IR, the scope and justification must be provided in the proposal. Information on this facility, a *RELAB User's Manual* and sample submittal forms, and access to RELAB spectroscopy data can be found at: http://www.planetary.brown.edu/relab/

  For assistance contact:

  Carlé M. Pieters
  RELAB Science Manager
  Department of Geological Sciences
  Box 1846
  Brown University
  Providence, RI 02912-1846
  Telephone:(401) 863-2417
  Email: Carle_Pieters@brown.edu

- NASA Ames Vertical Gun Range (AVGR). The NASA AVGR is a national facility funded by the NASA Science Mission Directorate (SMD) 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.

For more information, potential users of the AVGR should contact:

Peter Schultz
Department of Geological Sciences
Box 1846
Brown University
Providence, RI 02912-1846
Telephone: (401) 863-2417
Email: peter_schultz@brown.edu

- 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 the Planetary Geology and Geophysics 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.

3. Data Sources Available for the PGG Program

Prospective proposers should be aware of sources for data that might be used in their research and whether the required data are available. Useful contacts for making these determinations are given below:

- General Lunar and Planetary Information. The Lunar and Planetary Institute (LPI) is the most concentrated and readily accessible source of information in lunar and planetary science. Information about its services can be found on the LPI home page at http://www.lpi.usra.edu/ and/or contact:

  Stephen Mackwell
  Director, The Lunar and Planetary Institute
  3600 Bay Area Boulevard
  Houston, TX 77058-1113
  Telephone: (281) 486-2128
  Email: mackwell@lpi.usra.edu

- Data from Completed NASA Flight Programs. The National Space Science Data Center (NSSDC) archives digital and other data from completed flight experiments. Such data include lunar and planetary photographs, digital planetary images, data from numerous flight experiments, and lunar cartographic products. Investigators are responsible for acquiring the data needed for their proposal. Modest requests for imaging and nonimaging data are free of charge, while charges will be made for large requests. Requests from U.S. investigators for data products and information may be made to:

National Space Science Data Center
Code 633.4
Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, MD 20771-0001
Telephone: (301) 286-6695.
http://nssdc.gsfc.nasa.gov/nssdc/obtaining_data.html

- Planetary Cartographic Products. A variety of planetary cartographic products such as topographic, orthophoto, geological, and other special maps and geodetic information are available. Requests from NASA-funded investigators for production of special maps or other cartographic materials will be accommodated when possible. Request available data or specific maps from:

  USGS Information Services
  Box 25286
  Denver, CO 80225
  Telephone: (888) 275-8747
  http://ask.usgs.gov/to_order.html

  Request information related to the availability of base maps and materials or U.S. Geological Survey criteria for map publication through http://astrogeology.usgs.gov/DataAndInformation/ImagesAndMaps/ and/or

  Data Manager
  Regional Planetary Information Facility
  Astrogeology Research Program
  U.S. Geological Survey
  2255 North Gemini Drive
  Flagstaff, AZ 86001
  Telephone: (928) 556-7264
  Email: RPIF-flag@usgs.gov

- 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 the address given above. 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.

- Digital Planetary Image Data. Digital planetary image data are available through the PDS. The Planetary Data System/Imaging Node can be found at http://pds-imaging.jpl.nasa.gov/. Submit requests for imaging data and support documentation to:

  Planetary Data System/Imaging Node
  U.S. Geological Survey
  2255 North Gemini Drive
  Flagstaff, AZ 86001
  Telephone: (928) 556-7053

  The Planetary Data System/Geosciences Node can be found at http://pds.nasa.gov. Requests for other planetary geoscience data may be submitted to:

  Planetary Data System/Geosciences Node
  Washington University
  Campus Box 1169
  One Brookings Drive
  St. Louis, MO 63130
  Telephone: (314) 935-5493

4. Programmatic Information

4.1 Supplemental Funding for Additional Instrumentation

The Planetary Major Equipment (PME) program described in Appendix C.23 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 Research 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 Appendix C.23. Two types of instrumentation requests are permitted. (1) A PME request may be made as a special section that is appended to a new research proposal to the PGG 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. (2) A stand-alone PME proposal may be prepared and submitted to the PGG program. Such a stand-alone proposal must be explicitly affiliated with an existing “parent” award in the program in order to be considered for selection. See Appendix C.23 for details on how to prepare both types of PME requests.

4.2 Early Career Researchers

Early career researchers are encouraged to apply for the Early Career Fellowships (see Appendix C.22 in this NRA) by simply checking an additional box on the cover page of their proposal. To

be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program was established to facilitate the integration of new Planetary Science Division discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (e.g., tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Early Career Fellowships.

4.3 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 completed Antarctic Operations Requirements Worksheet (ORW) and evidence that the ORW has been submitted to the NSF Office of Polar Programs. The ORW and instructions on submitting it to NSF are available at http://www.usap.gov/scienceSupport/polarice/.

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 earlier than late-2013/early-2014 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	$2.7 M
Number of new awards pending adequate proposals of merit	~ 23-27
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	**July 2, 2012 [Amended May 11, 2012]**
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 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 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	NNH12ZDA001N-PGG
NASA point of contact concerning this program	Michael S. Kelley Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0607 E-mail: HQ-PGG@mail.nasa.gov

C.5 PLANETARY ASTRONOMY

1. Scope of Program

The NASA Planetary Astronomy program for ROSES-2012 includes support for both ground-based astronomical observations and suborbital investigations 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 general properties and evolution of the Solar System, its planets, their satellites, and of asteroids and comets. Proposals must follow the preparation guidelines in Chapter 2 of the *NASA Guidebook for Proposers* (see Section 3 below).

1.1 Ground-based Observations

The investigations proposed to this portion of the program must contain an element of new observation and must support those NASA Solar System program objectives that cannot be met by current spacecraft missions or that directly support specific current flight missions. 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.

It is expected that most proposals will request awards with a duration of three years, but proposals may be submitted for projects of duration from one to five years. The detailed justification for the duration of the proposed work will be an important evaluation criterion. The justification will be used in determining the duration of any award, should the proposal be selected.

Proposals that utilize newly obtained data 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 or as a Collaborator in order to meet the requirement for an element of new observation.

1.2 Suborbital Flight Investigations

This Planetary Astronomy category supports science investigations and technology development utilizing payloads flown on sounding rockets, balloons or reusable suborbital vehicles. Suborbital 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 should be given. Proposals may request durations of up to five years.

Suborbital 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 suborbital 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 leadership roles on future NASA space flight missions.

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. Proposers may also wish to refer to the established suborbital program under the Astrophysics Research and Analysis Program (APRA) (Appendix D.3, Section 1.2.1 of this NRA) for more insight on conducting this type of investigation.

2. Programmatic Information

2.1 Supplemental Funding for Additional Instrumentation

The Planetary Major Equipment (PME) program described in Appendix C.23 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 Research 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 Appendix C.23. Two types of instrumentation requests are permitted. (1) A PME request may be made in a special section of a new research proposal to this program. This section is to be titled "Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal. (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” award in the program in order to be considered for selection. See Appendix C.23 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 Proposals for Suborbital Flight Investigations

Owing to the anticipated greater degree of complexity, the Scientific/Technical/Management section of proposals for a suborbital flight investigation may be 20 pages long instead of the default 15 pages specified in the *NASA Guidebook for Proposers*.

Proposers should refer to Section V on pages 21-30 of the *ROSES Summary of Solicitation* for more information about NASA-provided Sounding Rocket and Balloon Services, Suborbital Reusable Launch Vehicles, Research Investigations utilizing the International Space Station, and the use of Short Duration Orbital Platforms, including CubeSats. Points of contact are given there for each category of Suborbital Flight Investigations.

2.4 Early Career Researchers

Early career researchers are encouraged to apply for the Fellowships for Early Career Researchers (see Appendix C.22 in this ROSES NRA) by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program was established to facilitate the integration of new Planetary Science Division discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (*i.e.*, tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Fellowships for Early Career Researchers.

2.5 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 the Planetary Astronomy 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.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $1.3M

Number of new awards pending adequate proposals of merit	~ 8-12
Maximum duration of awards	Up to 5 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; 20 pp for suborbital proposals (see Section 1.2.2); see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the planetary 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 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	NNH12ZDA001N-PAST
NASA point of contact concerning this program	Kelly Fast Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0768 Email: kelly.e.fast@nasa.gov

C.6 PLANETARY ATMOSPHERES

1. Scope of Program

The Planetary Atmospheres program supports scientific investigations that contribute to the understanding of the origins and evolution of the atmospheres of planets and their satellites and of comets. Its broad objectives include the determination of compositions, dynamics, energetics, and chemical behaviors of planetary atmospheres. For example, investigations that may be submitted to this program include:

- The study of sources and mechanisms for deposition of energy
- The characterization and understanding of dynamical processes and circulation, both global and local
- Relationships between currently observed properties and/or states of matter including clouds, particles, and ices
- Interaction of atmospheres with the solar wind and the effects of magnetic fields both permanent and induced on these processes
- Interactions of planetary atmospheres with planetary surfaces
- The chemical abundance, physical conditions, and processes that may have prevailed at the time the planets were formed, as they pertain to atmospheres

The scope of the Planetary Atmospheres activity also includes laboratory investigations that supply basic physical measurements that are currently needed to interpret planetary data, including measurements and calculations of spectroscopic, optical, and thermodynamic properties of materials found in planetary atmospheres. In addition, while comparative studies of various planetary atmospheres (including the Earth) are appropriate, investigations that focus primarily on the Earth's atmosphere are not; research opportunities supporting the Atmospheric Composition Focus Area of the Earth Science Research Program may be found in Appendix A of this solicitation. Comet investigations are relevant only if they address comet coma properties and behaviors. Investigations that primarily involve making ground-based or suborbital observations of solar system atmospheres should be submitted to the Planetary Astronomy program (Appendix C.5).

Investigations of the atmospheres of extrasolar planets are included within the scope of this program, provided that they address the same features, properties, and behaviors listed above; however, research that is primarily directed toward discovering extrasolar planets is not appropriate for the Planetary Atmospheres program, but instead may be proposed to the Origins of Solar Systems program (Appendix E.3). Investigations that primarily involve making ground-based observations of extrasolar planets also should be submitted to the Origins of Solar Systems program.

Proposals for the analysis of atmospheric data from NASA space science missions that are calibrated and archived and in the public domain on the Planetary Data System are encouraged. However, if there is a specific data-analysis program devoted to the area of the proposal, such as Outer Planets Research (Appendix C.7), Cassini Data Analysis (Appendix C.10), or Mars Data Analysis (Appendix C.12), then the proposal should be submitted to that ROSES program element.

Proposals that serve as an umbrella for a variety of research tasks are appropriate only if the proposed tasks have a clear focus and directly address the objectives of this program. Proposals must follow the preparation guidelines in Chapter 2 of the *NASA Guidebook for Proposers* (see Section 3 below).

2. Programmatic Information

Investigations that involve the participation of postdoctoral fellows and graduate students are encouraged.

It is expected that most proposals will request an award with a duration of three years, but proposals may be submitted for projects of duration from one to five years. The detailed justification for the duration of the proposed work will be an important evaluation criterion. The justification will be used in determining the duration of any award, should the proposal be selected.

2.1 Demonstration of Relevance

Proposals must clearly and explicitly identify the rationale for submitting the proposed investigation to this particular program element of the ROSES NRA and not some other closely related program element. Proposals will be carefully reviewed against this requirement and the findings will be an important element in the selection process.

2.2 Supplemental Funding for Additional Instrumentation

The Planetary Major Equipment (PME) program described in Appendix C.23 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 Research 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 Appendix C.23. Two types of instrumentation requests are permitted. (1) A PME request may be made in a special section of a new research proposal to this program. This section is to be titled "Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal. (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” award in the program in order to be considered for selection. See Appendix C.23 for details on how to prepare both types of PME requests.

2.3 Early Career Researchers

Early career researchers are encouraged to apply for the Fellowships for Early Career Researchers (see Appendix C.22 in this ROSES NRA) by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program was established to facilitate the integration of new Planetary Science Division

discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (*i.e.*, tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Fellowships for Early Career Researchers.

2.4 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 the Planetary Atmospheres 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.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $ 2.0M
Number of new awards pending adequate proposals of merit	~ 8-24
Maximum duration of awards	5 years: shorter term proposals are encouraged.
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 planetary 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 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	NNH12ZDA001N-PATM
NASA point of contact concerning this program	Kelly Fast Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0768 Email: kelly.e.fast@nasa.gov

C.7 OUTER PLANETS RESEARCH

Amended on October 29, 2012. The Due Date for C.7 Outer Planets Research has been delayed by a week to give more time to proposers who will be without power because of Hurricane Sandy. The new due date for proposals to Appendix C.7 Outer Planets Research is November 9, 2012.

Amended on August 10, 2012. The due date for proposals to the Outer Planets Research Program has been delayed to November 2, 2012, so as not to overlap with the 44th Annual Meeting of the Division for Planetary Sciences of the American Astronomical Society.

1. Scope of Program

The Outer Planets Research (OPR) program supports diverse scientific investigations that contribute to the understanding of the outer Solar System, including the giant planets, their satellites, and smaller solid bodies including comets, asteroids, and Kuiper Belt objects. The program includes both data analysis from NASA missions and fundamental research. The objectives of the OPR program include:

- Enhancing the scientific return from the New Horizons, Cassini, Galileo, Voyager, and Pioneer missions by continuing the analysis of their respective data sets through broadened scientific participation;
- Improving our understanding of the evolution of the outer Solar System, including the giant planets, their satellites, and other small bodies; and
- Defining the dynamical processes operating in the outer Solar System.

Investigators may propose tasks that involve one or more of the following activities that support the program goals above:

- Development of basic theory, laboratory studies, and/or modeling relevant to the interpretation of mission data listed above or the evolution and dynamics of giant planets, their satellites, and other small bodies in the outer Solar System;
- Additional analysis of ground-based observations of asteroids, comets, and outer planets and their satellites funded by the Planetary Astronomy program;
- Correlative analyses that combine data from the Planetary Science Division's outer planets missions (New Horizons, Cassini, Galileo, Voyager, and Pioneer), the Planetary Astronomy program, and other sources; and/or
- Research that seeks to place the results of these outer planets missions in a larger context of processes and evolution of bodies in the outer Solar System.

Each proposal must describe a complete scientific investigation organized in terms of unresolved scientific questions to be addressed; objectives of the research; lines of inquiry, methodology, and analysis; and conclusions. Tasks involving the refinement of mission datasets or the creation of new data products are appropriate as long as such tasks support a broader scientific investigation driving the proposal. Investigations are expected to result in one or more peer-

reviewed publications. Investigations that generate data products useful to the broader scientific community are encouraged to include plans in their proposals to make those products easily available (via the Planetary Data System (PDS) or by other appropriate means) by the end of the funding period.

The use of flight mission data in proposed investigations from the New Horizons, Cassini, Galileo, Voyager, and Pioneer missions, which were led by the Planetary Science Division, is explicitly supported. However, missions led by other divisions of NASA have produced data valuable to the exploration of the Outer Solar System. These missions include, but are not limited to, Ulysses, which has studied Jupiter's magnetosphere, as well as the heliosphere; the Solar and Heliospheric Observatory (SOHO) mission, which has successfully observed dozens of Sun-grazing comets; and the Far Ultraviolet Spectroscopic Explorer (FUSE) mission, which supported research of objects in the outer Solar System (listed under OPR objectives above). Investigators wishing to use data from nonsupported division sources must demonstrate that the inclusion of these data sets significantly enhances tasks supported by OPR (as listed above). Investigators proposing correlative analyses using data from Planetary Science Division missions (New Horizons, Cassini, Galileo, Voyager, and Pioneer) with other mission data sources (Ulysses, SOHO, and FUSE) should clearly describe the rationale driving the use of the data and the source of the data.

Investigators who wish to use data from Discovery missions should submit their proposals to the Planetary Mission Data Analysis (formerly Discovery Data Analysis) program (see Appendix C.11).

Investigators who wish to conduct research to understand the formation and early evolution of extrasolar planetary systems and to provide the fundamental research and analysis necessary to detect and characterize other planetary systems should submit their proposals to the Origins of Solar Systems program (see Appendix E.3).

The OPR program is not intended to support the acquisition of new ground- or space-based observations nor support ground-based observing facilities. Such proposals should be directed to the Planetary Astronomy program (see Appendix C.5). However, investigators who wish to pursue further analysis of existing ground observations of asteroids, comets, giant planets, outer planet satellites, rings, and Kuiper Belt objects are encouraged to apply to the OPR program. Such extended analyses are restricted to observations funded by the Planetary Astronomy program, and OPR proposals must reference and describe the antecedent Planetary Astronomy grant that funded the observations. These proposals are not required to use flight-mission data, though such correlative analyses are encouraged.

Investigations focused solely on analysis of space- or ground-based data that do not utilize data from the missions supported by the Planetary Science Division, as listed above or from existing ground observations previously funded by the Planetary Astronomy program, will not be considered responsive to this program.

Proposals for topical conferences, workshops, or symposia related to the OPR program may no longer be proposed through this solicitation. Proposers are encouraged to pursue such

submissions through ROSES Appendix E.2, Topical Workshops, Symposia and Conferences.

2. Sources of Information and Data

It is the responsibility of the investigators selected for this program to acquire any needed data. Therefore, before submitting a proposal, the investigator must determine that all data required for the proposed investigation are publicly available. Proposals requiring the use of data that are not publicly available at the time of proposal submission may be rejected without review. Mission data are available from the PDS and can be accessed via the Internet at http://pds.jpl.nasa.gov/.

Proposals dealing with mission data should provide convincing evidence that currently available public data has sufficient quality and is 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. For proposals dealing with data from ongoing missions, proposals whose success hinges on future availability of mission data in the PDS may be rejected without review.

3. Programmatic Information

3.1 Evaluation Criteria

Evaluation criteria for the OPR program are given in Appendix C of the *NASA Guidebook for Proposers*. These criteria are intrinsic merit, relevance/impact, and cost realism/reasonableness. In addition to the factors for the relevance criterion given in the *NASA Guidebook for Proposers*, this program specifically includes the following factors of approximately equal importance:

- Relevance of the proposed investigation to the OPR program as demonstrated by linkages between the proposal objectives and the OPR objectives described above; and
- Impact and importance of the proposed research to the field, including a description of how and to what extent the proposed research will advance our current state of knowledge.

Proposals must contain brief narrative text addressing these two factors. Investigators are also strongly encouraged to carefully consider which program element(s) are relevant to the proposed research, submit the proposal accordingly, and describe the rationale for the submission.

3.2 Maximum Duration of Award

It is expected that most proposals will request a duration of three years, but proposals may be submitted for projects of duration from one to five years. The detailed justification for the duration of the proposed work will be an important evaluation criterion. Proposals that are otherwise excellent, but do not provide sufficient justification for the duration of the proposal, are less likely to be funded than proposals that do provide appropriate and adequate justification.

Proposers are reminded that continued funding in any year is contingent upon satisfactory progress, as documented in annual progress reports. Investigations not demonstrating satisfactory progress will be terminated.

3.3 Supplemental Funding for Additional Instrumentation

The Planetary Major Equipment (PME) program described in Appendix C.23 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 Research 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 Appendix C.23. Two types of instrumentation requests are permitted. (1) A PME request may be made in a special section of a new research proposal to this program. This section is to be titled "Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal. (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” award in the program in order to be considered for selection. See Appendix C.23 for details on how to prepare both types of PME requests.

3.4 Early Career Researchers

Early career researchers are encouraged to apply for the Fellowships for Early Career Researchers (see Appendix C.22 in this ROSES NRA) by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program was established to facilitate the integration of new Planetary Science discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (*i.e.*, tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Fellowships for Early Career Researchers.

3.5 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 the Outer Planets 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.

4. Summary of Key Information

Expected program budget for first year of new awards	~ $1.8M
Number of new awards pending adequate proposals of merit	~ 14

Maximum duration of awards	5 years
Due date for Notice of Intent to propose (NOI)	August 24, 2012
Due date for proposals	**November 9, 2012 [Amended October 29, 2012]**
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 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 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	NNH12ZDA001N-OPR
NASA point of contact concerning this program	Terry Hurford Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0780 E-mail: terry.a.hurford@nasa.gov

C.8 LUNAR ADVANCED SCIENCE AND EXPLORATION RESEARCH

1. Scope of Program

1.1 Program Overview

The Lunar Advanced Science and Exploration Research (LASER) program funds basic and applied lunar science. The goal of the program is to support and enhance lunar basic science and lunar exploration science.

It is the objective of the LASER program to conduct a suite of lunar science investigations spanning the continuum from basic science to applied exploration science. Proposals having significant components of both basic and applied lunar science that further our understanding of the Moon and how to conduct science there are sought and highly encouraged.

The LASER program also welcomes the submission of "data restoration" proposals. The program seeks to identify science data archives that are considered of significant value to lunar science that are in need of restoration and digital archiving. A LASER proposal may request funding support to restore, archive, and prepare these holdings for public access through the Planetary Data System (PDS; http://pds.nasa.gov/).

1.2 Fundamental (Basic) Lunar Science

The LASER program supports the broad spectrum of fundamental lunar science encompassing investigations of the lunar surface, interior, exosphere, and the Moon's near-space environment. Investigations of Earth-Moon system processes and selenogenesis are equally welcome. Supported investigations include, but are not limited to, theoretical investigations, numerical modeling of physical or chemical processes, experimental/laboratory investigations, and field analog studies. Proposed investigations may involve a combination of these activities. The spectrum of lunar science funded by LASER includes the following fields: geology, geochemistry, geophysics, exospheric science, solar wind environment history/physics, and radiation environment physics. Topical study areas that are supported by LASER include, but are not limited to, the following:

- Genesis and dynamical evolution of the Earth-Moon system;
- Lunar evolution (crust, interior, radiation environment, etc.);
- Physics and chemistry of the lunar interior (e.g., composition, structure, heat flow etc.);
- Geomorphological analysis of the lunar surface;
- Lunar cratering processes;
- Petrogenesis of lunar materials;
- Lunar volcanological history and processes;
- Evolution of the lunar radiation environment;
- Growth and development of the lunar regolith; and
- Development, composition, and physics of the Moon's exosphere.

A description of science research priorities for lunar exploration can be found in the document: *The Scientific Context for Exploration of the Moon (2007)* by the Space Studies Board of the National Research Council. It can be obtained at http://books.nap.edu/catalog.php?record_id=11954.

1.3 Lunar Exploration Applied Science

The LASER program supports applied science that is synergistic with basic lunar science as discussed in Section 1.2 above or considerably advances NASA's preparedness for conducting science on and from the Moon. Supported investigations include, but are not limited to, theoretical investigations, numerical modeling of physical and chemical processes, experimental/laboratory investigations, and field analog studies. While LASER is not designed to support large technology or instrument development projects, it is well suited for field activities that integrate technology, operational tests, and basic science to optimize scientific return from robotic and human missions to the Moon. Examples of investigations identified by the Science Mission Directorate as addressing high-priority lunar exploration science objectives include:

- Lunar Data Processing and Modeling to Support Human Lunar Missions and Surface Science Activities. This topic area includes identification, processing, analysis, and delivery to the Planetary Data System of lunar data sets that would be of value to surface science. It also includes modeling that can improve our understanding of the local or general lunar environment (e.g. lighting, thermal, radiation, etc.). This topic also includes any work on the topic of volatile deposition, transport, segregation, and distribution at or near the lunar poles. Developing strategies and identifying considerations for site selection, including the roles of planetary processes, resource availability, topography, and geochemistry/mineralogy. Recognizing that measurements to be made on existing or upcoming international robotic missions will add greatly to our quantitative understanding of the Moon, proposals should clearly indicate how any near term theoretical/modeling efforts will add significant value in the current phase of lunar exploration.

- Field Exploration Techniques and Outpost Science Operations. This topic area addresses key field exploration techniques and outpost science and operations, including sample collection, documentation, curation, human-robotic interactions, and planetary protection. This includes development, analysis, and possible ground demonstration of techniques to support science. This topic will support the study of exploratory strategies for maximizing scientific return from surface activities. Studies using field sites, facilities, or hardware on Earth as analogs for lunar science are included, but they must demonstrate how the proposed research will directly benefit lunar science or conducting science on the Moon.

- Lunar Regolith and Simulant Investigations. This topic area includes exploration science research that expands knowledge of the physical and chemical properties of lunar regolith (charging, chemistry, mineralogy, etc.). It includes research that leads to the creation of improved lunar regolith simulants.

- Resource Prospecting. This topic area includes research on or leading to the identification and/or quantification of potential lunar resources (e.g., oxygen, nitrogen, and other volatiles, fuels, metals, etc.).

1.4 Data Analysis

An objective of the LASER program is to enhance the scientific return from NASA - and other - missions to the Moon. These include, but are not limited to, the Ranger, Surveyor, Lunar Orbiter, Apollo program, Clementine, Lunar Prospector, Lunar Crater Observation and Sensing Satellite (LCROSS), Moon Mineralogy Mapper (M3), and Lunar Reconnaissance Orbiter (LRO) missions. LASER broadens scientific participation in the analysis of mission data sets and funds high-priority areas of research that support planning for future lunar missions. LASER supports scientific investigations of the Moon using publicly available (released) data.

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 (including flybys). Proposals may incorporate the analysis of data from more than one mission. 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 of potential landing sites of high lunar science return;
- Characterization of potential landing sites (e.g., geomorphology, regolith, radiation and compositional properties);
- Modeling of the lunar gravitational field, global topography and global lunar figure; and
- Enhancement of the lunar geodetic network to enable precision lunar landing.

Investigators may propose to produce data products (e.g., cartographic products, such as geologic, topographic or mineral maps, and/or calibration data). Such investigations need not have associated scientific tasks; however, the utility of the proposed data products to the Lunar/science community must be clearly specified in the proposal and will be judged on this basis. Scientific research tasks may also result in data products. Regardless of the nature of the proposal, 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 LASER selected proposals. Proposed investigations that will result in a geologic map suitable for publication by the U.S. Geological Survey (USGS) should clearly indicate this intention in the *Proposal Summary*, as well as in the text of the proposal, and must follow the guidelines for USGS map products outlined in ROSES element C.4, Planetary Geology and Geophysics.

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
Thomas Morgan	Program Manager	thomas.h.morgan@nasa.gov

1.5 Witness-plate Science

LASER is also open to proposals that use the Moon as a witness-plate for the study of current and past solar system processes. For example, proposals to investigate lunar craters for the expressed purpose of understanding cratering processes in general are within the scope of the program; however, all else being equal, higher priority will be given to those proposals that are tied more directly to expanding the lunar sciences and lunar knowledge base.

1.6 Data Restoration

The LASER program supports the restoration and digital archiving of unarchived or poorly archived datasets relevant to the lunar sciences. Priority will be assigned to datasets that are identified, and demonstrated by the proposal, to be of high value to lunar science and NASA. Proposals should provide as much information as possible on the nature and current extent of the data proposed for restoration. For evaluation purposes, data restoration proposals should contain a thorough discussion and description of:

- Data Source (e.g., Ranger 8);
- Data Type (e.g., images of a, b, c, etc.);
- Data Format (e.g., tape, hard copy images, punch cards, JPEG);
- Condition of data (e.g., poor, fair, good, excellent); and
- Completeness of data (e.g., fragmentary, etc.).

Proposals should provide the general details of the data restoration procedure, as well as: a) a detailed plan for how the data will be restored; b) a plan and timetable for archiving the data and metadata in PDS, in a PDS-compliant form, and resolving all liens arising from the PDS peer-review; and c) a description of documentation, calibration data, and related software necessary to interpret the data. Proposers should refer to the documents listed in section 1.4 of this element for information on PDS compliance. Additional information on the PDS may be obtained from the individuals listed in the Table contained in section 1.4.

Types of archival data products include low-level (raw) data; high-level (processed) data; and derived data products such as maps, ancillary data, calibration data (ground and inflight), documentation, and related software or other tools. All data products must be documented,

validated, and calibrated in physical units usable by the scientific community at large. It is the proposer's responsibility to conform to the standards of the relevant data archive.

2. Programmatic Information

2.1 Sources of Information and Data

The LASER program supports research investigations relevant to the scientific interpretation of data from past lunar missions that are now in the public domain and to the science and exploration objectives of future missions. LASER 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 another publicly accessible archive at least 30 days prior to the submission due date for LASER proposals. Spacecraft data that have not been placed in the public domain may not be proposed for use in LASER 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 LASER submission date.

Members of current lunar flight teams who wish to apply to the LASER 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, current flight team members must rigorously demonstrate how the proposed LASER research does not overlap – and is not redundant with – data analysis duties/responsibilities already funded within their respective mission.

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.

In all cases, it is the responsibility of the LASER investigator to acquire any necessary data. Therefore, before submitting a proposal, each proposer must determine 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.

2.2 Early Career Researchers

Early career researchers are encouraged to apply for the Early Career Fellowships (see Appendix C.22 in this NRA) by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program was established to facilitate the integration of new Planetary Science discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (i.e., tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Early Career Fellowships.

2.3 Supplemental Funding for Instrumentation: Construction or Upgrade

The Planetary Major Equipment (PME) program described in Appendix C.23 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 Research 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 Appendix C.23. Two types of instrumentation requests are permitted. (1) A PME request may be made as a special section that is appended to a new research proposal to the LASER 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. (2) A stand-alone PME proposal may be prepared and submitted to the LASER program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" award in the program in order to be considered for selection. See Appendix C.23 for details on how to prepare both types of PME requests.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $2.7M
Number of new awards pending adequate proposals of merit	~ 27
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	This program is relevant to the planetary 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 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	NNH12ZDA001N-LASER
NASA point 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 NEAR EARTH OBJECT OBSERVATIONS

1. Scope of Program

1.1 NEO Survey and Characterization Proposals

Near Earth Objects (NEOs) are defined as asteroids or comet nuclei whose perihelia are less than 1.3 AU. NASA is committed to discovering all NEOs with diameters greater than or equal to ~1 km and to characterizing that population through determination of their orbital elements, with the goal of detecting more than 90 percent of this population as soon as possible. In support of NASA's commitment and goal, this program supports NEO investigations whose primary objective is to complete the inventory of the population of NEOs with diameters greater than or equal to 1 km. In addition to this goal, the U.S. Congress has expressed an interest for NASA to extend the survey down to objects as small as 140 meters which might pose a hazard to impacting the Earth. Therefore, investigations that provide capability to detect the subset of NEOs in this category, Potentially Hazardous Objects (PHOs) down to 140 meters in size, will receive additional consideration.

In order to help achieve this inventory of NEOs, NASA seeks investigations that promise a sustained, productive search for NEOs and/or obtain follow-up observations of sufficient astrometric precision to allow the accurate prediction of the trajectories of discovered objects. NASA will also consider within this program proposals that characterize a representative sample of these objects by measuring their sizes, shapes, and compositions.

In keeping with NASA data rights policies, all funded NEO search or follow-up programs will be expected to make their data permanently available in a timely manner to the scientific community. Specifically, this requirement shall apply to all astrometric measurements of putative asteroids and comets that are made by NEO search and follow-up projects funded under this program. In particular, the internationally recognized archive for this data is the International Astronomical Union (IAU) Minor Planet Center, currently located at the Harvard Smithsonian Astrophysical Observatory (see http://minorplanetcenter.net/).

1.2 Proposals for Impactor Characterization and Mitigation Studies.

A limited amount of funding under this program ($400-500K) will be made available for research directed at determination of the parameters necessary to understand the characteristics of PHOs important for implementation of mitigation actions against a detected impact threat – that is, for operations designed to disrupt or deflect the trajectory of an asteroid on an impending Earth impact trajectory.

2. Programmatic Information

2.1 Instrumentation: Construction or Upgrade

The Planetary Major Equipment (PME) program described in Appendix C.23 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 Research 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 Appendix C.23. Two types of instrumentation requests are permitted. (1) A PME request may be made in a special section of a new research proposal to the NEOO program. This section is to be titled "Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal. (2) A stand-alone PME proposal may be prepared and submitted to the NEOO program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" award in the program in order to be considered for selection. See Appendix C.23 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.

Martin Slade
GSSR Task Manager:
M/S 238-420
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109
Phone: (818) 354-2765
Email: Martin.A.Slade@jpl.nasa.gov

2.3 Early Career Researchers

Early career researchers are encouraged to apply to the Fellowships for Early Career Researchers (see Appendix C.22 in this ROSES NRA), named for Dr Stephen J. Ostro in the case of the NEOO Program, by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program was established to facilitate the integration of new Planetary Science discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (*i.e.*, tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Fellowships for Early Career Researchers.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $4.5M
Number of new awards pending adequate proposals of merit	~ 10-14

Maximum duration of awards	Up to 5 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	This program is relevant to the planetary 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 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	NNH12ZDA001N-NEOO
NASA point of contact concerning this program	Lindley N. Johnson Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-2314 E-mail: HQ-NEOO@mail.nasa.gov

C.10 CASSINI DATA ANALYSIS AND PARTICIPATING SCIENTISTS

Notice: The limit on the number of Step-1 proposals per P.I. was removed on February 22, 2012.

Notice: Proposals to this program will be taken via a two-step proposal process (see Section 4.1). This means that the Notice of Intent is replaced by a required Step-1 proposal and the Title and Team are binding. The three page Step-1 proposal will be used to conduct a preliminary evaluation, which will result in full proposals being either encouraged or discouraged. See section 4.1 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. A subset of CDAPS selectees will also serve as Participating Scientists, which will further broaden participating in the mission by augmenting the existing science team. 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 90 days before the CDAPS **Step-2** [added March 1, 2012] 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. Proposers selected as Participating Scientists will have access to data prior to its release to the public domain.

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 is not certified or otherwise has issues that might represent an obstacle to analysis, the proposers must clearly demonstrate that such potential difficulties can be overcome.

Proposals must be focused on the Saturn system and make significant use of (or greatly enhance the use of) data returned by Cassini instruments. 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.

Proposals should describe a unique science investigation for which proposers are not currently funded. For example, members of the Cassini team applying to CDAPS should explain clearly how the proposed research does not overlap with data analysis duties/responsibilities already funded as a member of the mission team.

In the first two years of the CDAPS program data from the Cassini Jupiter flyby in 2000 were eligible. This is no longer true. Proposals that address Jupiter data should be directed to the Outer Planets Research program described in Appendix C.7 of this ROSES NRA.

Proposals to produce a higher order data product that enhances the science return from the mission; 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. Sources of Information and Data

It is the responsibility of the proposers to CDAPS 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 has sufficient quality and is 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.

- 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

3. Participating Scientists

3.1 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 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 addresses the goal of the Cassini Solstice mission, which is to observe seasonal and temporal change in the Saturn system to understand underlying processes and prepare for future mission. Science objectives supporting this goal, as well pursuing new questions posed for the Solstice mission, are posted along with this announcement. 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 reasonably 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.

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 or Co-Investigator on a PI-led instrument team, or as an Interdisciplinary Scientist. The opportunity is open to all current Cassini team associates and affiliates. The Participating Scientist opportunity will be solicited annually for at least three years. Proposers are encouraged to also refer to the FAQ in the "Other Documents" section of the CDAPS program element page.

3.2 Proposal Guidelines

Proposers interested in consideration as a Participating Scientist should submit a proposal for a scientific investigation utilizing Cassini data containing the elements described in Section 2 of the *Guidebook for Proposers*. The proposer must select the Participating Scientist checkbox on the Cover Page of the proposal. NASA desires to keep the budget request for the proposed research investigation separate from the budget request for the Participating Scientist role. Therefore, for U.S. investigators, the budget associated with the Participating Scientist request should be listed as "Other" in the budget information. The research proposal must contain an appendix entitled "Participating Scientist Request." This appendix should include a maximum of five (5) pages describing the Participating Scientist Request, including: (a) a description of how serving as a Participating Scientist will contribute to the research described in the main body of the science research proposal; (b) a description of how the proposed investigation will fit into the broader body of scientific research being conducted by the Cassini science team; (c) 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; (d) a statement that the proposer will abide by the appropriate Cassini team rules; and (e) a detailed budget narrative and spreadsheet describing and justifying the budget requested for the Participating Scientist role, including any cost-sharing arrangements.

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 is only for NASA. 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.

3.3 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 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 Cassini Solstice mission.
- Relevance 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
- 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).

4. Programmatic Information

4.1 The Two-Step Submission Process

To diminish the workload on authors and reviewers of proposals the CDAPS program will be using a two-step proposal submission process starting in ROSES 2012. The two-step procedure means that three-page Step-1 Proposals will replace the Notice of Intent. These Step-1 proposals are required in order to later submit a normal (i.e., full, 15-page) proposal, which is now called the Step-2 proposal. Any Step-2 proposal that was not preceded by a corresponding Step-1 proposal may be rejected without review. The only exception to this requirement is proposals from non-U.S. institutions; proposers from non-U.S. institutions are encouraged but not required to submit Step-1 Proposals. The Step-1 Proposal Title, Principal Investigator and all co-investigators are considered binding and cannot be adjusted in the full (Step-2) proposal. Step-1 Proposals must be submitted electronically by the Step-1 due date (see Tables 2 and 3 in the *ROSES Summary of Solicitation*). Because of the way the NSPIRES web interface works, the required Step-1 proposal must be submitted by the organization. However, submission of the Step-1 proposal does not obligate the offerors to submit a full proposal later. The scientific/technical section of Step-1 proposals may be at most 3 pages in length. Additionally, each paid investigator is permitted one page for a CV and one page is permitted to list the names and time commitments of all investigators. No detailed budget is requested for Step-1. **[Limit on**

number of Step-1 proposals per P.I. was removed on February 22, 2012.]

NASA will review each Step-1 Proposal to determine whether submission of a full Step-2 proposal will be encouraged or discouraged. Responses to the Step-1 Proposals will be provided to proposers at least 30 days in advance of the deadline for full Step-2 Proposals. Proposers from non-U.S. institutions are encouraged but not required to submit Step-1 Proposals.

4.2 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 (RTOPS) 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).

4.3 Early Career Researchers

Early career researchers are encouraged to apply for the Early Career Fellowships (see Appendix C.22 in this NRA) by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program was established to facilitate the integration of new Planetary Science discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (i.e., tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Early Career Fellowships.

4.4 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." that describes the opportunity for successful proposers 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

(http://science.gsfc.nasa.gov/sed/index.cfm?fuseAction=home.main&&navOrgCode=606) or at the Ames Research Center's Advanced Supercomputing Division (http://www.nas.nasa.gov/).

5. Summary of Key Information

Expected program budget for first year of new awards	~ $1.5M/Year (and ~$300K/Year for Participating Scientists)
Number of new awards pending adequate proposals of merit	~ 16 CDAP awards (and ~10 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	Jan 1, 2013
Page limit for the central Science-Technical-Management section of proposal	Step-1 proposals: 3 pp; Step-2 proposals: 15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the planetary 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 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 (Step-1 only)	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	NNH12ZDA001N-CDAPS

NASA point of contact concerning this program	Henry Throop Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1364 E-mail (Preferred): HQ-CDAP@mail.nasa.gov

C.11 PLANETARY MISSION DATA ANALYSIS

1. Scope of Program

1.1 Programmatic Overview

The objective of the Planetary Mission Data Analysis Program (PMDAP) is to enhance the scientific return of Planetary Science Division missions by broadening the scientific participation in the analysis of archived data collected by those missions. In addition, this program supports the analysis of archived planetary data from other NASA and non-NASA missions.

The following planetary missions are a representative, but not complete, alphabetical list of missions for which archived data is available in the PDS:

- Dawn
- Deep Impact
- Deep Space 1
- EPOXI
- Galileo (asteroid flyby data)
- Giotto
- Hayabusa
- Magellan
- MESSENGER
- Near Earth Asteroid Rendezvous (NEAR)
- Pioneer Venus
- Stardust-NExT

Other missions with archived planetary data not covered by other data analysis programs may include, but are not limited to:

- Cosmic Background Explorer (COBE)
- Far Ultraviolet Astronomy Explorer (FUSE)
- Infrared Astronomical Satellite (IRAS)
- Infrared Space Observatory (ISO)
- International Ultraviolet Explorer (IUE)
- Midcourse Space Experiment (MSX)
- Rosetta
- SOHO

The PMDAP also welcomes the submission of “data archiving” proposals. The program seeks to identify science data collections that are considered of significant value to solar system science. The PMDAP will provide funding to restore, prepare, and archive these collections in the PDS so that they may be publicly available and a resource to support solar system exploration.

1.2 Data Analysis Investigations

Scientific investigations proposed to the PMDAP must enhance the science return from a Planetary Science Division mission or planetary data from other NASA- and non-NASA-supported missions. Such mission data analysis must be the principal focus of the investigation. In support of any mission data analysis proposal to the PMDAP, but 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 theoretical research or numerical modeling, may use existing data from ground-based observations, or may use suborbital observations and/or laboratory measurements. The PMDAP also 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 to the PMDAP. Such requests to perform new theoretical research, modeling, observations, or field/laboratory measurements will be considered only if their cost (including FTEs, travel, etc.) does not exceed 10 percent (10%) of the proposal's total effort.

The PMDAP supports scientific investigations that use only data available in the Planetary Data System (PDS) (http://pds.nasa.gov/) or other publicly accessible archive(s), such as planetary data in the NASA astrophysics data archives (http://nssdc.gsfc.nasa.gov/astro/). The data must be archived and publicly available 30 days prior to the submission deadline for PMDAP proposals. Spacecraft data that have not been placed in such archives may not be proposed for use in PMDAP investigations. In all cases, it is the responsibility of the PMDAP investigator to acquire any necessary data. Investigators are encouraged to contact the PDS for assistance in identifying specifics of available datasets. It is recommended that datasets to be analyzed be specifically identified in the proposal.

Data products accessible in the PDS must be designated "certified" (ready for scientific use) in order to be eligible for the PMDAP (see Appendix C.1). Data products accessible in archives other than the PDS that are still in liens resolution are not considered archived and their analysis will not be supported by the PMDAP.

Additional information on the PDS may be obtained from the following individuals:

Contact	Title	E-mail
William Knopf	Program Executive	William.Knopf-1@nasa.gov
Thomas Morgan	Program Manager	thomas.h.morgan@nasa.gov

1.3 Data Archiving into PDS

Selected investigations may result in data products that are of broad use to the science community, including maps, data with improved calibrations, etc. These data should be archived in the Planetary Data System, unless the investigator explicitly makes a case against this in the proposal. When proposing the archiving of such products into the PDS, an archive plan must be included, identifying schedule and budget to go through the PDS ingestion process. NASA reserves the option to require the archiving of data products resulting from PMDAP selected proposals in the Planetary Data System (http://pds.nasa.gov/).

The PMDAP supports the restoration and digital archiving of unarchived, nonlunar datasets relevant to the planetary sciences. (Restoration and archiving of lunar datasets is supported through the LASER program element of ROSES, as described in Appendix C.8.) Priority will be assigned to datasets that are identified and demonstrated by the proposal to be of high value to solar system science and NASA. Proposals should provide as much information as possible on the nature and current extent of the data proposed for archiving. For evaluation purposes, data archiving proposals should contain a thorough discussion and description of:

- Data Source (e.g., Voyager I);
- Data Type (e.g., images of a, b, c, etc.);
- Data Format (e.g., tape, hard copy images, punch cards, JPEG);
- Condition of data (e.g., poor, fair, good, excellent); and
- Completeness of data (e.g., fragmentary, etc.).

Proposals should provide: a) a detailed plan for how the data will be restored; b) a plan and timetable for submitting the data and metadata to PDS in a PDS-compliant form and resolving all liens arising from the PDS peer-review, and c) a description of documentation, calibration data, and related software necessary to interpret the data.

Types of archival data products include, but are not limited to, low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in flight), documentation, and related software or other tools. All data products must be documented, validated, and calibrated in physical units usable by the scientific community at large. It is the proposer's responsibility to conform to PDS standards.

Proposers 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/documents/pag/index.html
Standards Reference	http://pds.nasa.gov/documents/sr/index.html

Proposers planning to archive data in the PDS 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 the PMDAP.

1.4 Program Exclusions

The PMDAP is not intended to overlap other active data analysis programs. Thus, the PMDAP does not support the analysis of:

- Lunar data (see the Lunar Advanced Science and Exploration Research (LASER) program in Appendix C.8);
- Mars data obtained by missions to Mars (see the Mars Data Analysis Program (MDAP) in Appendix C.12);

- Jupiter, Saturn, Uranus and Neptune system phenomena (see the Outer Planets Research (OPR) program in Appendix C.7);
- Data from Cassini (see the Cassini Data Analysis Program (CDAP) in Appendix C.10); and
- Data from the New Horizons, Galileo, Voyager, Pioneer, and Ulysses missions (see the Outer Planets Research (OPR) program in Appendix C.7).

This list is not exhaustive. Please refer to the solicitations of the Cassini Data Analysis program (Appendix C.10), the Outer Planets Research program (Appendix C.7)), the Mars Data Analysis program (Appendix C.12), and the Lunar Advanced Science and Exploration Research (LASER) program (Appendix C.8). In addition, the restoration and archiving of lunar datasets is supported through the LASER program, and should be the targeted solicitation for investigations of this nature.

Proposers to this NRA should note that the PMDAP is not intended to support:

- Investigations whose primary emphasis is fundamental theoretical research, the development of numerical models, laboratory measurements, or detector development (other NASA programs support these research activities);
- Investigations whose primary focus is on Astrophysics (non-Solar System) objects, Heliophysics, or on the solar-terrestrial interaction (other NASA programs support this kind of research, see Appendices B and D);
- Proposals primarily for the general education and/or training of students (note: this does not exclude students from doing research under the proposal);
- Proposals for organizing and/or hosting scientific meetings; and
- Proposals for the acquisition of substantial computing facilities or resources beyond nominal workstation or network requests.

Spacecraft data that have not been obtained (i.e., future mission data), or those that have not been placed in approved archives may not be proposed for use in PMDAP investigations.

Members of spacecraft flight teams who wish to apply to the PMDAP 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 PMDAP research does not overlap and is not redundant with data analysis duties or responsibilities already funded by their respective mission.

2. Programmatic Information

2.1 Early Career Researchers

Early career researchers are encouraged to apply to the Fellowships for Early Career Researchers (see Appendix C.22 in this ROSES NRA) by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program

was established to facilitate the integration of new Planetary Science discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (*i.e.*, tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Fellowships for Early Career Researchers.

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 the PMDAP 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.

3. Summary of Key Information

Expected program budget for first year of new awards	~2.5M
Number of new awards pending adequate proposals of merit	~ 10-13
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	This program is relevant to the planetary 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 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	NNH12ZDA001N-PMDAP
NASA point of contact concerning this program	Michael S. Kelley Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0607 E-mail: HQ-PMDAP@mail.nasa.gov

C.12 MARS DATA ANALYSIS

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), and Phoenix (PHX). 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 (scientific, landing site science, cartographic, topographic, geodetic research) based on analysis of Mars data collected by spacecraft at Mars, including MPF, MGS, MO, MERs, MEX, MRO and PHX. 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/.

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.

Investigators may propose to produce data products (e.g., cartographic products, such as geologic, topographic or mineral maps, and/or calibration data). Such investigations need not have associated scientific tasks; however, the utility of the proposed data products to the Mars/science community must be clearly specified in the proposal and will be judged on this basis. Scientific research tasks may also result in data products. Regardless of the nature of the proposal, 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 (PDS; http://pds.nasa.gov/) of any data products resulting from MDAP selected proposals. Proposed investigations that will result in a geologic map suitable for publication by the U.S. Geological Survey (USGS) should clearly indicate this intention in the *Proposal Summary*, as well as in the text of the proposal, and must follow the guidelines for USGS map products outlined in ROSES element C.4, Planetary Geology and Geophysics.

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 closely related Mars Fundamental Research Program described in Appendix C.13 of this NRA.

2. Sources of Information and Data

MDAP 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(s) at least 30 days prior to the submission due date for MDAP proposals. Spacecraft data that have not been placed in the public domain may not be proposed for use in MDAP 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 MDAP submission date.

Members of current Mars flight teams who wish to apply to the MDAP 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, current flight team members must demonstrate clearly how the proposed MDAP research does not overlap and is not redundant with data analysis duties/responsibilities already funded within their respective mission.

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.

In all cases, it is the responsibility of the MDAP investigator to acquire any necessary data. Therefore, before submitting a proposal, each proposer must determine 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.

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/.

3. Programmatic Information

3.1 Early Career Researchers

Early career researchers are encouraged to apply for the Early Career Fellowships (see Appendix C.22 in this NRA) by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program was established to facilitate the integration of new Planetary Science discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (i.e., tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Early Career Fellowships.

3.2 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 the Mars Data Analysis 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 (http://science.gsfc.nasa.gov/sed/index.cfm?fuseAction=home.main&&navOrgCode=606) or at the Ames Research Center's Advanced Supercomputing Division (http://www.nas.nasa.gov/).

4. Summary of Key Information

Expected program budget for first year of new awards	~ $2.5M
Number of new awards pending adequate proposals of merit	~ 25
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	This program is relevant to the planetary 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 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	NNH12ZDA001N-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.13 MARS FUNDAMENTAL RESEARCH

1. Scope of Program

1.1 Programmatic Overview

The Mars Fundamental Research Program (MFRP) seeks to sponsor the best and most innovative scientific research concerning atmospheric, climatological, geologic, geophysical, and geochemical processes on Mars. The program offers opportunities for Mars research beyond those available from analyses of spacecraft data alone.

The MFRP includes investigations that use: (i) theoretical and experimental studies, including laboratory studies of analog materials, to investigate the coupled atmospheric and geological systems on Mars; (ii) quantitative terrestrial field experiments that improve understanding of the *in situ* measurements that have been or that will be made on Mars; and (iii) any other innovative research activities that demonstrate relevance to NASA's overarching goals for the scientific exploration of Mars. This program solicitation is intentionally broad, with only a few ground rules and boundary conditions, as follows:

1) Investigations submitted to this program must demonstrate how the research to be undertaken will directly improve our understanding of Mars relative to current knowledge;
2) Research activities must not duplicate those that involve analysis of flight mission data; such investigations may be submitted to the companion Mars Data Analysis Program (MDAP) (Appendix C.12 in this ROSES NRA);
3) All proposed research must demonstrate relevance to the overarching scientific research directions of the Mars Exploration Program (MEP; see Web site http://mars.jpl.nasa.gov/), as summarized in the *Mars Scientific Goals, Objectives, Investigations and Priorities* by the Mars Exploration Program Analysis Group (MEPAG, 2008) at http://mepag.jpl.nasa.gov/reports, and the *MEP Robotic Mars Exploration Strategy 2007-2016* (2006) JPL 400-1276. Further guidance is provided in the Space Studies Board report, *Assessment of NASA's Mars Architecture 2007-2016* (2006) at http://books.nap.edu/catalog.php?record_id=11717; and NASA's response *Update to Robotic Mars Exploration Strategy 2007-2016* (2006) at http://mepag.jpl.nasa.gov/reports; 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*, available at http://www.nap.edu/catalog.php?record_id=13117.
4) Research involving field experiments must demonstrate how the proposed activities directly relate to current questions about the environment of Mars;
5) Laboratory experiments submitted to MFRP must relate directly to questions about the Martian environment and Mars-relevant materials and must clearly demonstrate the uniqueness of the approach;
6) Proposals to develop basic geochemical and geophysical datasets for Mars-relevant materials are permitted, provided there is sufficient justification for such measurements in

the context of the MEP during the coming decade. Basic research pertaining to future Mars sample return may also be considered;

7) Investigations in this program must not be posed as extensions of flight experiments that are part of ongoing or soon-to-be active science missions; rather investigators must state how any proposed activities that pertain to current or future flight missions are independent of those to be pursued by the typical mission-related science team activities;
8) Investigations using innovative information technology (IT) approaches for understanding Mars as a system, including field experiments that clearly demonstrate the potential of IT solutions to increase substantially the scientific yield (and scope) of planned investigations, are permitted (e.g., IT developments that could radically improve the time required for field deployable rovers to approach rocks and other interesting targets), provided that scientific products are proposed as an end product (i.e., technology demonstrations alone are not relevant to this NRA); and
9) Topical science conferences, workshops, and symposia may be considered by this program element. Proposers are encouraged to review the guidelines found on page 3 of 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

As part of this research solicitation, NASA encourages innovative research approaches involving the full spectrum of possibilities listed in items (1) – (8) above, as well as others that can be scientifically justified.

1.2 Background

NASA's Mars Exploration Program (MEP) (http://mars.jpl.nasa.gov) is a science-driven program that focuses on understanding the planet Mars as a "system." The MEP is characterized by a suite of core program flight missions, as well as fully competed Scout missions, whose aim is to provide new observational and measurement data concerning Mars.

Through MDAP (Appendix C.12), NASA solicits research that is based upon flight mission data from the suite of flight experiments that have flown or are currently collecting data concerning Mars. However, there is a broad variety of fundamental research investigations that are key to understanding Mars as a dynamic system in space and time, some of which may not be directly linked to the flight experiment data that have either recently been collected or will be in the near future. These investigations may be submitted to this MFRP solicitation. It is expected that most MFRP investigations will provide a basis for better or more complete analysis of existing or future Mars spacecraft data.

1.3 Sources of Information and Data

It is the responsibility of the investigator to acquire any required data needed to complete his/her investigation. Therefore, before submitting a proposal, each proposer must determine that the required data are or will be available. Data from Mars Pathfinder, Mars Global Surveyor, Mars Odyssey, Mars Exploration Rover, and Mars Reconnaissance Orbiter missions, as well as data from previous Mars missions, are available from the Planetary Data System, whose home page

can be accessed at http://pds.jpl.nasa.gov/. Proposers who wish to use photographic and cartographic materials may find such data at the nearest Regional Planetary Image Facility (RPIF), whose locations are listed on the RPIF home page at http://www.lpi.usra.edu/library/RPIF/. Curation and analysis data on Martian meteorites are available from the Mars Meteorite Compendium at http://curator.jsc.nasa.gov/antmet/mmc/index.cfm.

Documents that describe the science priorities and proposed missions for Mars exploration are referenced above and include:

- SSB-NRC - *Visions and Voyages for Planetary Science in the Decade 2013-2022* at http://www.nap.edu/catalog.php?record_id=13117;
- *Science Perspectives for Candidate Mars Mission Architectures for 2016-2026* (2009) at http://mepag.jpl.nasa.gov/reports/
- MEPAG – *Mars Scientific Goals, Objectives, Investigations and Priorities* (2010), and MEP - *Robotic Mars Exploration Strategy 2007-2016* (2006), both available at http://mepag.jpl.nasa.gov/reports/;
- SSB-NRC - *Assessment of NASA's Mars Architecture 2007-2016* (2006), available at http://books.nap.edu/catalog.php?record_id=11717
- MEP – *Update to Robotic Mars Exploration Strategy 2007-2016* (2006), available at http://mepag.jpl.nasa.gov/reports/.

2. Programmatic Information

2.1 Augmentation for Instrumentation Upgrades

The Planetary Major Equipment (PME) program described in Appendix C.23 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 Research 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 Appendix C.23. Two types of instrumentation requests are permitted. (1) A PME request may be made in a special section of a new research proposal to the MFRP. This section is to be titled "Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal. (2) A stand-alone PME proposal may be prepared and submitted to the MFRP. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" award in the program in order to be considered for selection. See Appendix C.23 for details on how to prepare both types of PME requests.

2.2 Early Career Researchers

Early career researchers are encouraged to apply to the Fellowships for Early Career Researchers (see Appendix C.22 in this ROSES NRA) by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program was established to facilitate the integration of new Planetary Science discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (*e.g.*, tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Fellowships for Early Career Researchers.

2.3 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 the Mars Fundamental 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.

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 completed Antarctic Operations Requirements Worksheet (ORW) and evidence that the ORW has been submitted to the NSF Office of Polar Programs. The ORW and instructions on submitting it to NSF are available at http://www.usap.gov/scienceSupport/polarice/.

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 earlier than late-2013/early-2014 Proposals requiring Antarctic access in their first performance year may suggest a start date commensurate with this schedule.

3. Summary of Key Information

Expected program budget for first year of new awards	~$2.3M
Number of new awards pending adequate proposals of merit	20-23
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	This program is relevant to the planetary 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 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	NNH12ZDA001N-MFRP
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: HQ-MFRP@mail.nasa.gov or Mitchell.D.Schulte@nasa.gov

C.14 MARS INSTRUMENT DEVELOPMENT PROJECT

NOTICE: Proposals for the Mars Instrument Development Project (MIDP) will not be solicited this year.

NASA's Mars Exploration Program (MEP) calls for a series of highly ambitious missions over the next decade. The overall goals of the MEP must be achieved with relatively low mission risk and within tightly constrained cost resources. The current overarching scientific goals of the MEP are: life, climate, geology, and preparation for human exploration. These have a common, measurable link: water. For Mars (like Earth), water is central to the planet's history; it is also the primary reason for interest in it as a potentially habitable world.

Questions or comments may be directed to the MIDP Program Executive, at the address given below.

Dave Lavery
Planetary Science Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC, 20546-0001
Phone: 202-358-4684
Email: dave.lavery@nasa.gov

C.15 MARS TECHNOLOGY PROJECT

NOTICE: Proposals for The Mars Technology Project (MTP) will not be solicited this year.

NASA's Mars Exploration Program calls for a series of highly ambitious missions over the next decade and beyond. The overall goals of the Mars Exploration Program must be achieved with relatively low mission risk and within tightly constrained cost resources. Information on NASA's Mars programs may be obtained at http://mars.jpl.nasa.gov.

The Mars Technology Project (MTP) seeks to ensure that appropriate spacecraft technologies are available in a sufficiently mature state to be support the challenges of the Mars Exploration Program, and they are ready for incorporation into future mission systems.

Questions or comments may be directed to the MTP Program Executive, at the address given below.

Dave Lavery
Planetary Science Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC, 20546-0001
Phone: 202-358-4684
Email: dave.lavery@nasa.gov

C.16 PLANETARY INSTRUMENT CONCEPTS FOR THE ADVANCEMENT OF SOLAR SYSTEM OBSERVATIONS

Notice: This Appendix C.16, the Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) Program, will not be solicited this year. However, draft text is presented below to prepare potential proposers for next year. The related program, Appendix C.19, the Maturation of Instruments for Solar System Exploration (MatISSE), is being solicited this year.

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, Appendix C.19 of ROSES. 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. 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 technology readiness level (TRL) that PICASSO supports is 1-3. 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 TRL 1- 9 is available at www.hq.nasa.gov/office/codeq/trl/trl.pdf.

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 Science Plan for NASA's Science Mission Directorate 2007-2016 (http://science.nasa.gov/media/medialibrary/2010/03/31/Science_Plan_07.pdf) to learn more

about relevant missions.

The PICASSO program encompasses and replaces elements that were previously solicited by the Planetary Instrument Definition and Development Program (C.16), the Astrobiology Science and Technology for Instrument Development Program (C.19), and the Mars Instrument Development Project (Appendix C.14). 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.19. 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, 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.

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/SBIR/awards.htm) 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

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 *Initial Plans and Reports*

Within 15 days of award, the PI shall provide an initial Quad Chart, and an updated project plan. The updated project plan is only required if the selected proposal has been descoped by the NASA Selection Official. The initial (entry) Quad Chart and project plan (if applicable) shall be e-mailed to the NASA Program Officer for this program.

The Quad Chart shall contain the following information:

- Upper Left Quadrant: "Description and Objectives"
- Lower Left Quadrant: "Approach" and "Co-Is/Partners"
- Upper Right Quadrant: A visual, graphic, or other pertinent information
- Lower Right Quadrant: "Milestone Schedule" and "Entry TRL."

The Quad Chart shall be updated at least annually and more often if appropriate. A template can be obtained from the NASA Program Officer for this program.

The TRL assessment shall be updated at least annually, more often if appropriate.

2.3.2 *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.

The Annual Report and 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.

2.3.3 *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:

1. The Final Review must provide conclusions of the work performed and make recommendations for follow-on activities that should be pursued,
2. 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, including a rough order of magnitude cost and a description and estimate of the duration of the follow-on activities necessary to achieve TRL 4;
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.

2.4 Early Career Researchers

Early career researchers are encouraged to apply for the Fellowships for Early Career Researchers (see Appendix C.22 in this ROSES NRA) by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track or equivalent position. This program was established to facilitate the integration of new Planetary Science discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (*i.e.*, tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Fellowships for Early Career Researchers.

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 in 2012. 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 http://www2.orau.gov/NASA_Catalog/.

3. Summary of Key Information

Expected program budget for first year of new awards	Not solicited this year (expected budget solicited in ROSES 2013 ~ $3.5M)
Number of new awards pending adequate proposals of merit	Not solicited this year (expected awards from ROSES 2013 ~ $3.5M)
Maximum duration of awards	3 Years
Due date for Notice of Intent to propose (NOI)	Not solicited this year
Due date for proposals	Not solicited this year
Planning date for start of investigation	Not solicited this 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 planetary 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 Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Not solicited this year
Website for submission of proposal via NSPIRES	Not solicited this year
Web site for submission of proposal via Grants.gov	Not solicited this year
Funding opportunity number for downloading an application package from Grants.gov	Not solicited this year
NASA point of contact concerning this program	Janice L. Buckner NASA Program Officer Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington DC 20526-0001 Telephone: 202-358-0183 E-mail: janice.l.buckner@nasa.gov

Other NASA points of contact related to this program	Questions concerning Discovery or Astrobiology Program may be addressed to : Michael H. New, PhD Astrobiology Discipline Scientist Lead Discovery Program Scientist Planetary Science Division National Aeronautics and Space Administration Washington DC 20526-001 Telephone: 202-358-1766 E-mail: michael.n.new@nasa.gov Mary A. Voytek, Ph.D. Senior Scientist for Astrobiology Science Mission Directorate National Aeronautics and Space Administration Washington DC 20526-001 Telephone: 202-358-1577 E-mail: mary.voytek-1@nasa.gov Questions concerning New Frontiers Program may be addressed to : Curt Niebur, Ph.D. Program Scientist Cassini/Huygens Mission to Saturn Discovery 12 Mission New Frontiers Program Discipline Scientist Early Career Fellowship Program National Aeronautics and Space Administration Washington DC 20526-001 Telephone: 202-358-0390 E-mail: curt.neibur@nasa.gov Questions concerning Mars Exploration Program may be addressed to : Michael A. Meyer, Ph.D. Lead Scientist Mars Exploration Program National Aeronautics and Space Administration Washington DC 20526-001 Telephone: 202-358-0307 E-mail: michael.a.meyer@nasa.gov

C.17 ASTROBIOLOGY: EXOBIOLOGY AND EVOLUTIONARY BIOLOGY

NOTICE: Proposals for the Exobiology and Evolutionary Biology program will not be solicited in ROSES-2012. This program will be solicited in ROSES-2013

1. Scope of Program

The goal of NASA's Exobiology and Evolutionary Biology program 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, please refer to the Astrobiology roadmap, which can be found on the Astrobiology web page http://astrobiology.arc.nasa.gov/. The areas of research emphasis in this solicitation are as follows:

- *Planetary Conditions for Life*

Research in this area seeks to delineate the galactic and planetary conditions conducive to the origin of life. Topics of interest include the formation and stability of habitable planets, the formation of complex organic molecules in space and their delivery to planetary surfaces, models of early environments in which organic chemical synthesis could occur, the forms in which prebiotic organic matter has been preserved in planetary materials, and the range of planetary environments amenable to life. Emphasis is placed on studies that constrain or extend concepts of possible chemical evolution relevant to the origin, evolution, and distribution of life. Studies of sites thought to be analogues to the early Earth will be considered as part of NASA's broader interest in the search for life in the Universe.

- *Prebiotic Evolution*

Research in the area of prebiotic evolution seeks to understand the pathways and processes leading from the origin of planetary bodies to the origin of life. The strategy is to investigate 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. Laboratory and theoretical, as well as related data-analysis, studies will be considered.

- *Early Evolution of Life and the Biosphere*

The goal of research into the early evolution of life 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) examine the response of Earth's biosphere to extraterrestrial events; vi) 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 vii) 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.

- *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 development of multicellularity on Earth and the potential distribution of complex life in the Universe. This research includes studies of 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. This research area also includes an evaluation of environmental factors such as the influence of 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 appearance and evolution of multicellular life. Of particular interest are mass extinction events. Proposals aimed at identification and characterization of signals and/or properties of extrasolar planets that may harbor intelligent life are also solicited.

- *Exobiology for Solar System Exploration*

Research in this area focuses on relating what is known about life on Earth to conditions prevailing on other planetary bodies. This research includes assessments of the survivability of various types of Earth microorganisms and the formation and retention of biosignatures under non-Earth conditions (*e.g.*, Mars, Europa). Also included under this research area are efforts to assess the potential habitability of planetary environments other than those found on the Earth. Studies of 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.

2. Programmatic Information

2.1 General Information

Proposals are sought for new projects within the scope of the Astrobiology: Exobiology and Evolutionary Biology program. 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 program, but whose periods of performance expired last year or are expiring in the first half of this year. Periods of performance from one to four years may be proposed, as appropriate, to the nature of the contemplated research. 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.

2.2 Instrumentation: Construction or Upgrade

The Planetary Major Equipment (PME) program described in Appendix C.23 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 Research 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 Appendix C.23. Two types of instrumentation requests are permitted. (1) A PME request may be made in a special section of a new research proposal to the Exobiology program. This section is to be titled "Major Equipment Request" and should be separate from the Scientific/Technical/Management section of the research proposal. (2) A stand-alone PME proposal may be prepared and submitted to the Exobiology program. Such a stand-alone proposal must be explicitly affiliated with an existing “parent” award in the program in order to be considered for selection. See Appendix C.23 for details on how to prepare both types of PME requests.

2.3 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 Astrobiology Science and Technology Instrument Development (ASTID) program (Appendix C.19 in this ROSES NRA and potential amendments thereto). 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 Astrobiology Science and Technology for Exploring Planets (ASTEP) program (see Appendix C.20 and potential amendments thereto).

2.4 Early Career Researchers

Early career researchers are encouraged to apply for the Fellowships for Early Career Researchers (see Appendix C.22 in this ROSES NRA) by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program was established to facilitate the integration of new Planetary Science discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (*i.e.*, tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Fellowships for Early Career Researchers.

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 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 four Fellows associated with Exobiology research 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 http://www2.orau.gov/NASA_Catalog/.

2.6 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 completed Antarctic Operations Requirements Worksheet (ORW) and evidence that the ORW has been submitted to the NSF Office of Polar Programs. The ORW and instructions on submitting it to NSF are available at http://www.usap.gov/scienceSupport/polarice/.

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.

2.7 Facilities Available for the Exobiology Program

The following facilities are available to investigators supported by the Astrobiology: Exobiology and Evolutionary Biology program. 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.

- *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:

Peter Schultz
Department of Geological Sciences
Box 1846
Brown University
Providence, RI 02912-1846
Telephone: (401) 863-2417
Email: peter_schultz@brown.edu

- *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 the Astrobiology: Exobiology and Evolutionary Biology 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.

- *NASA Venus Pressure Test Chamber*

The Venus Pressure Test Chamber is a NASA facility that enables testing of components and small instruments under temperatures and pressures that simulate Venus surface conditions. Lower temperatures and pressures may also be accommodated. Exploratory or proof-of-concept programs requiring a limited number of experiments/tests 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 chamber should be explicitly described in the proposal. The proposal budget should include an estimate of usage costs. A letter of support from the Venus Chamber facility is required.

For more information, potential users of the Venus Chamber should contact:

Natasha Johnson
Astrochemistry Laboratory
Code 691
NASA Goddard Space Flight Center
Greenbelt, MD 20771
Telephone: (301) 286-3919
Email: natasha.m.johnson@nasa.gov

3. Summary of Key Information

Expected program budget for first year of new awards	Not Solicited this year
Number of new awards pending adequate proposals of merit	Not Solicited this year
Maximum duration of awards	4 years
Due date for Notice of Intent to propose (NOI)	Not Solicited this year
Due date for proposals	Not Solicited this year
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 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 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	Not Solicited this year
Funding opportunity number for downloading an application package from Grants.gov	Not Solicited this year
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: HQ-EXO@mail.nasa.gov

C.18 PLANETARY PROTECTION RESEARCH

Amended on March 9, 2012. The due dates have been changed for Appendix C.18, The Planetary Protection Research Program. Notices of Intent are now due June 29, 2012, and Proposals are now due September 5, 2012. This change is being made so that the due dates occur on work days.

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 research program entitled: Astrobiology: Exobiology and Evolutionary Biology (see Appendix C.17), the Planetary Protection Research program solicits research in the following areas:

- Characterizing the limits of life in laboratory simulations of planetary environments or in appropriate Earth analogs, particularly studies of the potential, distribution 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 within a subsurface ocean as may be present on Europa and other icy satellites. Studies addressing the distribution of life within relevant planetary environments, specifically in the context of informing life-detection experiments (e.g., localization of organisms within rocks or ice), are of particular interest.
- Modeling of 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;
- The development or adaptation of 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); and
- 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 might affect the priorities for funding among these areas.

2. Programmatic Information

2.1 Proposal Constraints

Proposals are sought for new projects in planetary protection that are not within the scope of the Astrobiology: Exobiology and Evolutionary Biology program (see Appendix C.17). 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 in 2012. Periods of performance from one to four years may be proposed, as appropriate, to the nature of the contemplated research. Approximately $300-500K per year of total funding is expected to be available to support two to four research tasks selected from proposals responding to this solicitation.

2.2 Instrumentation: Construction or Upgrade

The Planetary Major Equipment (PME) program described in Appendix C.23 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 Research 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 Appendix C.23. Two types of instrumentation requests are permitted. (1) A PME request may be made as a special section that is appended to a new research proposal to the Planetary Protection 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. (2) A stand-alone PME proposal may be prepared and submitted to the Planetary Protection program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" award in the program in order to be considered for selection. See Appendix C.23 for details on how to prepare both types of PME requests.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $300-450K
Number of new awards pending adequate proposals of merit	~ 2-4
Maximum duration of awards	4 years; shorter-term proposals are encouraged.
Due date for Notice of Intent to Propose (NOI)	**June 29, 2012 [Amended March 9, 2012]**
Due date for proposals	**September 5, 2012 [Amended March 9, 2012]**
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 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 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	URL: 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	NNH12ZDA001N-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.19 MATURATION OF INSTRUMENTS FOR SOLAR SYSTEM EXPLORATION

Amended October 29, 2012. The Due Date for Appendix C.19 Maturation of Instruments for Solar System Exploration has been delayed by a week to give more time to proposers who will be without power because of Hurricane Sandy. The new due date for proposals to Appendix C.19 Maturation of Instruments for Solar System Exploration is November 7, 2012.

Amended on July 30, 2012. This amendment presents final text for Appendix C.19, which replaces the previous version in its entirety. The name of this program has also been changed. Notices of intent are requested by August 31, 2012, and proposals are due by October 31, 2012.

1. Scope of Program

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 TRL 6). The proposed instrument must address specific scientific objectives of likely future planetary science missions.

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). 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 MatISSE Program is intended to enable technology infusion into NASA planetary science missions to take place in a timely and efficient manner. As such, the technology readiness level (TRL) that MatISSE supports is TRL 3-6. It is the responsibility of the proposer to justify the entry and exit level TRL of the proposed technology. Instrument development activities must be planned and initiated so that major technological risk is retired prior to a science solicitation via an Announcement of Opportunity (AO) or Request for Proposal (RFP). This program will permit appropriate funding to be applied at each stage of readiness associated with the development and demonstration of key and enabling technologies, such as breadboarding, brassboarding, and testing of critical components and complete instruments in a relevant environment.

A full description of Technology Readiness Levels (TRLs) 1- 9 is available at www.hq.nasa.gov/office/codeq/trl/trl.pdf.

Prospective proposers are encouraged to review "Visions and Voyages for Planetary Science in the Decade 2013-2022" (http://solarsystem.nasa.gov/2013decadal/ the most recent Decadal

Survey) and Science Plan for NASA's Science Mission Directorate 2007-2016 (http://science.nasa.gov/media/medialibrary/2010/03/31/Science_Plan_07.pdf) to learn more about relevant missions.

The MatISSE Program encompasses and replaces elements that were previously solicited by the Planetary Instrument Definition and Development Program (C.16), the Astrobiology Science and Technology for Instrument Development Program (C.19), and the Mars Instrument Development Project (Appendix C.14). Proposals not appropriate for MatISSE are feasibility studies, concept formulation, and proof of concept or advanced component development. These proposals should be submitted to the Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO) Program in ROSES-2013. Draft text for this call will be downloadable in ROSES-2012 from Appendix C.16. In addition, MatISSE 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, 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 improve instrument measurement capabilities. It is anticipated that the science payloads on most future planetary science spacecrafts 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 missions focus areas described in Decadal Survey or the Science Plan. All proposals submitted to this program element must specify:

- The mission focus area for which the proposed instrument is applicable. Instruments that are applicable to more than one mission will be given priority.

- The science objectives of the proposed instrument. The relationship between the science objectives and the instrumental capabilities must be clearly demonstrated. For those instruments applicable to more than one mission or capable of meeting multiple science objectives, examples of science objectives for the proposed mission or missions must be given.

- Technological advances to be pursued as an inherent element of achieving the science objectives. Proposers must identify potential mechanisms that could facilitate transfer of these technologies to other users, including the private sector, for possible application beyond the immediate one of meeting mission science objectives.

- A detailed description and justification for the entry Technology Readiness Level and a detailed plan for raising the instrument to the proposed exit Technology Readiness Level. The plan must include descriptions of planned tests or demonstrations, as well as

discussions of how those test or demonstrations will advance the Technology Readiness Level of the instrument.

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 MatISSE selection recommendations.

- The extent to which the proposed instrument is applicable to multiple Planetary Science missions;
- The extent to which the instrument 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/SBIR/awards.htm) 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.
- It is expected that most proposals will request awards with duration of three years, but proposals may be submitted for projects of duration from one to four years. For proposals that request an award of four years in duration, the detailed justification for the fourth year will be used in determining the duration of any award, should the proposal be selected.

2.3 Technical Reporting Requirements

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 *Initial Plans and Reports*

Within 15 days of award, the PI shall provide an initial Quad Chart, and an updated project plan. The updated project plan is only required if the selected proposal has been descoped. The initial (entry) Quad Chart and project plan (if applicable) shall be emailed to the NASA Program Officer for this program.

The Quad Chart shall contain the following information:

- Upper Left Quadrant: "Description and Objectives"
- Lower Left Quadrant: "Approach" and "Co-Is/Partners"
- Upper Right Quadrant: A visual, graphic, or other pertinent information
- Lower Right Quadrant: "Milestone Schedule" and "Entry TRL."

The Quad Chart shall be updated at least annually and more often if appropriate. A template can be obtained from the NASA Program Officer for this program.

The TRL assessment shall be updated at least annually, more often if appropriate.

2.3.2 *Quarterly Technical Reports*

The quarterly technical report shall focus on the preceding three month's efforts. Each report shall address:

1. Technical status: The PI shall summarize accomplishments for the preceding three months, including technical accomplishments (trade study results, requirements analysis, design, etc.), technology development results, 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.

Quarterly Technical Reports shall be emailed to the NASA Program Officer for this program, starting on the third-month anniversary date of the signing of the award vehicle.

In months for which the PI is providing an Annual Review, the requirement for a quarterly report is superseded by the 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 NASA Program Officer and the PI to review and discuss each report.

2.3.3 *Annual Progress Report Deliverable*

The PI shall provide an Annual Review at the end of the first twelve-month calendar period commencing from the date of award and at twelve-month intervals thereafter. The PI must conduct an oral presentation summarizing the work accomplished and results leading up to this Annual 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, 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. 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 committed, obligated, and costed, along with a graphical representation of the project cost profile to completion;

4. Provide a summary of accomplishments and anticipated results at the end of the task;
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 Annual Review should be comprehensive and should include a discussion of the planned content of the written report.

The NASA Program Officer will conduct the Annual Review at the PI's facility or via teleconference. If the review is conducted at the PI's facility, or a mutually agreed to location, the PI may also provide a laboratory demonstration, if appropriate, to show technical results and status. The presentation slides (Power Point) shall be e-mailed to the NASA Program Officer at least two (2) working days prior to the review.

Following the review, the presentation shall be updated in accordance with comments and discussion resulting from the review, this will constitute the Annual Review. The presentation, updated in accordance with comments and discussion resulting from the review, together with the separate written Annual Report, shall constitute the Annual Progress Report deliverable, and shall be E-mailed to the NASA Program Officer and the NASA Shared Services Center (NSSC) within ten days after the review. The release of the annual budget allocation is contingent on the timely submission of the Annual Progress Report deliverable.

2.3.4 *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 exceptions:

1. 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 achieve TRL 7.
2. As this is the Final Review, 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, 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 achieve TRL 7;
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 within ten days of the final review.

2.4 Early Career Researchers

Early career researchers are encouraged to apply for the Fellowships for Early Career Researchers (see Appendix C.22 in this ROSES NRA) by simply checking an additional box on the cover page of their proposal. To be eligible, proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track or equivalent position. This program was established to facilitate the integration of new Planetary Science discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (*i.e.*, tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Fellowships for Early Career Researchers.

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 MatISSE Program expects to select no more than two Fellows associated with Planetary Science or Astrobiology Instrument Development in 2012. 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 http://www2.orau.gov/NASA_Catalog/.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $1.0M per year per award
Number of new awards pending adequate proposals of merit	~ 1 to 2
Maximum duration of awards	4 Years, but see last bullet in Section 2.2

Due date for Notice of Intent to propose (NOI)	August 31, 2012
Due date for proposals	~~October 31, 2012~~ **November 7, 2012 [amended October 29, 2012]**
Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	25 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the planetary 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 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 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	NNH12ZDA001N-MatISSE
NASA point of contact concerning this program	Janice L. Buckner NASA Program Officer Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington DC 20526-0001 Telephone: 202-358-0183 E-mail: janice.l.buckner@nasa.gov

NASA points of contact for related programs	Questions concerning Discovery or Astrobiology Program may be addressed to : Michael H. New, PhD Astrobiology Discipline Scientist Lead Discovery Program Scientist Planetary Science Division National Aeronautics and Space Administration Washington DC 20526-001 Telephone: 202-358-1766 E-mail : michael.n.new@nasa.gov Mary A. Voytek, Ph.D. Senior Scientist for Astrobiology Science Mission Directorate National Aeronautics and Space Administration Washington DC 20526-001 Telephone: 202-358-1577 E-mail: mary.voytek-1@nasa.gov Questions concerning New Frontiers Program may be addressed to : Curt Niebur, Ph.D. Program Scientist Cassini/Huygens Mission to Saturn Discovery 12 Mission New Frontiers Program Discipline Scientist Early Career Fellowship Program National Aeronautics and Space Administration Washington DC 20526-001 Telephone: 202-358-0390 E-mail: curt.neibur@nasa.gov Questions concerning Mars Exploration Program may be addressed to : Michael A. Meyer, Ph.D. Lead Scientist Mars Exploration Program National Aeronautics and Space Administration Washington DC 20526-001 Telephone: 202-358-0307 E-mail: michael.a.meyer@nasa.gov

C.20 ASTROBIOLOGY SCIENCE AND TECHNOLOGY FOR EXPLORING PLANETS

NOTICE: On release of the ROSES 2012 Solicitation in mid February, the placeholder for this call included a notice that it might be solicited in ROSES 2012. We regret to inform potential proposers that Appendix C.20 will not be solicited this year. [July 27, 2012]

~~**This is a draft version of Appendix C.20 released with the ROSES 2012 NASA Research Announcement. NASA may release a revised version of this call by Amendment, if funds are available. If so, proposals will be due no earlier than 90 days after release of the amendment presenting final text.**~~

1. Scope of Program

Future astrobiological research associated with solar system exploration and the Vision for Space Exploration requires the development of astrobiologically relevant, miniaturized instrumentation capable of extensive operations on lunar and planetary surfaces throughout the Solar System. To this end, and in collaboration with other Directorates at NASA and other agencies, this Astrobiology Science and Technology for Exploring Planets (ASTEP) 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 ASTEP 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. A unique feature that is central to the ASTEP program is the use of terrestrial field campaigns to further science and technology and NASA's exploration capabilities. Therefore, proposals that integrate the following three concerted objectives will be given priority:

1) Science: ASTEP seeks science investigations designed to further astrobiological research in the terrestrial extreme environments that may be analogous to those found on other planets, past or present. Such investigations should increase our understanding of the limits and constraints (or lack thereof) of 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) Technology: ASTEP seeks the development and application of technologies that support science investigations by enabling 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, sample acquisition and handling techniques, sample manipulation, and the use of mobile science platforms (including planetary rovers and astronauts) including techniques for autonomous operations and self-contained deployment systems. (N.B. Science instrument technology proposals should be submitted to the Astrobiology Science and Technology Instrument Development Program; see Appendix C.19.)
3) Field Campaigns: ASTEP seeks systems-level terrestrial field campaigns designed to address astrobiology science goals and demonstrate and validate related technologies in remote and/or extreme environments on Earth. It is expected that such field campaigns will be 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.

In summary, ASTEP is expected to lower the risks of planetary exploration through instrument/technology development coupled with systems-level field tests in Earth's extreme environments that will obtain scientific data and 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 ASTEP that provide for student involvement (both graduate, as well as undergraduate) are encouraged. In addition, proposals are also sought that incorporate Education/Public Outreach (E/PO) activities through telepresence capabilities and involvement of professional educators and students nationwide in the fun and challenges of science and technology. Further guidance on the E/PO program sponsored by the Science Mission Directorate may be found in Section I(c) of the *ROSES Summary of Solicitation* of this NRA. Conversely, proposers who prefer not to propose a significant E/PO effort should state in their proposals whether they are willing to host an outside E/PO activity arranged by NASA.

2. Programmatic Information

2.1 General Information

Proposals are sought for new science-driven field campaigns that are expected to produce new science results, as well as new operational or technological capabilities. 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 program, but whose periods of performance expired last year or are expiring in the first half of this year. Periods of performance from one to four years may be proposed, as appropriate, to the nature of the contemplated research. 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.

2.2 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 Astrobiology Science and Technology Instrument Development (ASTID) program (Appendix C.19 in this ROSES NRA and potential amendments thereto).

2.3 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 completed Antarctic Operations Requirements Worksheet (ORW) and evidence that the ORW has been submitted to the NSF Office of Polar Programs. The ORW and instructions on submitting it to NSF are available at http://www.usap.gov/scienceSupport/polarice/.

Due to the scheduling of NASA and NSF review cycles, proposals requesting access to Antarctica should expect that their first field season will start in late-2013/early-2014 Proposals requiring Antarctic access in their first performance year may suggest a start date commensurate with this schedule.

2.4 Early Career Researchers

Early career researchers are encouraged to apply for the Fellowships for Early Career Fellowships (see Appendix C.22 in this ROSES NRA) by simply checking an additional box on the cover page of their proposal. To be eligible proposers must be within seven years of the date of receipt of their Ph.D. and not currently employed in a tenure-track, or equivalent, position. This program was established to facilitate the integration of new Planetary Science discipline researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (i.e., tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Fellowships for Early Career Fellowships.

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 ASTEP 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 ASTEP research in 2012. More information about the NASA Postdoctoral Program may be found at http://nasa.orau.org/postdoc/.

2.6 Instrumentation: Construction or Upgrade

The Planetary Major Equipment (PME) program described in Appendix C.23 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 Research 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 Appendix C.23. Two types of instrumentation requests are permitted. (1) A

PME request may be made as a special section that is appended to a new research proposal to the ASTEP 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. (2) A stand-alone PME proposal may be prepared and submitted to the ASTEP program. Such a stand-alone proposal must be explicitly affiliated with an existing "parent" award in the program in order to be considered for selection. See Appendix C.23 for details on how to prepare both types of PME requests.

3. Summary of Key Information

Expected program budget for first year of new awards	Not solicited this year
Number of new awards pending adequate proposals of merit	Not solicited this year
Maximum duration of awards	Not solicited this year
Due date for Notice of Intent to propose (NOI)	Not solicited this year.
Due date for proposals	Not solicited this year.
Planning date for start of investigation	Not solicited this 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 planetary 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 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	Not solicited this year

NASA point of contact concerning this program	Mary Voytek Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1577 E-mail: HQ-ASTEP@mail.nasa.gov

C.21 IN-SPACE PROPULSION TECHNOLOGY PROGRAM: ASTRODYNAMICS RESEARCH GRANTS

Amended on May 21, 2012. This Amendment presents a new opportunity in Planetary Science Mission Astrodynamics Research via Appendix C.21. Notices of Intent are due by June 11, 2012, and proposals are due by August 20, 2012.

1. Scope of Program

The In-Space Propulsion Technology (ISPT) program, within the Planetary Science Division of the Science Mission Directorate, provides mission design tools for the NASA and external community. In 2006, the ISPT program released its first version of the trajectory tool suite, including Mystic and MALTO, led by the Jet Propulsion Laboratory, OTIS and SNAP, led by the Glenn Research Center, and Copernicus, led by the Johnson Space Center. While the tools are currently maintained as NASA in-house developments, many of the initial algorithms and frameworks were external research projects at various universities.

In addition to the generalized mission design tools, several universities have been actively involved in astrodynamics research and mission design activities that have enabled planetary science missions; extended missions; and potential mass, risk, and time reduction of future planned missions. Low-thrust trajectory optimization and weak stability trajectory designs are examples of astrodynamics enabling new classes of planetary science missions.

It is critical that new tools and capabilities are available for future mission assessment applicable to rapid mission design collaborative engineering environments (e.g. Team-X), proposal development activities for requirements development, sensitivity, and risk assessment, and for mission implementation and operations.

Short proposals (seven pages) are solicited for astrodynamics research grants. This program is seeking astrodynamics research that falls into two categories:

1) Research or development of an astrodynamics algorithm or methodology suitable for infusion into one of ISPT's existing tools (Mystic, MALTO, Copernicus, SNAP, and/or OTIS).
    - Examples include, but are not limited to: rapid and robust low-thrust geocentric optimization for Copernicus, lunar gravity assist optimization module for Mystic and/or MALTO, multiasteroid system gravity model module for Mystic and/or Copernicus, Rapid Uranus Satellite Tour Development Module, multitarget optimization in MALTO, etc.
2) Research or development applicable to the development of a new tool to meet the needs of future NASA planetary science missions.
    - Examples include, but are not limited to: rapid and robust impulsive and low-thrust orbiter transfer optimization for the n-body Earth-Moon system and escape, V_∞ leveraging tool for rapid assessment of ΔV vs. time for outer-planet moon tour development, small body and/or multiasteroid system orbit insertion and proximity operations rapid design tool, etc.

2. Programmatic Information

2.1 Constraints and requirements

Proposers should be aware of the following compliance requirements when preparing their proposals:

- Proposal teams must be led by a U.S. academic institution.
- NASA expects to fund grants at a level of $90,000 - $100,000. Proposals that request NASA funds significantly beyond this amount may be deemed noncompliant and returned without review. Proposers are encouraged, but not required, to provide commitment letter(s) from one or more partner institutions (industry, Government, research, or academic) indicating a commitment to match NASA funds.
- Collaboration is highly encouraged. The grant funds shall only be used at the proposal lead institution.

Proposers considering category 1 are encouraged to discuss their concepts and/or collaborate with the respective points of contacts prior to proposal submission and include a letter of endorsement and/or infusion feasibility assessment. The points of contact for the various tools are provided below.

Tool	Point of Contact
Mystic and MALTO	Jon Sims Jet Propulsion Laboratory jon.a.sims@jpl.nasa.gov 818-354-0313
OTIS and SNAP	Rob Falck NASA Glenn Research Center rfalck@nasa.gov 216-433-2295
Copernicus	Jerry Condon NASA Johnson Space Center Gerald.l.condon@nasa.gov 281-483-8173

2.2 Evaluation Criteria

Evaluation criteria are intrinsic merit, relevance, and cost realism/reasonableness.

- Intrinsic merit specifically includes the realism and technical feasibility of the proposed scope of work for the two categories of interest,
- The ease of implementation into an existing trajectory tool or work to go before a broad release of a new stand-alone tool,
- Relevance specifically includes relevance of the mission design capability or research applicability to the Decadal Survey missions as demonstrated by linkages between the mission concept science objectives and the science themes, key questions, and objectives defined in the *Visions and Voyages for Planetary Science 2013 – 2022* (http://solarsystem.nasa.gov/multimedia/download-detail.cfm?DL_ID=742);

- and the impact and importance of the research or capability advancement expected from grant activities, including a description of how and to what extend the proposed research will advance our current state of knowledge or capability.

A final, but secondary, evaluation criteria will be contributions from partner institution(s) to match ISPT Program funds.

2.3 Proposal Guidelines

Proposals should contain all elements described in Section 2.3 of the *NASA Guidebook for Proposers*. However, the Scientific/Technical/Management section of the proposal is limited to seven pages rather than 15 pages. This section should cover the topics listed in Section 2.3.5 of the *NASA Guidebook for Proposers* and should be sure to discuss the following elements:

- High level summary of proposed research;
- Objectives for final product;
- Implementation approach or technology transfer approach; and
- Justify the need to use new tool capability or gap addressed by this development activity.

Proposals should include a fact sheet (one page) that is not counted against the page limit. This fact sheet should include the research objectives, relevance and importance to mission design activities and advancement over state-of-the-art. The fact sheet will be made public upon selection.

2.4 Frequently Asked Questions

All questions and responses will be posted online at: http://spaceflightsystems.grc.nasa.gov/SSPO/ISPTProg/Astrodynamics and on the NSPIRES home page for this program element.

2.5 Final Report

Selected proposals must provide a final report to NASA describing the final results of the research activity and there will also be a final presentation at the proposer's site; anticipated at award plus 10 months. The report is due no later than 12 months after award and must contain the following elements:

- Research objectives,
- Applicability of research to future NASA mission assessment,
- Any associated testing (if applicable),
- Infusion plan or technology transfer plan,
- Recommendation for follow-on work.

An updated fact sheet should be provided with the final report. This fact sheet will be made publicly available. Selected study leads are also required to present the results of their work at The Astrodynamics Specialist Conference or other appropriate venue, so this should be included in the budget. Journal publications are highly desired.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $500K

Number of new awards pending adequate proposals of merit	~ 5
Maximum duration of awards	1 year
Due date for Notice of Intent to propose (NOI)	June 11, 2012
Due date for proposals	August 20, 2012
Planning date for start of investigation	Fall 2012
Page limit for the central Science-Technical-Management section of proposal	7 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the planetary 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. See Section 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	NNH12ZDA001N-ISP
NASA point of contact concerning this program	Gordon Johnston Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-4685 email: gordon.johnston@nasa.gov

C.22 FELLOWSHIPS FOR EARLY CAREER RESEARCHERS

1. Scope of Program

The Early Career Fellowship program was established to facilitate the integration of new planetary science researchers into the established research funding programs and to provide tools and experience useful when searching for a more advanced (i.e., tenure-track, civil servant, or equivalent) position.

Two proposal opportunities are offered under the Early Career Fellowship program in ROSES. The first is an opportunity for researchers to be selected as Early Career Fellows (Section 4.2). Early career researchers are encouraged to apply for the Fellowship through any participating Planetary Science Research Program element of this ROSES NRA (see Section 2, below). The second is an opportunity for current Fellows (selected in a prior solicitation) to apply for start-up funds (Section 4.3). Selected Fellows have the opportunity to apply directly to the Early Career Fellowship program for up to $100K in start-up funds when they obtain a tenure-track or equivalent position.

2. Eligibility

This program is intended to bring new researchers into the planetary science community and to help them become established in tenured or equivalent positions. In keeping with this goal, proposers who wish to become Early Career Fellows must have received their Ph.D. no earlier than 2004 and must be currently employed as a postdoctoral researcher, research assistant, or an equivalent nontenured position. Tenure-track faculty are not eligible to apply for the Fellowship. Researchers who received their Ph.D. earlier than 2004 and have been inactive from the field for a period of time (for example, for child-rearing) and wish to reenter planetary science research are also welcome to apply, although no applicant may have held tenure (or its equivalent) on or before the submission of his/her proposal.

Participation in this program is funded by individual participating planetary science research programs. Accordingly, participation is limited to proposers submitting research proposals to the following planetary science research programs:

- Cosmochemistry (Appendix C.2);
- Planetary Geology and Geophysics (Appendix C.4);
- Planetary Astronomy (Appendix C.5);
- Planetary Atmospheres (Appendix C.6);
- Outer Planets Research (Appendix C.7);
- Lunar Advanced Science and Exploration Research (Appendix C.8);
- Near Earth Object Observations (Appendix C.9)
- Cassini Data Analysis and Participating Scientists (Appendix C.10)
- Planetary Mission Data Analysis (Appendix C.11);
- Mars Data Analysis (Appendix C.12);
- Mars Fundamental Research (Appendix C.13);
- Astrobiology: Exobiology and Evolutionary Biology (Appendix C.17)

- Astrobiology Science and Technology for Instrument Development (Appendix C.19); and
- Astrobiology Science and Technology for Exploring Planets (Appendix C.20).

3. Benefits

Executing a successful research program is dependent on a number of field-specific factors and qualifications. There are, however, a few key elements that are critical to success across the field of planetary science:

- Successful proposal writing;
- Adequate (paid) research time;
- Management of a laboratory;
- Collaboration and networking;
- Frequent and high-quality publications; and
- Adequate start-up equipment funds.

These elements may be particularly critical for early career researchers searching for a tenure-track or equivalent position at the institution of their choice. To facilitate this process, the Early Career Fellowship program strongly encourages qualified proposers to any of the planetary science research programs listed above to carefully consider their own professional development needs and include requests for additional funding (with justifications) for the following elements in their research proposals:

- Salary;
- Undergraduate and/or graduate research assistants;
- Supplies and instrument upgrades (up to $25K);
- Travel to conferences, meetings, and advisory groups;
- Time and travel for learning new skills;
- Participation in NASA's Early Career Workshop, currently held in conjunction with the annual Lunar and Planetary Science Conference;
- Publication page charges;
- Books and journal subscriptions;
- Computer time and/or specialized software; and
- Other research-specific needs.

Successful proposers who are selected as Fellows may then be offered the opportunity to submit proposals for funding to be used at the institution of their choice when they obtain a tenure-track or equivalent position. These proposals can be for up to an additional $100K in a subsequent year of their nominal research award to be used as laboratory start-up funds. This last option, for start-up funds, is available as part of the ROSES NRA for Fellows selected under prior year ROSES solicitations. Information on applying for start-up funds is given in Section 4.3 (below).

All budget items must conform to any stated limits in the *NASA Guidebook for Proposers.*

4. Programmatic Information

4.1 Introduction

This Fellowship program is an add-on to the planetary science research programs listed in Section 2. All Fellows are originally selected and funded through a parent proposal to, and subsequent award from, one of these program elements.

In the event that a proposer's institution does not allow nontenured faculty or postdoctoral researchers to independently apply for NASA grants, the proposal may include a mentor as the "Institutional PI" with the nontenured faculty or postdoctoral researcher as the "Science PI," as outlined in Section 1.4.2 of the *NASA Guidebook for Proposers.*

Annual progress reports should be sent to the cognizant program officer for the parent award, with a copy sent to the Fellowship program officer listed in the *Summary of Key Information* in Section 5.

4.2 Consideration for Selection as an Early Career Fellow

Interested researchers must meet all eligibility requirements in Section 2 to be considered as an Early Career Fellow. To be considered for the Fellowship, eligible scientists must submit a standard research proposal (referred to as the parent proposal) to one of the participating programs listed in Section 2. In addition, the proposer must select the *Early Career Fellowship checkbox* on the *Cover Page* of this parent proposal. Proposers are encouraged to include a short statement as part of their CV describing their qualifications for the Fellowship and specific information regarding how the Fellowship would impact their future career plans.

The parent proposal must adhere strictly to the deadlines and instructions for the participating program to which it is submitted. The parent proposal will be reviewed along with all other proposals submitted to the respective participating program as part of the normal peer review process. Selection of the parent proposal by the participating program is a prerequisite for consideration as an Early Career Fellow. Program Officers will nominate from one to three selected proposers (per participating program) as Early Career Fellows.

Since this program is an add-on to the planetary science research programs listed in Section 2, there is no absolute standard for budget requests. Proposers are encouraged to request the funding that they need to carry out their research program, roughly in line with the typical support offered by the research program to which they propose. Proposers are eligible to apply independently for Planetary Major Equipment funds (Appendix C.23), Education/Public Outreach funds (Section I(c) of the *ROSES Summary of Solicitation*), travel grants, Participating Scientist Programs, and other NASA opportunities as they arise.

4.3 Submission of Proposals for Start-up Funds

Current Fellows (named in response to a proposal submitted under a prior year solicitation) are eligible to apply for start-up funds under this program. The start-up package is intended to aid

Fellows in establishing a research group or laboratory in their new position, enabling Fellows to continue their NASA-funded investigation. The funds may be used to purchase laboratory equipment, provide salary for the Fellow, as well as students and research associates, and cover other expenses associated with establishing research efforts.

Fellows selected under prior ROSES NRAs are eligible to apply for up to $100K in laboratory start-up funds. This funding is not guaranteed and is subject to peer review. To obtain the start-up funds, the Fellow must submit a proposal describing how the funds will be used. The Fellow must also obtain a tenure-track or equivalent position at the institution of his or her choice. Fellows should submit their proposals for start-up funds under the sponsorship of their new institution.

To request start-up funds, Fellows should provide a short proposal detailing the research group they plan to establish upon gaining a tenure-track or equivalent position. 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 will benefit NASA and further its goals.

Proposals for start-up funds are submitted directly to this Early Career Fellowships program (and not to the parent planetary science research program). Note that proposals for start-up funds must be submitted by either of two annual proposal due dates given in Tables 2 and 3 of the *ROSES Summary of Solicitation*.

5. Summary of Key Information

Please note that proposals for new Early Career Fellowships are not independent of the other planetary science research program elements and that the constraints and requirements may vary with the associated science research program. For example, Cosmochemistry proposals have a different due date from Outer Planet Research proposals, and the typical funding levels vary as well. Refer to the information in the corresponding science research program element for questions about those programs and specific constraints and requirements for proposals to those programs.

Expected program budget for first year of new awards	N/A; all funds are distributed by the corresponding science research program element
Number of new awards pending adequate proposals of merit	1 to 3 per science research program element
Maximum duration of awards	3 years for Fellowship start-up funds, if selected
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 standard research proposal to the participating program by the deadline specified for the participating program. See Tables 2 and 3 in the *ROSES Summary of Solicitation* for the appropriate science research program element. Proposals for start-up funds from current Fellows selected in prior years are due twice annually; 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	7 pp, for proposals from current Fellows for start-up funds; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the planetary 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 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	NNH12ZDA001N-ECF (for current Fellow applications for start up funds; otherwise please see the specific science research program element.)
NASA point of contact concerning this program	Heather Smith Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-2336 E-mail: heather.d.smith@nasa.gov **[updated June 13, 2012]**

C.23 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 sponsored by the Planetary Science Research Program's science research programs as offered in this solicitation, entitled:

- Cosmochemistry (Appendix C.2);
- Laboratory Analysis of Returned Samples (Appendix C.3);
- Planetary Geology and Geophysics (Appendix C.4);
- Planetary Astronomy (Appendix C.5);
- Planetary Atmospheres (Appendix C.6);
- Outer Planets Research (Appendix C.7);
- Lunar Advanced Science and Exploration Research (Appendix C.8);
- Near Earth Object Observations (Appendix C.9);
- Mars Fundamental Research (Appendix C.13);
- Astrobiology: Exobiology and Evolutionary Biology (Appendix C.17);
- Planetary Protection Research (Appendix C.18);
- Astrobiology Science and Technology for Exploring Planets (Appendix C.20); and
- Origins of Solar Systems (Appendix 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 programs in this NRA, listed above; or (2) as a stand-alone equipment proposal submitted to one of the programs listed above.

A stand-alone PME proposal must be explicitly affiliated with an existing "parent" award in the same program. 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 US 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 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 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

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*

To submit a request for PME funds in conjunction with an existing (previously funded) "parent" science research award in one of the Planetary Science Research Programs noted above, the proposer should prepare a complete proposal in full compliance with all applicable instructions and deadlines associated with the science research program. 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 re-reviewing the parent award. It should also specify the 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 re-reviewed. 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.
- Cost sharing will be considered in evaluating the cost reasonableness.

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 non-selection 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 Notice of Intent to propose (NOI)	For stand-alone PME proposals, NOIs should be submitted to the relevant science research program according to the schedule in Tables 2 and 3 in the *ROSES Summary of Solicitation*. No separate NOI is required for PME proposals appended to new research proposals; information about the PME request may be included in the NOI for the main science proposal.
Due date for proposals	PME proposals are subject to the same due dates as the science research programs to which they are submitted. See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
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 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 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	Please refer to the specific science research program element.
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.24 MOON AND MARS ANALOG MISSIONS ACTIVITIES

1. Scope of Program

1.1 Programmatic Overview

NASA Analog Missions research addresses the need for integrated interdisciplinary field experiments as an integral part of preparation for planned human and robotic missions to asteroids, the Moon, and/or Mars. This program addresses NASA's planetary science goal to "ascertain the content, origin, and evolution of the solar system, and the potential for life elsewhere" by preparing us to maximize science in the human exploration of planetary bodies. The focus of this program will be 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 of the Moon, Mars, and other planetary bodies with both robots and humans.

Through this research program element, investigators will be selected to carry out specific scientific research analogous to investigations anticipated for missions to asteroids, the Moon, and/or Mars. Areas of specific interest to the Science Mission Directorate (SMD) include, but are not limited to:

1. Understanding and optimizing human and robotic performance to maximize scientific return;
2. Defining science requirements for human missions, including requirements for mobility, navigation, communications, *in situ* analysis, surface laboratory functionality, crew scheduling, and sample acquisition, handling, documentation, and curation;
3. Developing surface science scenarios for use in architecture planning and science payload manifesting; and
4. Illuminating areas of critical importance for robotic precursor missions, including robotic operations of/with human-oriented systems during periods when humans may not yet be present.

Although this is primarily a Planetary Sciences call, proposals in other areas of SMD research such as Heliophysics, Astrophysics, and Earth Science will be considered, to the extent that they reflect NASA's strategic scientific goals at asteroids, the Moon, and/or Mars.

1.2 Program Goals for Analog Mission Fidelity

In response to NASA's current plans for human exploration, proposals that directly address preparation for support of human activities at a near-Earth asteroid will be given priority for funding at this time. NASA is in need of data to support surface science and operations scenarios as it moves forward in its architecture and requirements definition processes. This program will continue to support activities relevant to the Moon and Mars as well.

Individual analog experiments typically strive for high-fidelity in one or more Fidelity Areas:

1. Science – Fidelity in this area means that publishable, high quality science is being done during or after the field activity that results in an advancement of knowledge in a scientific field such as astrobiology, geology, geochemistry, astronomy, etc.

2. Science Operations – 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 heavily impact the design of surface infrastructure elements. Some examples of science operations include:

(a) Crew scheduling for IVA and EVA;
(b) Decision-making protocols;
(c) Traverse planning;
(d) Sample acquisition, storage, documentation, and high-grading protocols;
(e) Communications and data flow protocols to support science;
(f) Navigation unique to science support;
(g) Concepts for power distribution to support science;
(h) The use of robotic assistants; and
(i) Science backroom design and support for surface science activities.

3. Technology – Fidelity in this area means that the technologies in the field are physically, as opposed to only functionally, similar to those being designed for deployment. The field activity with the highest degree of technology fidelity is a field test of flight hardware such as the final tests of the Mars Exploration Rover engineering model before launch. High fidelity technology drives the choice of field sites toward similar terrains and broad physical characteristics such as slopes, rock abundance, surface area, and vegetation. Some examples of technology systems of greatest interest to both human exploration and SMD for the optimization of science productivity include:

(a) Rovers (all sizes, all degrees of autonomy, pressurized and unpressurized);
(b) Habitats;
(c) Space suits;
(d) Landers;
(e) Cranes or other surface material handling systems;
(f) Power systems;
(g) Communication and navigation systems;
(h) Intelligent systems and human/robotic interfaces;
(i) Sample acquisition and handling systems; and
(j) Instrument packages.

Field activities with a high degree of technology fidelity tend to attract the attention of the public and the media. It is the intention of this program to have some degree of technology fidelity in every activity, and therefore, proposers should describe their plan for engaging the public and media during their field deployment.

4. Mission Operations – Fidelity in this area means that the functional aspects of other non-science mission operations are highly consistent with real planetary missions. High fidelity

mission operations require heavy support of simulated ground teams and great attention to communications and scheduling. Some elements of mission operations include:

(a) High level Concepts of Operations (con-ops);
(b) Mission control center support;
(c) Communications protocols and light-time delays;
(d) Consumables and element status tracking; and
(e) Crew health and safety, remote medicine, psychology.

1.3 Eligibility

NASA will consider proposals for investigations in conjunction with field activities that integrate science with exploration and operations research, provided the proposals meet the requirements specified in Section 2.1.

Questions or comments may be directed to the MMAMA Program Executive, using the contact information provided in Section 3.

1.4 Types of Investigations Supported

Unlike previous years' solicitations, there is now only one "type" of proposal, roughly equivalent to the "type 1" proposals of years past; *i.e.*, field testing of individual scientific experiments or validation of concepts, as specified in Section 1 above.

As stated in Section 1.1, the intent of this solicitation is to provide high-fidelity scientific investigations, scientific input, and science operations constraints in the context of a scientific field campaign. Examples of supported activities for investigations include, but are not limited to:

1. Validation of specific surface science scenarios to assist NASA in its requirements definition for surface systems and operations. Science operations scenarios can include:
    a. Traverse planning
    b. Traverse documentation
    c. Tele-robotic operations – scouting, sample return, sample handling, etc.
    d. Laboratory analysis for subsequent traverse and sample acquisition strategies
    e. Surface sample curation
    f. Operations timelines for science activities such as drilling, trenching, cryogenic or aseptic sampling, etc.
2. Mounting and deployment of sample collection systems or *in situ* analysis instruments onto exploration technology hardware or mock surface systems.
3. Collection of instrument data and simulation of scientific data and information flow for real-time mapping, navigation, documentation, sample acquisition, traverse planning, etc.
4. Field-testing of prototype instrument packages being currently developed through any of NASA's other ROSES programs, such as Lunar Advanced Science and Exploration Research (LASER), Planetary Instrument Definition and Development Program (PIDDP), Astrobiology Science and Technology for Exploring Planets (ASTEP), Astrobiology Science and Technology Instrument Development (ASTID), Planetary Atmospheres, Cosmochemistry, etc.
5. Testing of specific geological hypotheses requiring human observation in the field,

especially if carried out in partnership with robotic or tele-robotic field tools.

6. Development of training strategies for future astronaut crews and ground support teams.

2. Programmatic Information

2.1 Special Requirements for Proposals

Proposals should follow the guidelines set for all ROSES proposals as given in the *NASA Guidebook for Proposers*.

Proposals are limited to 15 pages.

Proposals should also specify:

- Area(s) of fidelity from Section 1.2 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
- Evidence of coordination with field campaign leaders if proposed investigation(s) are to be conducted in conjunction with established field campaign(s)
- Field resource requirements
    - Duration, timing, and scheduling of investigations
    - Power requirements
    - Communications requirements (bandwidth, type of communications, etc.)
    - Logistics Support Requirements
- Level and type of integration with hardware or operations (rover and mounting), including any specific teams, whether desired or already formed
- 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.
- Plan for interfacing with public and media.

2.2 Evaluation of Proposals

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 where relevant:

- The extent that the proposal demonstrates adequate external financial and programmatic support to ensure that the field experiments can be completed
- The extent that the proposal clearly and specifically describes the integration between science, exploration, and/or operational tests, demonstrations, or experiments

- The extent that the proposal demonstrates relevance to the goals of the Science Mission Directorate at asteroids, the Moon, and/or Mars.

2.3 Future Solicitations

It is expected that NASA will repeat this program element in ROSES-2013 at the same funding level. One objective of NASA's Science Mission Directorate is to provide a mechanism for science to play an integral role in the requirements for human exploration through this and other opportunities.

2.4 Selection of Proposals

NASA expects to announce the results of this selection by January 2013. Funding should be expected no earlier than late February 2013, but could take longer to award. Proposers should plan accordingly.

3. Summary of Key Information

Expected annual program budget for new awards	~ $0.3 M.
Number of new awards pending adequate proposals of merit	4-6
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	See Section 2.4
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 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 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	NNH12ZDA001N-MMAMA
NASA point of contact concerning this program	Sarah Noble Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 643-5862 E-mail: sarah.k.noble@nasa.gov

C.25 MISSION CONCEPT DEVELOPMENT FOR ASTROBIOLOGY SMALL PAYLOADS

NOTICE: The Mission Concept Development Program for Astrobiology Small Payloads will not solicit proposals in ROSES-2012.

1. Scope of Program

The Planetary Division is planning a new program element within future ROSES to solicit proposals for the development of mission concepts for Astrobiology Small Payloads (ASP). The ASP Program would support the development of payloads that could fly on pico-, nano-, and small-sat free-flyers, suborbital sounding rockets, commercial reusable suborbital research vehicles long-duration balloons and the International Space Station. ASP Program payloads must address the science goals of the Astrobiology Program (the current version of the Astrobiology Roadmap available from http://astrobiology.nasa.gov/roadmap); these goals do not include life and microgravity science or fundamental space biology. Life and microgravity science investigations are solicited by the Human Exploration and Operations Mission Directorate. For further information contact: David L. Tomko, Human Research Program and Fundamental Space Biology, NASA Headquarters, Washington, DC 20546; Tel.: 202-358-2211; email: dtomko@nasa.gov. For more information on the ASP program, please see http://nai.nasa.gov/asp/asp_report.pdf. For information on the O/OREOS mission, the first mission of the ASP program, please see http://www.nasa.gov/mission_pages/smallsats/ooreos/main/.

For additional information, contact the NASA point of contact concerning this program:

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NASA Headquarters
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E-mail: michael.h.new@nasa.gov

C.26 RADIOISOTOPE POWER SYSTEMS TECHNOLOGY DEVELOPMENT

NOTICE: On release of the ROSES 2012 Solicitation in mid February, the placeholder for Appendix C.26, The Radioisotope Power Systems (RPS) Program included a notice that it might be solicited in ROSES 2012. We regret to inform potential proposers that Appendix C.26 will not be solicited this year. [Changed September 25, 2012]

1. Scope of Program

The Radioisotope Power Systems (RPS) Program is a multicenter, multiagency (with the Department of Energy (DOE)) program whose purpose is to manage the Science Mission Directorate's investments in radioisotope power systems and their deployment to future missions. The majority of these missions are a result of planning arising from the Planetary Science Division.

The RPS Program is responsible for acquisition and development of thermal energy conversion technologies and related system technologies and with the DOE, acquisition and development of flight radioisotope power systems for future mission uses. In addition, the RPS Program is responsible for maintaining a capability to acquire future systems through strategic investment in unique competencies that may be needed by future missions.

On behalf of the Science Mission Directorate, the Radioisotope Power Systems Program coordinates investments to:

Ensure the availability of radioisotope power systems for the planetary science community;
Successfully execute RPS flight projects / mission deployments;
Maintain a robust technology development portfolio;
Reduce NEPA and launch safety approval schedule risk; and
Maximize utilization of the available Pu-238 supply in the development of RPSs for science missions.

One element of the RPS program is the Technology Advancement Project. The goal of the radioisotope power systems' technology portfolio is to advance performance of RPS through new and novel innovations being developed and transitioned to flight systems. Historically, this has been achieved through an increase of energy conversion efficiency. The mission users benefit from such a gain in performance because an increase in the specific power (power per unit mass) reduces the spacecraft mass. This reduction can also enable a larger instrument suite. The effort to improve efficiency has taken on renewed significance with the increased constraint posed by a limited supply of Pu-238. Current investments include improving efficiency of thermoelectrics through novel materials selections, the Stirling conversion process, and supported systems development on materials and electronics.

An RPS Program study is underway to determine priorities to be solicited in response to the recently completed planetary science Decadal Survey. As a result of this study, this solicitation will be updated with the exact details and scope of the technologies to be sought for the upcoming RPS technology portfolio call for proposals.

2. Solicited Technology Development

Appendix C.26, The Radioisotope Power Systems (RPS) Program will not be solicited this year.

3. Programmatic Information

Proposals are sought for new projects within the scope of the Radioisotope Power Systems Program. Proposals submitted in response to this NRA should be for new work that is not currently supported by the program. Periods of performance from one to four years may be proposed, as appropriate, to the nature of the contemplated technology development. The appropriateness of the proposed funding period will be reviewed and adjustments may be requested. There may also be a downselect of proposals based on program goals and project progress towards those goals. Programmatic balance may limit the opportunities for funding in some areas.

4. Point of Contact for Further Information

Leonard Dudzinski
Planetary Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Tel: 202-358-2553
Email: Leonard.A.Dudzinski@nasa.gov

C. 27 Mars Atmosphere and Volatile EvolutioN Mission Participating Scientist Program

1. Scope of Program

The objectives of the Mars Atmosphere and Volatile EvolutioN (MAVEN) Participating Scientist (PS) Program are to aid in mission planning and data archiving and to enhance and supplement Mars science to be performed by MAVEN. NASA expects to select approximately six to eight Participating Scientists with support for approximately two and a half years.

1.1 Overview

The Mars Atmosphere and Volatile EvolutioN (MAVEN) mission is expected to launch sometime between November 18 and December 7, 2013. It will begin its primary science mission in orbit around Mars in November 2014. The MAVEN mission will survey the processes that currently control the structure of the upper atmosphere of Mars, with the primary science objective to determine the role that the loss of atmospheric volatiles to space has played through time in the history of the Martian atmosphere and climate. This mission will use a variety of instruments carried on an orbiting spacecraft (in a 75° inclination, 4.5 hour period, eccentric obit) that has sufficient fuel to execute several deep-dip campaigns that will bring periapsis to below its nominal orbit periapsis altitude (~150 km) to the homopause region (~125 km). The primary science mission duration is one Earth year. The documents that comprise the Proposal Information Package for the MAVEN PS Program provide more details about the MAVEN mission, and a Frequently Asked Questions (FAQ) file will be established and updated as appropriate during the proposal period (see Section 4 below).

1.2 Participating Scientist Program

This solicitation is for Participating Scientist proposals to enhance the scientific return from the mission by: broadening participation in the mission, 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 Mars. The second and equally important goal of this opportunity is to increase the number of scientists supporting mission planning and execution. While a large fraction of the planned observations will be repetitive and 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. Participating Scientist proposals can include investigations that are instrument specific or that use multiple instruments, but, in all cases, must include both science analysis and a commitment to participate in operations planning in order to be considered. Because the intention is to enhance and broaden the scientific return, as well as increase the number of scientists supporting the mission, investigations submitted by the mission Principal Investigator (PI) or by Co-Investigators (Co-Is) will not be considered.

Participating Scientists will become members of the science team and will be required to fulfill responsibilities similar to those of current science team members. The PSs will be assigned to the

Project, rather than to an instrument lead. The selected PSs will coordinate their activities and analyses with other science team members to achieve the essential scientific objectives of their PS investigation, within the scope and resources of the project, and ensure dissemination of the results of the investigation to the scientific community and the general public.

Before MAVEN goes into orbit about Mars, each PS will:

- become thoroughly familiar with the spacecraft, its instruments, its investigations, and the mission plan and observing plans;
- participate in MAVEN science team meetings;
- participate, as appropriate, in MAVEN science team working groups and/or instrument team meetings;
- prepare to analyze data, developing techniques or algorithms, if necessary;
- prepare to archive any data products that will be generated by the PS investigation; and
- support Education and Public Outreach efforts of the MAVEN mission.

During the mission science phase, each PS will:

- execute the selected PS scientific investigation as a science team member;
- actively and regularly participate in science and mission planning activities;
- participate in MAVEN science team, working group, and instrument team meetings;
- work with other members of the science and operations teams to define the short-term and long-term science operations strategy;
- perform initial data analysis and carry out subsequent analysis necessary to complete the selected scientific investigation;
- present science results at science team meetings and interact and collaborate with the science team to enhance the value of the results;
- 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 MAVEN Science Data Management Plan;
- present scientific results at science meetings and conferences and publish the results in peer-reviewed journals in accordance with NASA, Mars Exploration Program, and MAVEN project data release and publication policies; and
- support Education and Public Outreach efforts of the MAVEN mission.

Proposers should propose a science investigation that addresses one or more of the MAVEN science questions listed below. Selected investigators will become members of the MAVEN science team and will work in a collaborative manner with other MAVEN science team members after selection. All team members will be bound by the MAVEN "Rules of the Road" document that describes the data access rights, data-sharing responsibilities, and data release policies of the MAVEN science team. They will coordinate with the Science Data Working Group to archive data following the processes outlined in the Science Data Management Plan. The "Rules of the Road" is downloadable as a PDF file from the NSPIRES web page for this program element.

1.3 Science Priorities for this Solicitation

Participating Scientists may propose to address any of the goals of the Mars Exploration Program, although emphasis will be placed on investigations addressing one or more of the MAVEN science questions, which are:

1. What is the current state of the upper atmosphere and what processes control it?
2. What is the escape rate at the present epoch and how does it relate to the controlling processes?
3. What has the total loss to space been through time?

The topics listed below, not in ranked order, are considered appropriate for Participating Scientist studies. However, proposals on other topics that are related to core MAVEN science are encouraged. The proposed topics should not significantly overlap mission-objective analyses planned by the existing science team. Proposal evaluations will include the quality and justification of the value of the proposed science, the degree to which the proposer and the proposed research complements the existing team, the ability of the proposer to participate effectively in mission operations and planning, and the potential for the proposed work to improve the quality of the data products to be prepared by the team for community release. See also Section 3.4, Evaluation Criteria.

1.3.1. The Present Mars Upper Atmosphere and Ionosphere

Characterizing the present upper atmosphere of Mars is key to MAVEN science questions one and two. Development of new/improved global models of the magnetoplasma environment of Mars that incorporate MAVEN measurements will be important for addressing those questions.

1.3.2. Evolution of Mars Atmosphere

MAVEN's focus in its prime mission phase is to establish the escape rate dependence on solar activity and extrapolate backwards in the Sun's history using models of solar system evolution. Of particular value to the backward-coupling objective (MAVEN science question three) is state-of-the art modeling of the of the early Mars upper atmosphere constrained by data to be obtained by MAVEN that may guide further data collection during the prime mission.

1.3.3. Influence of the Lower Atmosphere on the MAVEN Measurement Regime

Although MAVEN will not be making *in situ* measurements of the lower atmosphere, it will obtain remote UV observations that provide information that extends down to as low as ~80 km altitude, sampling the source region for upper atmosphere escaping species. These data can be used to characterize input from the lower atmosphere into the region above the homopause targeted by MAVEN *in situ* measurements.

1.3.4. Atmospheric Waves

One of the energy inputs into the upper atmosphere of Mars is known to be atmospheric waves. Thermal tides and gravity waves underlay the ionosphere and thermosphere particle distributions. Atmospheric waves and tides generated below the homopause provide significant input. MAVEN data will allow characterization of these phenomena between the homopause and the exobase, and of dynamical coupling between the lower and upper atmosphere, important to understanding MAVEN science goal two.

1.3.5. Ionosphere Electrodynamics

The electrodynamic physics of the ionosphere resulting from the plasma interaction with the neutral atmosphere plays a significant role in MAVEN's *in situ* measured characterization of the system. This low altitude interplay between the plasma and atmosphere reacts to and plays a role in how the solar wind and the interplanetary magnetic field interact with the Mars environment.

1.3.6. Energetic Particle Interactions

The chains, both physical and chemical, by which very energetic particles interact with the lower atmosphere down to the surface determine the response of the atmosphere to solar energetic particle events. MAVEN will measure the atmospheric responses and particle inputs.

This NRA is soliciting investigations primarily involving the measurements made by the instruments that comprise MAVEN's science payload. Investigations involving data from outside the science instruments may be considered if they are vital to the interpretation of MAVEN core science measurements.

NASA invites proposals from people who have not previously participated in Mars missions. The Proposal Information Package for the MAVEN PS Program provides more details about the mission (Section 4).

2. Proposal Submission

MAVEN Notices of Intent are requested by January 11, 2013, and proposals are due March 1, 2013. Please check Tables 2 and 3 of the ROSES 2012 solicitation or the SARA RSS feed for the most up to date information and links to amendments or clarifications for ROSES solicitations. We anticipate selections approximately six months after proposals are received.

2.1 Proposal Guidelines

Only the Principal Investigator from each proposal selected through this program will be designated as a Participating Scientist on the MAVEN mission. Although not encouraged, proposals may include co-investigators and/or unfunded collaborators (including graduate students and postdoctoral researchers), but only if they are critical to completing the proposed science investigation. Participating scientists, along with any co-investigators or collaborators on their proposal, will be subject to MAVEN "Rules of the Road." Proposals may include already

funded MAVEN co-investigators *only* as unfunded collaborators. Any proposal team member must have a clearly defined role. Previous participation in a Mars mission is not required.

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. Key projected milestones, accomplishments, and deliverables during each year of the proposed investigation should be identified.

3. Programmatic Information

3.1 Eligibility to Propose

Current MAVEN PI and Co-Is are not eligible to propose to this solicitation (except as unfunded collaborators as defined above). Current MAVEN collaborators are eligible to propose to this solicitation.

3.2 Duration of Award

Selected investigators are expected to be funded beginning approximately at launch and extending for a period of about two and a half years until the end of the project following the primary mission. This would include the time periods of cruise to Mars, orbit insertion, on-orbit checkout during the transition period, primary science mission of one Earth year, and six months of postprimary mission data analysis and (as appropriate) archiving. There is a possibility of an extension beyond that time period if resources permit and if MAVEN is approved for an extended mission. Such an extension for Participating Scientists will be at the discretion of NASA and subject to review based on performance.

3.3 Budget Information

Proposers must provide a detailed budget covering the entire time period from November 2013 though April 2016. The proposal should provide a plan for being involved in MAVEN science operations planning, data archive preparation for the Planetary Data System, outreach, and for carrying out their science investigation; this plan may involve visits/residence at one of the MAVEN instrument or team-member institutions or may involve collaborating at a distance from their home institution, at the discretion of the proposer. From launch to six months after the end of the prime mission, proposers should plan to be involved in science operations, data archiving, outreach, data analysis, and publication of results. If MAVEN operations continue beyond the primary mission, adjustments to work plans and budgets will be at the discretion of NASA. The budget must follow the guidelines described in the *Guidebook for Proposers*.

The PS proposal budgets should include adequate funds for the PI to attend quarterly MAVEN science team meetings (we expect that the weekly/monthly planning meetings will be done largely by telecon). Participating Scientists closely tied to a particular instrument are also encouraged, but not required, to include travel funds in their budget to visit that instrument lead's institution for an appropriate number of visits or instrument team meetings per year. For simplicity, proposers should assume that MAVEN science team meetings will take place in

Boulder, CO; in Berkeley, CA; or in Greenbelt, MD. The expected total program budget and number of awards are indicated in Section 4, the Summary Table of Key Information.

3.4 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, the criterion for intrinsic merit for this program specifically includes the following factors:

- Technical consideration of the capability of the MAVEN payload to reasonably accomplish the proposed investigation;
- The material contribution of the investigator's proposed involvement in mission planning and mission operations to obtaining data to support the investigation;
- The value added to the science mission planned by the existing MAVEN science team and the extent to which the proposed investigation complements the currently planned science investigations; and
- The role of the investigator in improving existing and planned MAVEN data products.

The criterion for relevance will include evaluation of the extent to which the proposal addresses MAVEN mission-level science objectives. Investigations must have an effect on or be responsive to the primary mission as it is underway. Investigations whose objectives can otherwise be accomplished through a data analysis program will not have strong relevance to this MAVEN Participating Scientist program element.

3.5 Guidelines for Non-U.S. Proposals and Proposals Including Non-U.S. Participation

NASA welcomes proposals from outside the U.S., but all proposals with non-U.S. participants must be compliant with the policies stated in the *NASA Guidebook for Proposers.* Foreign entities are generally not eligible for funding from NASA and should propose to participate on a no-exchange-of-funds basis. Therefore, unless otherwise noted, proposals from foreign entities should not 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. entities that include foreign participation must be endorsed by the respective Government agency or funding/sponsoring institution in the country from which the foreign entity is proposing. Such endorsement should indicate that the proposal merits careful consideration by NASA, and, if the proposal is selected, sufficient funds should be made available by the respective foreign government agency or funding/sponsoring institution to undertake the activity as proposed.

3.6 Progress Reports and Deliverables

After selection, each Participating Scientist shall provide an Implementation Plan to the MAVEN Project Scientist, including a schedule for deliverables (software, data products, reports, plans) and details regarding plans for data analysis, computing facilities, ground data system support,

software development, support of instrument calibration, data archiving, and participation in E/PO activities. The Participating Scientists shall provide semiannual reports to the MAVEN Project Scientist and the NASA Headquarters Program Scientist that include: accomplishments over past two quarters, plans for next two quarters, issues, concerns, schedule performance, financial performance, recovery plans (if appropriate), and status of publications and other deliverables.

4. Summary of Key Information

Expected *total* program budget for the duration of the program	$2M
Number of new awards pending adequate proposals of merit	~ 6-8
Maximum duration of awards	2 years and 6 months (assuming a funding start date of November 1, 2013);
Due date for Notice of Intent to propose (NOI)	January 11, 2013
Due date for proposals	March 1, 2013
Planning date for start of investigation	November 1, 2013
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 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 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	NNH12ZDA001N-MAVENPS

Detailed information on the MAVEN mission and instrument complement	See the Proposer Information Package files listed under "Other Documents" on the NSPIRES homepage for this call (Appendix C.27 of ROSES 2012).
NASA point of contact concerning the Proposer Information Package for this program	Joseph Grebowsky MAVEN Project Scientist Planetary Magnetospheres Laboratory, Code 695 NASA Goddard Space Flight Center Greenbelt, MD 20771 Telephone: (301) 286-6853 Email: Joseph.M.Grebowsky@nasa.gov
NASA point of contact concerning this program	Kelly Fast MAVEN Program Scientist Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0768 Email: Kelly.E.Fast@nasa.gov

C. 28 LUNAR ATMOSPHERE AND DUST ENVIRONMENT EXPLORER GUEST INVESTIGATOR PROGRAM

1. Scope of Program

1.1 Introduction

The Lunar Atmosphere and Dust Environment Explorer (LADEE) is expected to launch in August 2013, with the overall science objectives of: 1) Determining the composition of the lunar atmosphere and investigating the processes that control its distribution and variability, including sources, sinks, and surface interactions; and 2) Characterizing the lunar exospheric dust environment and measuring any spatial and temporal variability and impacts on the lunar atmosphere.

Measurements will be obtained at 50 km average altitude in a near-equatorial, retrograde orbit over a 100 day primary science mission.

This solicitation is for investigations in the LADEE Guest Investigator Program (GIP). The goals of the program are to: a) enhance the scientific return from the LADEE mission by broadening participation in the mission and b) augment the existing LADEE science team to include new members conducting investigations that broaden and/or complement the funded Principal Investigator (PI) and Co-Investigator (Co-I)-led investigations, thus maximizing the contribution of LADEE to the future exploration and scientific understanding of the Moon. *Because the intention is to enhance and broaden the scientific return, investigations submitted by LADEE PIs and Co-Is will not be considered.*

Selected Guest Investigators (GIs) will become members of the LADEE science team and be required to fulfill some of the same responsibilities as those of current science team members. The selected GIs will coordinate their activities and analyses with the LADEE Mission Project Scientist, Instrument Principal Investigators (PIs) and their teams, and NASA Program Scientist, and they will be bound by team agreements. The selected GI activities and analyses will, thus, be coordinated with the LADEE science team to achieve the essential scientific objectives of their GI investigation, within the scope and resources of the LADEE project, and ensure dissemination of the results of the investigation to the scientific community and the general public.

Before LADEE attains Lunar Orbit Insertion, each Guest Investigator will:

- Become thoroughly familiar with the spacecraft, its instruments, and investigations;
- Participate in LADEE science team meetings;
- Participate, as appropriate, in LADEE science team working groups;
- Prepare to analyze data, developing techniques or algorithms if necessary;
- Prepare to archive any data products that will be generated by the GI investigation which are not currently in the LADEE Data Management and Archive Plan, including participating, as necessary, in the LADEE Data Archive Working Group; and
- Support the education and public outreach efforts of the LADEE mission.

During the primary science mission and following the mission's end, each GI will:

- Participate in LADEE science team and/or working group team meetings;
- Perform analyses necessary to complete the proposed scientific investigation;
- Participate, as necessary, in the LADEE Data Archive Working Group;
- Publish results in peer-reviewed journals in accordance with NASA policies, LADEE project data release, and publication policies; and
- Support the education and public outreach efforts of the LADEE Mission.

1.2 Types of Investigations

As stated previously, LADEE has two primary science objectives:

1. Determine the composition of the lunar atmosphere and investigate the processes that control its distribution and variability, including sources, sinks, and surface interactions, and
2. Characterize the lunar exospheric dust environment and measure any spatial and temporal variability and impacts on the lunar atmosphere.

Guest Investigators may propose any investigation that addresses or expands on the objectives of the LADEE project.

Consistent with the goals of the LADEE GIP laid out above, NASA is soliciting a broad range of expertise and investigations. Potential types of investigations sought include, but are not limited to:

- Modeling of grain "stickiness" as a function of composition and temperature, and the effective vapor pressure of various potential species in the lunar exosphere with temperature, visible and UV solar input, and plasma processes (ion sputtering, electron stimulated desorption).
- Modeling and/or empirical results connected with the vaporization of impactor and target material by meteoric infall.
- Research that addresses the following topics, and results in predictive tools: thermal accommodation of non-reactive species on airless body regoliths; chemical processes involving reactive species, including chemical sputtering and loss; photon-stimulated desorption, plasma sputtering, and secondary particle production.
- Monte Carlo and/or other techniques that simulate the global structure and variability of lunar exospheric species, including the effects of cold trapping.
- Model photon scattering/radiative transport of visible and UV light by small (100 nm to 100 micron) silicate grains suspended in vacuum, particularly photon forward- and back-scattering and extinction.
- Modeling of the instrument response to dust scattering effects in the context of an orbital spacecraft.
- Understanding the physics of dust charging, adhesion, Van der Waals forces and other grain-grain and grain-particle interactions immersed in the space environment (i.e., in the presence of direct sunlight and plasmas).

- Understanding the dynamics of dust and dust aggregates under the influence of radiation pressure and charging due to solar ultraviolet light and the lunar plasma environment.

NASA is particularly interested in activities that combine both *in situ* and remote sensing datasets.

LADEE has three science instruments: the Neutral Mass Spectrometer, the UV/VIS Spectrometer, and the Lunar Dust Experiment. Specific information on each of the instruments and the spacecraft can be found in the Proposal Information Package (PIP) on the NSPIRES index page for this Appendix. We encourage applicants to explicitly make the connection between the work they propose to do, and the interpretation of data from the three instruments. Proposals may focus on utilizing data from a single instrument or a combination of instruments.

LADEE also has a technology demonstration, Lunar Laser Communications Demonstration (LLDC), but we are not seeking proposals for that instrument through this call.

Proposed investigations involving data from other missions will be considered and may potentially bring added value to the data generated by LADEE. Most importantly, however, such proposals must make use of a significant amount of LADEE fundamental or derived data and show how the LADEE data in combination with other mission data contributes significantly to lunar or planetary sciences.

Selected investigators will become members of the LADEE science team and will work in a collaborative manner with other LADEE science team members after selection. All team members will be bound by the LADEE "Rules of the Road" document that describes the data access rights, data-sharing responsibilities, and data release policies of the LADEE science team. The current version of this document is available in the PIP on the NSPIRES index page for this Appendix. If, in the course of carrying out a LADEE GIP scientific investigation, a GI has to generate higher-level instrument products than those the LADEE project is already planning to produce and archive, the Guest Investigator proposal must indicate that the GI will archive those products in the PDS.

The PIP for the LADEE GI Program provides more details about the spacecraft and instruments. The PIP, including the contained "Rules of the Road" section, will be downloadable as a PDF file from the NSPIRES web page for this program element.

2. Proposal Submission

2.1 Proposal Guidelines

All proposals should contain the elements described in Section 2 of the *NASA NRA Proposers Guidebook*. 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 Guest Investigator on the LADEE mission; any co-investigators or collaborators on the proposal will be designated as LADEE science team co-investigators or collaborators according to LADEE “Rules of the Road.” The principal investigator is expected to be the primary, if not

sole, individual contributing to the proposed science and all proposals should indicate a commitment level in each of the fiscal years FY14-FY15. Although not encouraged, proposals may include funded co-investigators and/or unfunded collaborators, but only if they are critical to complete the proposed science investigation. However, participation of graduate students and postdoctoral researchers is encouraged in all proposals. Co-investigators, students, and postdocs should be working under the supervision of the PI and at the PI's institution during the mission. Collaborators should provide focused contributions to specific tasks and may be from any institution.

Proposals should identify scientific ideas and unique theoretical and analytical capabilities that best meet the scientific objectives of the LADEE mission as described in this solicitation. Key projected milestones, accomplishments, and deliverables during each year of the proposed investigation should be identified.

2.2 Sources of Information and Data Used in the Proposal

All information and data used in the proposal pertaining to LADEE, the LADEE science instruments (or testbeds or engineering models belonging to the LADEE team), and LADEE science data (from instruments, testbeds, or engineering models belonging to the LADEE instrument teams) must be available in the public domain (which includes the information available through the NSPIRES web site), or the proposal will not be considered for selection. “Available in the public domain” is defined as information that can be found in the published literature, at the LADEE website (http://www.nasa.gov/mission_pages/LADEE/main/index.html) or through the NSPIRES web site. Such information should be referenced in the proposal accordingly.

Any planetary spacecraft mission data from missions other than LADEE to be used in proposed investigations must be available in the Planetary Data System (PDS) or similar publicly accessible archive at least 30 days prior to the proposal submission date.

3. Programmatic Information

3.1 Duration of Award and Funding

Selected investigators are expected to be funded for the period of August 1, 2013 through July 31, 2015. This start date is contingent on funding availability. It is expected that most investigators will propose for the maximum two years. Annual award renewal is contingent upon availability of funds and annual assessment of performance and relevance of the research effort to the LADEE mission and program requirements.

3.2 Budget Information

The budget must follow the guidelines described in the *NASA NRA Proposers Guidebook*, and the budget must include funding for any training and data analysis to support the proposed science investigation. Budgets should include salary, all page charges for publication and reprints, attendance at conferences, all travel and other necessary expenses.

The GI proposal budgets should include adequate funds for the PI to attend four LADEE science team meetings in year 1, two at or near Ames Research Center in Mountain View, CA, and two at or near Goddard Space Flight Center in Greenbelt, MD.

The expected total program budget and number of awards are indicated in Section 4, the Summary Table of Key Information.

3.3 Evaluation Criteria

Evaluation criteria are given in the *NASA NRA Proposers Guidebook*. 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 LADEE science mission to reasonably accomplish the proposed investigation.
>
> Intrinsic merit will also include the value added to the science mission planned by the existing LADEE science team and the extent to which the proposed investigation complements the currently planned science investigations; and
>
> Relevance will include evaluation of the extent to which the proposal meets the objectives of the LADEE Guest Investigator Program outlined above.

3.4 Progress Reports and Deliverables

After selection, each Guest Investigator shall provide an Implementation Plan to the LADEE Project Scientist, including a schedule for deliverables (software, data products, reports, plans), and details regarding plans for data analysis, computing facilities, Ground Data System support, software development, data archiving, and participating in E/PO activities. The Guest Investigator shall provide semiannual reports to the LADEE Project Scientist and the NASA Headquarters LADEE Program Officer that include: accomplishments over the past two quarters; plans for the next two quarters; issues; concerns; schedule performance; financial performance; and status of publications and other deliverables.

4. Summary of Key Information

Expected program budget for first year of new awards	$500K
Number of new awards pending adequate proposals of merit	~ 4-6
Maximum duration of awards	2 years
Due date for Notice of Intent to propose (NOI)	February 22, 2013
Due date for proposals	March 29, 2013
Planning date for start of	August 1, 2013

investigation	
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 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 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	NNH12ZDA001N-LADEE
NASA point of contact concerning the Proposer Information Package for this program	Richard Elphic LADEE Project Scientist Planetary Systems Branch NASA Ames Research Center Moffett Field, CA 94035 Telephone: (650) 604-4164 Email: Richard.C.Elphic@nasa.gov
NASA point of contact concerning this program	Sarah Noble Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 643-5862 E-mail: Sarah.K.Noble@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.9 of this NRA are focused on achieving the goals of the Science Mission Directorate's Astrophysics Research Program as defined in the *2010 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 NASA.

The *NASA Guidebook for Proposers* (Section 2) and the *ROSES 2012 NRA* (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. 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.

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. Proposers are strongly urged to download copies of all documents after upload to NSPIRES, to ensure that they still conform to all formatting requirements.

The program elements are described below. Abstracts of previously selected investigations may be found online at http://nspires.nasaprs.com/.

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 approved priority A or B Guest Observer (GO) programs using Suzaku, and priority B GO programs using XMM-Newton, 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 investigations in the areas of suborbital flights, 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 particles of astronomical origin.

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.

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), and the Kepler mission (Appendix D.7). Guest investigator programs for the Hubble Space Telescope (http://www.stsci.edu/), the Chandra X-ray Observatory (http://cxc.harvard.edu/), 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.

6. Strategic Astrophysics Technology

The Strategic Astrophysics Technology program (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.

7. Nancy Grace Roman Technology Fellowships in Astrophysics

The Nancy Grace Roman Technology Fellowship in Astrophysics (Appendix D.9) gives early career researchers the opportunity to develop the skills necessary to lead astrophysics flight instruments or projects, and future 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.

8. Origins of Solar Systems

The cross-division program Origins of Solar Systems is described in Appendix E.3. Work related to the detection and characterization of planetary systems that is directly tied to the NASA strategic goal to search for Earth-like planets is of interest to the Astrophysics Division.

D.2 ASTROPHYSICS DATA ANALYSIS

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 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. The table below provides a representative—but not exhaustive—list of NASA space astrophysics missions for which suitable archival data are publicly available:

Beppo Satellite di Astronomia X (BeppoSAX)	Keck Interferometer (KI) and Palomar Testbed Interferometer (PTI) Archives
Compton Gamma-Ray Observatory (CGRO)	Keck Observatory Archive (KOA) at the NASA Exoplanet Science Institute (NExScI)
Cosmic Background Explorer (COBE)	Kepler
Extreme Ultraviolet Explorer (EUVE)	Midcourse Space Experiment (MSX)
Far Ultraviolet Spectroscopic Explorer (FUSE)	Planck
Fermi Gamma Ray Space Telescope	Roentgen Satellite (ROSAT)
Galaxy Evolution Explorer (GALEX)	Rossi X-ray Timing Explorer (RXTE)
Gravity Probe B	Spitzer Space Telescope
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
Infrared Astronomical Satellite (IRAS)	Two Micron All Sky Survey (2MASS)
Infrared Space Observatory (ISO)	X-ray Multi-Mirror-Newton (XMM-Newton)*
International Gamma-ray Astrophysics Laboratory (INTEGRAL)*	Wide-field Infrared Survey Explorer (WISE)
International Ultraviolet Explorer (IUE)	Wilkinson Microwave Anisotropy Probe (WMAP).
Shuttle-based Astrophysical Observatories, including: the Hopkins Ultraviolet Telescope (HUT), the Wisconsin Ultraviolet Photopolarimetry Experiment (WUPPE), the Ultraviolet Imaging Telescope (UIT), the Broad-Band X-Ray Telescope (BBXRT), and ORFEUS-SPAS I and II	

* - including selected GO investigations; some restrictions apply; see section 1.2.4 for details.

Researchers interested in analyzing datasets from missions or projects that are not included in the table above should contact the ADAP Program Officer before writing their proposal to confirm that their planned research program is compliant with this solicitation. Proposals judged to be noncompliant will be returned without review.

Most NASA space astrophysics data may be found in one or more of the following NASA astrophysics data centers:

- Astrophysics Data System (ADS) (http://adswww.harvard.edu/);
- High Energy Astrophysics Science and Analysis Data Center (HEASARC) (http://heasarc.gsfc.nasa.gov/);
- Infrared Science Archive (IRSA) (http://irsa.ipac.caltech.edu/);
- Multimission Archive at Space Telescope (MAST) (http://archive.stsci.edu/);
- NASA Exoplanet Science Institute (NExScI; formerly the Michelson Science Center) (MSC) (http://nexsci.caltech.edu/);
- NASA/IPAC Extragalactic Database (NED) (http://nedwww.ipac.caltech.edu/); and
- National Virtual Observatory (NVO) (http://www.us-vo.org/).

1.2 Limitations of the Program

1.2.1 *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.

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. In such cases, the onus is on the proposer to clearly establish compliance with this restriction in their proposal.

1.2.2 *Analysis of data from Hubble Space Telescope (HST) or Chandra X-Ray Observatory (CXO)*

Proposals for archival research based exclusively on the data from either HST or CXO 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 involves a combination of data from these Great 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 or Chandra archival research program compliant with the ADAP.

1.2.3 *Astrophysical databases and development of new data products/analysis tools*

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. To leverage this effort, NASA also supports the Virtual Astronomical Observatory (VAO) and the development of data mining tools that take advantage of the interoperability framework established by the VAO. The development of VO-compliant applications and their public distribution through VAO is also eligible for funding under the ADAP.

In addition, 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.

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 §1.1 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.

1.2.4 *Support for Approved Suzaku and XMM-Newton Guest Investigators*

Direct support for U.S. investigators who compete and win General Observing (GO) time has been eliminated for the Suzaku mission, and support for XMM-Newton GO programs is limited to priority A observations. Consequently, scientists with approved priority A or B GO programs using Suzaku, or priority B programs using XMM-Newton at the time of ADAP 2012 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.

However, 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-2012 NRA and the ADAP solicitation. It is not sufficient to simply submit the approved GO proposal.

Please note, since there is no exclusive use period associated with Swift GO data, that mission is no longer covered under this waiver. Investigators with Swift GO data are, of course, welcome to propose for data analysis support under the ADAP, as long as their data satisfies the program's data-availability criterion (i.e., available in the public domain at the time of proposal).

1.2.5 *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 it must 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 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, multiyear 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 2012 proposal submission deadline will be judged noncompliant and returned without review.

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 at http://nspires.nasaprs.com/). Therefore, ADAP proposals 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.

1.2.6 *Proposal formatting.*

In addition to the scientific scope of the SAT described in the following sections, both the *NASA Guidebook for Proposers* (Section 2) and the *ROSES-2012 NRA* (Section IV) 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 submission 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, 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.

1.3 Identification of Proposal Data Set(s) and Research Areas

The Cover Page (see the *NASA Guidebook for Proposers*) 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, planetary nebulae, supernova remnants);
4. Collapsed Objects and X-ray Astrophysics (e.g., white dwarfs, neutron stars, cataclysmic variables, X-ray binaries, black-hole binaries);
5. Supernovae and Gamma Ray Bursts;
6. Interstellar Medium (including dense clouds, the diffuse ISM, 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, AGNs, 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, higher-level data products based on existing archival astrophysical data sets, and data analysis tools).

2. Current Profile of the ADAP

2.1 ADAP 2011 Submission statistics

In 2011, a total of 280 proposals were submitted in response to the ADAP solicitation, a 50% increase in the number of proposals submitted to the program compared to the previous year, and three times the number received under ADAP 2008. The distribution of those proposals over the various Research Areas covered by ADAP 2011 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.

2.2 Distribution of annual funding levels for ADAP tasks

With an annual budget of around $16M, the ADAP typically supports around 150 investigations in any given year (includes new starts, plus continuing investigations). Although the average annual ADAP award is approximately $100,000, actual award amounts span the range from less than $40,000 per year to more than $170,000 per year. The plot in Figure 2 on the following page shows the distribution of annual awards for the ADAP in FY 2012.

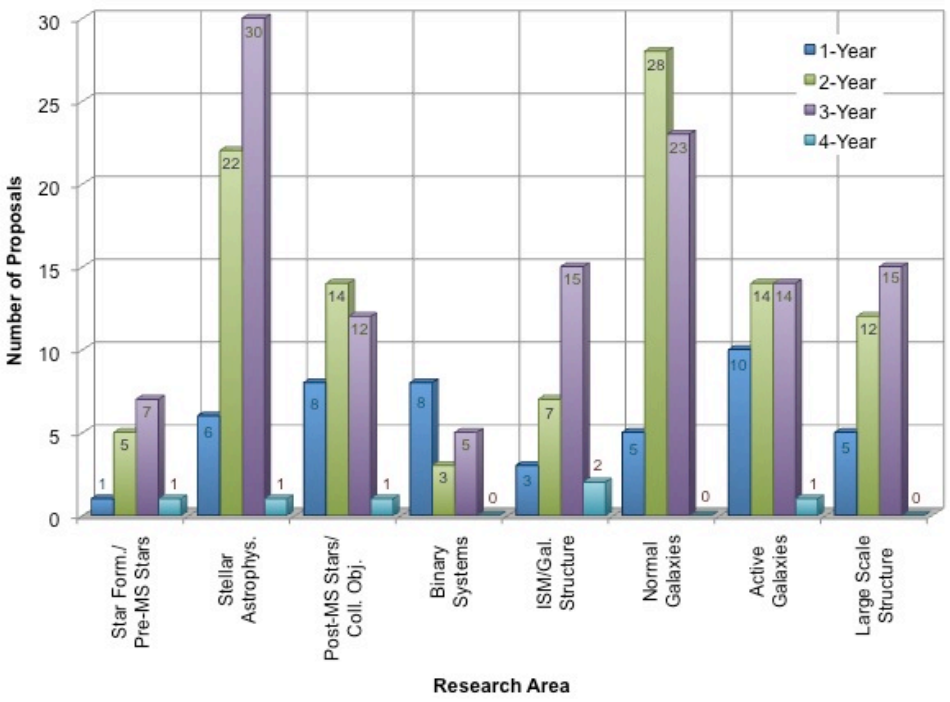

Figure 1. The distribution of 2011 ADAP proposals, broken down by proposed funding duration, across the Research Areas covered by the program. Proposals in the Binary Systems and Astrophysics Databases Research Areas are grouped into one of the Research Areas shown based on their subject matter.

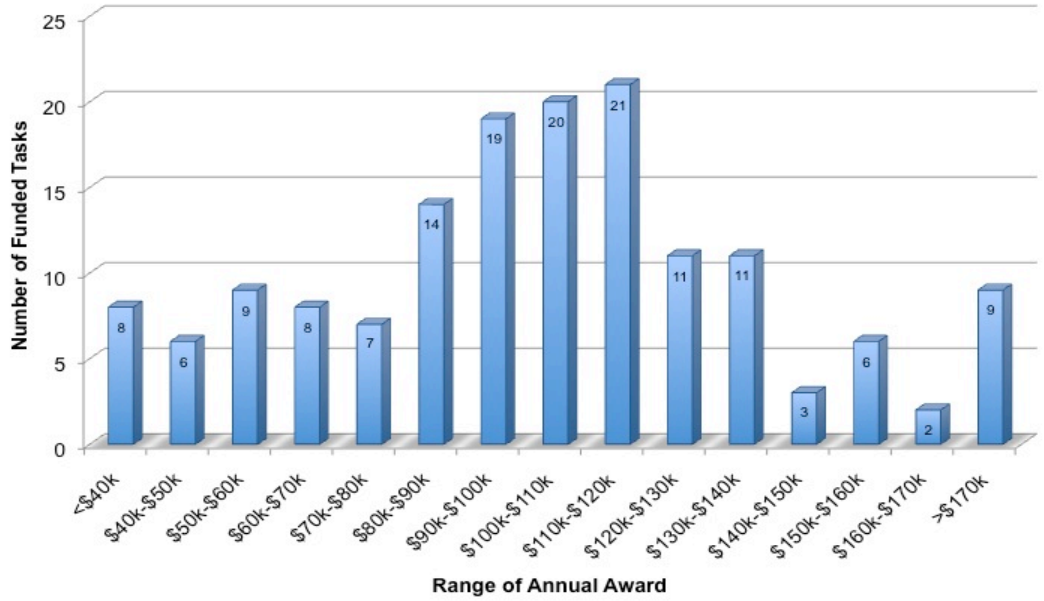

Figure 2. The distribution of annual awards for funded ADAP tasks in FY 2012. Data include both ADAP 11 new starts and ongoing tasks from previous solicitations.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $ 8.0M
Number of new awards pending adequate proposals of merit	~ 60 - 70
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	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 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 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	NNH12ZDA001N-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

Clarified on February 26, 2013. The planning date for start of investigation given in the Summary Table of Key Information has been corrected.

Amended on December 20, 2012. This Amendment permits proposals for development of new data analysis methods for future space missions to APRA, see Section 1.2, and also corrects dates for Sounding Rocket launches from Woomera, see Section 1.2.1.1.

Amended on December 11, 2012. This Amendment defers until ROSES-13 the portion of this solicitation on Laboratory Astrophysics proposals of potentially larger scope that address the acquisition of data for understanding the molecular universe at infrared and submillimeter wavelengths (see Section 1.2.4). The funding level for Laboratory Astrophysics indicated in the table in section 2.1 of element D.3 remains unchanged. This amendment also changes several of the points of contact (see Section 3). New text is in bold and deleted text is struckthrough. The due date for notices of intent to propose and proposals remain unchanged at January 25, 2013, and March 22, 2013, respectively.

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 particles of cosmic origin. 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.

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/Special Orbital Investigations
- Detector Development
- Supporting Technology
- Laboratory Astrophysics

- Ground-Based Observations.

Specific Considerations and Exclusions:

- The scientific/technical/management section of proposals for a suborbital/special orbital investigation may be 20 pages long, instead of the default 15 pages specified in the *NASA Guidebook for Proposers,* because of the anticipated greater degree of complexity.
- Investigators proposing stand-alone detector development should propose to the Detector Development category, whereas proposals for which detector development is integrated into a suborbital/special orbital program should be submitted to the Suborbital Investigations category.
- The Fundamental Physics component of 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. This program is not intended to support applied physics or laboratory experiments. Proposals submitted to this program element should be space-related (suborbital, orbital, etc.) Investigations predominantly theoretical in nature should be directed to the Astrophysics Theory Program or to other Federal agencies, as appropriate.
- The Laboratory Astrophysics component 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 component of APRA will consider proposals <u>only</u> 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 the Origins of Solar Systems program described in 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 astroparticle physics 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).
- 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. ~~Proposals for development of new data analysis methods for future space missions should be directed to the Astrophysics Theory Program (see Appendix D.4).~~ **[Text removed December 20, 2012]**
- 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.
- In past years, SR&T-class programs have permitted grants to be made separately to the Principal and Co-Investigators of the same proposal, but at different institutions, in order

to avoid the overhead costs associated with subawards. However, this practice has been discontinued, except for Suborbital/Special Orbital Investigations, see Section 1.2.1.3 below. In all other cases, the PI institution is expected to fund grants to participating Co-I(s) as subawards.

1.2.1 *Suborbital/Special Orbital 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 payloads. These are described in Section V of the *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.

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 a suborbital investigation 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 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 junior researchers and graduate students. For suborbital 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 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. 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, 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.

The Sounding Rocket Program is currently planning to provide launches from Woomera, Australia, in July-September of 201**5** and again in April-June of 201**7**, 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. **[Dates changed December 20, 2012]**

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 young 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 needing unique engineering and/or technical support services and/or vehicles 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 Investigations: Co-Investigator Proposals*

Proposals for suborbital investigations often involve the development of payloads that require major hardware collaborations amongst 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, 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 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. The emphasis of this solicitation is on technologies that address problems related to achieving the NASA-sponsored astronomy and astrophysics missions and goals in its current Strategic Plan. 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 or gratings.

1.2.4 *Laboratory Astrophysics*

The Laboratory Astrophysics component 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 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). 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.

~~In addition to the individual-investigator proposals that represent the core of the Laboratory Astrophysics program, we will particularly solicit proposals of potentially larger scope that address the acquisition of data for understanding the molecular universe at infrared and submillimeter wavelengths. Today, ESA's Herschel Space Observatory and NASA's SOFIA are opening new vistas on our universe, to probe regions of the cosmos that are obscured at other wavelengths. However, the very richness that makes the spectroscopic data from these missions so powerful also represents a significant challenge, as our understanding of many astronomical sources will be limited by our ability to interpret their line spectra, rather than observing instrument performance. This aspect of the Laboratory Astrophysics solicitation is contingent upon the availability of funding. Further information will be forthcoming as an amendment late in 2012.~~ **[Text removed December 11, 2012]**

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 approximate amount of FY 2014 funding and the number of new investigations that may be selected for the five APRA categories pending the availability of funds and an adequate number of proposals of adequate merit.

APRA Category	Approximate Funds for New Selections [$M]	Approximate Number of New Selections
Suborbital Investigations	11	14
Detector Development	3	8
Supporting Technology	1.8	10

Laboratory Astrophysics	1.2	9
Ground-Based Observations	0.1	1

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. This information should be included in the proposal summary in the Notice of Intent.

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)	**January 25, 2013**
Due date for proposals	**March 22, 2013**
Planning date for start of investigation	Between 1 January and 31 March **of the** calendar year **following the proposal due date** ~~2013~~ (except that NASA Centers may plan for a start at the beginning of the fiscal year). **[Corrected on February 26, 2013]**
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 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 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	NNH12ZDA001N-APRA
NASA point of contact concerning this program	**Michael 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, who all share the same mailing address. If uncertain whom to address, contact the APRA Program Officer above.

Astrophysics Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001

NAME	PROGRAM RESPONSIBILITY	TELEPHONE	E-MAIL
Larry D Petro	**Infrared, Submillimeter, and Radio Astrophysics**	**(202) 358-4424**	**Larry.D.Petro@nasa.gov**
Michael Garcia	**Ultraviolet and Visible Astrophysics**	**(202) 358-1053**	**Michael.R.Garcia@nasa.gov**
Louis J. Kaluzienski	**X-ray and Gamma-ray Astrophysics**	(202) 359-0365	Louis.J.Kaluzienski@nasa.gov
W. Vernon Jones	Particle Astrophysics and Fundamental Physics	(202) 358-0885	W.Vernon.Jones@nasa.gov
Glenn M. Wahlgren	Laboratory Astrophysics	(202) 358-1551	Glenn.M.Wahlgren@nasa.gov

[POCs Changed December 11, 2012]

D.4 ASTROPHYSICS THEORY

1. Scope of Program

The Astrophysics Theory Program (ATP) supports efforts to develop the basic theory for NASA's space astrophysics programs. Abstracts of previously selected ATP projects may be found online at http://nspires.nasaprs.com/ (choose "Solicitations" then "Past/Selections" on the left). The periods of performance of investigations for this research element may range from one to four years. Most selected proposals will have a duration of three years, but four-year proposals may be selected if the need for the longer duration is sufficiently well justified.

Proposals submitted for this program must both:

- be directly relevant to space astrophysics goals by facilitating the interpretation of data from space astrophysics missions or by leading to predictions that can be tested with space astrophysics observations; and
- consist predominantly of theoretical studies or the development of theoretical models.

ATP proposals satisfying both of the above requirements may involve development of data analysis methods for astrophysics missions and may incidentally include actual data analysis as a test of the theory or the method.

Proposals to the ATP program may not:

- consist primarily of data reduction or data analysis (such proposals should be directed to the mission-specific programs or the Astrophysics Data Analysis Program (ADAP) described in Appendix D.2 in this solicitation);
- propose theoretical work pertaining to atomic and molecular astrophysics and other topics directly related to Laboratory Astrophysics (these should be proposed to the Astrophysics Research and Analysis (APRA) program element described in Appendix D.3);
- develop experimental payloads to test theories of gravitation and fundamental physics (such proposals should be submitted to the APRA program element described in Appendix D.3);
- address theoretical topics that are predominantly unrelated to the needs of NASA's space astrophysics programs (such proposals should be directed to other appropriate Federal agencies);
- deal strictly or predominantly with Solar System objects or solar-terrestrial interaction studies, including solar energetic particles (see Appendices B and C for appropriate programs);
- propose to develop technologies or experimental concepts for future NASA missions (these proposals should be submitted to the APRA program element described in Appendix D.3 or the Strategic Astrophysics Technology program element described in Appendix D.8);
- primarily aim at studying new mission concepts in preparation for future competitive solicitations;
- request support for organizing and/or hosting scientific meetings; or

- request support for substantial computing facilities or resources (Note: Requests for personal computers, at amounts typically under $5K, will be allowed, so long as they are used exclusively for the research being proposed).

2. Proposal Category and Research Areas

ATP proposals will only be accepted from individual Principal Investigators (PIs) whose proposed work has a clear, single focus. Group proposals, i.e., those in which several researchers submit an omnibus proposal of related, but separate, theoretical research investigations under a designated PI, are not solicited for the ATP and will be considered unresponsive to this solicitation. However, individual theory PIs may include as many Co-Investigators and Collaborators as they wish on their proposals.

Investigators may submit more than one proposal to the ATP if the research program of each proposal is significantly distinct and if the implied work does not over commit the personnel involved. If a proposal is submitted as a successor to work supported by an earlier proposal, the new proposal must identify the related work and clearly summarize all significant results from it.

For the purposes of conducting the peer review, every proposal for this ATP must identify one (or more, if appropriate) of the Topic Categories from the list below in both its Notice of Intent to propose and in the proposal submission itself. The primary use of these Topic Categories is to facilitate the assignment of the proposal to an appropriate review panel. NASA reserves the right to assign a proposal to a different category.

1. Star and Exoplanet Formation (e.g., star forming clouds, protostars, protoplanetary and debris disks, planet formation, astrochemistry);
2. Stellar Astrophysics and Exoplanets (e.g., asteroseismology, convection, stellar evolution, brown dwarfs and exoplanets, mass loss, circumstellar disks);
3. Collapsed Objects and X-ray Astrophysics (e.g., white dwarfs, neutron stars, cataclysmic variables, X-ray binaries, black-hole binaries);
4. Supernovae and Gamma Ray Bursts;
5. Interstellar Medium, Cosmic Rays, and Galactic Structure (e.g., supernova remnants, dark clouds, interstellar dust, H II regions, diffuse galactic emission, planetary nebulae, stellar clusters);
6. Normal Galaxies (e.g., quiescent galaxies, interacting galaxies, starburst galaxies);
7. Active Galaxies and AGNs (e.g., population studies, accretion discs, jets);
8. Large Scale Cosmic Structures and Dark Matter (e.g., clusters of galaxies, galaxy environment and evolution, intracluster medium, diffuse photon backgrounds);
9. Dark Energy and the Cosmic Microwave Background (e.g., theoretical studies of cosmological observation techniques, theoretical cosmology, dark energy models);
10. Gravitational Astronomy (e.g., gravitational wave sources, computation of gravitational radiation waveforms, data analysis methods for future missions to investigate gravitational radiation); and
11. Other Astrophysics Theory (NASA Headquarters will assign the proposal to what it deems is the most appropriate review panel).

3. Availability of High-End Computational Resources

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 Astrophysics Theory 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.

4. Summary of Key Information

Expected program budget for first year of new awards	~ $4M
Number of new awards pending adequate proposals of merit	~ 32
Maximum duration of awards	4 years; shorter term proposals are encouraged; four-year proposals must be well justified
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	No earlier than 6 months after the proposal due date, but no later than July 1, 2013
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 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 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	NNH12ZDA001N-ATP

NASA point of contact concerning this program	Linda S. Sparke Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-7335 E-mail: HQ-ATP@mail.nasa.gov

D.5 SWIFT GUEST INVESTIGATOR – CYCLE 9

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 9 observations and funding will commence on or around April 1, 2013, and last approximately 12 months. As was the case in Swift GI Cycles 4 through 8, 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. U.S. based Co-Investigators on foreign-led proposals do not qualify for funding. Funding for accepted target proposals will be initiated only after the relevant observations have begun.

The Swift GI program is intended to provide the following to participating scientists:

1. Funding (U.S. PIs only) for:
   - New Swift GRB projects;
   - Correlative GRB observations involving new or enhanced IR ground-based capabilities for investigating high redshift bursts;
   - Other correlative GRB projects; and
   - Theoretical investigations that will advance the Swift mission science return.

2. Observations (and funding for U.S. PIs) for:
   - non-ToO observations of non-GRB targets;
   - ToOs;
   - Large Programs requesting more than 100 targets or more than 100 ks total exposure time; and
   - "Fill-in" targets.

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 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 arc-minute 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 $E/\Delta E$ ~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 x 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/docs/swift/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 GRB projects not requiring GI-specified observatory pointing;
2. Correlative GRB observations involving new or enhanced IR ground-based capabilities for investigating high-redshift bursts or other correlative GRB projects involving non-Swift instruments and observatories; and other correlative GRB investigations;
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; and
7. Fill-in targets to be observed in what would otherwise be gaps in the planned science timeline.

1.3.1 *New Swift GRB project*

GIs may propose to initiate their own GRB 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 (Swift detected or elsewhere) and can propose innovative GRB data reduction and interpretation methods that increase our understanding of GRBs. 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 Correlative Observations*

GRB correlative observations substantially augment the science return from Swift. The Swift instruments make unique measurements of GRB afterglows starting immediately following the burst. However, it is not possible to follow up all GRBs 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, infrared spectroscopy (for high-z bursts redshifted out of the band pass of the UVOT), 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.

GRBs at high redshift are particularly compelling due to their distance and rely especially on high quality infrared 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 above the average award. 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-z GRB" 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*

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 2 million seconds of observing time will be made available during Cycle 9 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 9 (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 3 hours; and
- No more than 500 time-constrained visits will be performed during Cycle 9.

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.

There will be no time carried over from Cycle 9 to Cycle 10, except when observing for an awarded program has commenced during Cycle 9. GIs whose observing programs have not begun in Cycle 9 will be required to repropose if they wish to acquire observing time. Targets whose observations have commenced in Cycle 9 will be awarded carryover time in Cycle 10 until the proposed observations are substantially complete. Similarly, Cycle-8-accepted proposals that have not been initiated by the start of Cycle 9 will not be carried over. Cycle 8 GIs concerned that their programs may not be started before the end of Cycle 8, should repropose for Cycle 9.

1.3.5 *ToO Observations*

GIs are allowed to propose for ToOs in response to transient phenomena, including GRBs found by other observatories (but not including GRBs found by Swift). A total of at most 1 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 9; 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 Priority: Observation should be performed within four hours;

- High Priority: Observation should be performed within 24 hours;
- Medium Priority: Observation can be performed within days to a week; or
- Low Priority: 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 SGR 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/too_request.htm. It is highly recommended that ToO proposers register as Swift ToO users in advance at https://www.swift.psu.edu/secure/toop/too_newuser.htm. 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 9 ToO proposals may be triggered until March 31, 2014. GIs whose ToO programs do not trigger in Cycle 9 will be required to repropose in later cycles should they wish to acquire observing time on their targets of interest.

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*

PIs 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). The requested total integration time per target must be between a minimum of 1 ks and a maximum of 40 ks. 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 PIs 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 PIs 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; 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.

2. Programmatic Information

2.1 General Information

It is anticipated that approximately $700K will be available through this solicitation for the support of approximately 25 Guest Investigations of one-year duration each. 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; a brief management section, if funding is requested; a total budget; and a corresponding basis for this total budget. 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 but they should be from the same institution. All proposal materials will be submitted electronically.

Proposals requesting more than the average budget will need to provide a detailed cost justification. This includes proposals in the "high-z GRB" and Large Programs categories. 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 ARK/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-z GRB" 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://swiftsc.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	~$700K
Number of new awards pending adequate proposals of merit	~25
Maximum duration of awards	1 year
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, 2013 (6 months after start of Cycle 9 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-z GRB" category, which are allowed up to 6 pages. LaTeX and MS Word templates (available for download at http://swift.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 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 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	Option not available
Web site for submission of Phase 1 proposal via Grants.gov	Option not available

Programmatic information may be obtained from the Swift Program Scientist	Ilana M. Harrus Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1250 E-mail: Ilana.M.Harrus@nasa.gov
Technical questions concerning this program element may be directed to the Swift Guest Investigator Program	Stefan Immler Swift Guest Investigator Program Code 662 Goddard Space Flight Center National Aeronautics and Space Administration Greenbelt, MD 20771-0001 Telephone: (301) 286-0072 Email: swifthelp@athena.gsfc.nasa.gov

D.6 FERMI GUEST INVESTIGATOR – CYCLE 6

Amended October 22, 2012. This Amendment releases the final text for Appendix D.6, The Fermi Guest Investigator Program, which replaces the prior text in its entirety. These are the major changes since the prior version that was released with ROSES 2012. In this cycle, Fermi investigators can now apply for observing time through joint programs with the Arecibo Observatory or the VERITAS ground-based Cerenkov telescope facility. A new data product, intended primarily to facilitate studies of very short duration transients such as terrestrial gamma-ray flashes, will be available during Cycle-6 and beyond. This new operating mode will produce continuous TTE files in addition to the intervals currently available around a GBM trigger. The due date for proposals remains January 18, 2013.

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, including two that are new for Cycle 6. 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 or the VERITAS ground-based Cerenkov telescope facility. Please refer to section 1.1.3 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.

A new data product, intended primarily to facilitate studies of very short duration transients such as terrestrial gamma-ray flashes, will be available during Cycle-6 and beyond. In nominal operation the Fermi GBM will be continuously recording and sending to the ground time-tagged events (TTE) with 2 μs accuracy. This new operating mode will produce continuous TTE files

in addition to the intervals currently available around a GBM trigger. Additional details are provided on the Fermi Science Support Center web site at http://fermi.gsfc.nasa.gov/ssc/.

A Large Area Telescope (LAT) data product, which provides significant new analysis capabilities for short duration transients such as gamma-ray bursts and solar flares, was also recently introduced. These provide enhanced acceptance, especially at low energies, but with high background contamination. These data and associated response files will be provided for a time interval around selected transient events. For more details please see: http://fermi.gsfc.nasa.gov/ssc/data/analysis/documentation/Cicerone/Cicerone_Data/LAT_DP.html.

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 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 deadtime (<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.

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 CsI 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 5 years, with a goal of 10 years. After a checkout period, science operations began on August 4, 2008.

The GI community is supported by the Fermi Science Support Center (FSSC), which is managed by NASA's 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 6 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, and VERITAS. 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/suzaku.html,
http://fermi.gsfc.nasa.gov/ssc/proposals/veritas.html, and
http://fermi.gsfc.nasa.gov/ssc/proposals/arecibo.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/cycle6/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 astronomers 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

In Cycle 6 there will be 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.

The final determination as to the one- or two-year support duration will not be made until the completion of the Phase 2 evaluation process.

Proposers requesting two-year projects that are selected at Phase 1 should not assume that they have been awarded two years of support.

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 be at least two pages long and it should list the deliverables (papers, public software, etc.) that came 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.

PIs of Regular projects approved for two years will be required to submit a progress report, not to exceed two pages, at the time of the Phase 2 proposal submission (as an NSPIRES attachment) for year two. As in the case of Large projects, the progress report should list the deliverables and the spending history. Additional details regarding this procedure will be conveyed in the selection letters and posted on the FSSC web site.

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, 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 rejected without any 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

It is anticipated that approximately $5.1M will be available through this solicitation for the support of approximately 60 new Guest Investigations including up to approximately two or three new Large projects. Grants for Regular (one or two years) proposals will average $80,000 per year and will generally be for less than $100,000, and for Large proposals the grants will average $150,000-$180,000 per year and will generally be for less than $200,000 per year. Regular proposals for more than $100,000 per year and Large proposals for more than $200,000 per year are unlikely to be approved without extremely compelling justification.

Grants for triggered analyses (e.g., transients meeting specific criteria) will be released only after such triggers occur. Fermi GI funding is open only to individuals employed at U.S. institutions.

Grants for 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.

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 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 Fermi Program Scientist 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	The total GI program is ~$8M/year of which ~$5.1M is available for new awards (This might permit, for example, the selection of ~60 Regular proposals (both one and two years) with average awards of $80K and generally less than 100K, and 2 or 3 Large proposals with average awards of $150-180K per year and generally less than 200K per year.)
Number of new awards pending adequate proposals of merit	~60 Regular (one or two years) proposals; 2 to 3 Large proposals
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	4:30 p.m. Eastern time on January 18, 2013.
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 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 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	Dr. Ilana M. Harrus Astrophysics Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1250 E-mail: Ilana.M.Harrus@nasa.gov
Technical questions concerning this program element may be directed to the Fermi Science Support Center	Dr. Chris Shrader Fermi Guest Investigator Program Code 661 Goddard Space Flight Center National Aeronautics and Space Administration 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	Dr. Julie McEnery Code 661 NASA Goddard Space Flight Center Greenbelt, MD 20771 Telephone: 301-286-1632 Email: Julie.E.McEnery@nasa.gov

D.7 KEPLER GUEST OBSERVER – CYCLE 5

Amended October 1, 2012. This amendment presents the final text for Appendix D.7, The Kepler Guest Observer Program, which replaces in its entirety the placeholder text that was released with ROSES 2012. Notices of intent are requested by December 7, 2012 and proposals are due January 18, 2013.

1. Scope of Program

1.1 Overview

This program element solicits proposals for the acquisition and analysis of new scientific data from the Kepler mission, which is the tenth mission launched under NASA's Discovery Program. The Kepler mission is designed to continuously monitor a 116 square degree field-of-view (FOV) in the Cygnus region (α=19h 22m 40s, δ=44° 30' 00"), with the objective of photometrically detecting transits of Earth-size planets in the habitable zones (HZ) of stars in the solar neighborhood. The instrument's high-precision photometry capability, with short cadence and long cadence modes (1 minute and 30 minute exposures), provides a powerful tool for variability analyses of both Galactic and extragalactic sources.

In November 2012, Kepler will transition from its prime mission to its extended mission operations phase. This transition is accompanied by changes to the scope of the mission's Key Project study, described in §1.3.1 below, and its Guest Observer (GO) program. Cycle 5 will be the first full cycle of GO observations in the extended mission. Observations associated with the Kepler Guest Observer Cycle 5 solicitation are expected to begin following the summer quarterly roll on or near June 28, 2013. Proposals submitted to this program should be for new observations only, i.e., the proposed science should not be achievable using existing public data within the Kepler archive. Proposers must make the case in their proposal that existing data in the public Kepler data archive are not sufficient to accomplish the goals of their proposed investigation. Under Cycle 5, the Kepler GO program is open to:

i) proposals for Kepler observations that address any area of astrophysics outside of the exoplanet Key Project study (see Section 1.3.1);
ii) proposals for short cadence observations of known exoplanet candidates that are not currently being observed in short cadence; and
iii) proposals for long cadence observations of new targets for the identification of planets transits.

Proposers should note that short cadence resources are in high demand and heavily oversubscribed. Short cadence requirements must be compelling and carefully justified scientifically and technically. This solicitation is supported by technical and scientific material which are available at the Kepler Guest Observer website (http://keplerscience.arc.nasa.gov).

1.2 Changes Since ROSES 2011

- The Kepler GO program is now open to proposals for exoplanet and exoplanet-related scientific observations.
- The total number of targets available to the GO program has increased to 7,000 long cadence targets per quarter and 96 short cadence targets per month.
- Targets accepted for the GO program will not count against the GO target quota if they are already being observed by the project.

1.3 The Kepler Mission

1.3.1 *Kepler Mission Key Project*

The primary scientific objectives of the Kepler mission during its extended phase operations are to:

- Continue exoplanet survey operations to produce an initial catalog of planet candidates with >50% completeness for Earth-size planet candidates with periods up to one year;
- Execute a follow-up observing program that targets planet candidates with radius ≤2.5 R_{earth}. Follow-up observations are expected to provide improved stellar parameters leading to improved candidate radii and high resolution images to increase the catalog reliability for small exoplanet candidates; and
- Make a determination of η_{earth} by analyzing Kepler data, quantifying pipeline completeness.

The search for Earth-size and larger planets through transit events about solar-type stars will involve continuous monitoring of over 160,000 stars, consisting largely of F through K main sequence stars, through mission life. A detailed discussion of the Kepler mission and its scientific objectives can be found at http://keplerscience.arc.nasa.gov/. Background information on NASA's Discovery Program is available at http://discovery.nasa.gov/.

1.3.2 *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 mission duration. Quarterly rolls are performed – one roll every ~93 days – to reorient the solar arrays. With each roll, the stars in the FOV land on different regions of the detector relative to their preroll position, introducing possible artificial discontinuities in the light curve that must be eliminated during data reduction.

Kepler will achieve a benchmark photometric precision on a m_v = 12 G2V star of 66 parts-per-million (ppm) in 30 minutes of integration and 400 ppm in a one minute integration. While stars brighter than mV = 11 will saturate some pixels, Kepler performs well on stars as bright as m_v = 5, provided the large number of pixels needed to capture saturated flux can be justified by science gained. Kepler also has many faint-target scientific applications where m_v = 20 objects yield a photometric precision of 3% over 30 minutes and 20% over 1 minute. The broad photometric bandpass has a half-maximum transmission range of 430 to 840 nm. The instrument

has neither changeable filters nor dispersing elements. 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%.

1.3.3 *Observing Modes and Data Products*

Much of the data from the full focal plane are not saved due to constraints imposed by onboard storage and communications. Instead, data for specific targets are saved and transmitted as subimages, with a typical area of 20+ pixels, depending on source brightness. This buffer size can be varied to accommodate extended or very bright, saturated objects.

All observations are taken at one of two temporal resolution settings: long (30-minute) or short (1-minute) cadence. A fixed number of targets have been reserved for Cycle 5 GO observations and are available to successful proposers to this Cycle 5 solicitation: 7,000 long cadence targets per quarter, assuming a default 32-pixel target mask size and 96 short cadence targets per month, assuming a default 85-pixel target mask size. Extended or bright objects requiring larger aperture sizes decrease the total number of targets available to the GO program and must be justified carefully. Targets accepted for the GO program will not count against the GO target quota if they are already being observed by the project.

Data distribution and archival services will be done through the Space Telescope Science Institute's MAST (Mikulski Archive for Space Telescopes). Final data products available to GO observers will include original and calibrated pixel values and light curves for each target. The calibration will correct for bias level, smear, galactic cosmic rays, flat fielding, dark current, background, and instrument noise. Aperture photometry will be used to generate the light curves.

Data will be delivered to the observer in FITS format. A thorough understanding of the noise sources and systematic errors will be needed by observers who plan to generate their own light curves from the original (uncalibrated or calibrated) pixel data, particularly for data taken over a period of ~93 days, data sequences spanning one or more quarterly spacecraft rolls, and/or in the study of variability phenomena having amplitudes less than 100 ppm. For such conditions, the light curves provided from the pipeline software should be used with great caution because the data reduction technique used to eliminate artifacts in the light curves (caused by spacecraft roll, differential velocity aberration, and jitter) may also reduce or remove legitimate low amplitude variability having timescales exceeding several days.

2 Guest Observer Targets

2.1 Target Selection Tools

Pointed observations away from the single stare position of the mission cannot be accommodated by Kepler; GO targets are limited to the objects available in the fixed FOV. Small gaps between the 42 detector CCDs result in additional loss of available objects that would otherwise be within the Kepler FOV. A target search tool, http://archive.stsci.edu/kepler/kepler_fov/search.php, determines if an object of a particular coordinate lies within the observable FOV. Determining

whether or not desired targets fall on active regions of the focal plane is the responsibility of the proposer. The target search tool accesses the Kepler Input Catalog (KIC), which provides physical data for over four million stars on silicon (down to a magnitude limit of 20) present in the Kepler FOV. These data result from a compilation of existing databases (e.g., 2MASS) and extensive ground-based imaging and spectroscopy surveys of the Kepler FOV (Brown et al. 2011, AJ, 142, 112).

The KIC is complete to only $m_v = 17$. The GO Office at http://keplerscience.arc.nasa.gov provide additional tools to both select fainter targets and determine whether adjustments to observational parameters of KIC targets are required. These include additional target catalogs and software to select pixel masks based upon the monthly Full Frame Images (FFIs) obtained by the spacecraft.

2.2 Permitted GO Science Areas

The GO program no longer excludes proposals for exoplanet detection. Under Cycle 5, the Kepler GO program is open to: i) proposals for Kepler observations addressing any area of astrophysics outside of the exoplanet Key Project study (see Section 1.3.1); ii) proposals for short cadence observations of known exoplanet candidates that are not currently being observed in short cadence; and iii) proposals for long cadence observations of new targets for the identification of planets transits. Proposers should note that short cadence resources are in high demand and heavily oversubscribed. Short cadence proposals must justify scientifically and technically the need for higher cadence monitoring in the context of the existing long cadence observations.

Proposers must take into account the difference between science that can be achieved exclusively using archived data and science that requires new observations by Kepler. The 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 the ROSES NRA). All proposals must justify the need for new observational data within their program.

No current Kepler targets are guaranteed to be observed during Cycle 5, except the list of existing exoplanet candidates. All other survey targets could potentially be dropped from the observational list for scientific or operational reasons. By successfully proposing an existing target through the GO program, the proposer guarantees the observation of that target during Cycle 5, regardless of whether the target is removed from the exoplanet survey list.

All science proposals must be compelling and carefully justified scientifically and technically. Proposals with novel scientific objectives or approaches that expand the current range of science issues to be addressed using Kepler data, capitalize on the mission's unique capabilities, and minimize replication of ongoing investigations, are encouraged. All previous GO targets are provided at http://keplerscience.arc.nasa.gov/ProposalPreparationTargetCheck.shtml. The Data Availability Flag output by the Target Search Form at MAST (http://archive.stsci.edu/kepler/kepler_fov/search.php) indicates whether a target has been observed before and whether it is has been ingested within the archive.

All Kepler science data targets, including GO targets, will flow through the Kepler science processing and analysis pipeline. The Kepler pipeline converts raw detector coordinates and count rates to sky positions and calibrated fluxes. It also performs a sensitive search for candidate planetary transit events in all light curves.

The Kepler Project will not conduct any investigation upon GO target data that is not directly related to the search for exoplanets.

2.3 On-source Monitoring Times

Cycle 5 targets can be proposed for monitoring up to a maximum of one year. Both long and short cadence target list uploads to the spacecraft will happen on a quarterly basis. Long cadence targets may be changed on a quarterly basis, while short cadence targets can be changed on a monthly basis. The ability to swap targets after some integral numbers of days provides the ability for observation of a total number of targets over the course of a year larger than the 7,096 target "slots" allocated to the GO program. Specification of target swapping during the course of the year and other details regarding planned observing modes need to be included in the proposal using a target table, an example of which is given below. All Cycle 5 GO observations terminate one year after the Cycle 5 observations begin. Observers whose science objectives require observing timelines longer than one year may submit proposals to future cycles justifying the need for continuation of observations.

2.4 Target Table

All proposals 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 GO office website at http://keplerscience.arc.nasa.gov/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 GO office. Table 1 below includes example entries.

Table 1: Required format of target table

Object	J2000 Right Ascension	J2000 Declination	Kp	On-source Monitoring												Flag	Comments
				Q10			Q11			Q12			Q13				
	hh mm ss.s	±dd mm ss		1	2	3	4	5	6	7	8	9	10	11	12		
2436324			16.89	30	30	30	30	30	30	30	30	30	30	30	30	0	
2436781			15.78	0	0	0	1	1	1	0	0	0	0	0	0	1	Observed in long cadence, cycle 2
11862867			18.13	30	30	30	0	0	0	0	0	0	0	0	0	0	
J184751+4656	18 47 51.0	46 56 08	20.2	1	1	1	30	30	30	30	30	30	30	30	30	0	Not in KIC, Kp estimated from USNO-B mags; custom mask needed
10034169			13.21	30	30	30	30	30	30	30	30	30	30	30	30	1	Observed in Cycle 1, see science justification
7198959			7.86	30	30	30	1	1	1	30	30	30	30	30	30	1	RR Lyrae, observed in Cycle 1, custom mask desired
7440316			14.78	30	30	30	30	30	30	30	30	30	30	30	30	0	PM ~ 1.7" per year (KIC value)
5515897			9.3	30	30	30	30	30	30	30	30	30	30	30	30	0	Galaxy, a/b ~ 4
1026710			12	1	1	1	0	0	0	0	0	0	0	0	0	0	LPV (Teff ~ 3200, logg ~0), 12.0 < Kp < 13.5; KIC Kp = 12.75

3. Programmatic Information

3.1 Proposal Submission and Evaluation

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, and cost realism/reasonableness. 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 Kepler observatory and data products for the proposed investigation;
- The degree to which the investigation uses Kepler'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 Kepler's observational constraints; and
- The feasibility and suitability of the proposed analysis techniques.

In order to expedite the proposal review process and the timely selection of scientific peer review panels, investigators intending to submit proposals for participation in this program are asked to submit a Notice of Intent (NOI) to propose by the date given in Tables 2 and 3 of the *Summary of Solicitation*, to the NSPIRES web address given in Section 4. Note that a NOI submission is not required, but even minimal information (e.g., proposal topic, investigator names, and affiliated institutions) can be of considerable value in helping NASA plan for an expeditious peer review of proposals. The NOI is not used to do a preliminary proposal assessment. Proposals must be submitted before 11:59 p.m. eastern time on the date given in Tables 2 and 3 of the *Summary of Solicitation.*

3.2 Period of Performance and Availability of Funds

Cycle 5 Guest Observer observations are expected to start on or near June 28, 2013. All Cycle 5 GO observations will cease not more than one year after the start date. Cycle 5 funding will start upon availability of data to the PI in January 2014. The data will be placed into the public archive at MAST. There is no exclusive use period for any Kepler data, including data collected through the GO program.

3.3 Eligibility

Application to the Kepler 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.

3.4 Submission of Proposals to the Kepler GO Program

Prospective proposers to the Kepler GO program must adhere to the following procedures for the submission of proposals:

- Proposals should include a description of the scientific objectives, a demonstration of the feasibility of the proposed observations, and how the proposal will utilize the unique capabilities of Kepler to carry out the investigation.
- The scientific justification section of the proposal, which consists of text, tables (excluding the target table), figures, and references, must not exceed six pages.
- A complete table of proposed targets (see Section 2.4) must also be included in the body of the proposal.
- The Kepler GO call is a one-stage process. Proposals that request funding must provide complete budgets and detailed justification. All proposers, regardless of whether or not funds are requested, should include information regarding the level of effort and responsibilities of each investigator involved in the project. Requested budgets should be based on the level of effort required to achieve the scientific objectives, rather than based exclusively on quantity of requested data. For example, two proposals could request the same number of targets, but require very different budgets if one project uses pipeline-generated light curves but the other requires creating light curves from uncalibrated data files.
- 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.
- Complete and electronically submit the proposal through NSPIRES (http://nspires.nasaprs.com). Hard-copy submissions are not permitted.
- A separate electronic version of the target table must be submitted to the Kepler GO Office 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 GO Office, and information regarding the file-naming convention for the target table file are available at http://keplerscience.arc.nasa.gov/ProposalPreparationContent.shtml.
- Format such as font and margin sizes, etc. should follow those specified in the *NASA Guidebook for Proposers:* http://www.hq.nasa.gov/office/procurement/nraguidebook.
- All electronic proposal materials (proposal and separate electronic target file submitted to NSPIRES and the Kepler GO office, respectively) must arrive at the designated destinations by 11:59 p.m. Eastern time on the due date given in Section 4 in order to be included in the proposal review for this cycle of the Kepler GO Program.

3.5 Sources of Additional Information

The Kepler Guest Observer Office (http://keplergo.arc.nasa.gov), located at NASA Ames Research Center, provides support to Guest Observers and to proposers of this solicitation, such as technical information about the Kepler mission and instrument, and other information supporting proposal preparation, including a FAQ link and template files for proposal preparation. Contact information may be found in Section 4.

4 Summary of Key Information

Expected annual program budget for new awards	~$1.0M
Number of funded investigations selected for observations	~30 investigations representing 7,000+ long-cadence targets per quarter and 96+ short-cadence targets per month.
Maximum duration of awards	1 year
Due Date for Notice of Intent to Propose	December 7, 2012
Due Date for electronic submission of proposals	January 18, 2013
Planning date for start of investigation	Funds will be awarded when the data are made available to the PI. NASA Center proposers should use October 1, 2013 (3 months after the start of Cycle 5 observing) as a planning date for start of investigation and January 15, 2014 as the probable date for receiving data from the first quarter of the cycle.
Page limit for the central Science-Technical-Management section	No more than six pages for the science justification section, including text, tables, figures, references and other supporting materials. The budget justification and science justification combined must not exceed 15 pp; see Section 3.4.
Relevance	This program is relevant to the astrophysics 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 *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 Phase 1 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	NNH12ZDA001N-KEPLER
Mandatory submission of electronic version of target table	http://keplerscience.arc.nasa.gov/ProposalPreparationTargetTable.shtml
Kepler Guest Observer Office	Webpage: http://keplerscience.arc.nasa.gov Email: keplergo@mail.arc.nasa.gov
Technical questions concerning this program element may be directed to the Kepler Guest Observer Office	Martin Still Kepler Guest Observer Office NASA Ames Research Center, MS 244-30 Moffett Field, CA 94035-1000 Telephone: (650) 604-2018 Email: keplergo@mail.arc.nasa.gov
NASA point of contact for programmatic information	Dr. Douglas Hudgins Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0988 Email: douglas.m.hudgins@nasa.gov

D.8 STRATEGIC ASTROPHYSICS TECHNOLOGY

Amended on Dec 18 2012. This amendment makes a number of small changes to the text of Appendix D.8 SAT. The changes include: updated POCs for the TPCOS, TCOP, and Balloon piggyback Payloads; The pre-proposal informational workshops for TPCOS and TCOP have been removed; A date for the TDEM pre-proposal informational workshop has been added; Reporting methods for the PIs of selected TPCOS and TCOP programs have been specified in additional detail; Priorities for TCOP Technology Development have been updated to correspond with the most recent release of the Program Annual Technology Report; and the maximum duration of awards for the TDEM and TCOP elements is now 3 years. The due date for notices of intent to propose and proposals remain unchanged at January 25, 2013, and March 22, 2013, respectively. New text is in bold, deleted text is struckthrough.

1. Scope of Program

1.1 Overview

Over the next decade and beyond, NASA's Astrophysics Division expects to undertake a suite of 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 out and characterize the planets and planetary systems orbiting other stars. As compelling as these future missions will be, implementing them presents many daunting technological challenges. To overcome these challenges and pave the way to ever more ambitious missions, NASA'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.

1.2 Solicited Programs

The 2010 Decadal Survey of Astronomy and Astrophysics (hereafter, Astro2010), charts a path of discovery for the next decade and beyond that spans the three science program areas of the Astrophysics Division: Exoplanet Exploration, Physics of the Cosmos, and Cosmic Origins. Negotiating that path necessarily requires—either explicitly or implicitly—advancements in technology in each of these science areas. The SAT program is a key component in the Astrophysics Division's efforts to foster those advancements. The focus of the SAT Program can best be 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, as defined in Table D.8.1 below. These TRL definitions are articulated in more detail in NPR 7120.8 Appendix J (http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_7120_0008_&page_name=AppendixJ). 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 not intended to support "basic" research into new technologies and demonstration of their feasibility (TRL 1-3), nor is it intended to support flight qualification of mature technologies (TRL 7-9). On the contrary, Low-TRL research is funded through the Astrophysics Research and Analysis program (APRA; Appendix D.3 of this NRA) while flight qualification of technologies is funded through the associated flight project. 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). Sometimes referred to as the "mid-TRL gap," funding for such intermediate TRL development activities has historically been problematic because technologies in this regime are sufficiently mature that they are ill suited to funding under basic research programs,

Table D.8.1. Technology Readiness Levels Summary	
TRL 1	Basic principles observed and reported
TRL 2	Technology concept and/or application formulated
TRL 3	Analytical and experimental critical function and/or characteristic proof-of concept
TRL 4	Component and/or breadboard validation in laboratory environment
TRL 5	Component and/or breadboard validation in relevant environment
TRL 6	System/subsystem model or prototype demonstration in a relevant environment (ground or space)
TRL 7	System prototype demonstration in a space environment
TRL 8	Actual system completed and "flight qualified" through test and demonstration (ground or space)
TRL 9	Actual system “flight proven” through successful mission operations

yet still too immature for a mission to assume the risk of incorporating it into a flight system. The problem of the mid-TRL gap was of sufficient concern that an enhancement in funding specifically targeted at mid-TRL development is included among the Small Project recommendations in Astro2010. This is the role of the SAT program.

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. Nevertheless, all proposals must clearly and quantitatively articulate the expected final state (and TRL) of the relevant technology at the end of the two-year development program. Proposals must also 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.

Successful proposers must submit a progress report to the appropriate Program Officer that documents progress relative to their proposed schedule at the end of the first year of funding, which begins with the date of the initial receipt of funds. NASA reserves the right to terminate a grant after the first year if it deems that achievement of the proposed goals according to the proposed schedule is unlikely to occur.

1.3 Technology Development Milestones

Technology milestones verify technology readiness in measured steps and quantified terms that are themselves tied to the performance needs of a specific or representative mission. It is incumbent on the proposer to select the specific or representative mission concept that anchors the proposed technology advance and associated technology milestones. The proposed technology milestones shall be anchored by a quantified mission performance error budget allocation used to guide the proposed technology advance. The level of detail contained in these error budgets should be appropriate for the mission concept maturity.

Technology milestones can be developed in terms of one or more of the following three technology maturity approaches:

1. Demonstrate technology maturity through laboratory experiments conducted to quantify performance goals traceable to an error budget allocation.
2. Validate technology demonstration models against mission error budgets, including sensitivity assessment of technology performance on error allocations.
3. Apply validated technology demonstration models to mission analyses and error budget to demonstrate that the on-orbit performance is achieved.

The expanded TRL maturity definitions provided in NPR 7120.8 Appendix J shall be used to judge completion of technology advances in terms of Hardware, Software, and Exit Criteria considerations. It is incumbent upon the proposer to credibly establish and document that they have satisfied each of these three considerations fully before claiming advancement to the next TRL step. An excerpt of these detailed criteria covering the SAT scope of TRL 4 through 6 is reproduced in Table D.8.2 below for convenience.

Each proposal must include 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. The work plans for selected proposals will also be reviewed by the appropriate Program Officer or his/her designee(s) to ensure that they contain an adequate level of detail to demonstrate each milestone. Milestone achievements are to be reported in a format that varies among the three Programs: see Sections 2, 3, and 4 below for details.

1.4 Specific Considerations and Exclusions

The SAT program is not intended to support "basic" research into new technologies and demonstration of their feasibility. Support for such activities is available through NASA's APRA program described in Appendix D.3 of this *ROSES 2012 NRA*.

Proposers are responsible for making a compelling case that (a) their current technology is at least at TRL 3 and less than TRL 6, and that (b) their technology maturation project addresses a high-priority challenge specifically associated with successfully executing future space-based

measurements with the accuracy and precision required to achieve the scientific goals of the associated future mission.

If a proposal is offered as a direct successor to a previous NASA award, it must 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.

In addition to the scientific scope of the SAT described in the following sections, both the *NASA Guidebook for Proposers* (Section 2) and the *ROSES 2012 NRA* (Section IV) 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 submission 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, 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.

Table D.8.2. Expanded Maturity Definitions for MidRange TRLs

TRL	Definition	Hardware Description	Software Description	Exit Criteria
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 the final operating environment.	Key, functionally critical, software components are integrated, and functionally validated, to establish interoperability and begin architecture development. Relevant Environments defined and performance in this 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 demonstrates 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.

6	System/sub-system model or prototype demonstration in ~~an operational~~ **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 integrate with existing hardware/software systems. Limited documentation available. Engineering feasibility fully demonstrated.	Documented test performance demonstrating agreement with analytical predictions.

1.5 Categories of Proposals

To meet the goals, proposals are solicited in the following three science areas, each of which is described in greater detail below:

- Technology Development for Exoplanet Missions (TDEM)
- Technology Development for Physics of the Cosmos Program (TPCOS)
- Technology Development for the Cosmic Origins Program (TCOP)

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.

2. Technology Development for the Exoplanet Exploration Program (TDEM)

NASA's Exoplanet Exploration Program (ExEP) supports the development of those technologies that will allow us to search out 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 the Astro 2010 Decadal Survey is a flagship "New Worlds Mission" that would conduct imaging and spectroscopy of rocky planets in the habitable zones of stars in the Solar neighborhood. To advance this goal, Astro 2010 made "New Worlds Technology Development" its top priority medium class, space project for the decade. The TDEM element of the SAT solicitation is NASA's implementation of that recommendation.

To meet the challenge of Astro2010 in the coming decade, the TDEM element of the SAT program solicits investigations that will undertake focused development of technologies that feed into the key starlight suppression techniques for direct detection of exoplanets (coronagraphy, external occulters, interferometry). Detailed discussions 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.

Investigations that advance technologies for future missions with goals other than the direct detection of extrasolar planets (e.g. astrometry, transit spectroscopy) are not solicited at this time.

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).

2. *Wavefront Sensing and Control*
   In order to achieve the requisite degree of starlight rejection, the light paths within both coronagraphic and interferometric systems must be controlled to subnanometer precision. Advances in control algorithms, sensing technology, and deformable mirror technology are, therefore, central to implementing such instruments on a space-based platform.

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~~ **A preproposal teleconference for prospective TDEM proposers** will be held **Tuesday, 22 January 2013** 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~~ **participating in the preproposal teleconference** will be posted at http://exep.jpl.nasa.gov/news.

The SAT/TDEM program is not intended to support general technology maturation activities without specific application to exoplanet missions or the development and maintenance of testing facilities and/or tools that substantively reproduce the capabilities of existing ExEP infrastructure. Technologies that are specifically *excluded* from the SAT/TDEM solicitation at this time are (1) detector technology, (2) mirror technology (with the exception of adaptive systems), (3) telescope assembly technology, (4) spacecraft sunshields and thermal control, (5) propulsion systems, (6) vibration isolation systems, (7) spacecraft pointing control, and (8) formation flying technology.

2.2 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. Error budgets have been developed for a number of different ExEP mission architectures and are available to potential TDEM proposers by contacting the TDEM Program Officer (see Section 6).

For all technical milestones identified in a proposal, the PI will be expected to prepare a milestone white paper—a workplan 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 a NASA Headquarters appointed independent board 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.

Each year, PIs of selected tasks will be required to submit a written progress report and meet with ExEP officials, either in person or remotely, to discuss the progress of their task.

3. Technology Development for Physics of the Cosmos Missions (TPCOS)

The primary science objectives of the Physics of the Cosmos Program (PCOS) are to understand the origin and destiny of the Universe, 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.

The release of the ~~New World New Horizon (NWNH)~~ **Astro2010** Decadal report has brought forward a set of priorities for technology investment for PCOS in the near term. The TPCOS element of the SAT program represents NASA's implementation of these recommendations, as it identifies key technologies for future missions addressing ~~NWNH~~ **Astro2010** science priorities. Detailed discussions 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. To learn about potential opportunities for suborbital piggyback payloads, please contact:

~~David Gregory~~ **Debora A. Fairbrother**
Balloon Program Office
Code 820
Wallops Flight Facility
National Aeronautics and Space Administration
Wallops Island, VA 23337
Telephone: (757) 824-~~2367~~ **1453**
Email: ~~David.D.Gregory@nasa.gov~~ **Debora.A.Fairbrother@nasa.gov**

Questions concerning potential sounding rocket piggyback payloads may be addressed to:

Philip Eberspeaker
Sounding Rocket Program Office
Code 810
Wallops Flight Facility

National Aeronautics and Space Administration
Wallops Island, VA 23337
Telephone: (757) 824-2202
Email: Philip.J.Eberspeaker@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**. This Report will be included in the Program Annual Technology Report.**

~~An informational workshop will be held in advance of the proposal deadline to provide guidance for developing quantitative, practical technology milestones for proposed tasks. Information concerning the scheduling of the workshop and instructions for participation will be posted at http://pcos.gsfc.nasa.gov.~~

In addition, PIs of selected investigations are requested to submit a short status update on a bimonthly basis and to make an annual progress presentation to the Program Office. By the end of the full term of the investigation, the Program Office intends to convene 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 (TCOP)

The Cosmic Origins Program 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. ~~Areas of long-lead and mission enabling technology development that are of particular interest to the Cosmic Origins Program include (but are not necessarily limited to):~~ **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**a**. *Detectors*

Highly sensitive detectors and large arrays of detectors are fundamental to Cosmic Origins mission's capabilities. In particular, high-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.

1b. *Ultraviolet Coatings*.

Improved coatings for optics, for reflective purposes as mirrors, for antireflective (AR) uses on optical elements 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 an entry gate of TLR at least 3, proposals which address the needs outlined here and do not meet this TRL threshold should be submitted as APRA proposals.

~~Improved reflective coatings for optics, particularly in the ultraviolet part of the spectrum, could yield dramatically more sensitive instruments and permit more instrument design freedom. Increasing system throughput is a very cost effective way to achieve more science and often is less costly than simply using a larger primary mirror. Studies of improved deposition processes for known UV reflective coatings (*e.g.*, MgF_2); investigations of new coating materials with promising UV performance, and examination of handling processes, contamination control; and safety procedures related to depositing coatings, storing coated optics, integrating coated optics into flight hardware are all areas where progress would be valuable.~~

2. *Advanced, Normal Incidence Optics*

Missions within the Cosmic Origins Program rely heavily on their ability to collect enough light energy with appropriate angular resolution to address important Cosmic Origins questions. ~~Therefore, a premium is placed on the ability to manufacture, test and control optics of sizes greater than ~2 meters in diameter. 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 deployable structures to reduce launch volume for large-aperture space telescopes and interferometers; cryogenic optics; and mechanisms~~

~~and methods for improving control of the surface figure.~~ **Therefore, a premium is placed on the ability to develop scalable manufacturing techniques, including the testing and control optics of sizes up to at least ~4 meters in diameter. 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; and mechanisms and methods for improving control of the surface figure.**

In addition, heterodyne far-IR receiver arrays could provide significant enhancement to a variety of COR programs, including SOFIA. Compact, lightweight, high efficiency cryocoolers suitable for space flight would also be valuable for future COR missions at far-infrared wavelengths.

The proper justification and demonstration of the TR 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, suborbital programs and other technologies are not solicited at this time, but they could be considered 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 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 are requested to submit a short status update on a bimonthly basis, and to make an annual progress presentation to the Program Office. By the end of the full term of the investigation, the Program Office intends to convene 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. The following table provides the approximate amount of funding available for new awards, distributed over fiscal years ~~2012~~ **2014** and ~~2013~~ **2015**. 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	~$2.6M/yr	~3-10
TCOP	~$4.0M/yr	~4-10
TPCOS	~$2.4M/yr	~1-6

5.2 Student Participation

Where appropriate, participation of graduate students is 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 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 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 TCOP elements, 2 years for TPCOS; proposals with a term shorter than 2 years will be accepted, but are not encouraged.** ~~2 years; shorter term proposals will be accepted, but are not encouraged~~
Preproposal Teleconference (TDEM proposers only)	**Tuesday, 22 January 2013 (information for participating at http://exep.jpl.nasa.gov/news.**
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, 2014 (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; see also Chapter 2 of the *NASA Guidebook for Proposers*

Relevance		This program is relevant to the astrophysics 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 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		NNH12ZDA001N-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 St. SW Washington, DC 20546-0001	
Name	Program	Telephone	Email
Douglas Hudgins	TDEM	(202) 358-0988	Douglas.M.Hudgins@nasa.gov
~~Rita Sambruna~~ **Wilton Sanders**	TPCOS	~~(202) 358-2166~~ **(202) 358-1319**	~~Rita.M.Sambruna@nasa.gov~~ **Wilton.T.Sanders@nasa.gov**
~~Mario R. Perez~~ **Michael R. Garcia**	TCOP	~~(202) 358-1535~~ **(202) 358-1053**	~~Mario.Perez@nasa.gov~~ **Michael.R.Garcia@nasa.gov**

D.9 NANCY GRACE ROMAN TECHNOLOGY FELLOWSHIPS IN ASTROPHYSICS FOR EARLY CAREER RESEARCHERS

Amended October 29, 2012. The Due Date for D.9 Nancy Grace Roman Technology Fellowships in Astrophysics, has been delayed by a week to give more time to proposers who will be without power because of Hurricane Sandy. The new due date for proposals to Appendix D.9 Nancy Grace Roman Technology Fellowships in Astrophysics is November 8, 2012.

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 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 under 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 Astrophysics innovation and technology development, with the individual as the PI.

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 an initial one-year Concept Study to generate the detailed plans and commitments for developing the proposed 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 and a subset of the Technology Fellows will be selected to continue the fellowship and implement the plans conceived during the Concept Study. This Development Effort (Section 3.3) is for an additional four-years. Finally, a third opportunity is available to Fellows in the four-year Development Effort to apply for start-up funds (Section 3.4) when they obtain a tenure-track, permanent civil service, or equivalent position.

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.

2. Eligibility

To be eligible for an RTF award, proposal PIs must meet the following requirements:

- 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 are encouraged to obtain prior concurrence from NASA before proposal submission.

- 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.

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

[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.

to lead a flight instrument/project and become principal investigators of future missions; to develop innovative technologies 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.

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 for intrinsic merit given in the NASA *Guidebook for Proposers*, intrinsic merit includes 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 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.
- The wider application of the technology to other NASA programs, as well as national needs supported by other Government agencies (such as the Department of Homeland Security, Department of Energy, etc.).

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 Concept Study

The one-year Concept Studies are intended for the fellow to develop more definitive information regarding the cost, risk, and feasibility of the proposed investigation. The content and format of the Concept Study proposal should follow the *NASA Guidebook for Proposers* with the following additional guidance:

- The proposal should include a rough estimate of the budget required for the four-year Development Effort, in addition to the detailed budget for the Concept Study.

- 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 Effort. The proposal should also contain a plan for obtaining firm institutional commitments for such laboratory space and other institutional resources that will be required for the subsequent four-year Development Effort.

- The proposal should be for duration of two years, but only request support for up to one year. Support beyond the first year will be contingent upon a successful

request, submitted nine-months after the award of the Concept Study, for entering the four-year Development Effort.

The award amount for the Concept Study 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.

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 Effort to implement the plans developed during the Concept Study. Funding for years beyond the first is contingent on availability of funds and satisfactory progress, assessed through the normally required annual progress reports and a review towards the end of the second year that will be based on milestones defined in the proposal. Fellows should request Development Effort support in their final 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 Effort 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 Effort support may request salary support, plus up to $500K total (inclusive of institutional indirect costs) for capital equipment or other project costs. Researchers who are not in tenure-track or equivalent positions (such as term civil servants) may request full salary support for up to four years, plus up to $300K total (inclusive of institutional indirect costs) for capital equipment or 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 Effort 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 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 effort 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, enabling Fellows to continue their NASA-funded investigation. The funds may be used to purchase laboratory equipment, provide salary for the Fellow, as well as students and research associates, and cover 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 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 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.

4. Summary of Key Information

Expected program budget for first year of new awards	Concept Studies: $0.9M (FY 2013) Development Phase $1.2M (FY 2014)
Number of new awards pending adequate proposals of merit	About 3-6 for the study phase; about 4 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	See Chapter 2 of the *2012 NASA Guidebook for Proposers*
Relevance	This program is relevant to the astrophysics 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. **[clarified Sept. 4, 2012]**
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	NNH12ZDA001N-RTF
NASA point of contact concerning this program	Louis Kaluzienski Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 (202) 359-0365 Louis.J.Kaluzienski@nasa.gov **[Changed August 7, 2012]**

D.10 SCIENCE INVESTIGATIONS AS MEMBERS OF THE EUCLID CONSORTIUM AND EUCLID SCIENCE TEAM

Amended on May 23, 2012. This Amendment presents a new opportunity in Appendix D.10, Science Investigations as Members of the Euclid Consortium and Euclid Science Team. Notices of Intent are due by June 15, 2012, and proposals are due by August 31, 2012.

1. Scope of Program

1.1 Background

Space-based research into the nature of dark energy and cosmology is a science objective of the recent National Research Council (NRC) decadal survey of astronomy and astrophysics for 2012-2021, *New Worlds, New Horizons in Astronomy and Astrophysics* (the 'Astro2010 Decadal Study,' National Academies Press, http://www.nap.edu/catalog.php?record_id=12951).

The investigation of dark energy is also a top priority of the European Space Agency (ESA)'s Cosmic Vision program (2015 – 2025). ESA has selected Euclid, a space-based dark energy and cosmology sky-survey mission, as the second medium-class mission M2 in this program (http://sci.esa.int/euclid). ESA is currently conducting Phase B, the detailed design study of the Euclid mission, prior to the anticipated start of Phase C/D later in 2012 for a launch at the end of 2019. Commissioning is planned to take 3 months and the nominal science mission will last for 6 years.

As of the release of this announcement, NASA and ESA are discussing a strategic collaborative partnership on the Euclid mission. When this partnership is finalized, NASA may contribute directed space flight components to the Euclid mission, and ESA may allow NASA to appoint a maximum of 40 members of the Euclid Consortium, including one member of the Euclid Science Team.

This solicitation is for science investigations using the Euclid data during its nominal mission. The members of the selected science teams will be appointed as full members of the Euclid Consortium. NASA will select one or more proposed investigations subject to the constraint that a total not exceeding 40 individuals, including postdoctoral researchers, will be appointed to the Euclid Consortium. A nominated proposal team member from one of the selected investigations will be appointed to the Euclid Science Team and to the Euclid Consortium Board and will act as the U.S. national representative to the Euclid Consortium.

Selection of proposals submitted in response to this solicitation are subject to the finalization of a strategic collaborative partnership between ESA and NASA on the Euclid mission. The potential contribution of space flight components to the Euclid mission by NASA is separate from the science investigations solicited here; no link between the two is contemplated and no discussion of any NASA provided flight components is required in proposals.

1.2 Overview of this Opportunity

This solicitation invites proposals for science investigations using ESA's Euclid mission in collaboration with the members of the Euclid Consortium. Proposers should be familiar with the membership of the Euclid Consortium and with the organization of the Euclid Consortium into Science Working Groups; proposers should propose to join one or more Euclid Consortium Science Working Groups in order to carry out the proposed science investigation(s). Proposers may organize themselves into one large group or smaller groups or may propose as individuals. The science investigation described in the proposal will be the basis for the proposal evaluation and selection. However, the investigations that successful proposers may eventually perform will have to comply with the science exploitation policy of the Euclid Consortium Science Working Group in which they are integrated. In case of conflicts between the proposed investigations and the policies of the Euclid Consortium, the Euclid Consortium science programs have precedence. All selected Consortium scientists will have full data rights to the Euclid flight data consistent with ESA's Euclid Science Management Plan and with the Euclid Consortium Science and Management Policies.

The solicitation will result in the selection of up to 40 NASA-selected members of the Euclid Consortium, including one NASA-selected member of the Euclid Science Team.

The development of flight hardware and ground-system software or other support is not solicited.

NASA's agreement with ESA limits NASA's appointment of Euclid Consortium and Euclid Science Team members to individuals from U.S. organizations.

1.3 Overview of the Euclid Mission

Several independent observations indicate that the cosmological expansion began to accelerate when the universe was around half of its present age. This conclusion assumes the correctness of General Relativity and requires that the universe must contain a component known as dark energy, formerly known as the 'cosmological constant.' As a surprising consequence, the dark energy contributes about 76% of the total energy density of the universe, while the contribution of baryonic matter is only 4%. The remaining 20% is composed of dark matter, which, like dark energy, has no explanation in standard physical theory. Like the accelerated expansion which took place during the early epoch of our universe, commonly known as 'inflation,' the present acceleration leaves imprints on the different phases of the expansion of the universe. At the same time, the growth of structure in the universe is sensitive to the details of the acceleration process, but also to the very nature of gravity, a modification of which might be the alternative explanation of the apparent acceleration. The equation of state of dark energy can be constrained from observations of the expansion history of the universe throughout its visible epoch since the decoupling of the microwave background. Complementarily, the need for a new theory of gravity can be either ruled out or confirmed from observations of the growth of large scale structure in the universe.

Euclid is an ESA space telescope sky survey mission to map the geometry of the dark universe. The mission will investigate the distance-redshift relationship and the evolution of cosmic

structures by measuring shapes and redshifts of galaxies and clusters of galaxies. The statistical study of structures in a large volume of the universe requires a survey of a large fraction of the extragalactic sky. Euclid will be used to address key fundamental cosmological questions. Is dark energy merely a cosmological constant, as first discussed by Einstein, or is it a new kind of field that evolves dynamically with the expansion of the universe? Alternatively, is dark energy instead a manifestation of a breakdown of General Relativity or deviations from the law of gravity? What are the nature and properties of dark matter? What are the initial conditions which seed the formation of cosmic structure?

The Euclid Consortium has determined the science and observational requirements and instrumentation capabilities for Euclid, which will include the ‘baryon acoustic oscillation’ and 'weak lensing' techniques for the measurement of the properties of dark energy and other cosmological parameters. The mission may also be used to implement other cosmological probes of dark energy such as galaxy cluster statistics, the integrated Sachs Wolfe effect, redshift-space distortions, and the Alcock-Paczynski effect.

Beyond these breakthroughs in fundamental cosmology, the Euclid sky surveys will provide unique legacy science in various fields of astrophysics. In the area of galaxy evolution and formation, Euclid will deliver high quality morphologies, redshifts, masses, and star-formation rates for more than a billion galaxies out to $z\sim2$, over 15,000 deg^2 of extra-galactic sky. The Euclid deep survey will probe the ‘dark ages’ of galaxy formation, as it is predicted to find thousands of galaxies at $z>6$, of which about 100 could be at $z>10$, i.e., probing the era of reionization of the universe.

Euclid is also capable of performing ancillary or legacy science, including the study of microlensing events in the search for exoplanets and a search for supernovae of type Ia, and some of these studies may be performed as the primary observing program permits.

The management of the Euclid mission includes the Euclid Science Team and the Euclid Consortium.

The Euclid Science Team provides scientific advice to ESA during all phases of the mission's definition and operations. Membership in the Euclid Science Team does not, *per se*, carry any data rights.

The Euclid Consortium is responsible for the definitions of the scientific goals, the science requirements, and the survey (http://www.euclid-ec.org/). It is also in charge of the design, construction, tests, integration, and delivery to ESA of the imaging and spectroscopic instruments (VIS and NISP); the design, development tests, integration, and operation of the data processing tools, pipelines, and data centers; and the scientific analysis and interpretation of the Euclid data. Its activities are funded by national space agencies and national research organizations.

The more detailed science goals and concomitant requirements of the Euclid mission are contained in the *Euclid Science Management Plan*, the *Euclid Science Requirements Document*, and the *Euclid Definition Study Report (The Red Book).* All three documents are available in an

ESA proposal information package at http://sci2.esa.int/cosmic-vision/Euclid-ILS-AO_2012.zip. An update of the Euclid Science Management Plan will be issued by the end June 2012. Additional information on the Euclid mission is available at http://sci.esa.int/euclid, and additional documentation is available at http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=42396&farchive_objecttypeid=15&farchive_objectid=30995&fareaid_2=102.

2. Details of this Solicitation

2.1 Eligibility to Propose

NASA's agreement with ESA limits NASA's appointment of Euclid Consortium and Euclid Science Team membership to individuals from U.S. organizations. Participation in this solicitation is open to 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 current members of the Euclid Consortium, regardless of home organization, as collaborators.

2.2 Types of Investigations Solicited

Proposed science investigations will generally fall under the guidelines of the science investigations described in the *Euclid Red Book* (http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=48983#). Proposers should expect to collaborate with the respective Euclid Consortium members who are already members of the corresponding Working Groups.

2.3 Constraints on Proposal Teams

NASA may appoint up to 40 members of the Euclid Consortium, including one member of the Euclid Science Team.

2.3.1 Membership in the Euclid Consortium

NASA will select one or more proposals; the maximum of 40 NASA-appointed Euclid Consortium members will be drawn from the proposal team(s) of the selected proposal(s). Each member of each proposing team will be considered by NASA for selection as a member of the Euclid Consortium.

Therefore, the following constraints are placed on the proposal teams of proposals submitted in response to this solicitation. Failure to comply with these constraints may result in a proposal being declared noncompliant.

(a) All proposal team members must be proposed for membership in the Euclid Consortium. Consistent with the rules of the Euclid Consortium, there may be no affiliated scientists who participate in the science investigations of the Euclid Consortium and are not members of the Euclid Consortium. The only exception to this rule are graduate students; graduate students may participate in the science investigations of the Euclid Consortium through their major advisor who is a member of the Euclid Consortium,
(b) Proposals must identify the role that each proposal team member will play in the proposed science investigation and in the Euclid Science Working Groups (SWGs). NASA reserves the right to partially select proposals in order to select up to 40 members of the Euclid Consortium from among the proposal teams of the selected proposals. Nonselected proposal team members may not participate in the science investigations of the Euclid Consortium.
(c) Postdocs who participate in the Euclid science program must be members of the Euclid Consortium, and postdocs count toward the limit of 40 NASA-selected members of the Euclid Consortium. Proposals must identify at what point postdocs would be proposed for membership in the Euclid Consortium, even if the postdoc is unnamed at time of proposal submission.
(d) All proposal team members who are proposed for membership in the Euclid Consortium must be from U.S. organizations.
(e) Current Euclid Consortium members from U.S. organizations are not required to respond to this solicitation to retain their membership in the Euclid Consortium; the Euclid Consortium may appoint members from U.S. organizations through methods other than this NASA solicitation. Members of the Euclid Consortium from U.S. organizations who desire NASA funding must respond to the solicitation in order to receive NASA funding.
(f) Proposals may include current Euclid Consortium members from non-U.S. organizations as collaborators. NASA will not be considering these proposal team members for appointment to the Euclid Consortium, as they are already members. NASA will not be considering these proposal team members for funding, as they are not from U.S. organizations. Proposals should clearly identify these collaborators.

All U.S. and European scientists will be integrated in the Euclid Science Working Groups (SWGs). The Euclid Consortium SWGs are coordinated by 6 SWG Coordinators (4 for the Core program, 2 for the Legacy Programs) and the 6 Coordinators report to the Euclid Consortium Lead (ECL). All U.S.-based Euclid Consortium members will form part of this single Euclid SWG structure. The U.S. coordinator(s) will report to Consortium SWG Leads and SWG Coordinators and ultimately to the Euclid Consortium Lead.

2.3.2 Membership in the Euclid Science Team

Proposing teams may optionally nominate one member of their team to appointment by NASA to the Euclid Science Team. NASA will select one such proposer for appointment to the Euclid Science Team.

Proposers who would like to be considered for appointment to the Euclid Science Team must explicitly state that they are requesting consideration or appointment to the Euclid Science Team.

Their proposals must include a section in the proposal discussing the qualifications of the proposer for membership on the Euclid Science Team and the specific role that they will play on the Euclid Science Team.

An additional five pages is allotted to the page limit for this section. The NASA-appointed Euclid Science team member will be expected to participate fully in all aspects of the work of the Euclid Science Team. Those activities include the provision of advice to ESA on the scientific design, planning, and conduct of the Euclid mission.

2.4 Proposal Requirements

This solicitation invites proposals for science investigations using ESA's Euclid mission in collaboration with the members of the Euclid Consortium. Proposers should be familiar with the membership of the Euclid Consortium and with the organization of the Euclid Consortium into Science Working Groups; proposals should propose to join one or more Euclid Consortium Science Working Groups in order to carry out the proposed science investigation. Proposers may organize themselves into one large group or smaller groups or may propose as individuals. All selected Consortium scientists will have full data rights to the Euclid flight data consistent with ESA's *Euclid Science Management Plan* and with the Euclid Consortium Science Policies. NASA-appointed members of the Euclid Consortium will be subject to the rules of the Euclid Consortium Management Plan and any subsequent Euclid Consortium governing documents.

The proposed science investigation(s) shall use Euclid data primarily for research in cosmology, specifically for the constraint of cosmological parameters as a function of cosmic time or for other extragalactic research. The selected science investigation may involve more than one observing or data analysis strategy. The proposed investigation may be wholly or partially directed towards data analysis for ancillary or legacy science with the Euclid data set.

Proposers shall assume that the science requirements as delineated in the *Euclid Science Requirements Document* (see document in http://sci2.esa.int/cosmic-vision/Euclid-ILS-AO_2012.zip) shall be met during the mission.

All proposals must describe a complete science investigation with goals and objectives that address some or all of the Euclid mission science objectives or ancillary science. Investigators should fully explain their approach to the analysis of Euclid data and the results which they expect to obtain and publish.

All NASA-selected scientists will become members of the Euclid Consortium, which is responsible for the analysis of the mission flight data and the publication of the results. These activities are expected to be generally consistent with the science objectives of the Euclid mission described in the *Euclid Science Requirements* document and the *Euclid Science Management Plan*.

In common with all other Euclid Consortium members, all NASA-selected members of the Consortium will have access to Euclid data for the execution of their proposed science investigation during the period of limited access (often referred to as the proprietary data period).

Euclid Level-Q or early release data, derived from the first year of survey data, will be made publicly available within fourteen months following the start of the survey. Fully calibrated data from the same period directly suitable for research in cosmology will be publicly available twelve months later. The same scheme will be adopted for subsequent years of the survey.

The NASA-selected Consortium members will have authorship rights on scientific papers published during the relevant limited access phases, consistent with the Euclid Consortium data rights and publication policies. Authorship of individual papers will be the prerogative of the Euclid Consortium, its Science Working Group Leads, and the Euclid Consortium Lead.

2.5 Funding Constraints

Table D.10-1 shows the available funding profile through FY 2018 that NASA has budgeted for the total of the investigations selected in response to this solicitation. For FY 2018 and beyond, the annual funds will not exceed $4M. The total science team funding for FY 2013 through FY 2028 (assumed end of prime mission in 2026 plus two years for analysis, publication, and archiving) will not exceed $50M for the total of all selected proposals.

Proposers should take this guideline as an indication of the expected level of effort during the phases of Euclid 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.10-1.

Table D.10-1. Available Funding Profile for All Selected Proposals ($M)

Fiscal Year	13	14	15	16	17	18
Funding $M	1.0	1.5	2.0	2.5	3.0	4.0

The proposal must identify specific and essential responsibilities for each funded investigator of an investigation team. Travel costs should include the relevant Science Working Group meetings in Europe, and proposing Euclid Science Team members should include travel to Team meetings.

Up to 10% of the requested funds may be used towards ground-based support observations.

3. Programmatic Information

3.1 Additional Proposal Information

Questions and answers regarding this solicitation will be posted on its NSPIRES index page.

3.2 Page Limits

The page limit for the science/technical/management sections of the proposal is 20 pages. This modifies Section 2.3 of the *NASA Guidebook for Proposers*.

An additional 5 pages may be used when a member of the proposal team is proposing to be a member of the Euclid Science Team.

3.3 Submitting Budgets that exceed Five Years

When completing the NSPIRES "Proposal Cover Page," the "Budget" program element is shown as "not required" because the NSPIRES system does not allow input of more than five year budgets. Instead, details and justification for annual budgets must be included in the budget justification section of the proposal. The information required in this attachment is described in Section 2.3.10 of the *NASA Guidebook for Proposers*.

3.4 Student Participation

Where appropriate, participation of graduate students is encouraged. In such cases, brief details of the educational goals and training of the student participants should be included in the proposal. However, the students need not be identified.

3.5 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 proposers. This information should be included in the Program Specific Question(s) on the Notice of Intent form in NSPIRES.

3.6 Education and Public Outreach Opportunities

NASA policy strongly encourages participation in Education and Public Outreach (E/PO) activities by members of the science community. The NASA Euclid Project will have a robust and exciting core Education and Public Outreach (E/PO) program. At a later date, NASA will define the NASA Euclid Project core E/PO program and solicit participation in an appropriate manner. Selected science investigation teams are expected to contribute and support project level EPO activities including review of products and communicating with the public. The proposal should not include a separate line for funding for EPO activities.

3.7 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 shall include the following factors:

- The extent to which the proposed goals and objectives address Euclid mission science objectives or ancillary science;
- The extent to which the proposed investigation complements and enhances the planned work of the Euclid Science Working Groups;
- The suitability of using the Euclid data products for the proposed investigation;
- The degree to which the proposed investigation emphasizes research in cosmology;
- The degree to which the proposed investigation can be accomplished with the planned Euclid observatory capabilities; and
- For proposals requesting consideration for appointment to the Euclid Science team, the suitability of the proposers qualifications for membership on the Euclid Science Team and the value of the specific role that they will play on the Euclid Science Team.

In addition to the factors given in the *NASA Guidebook for Proposers*, the cost realism and reasonableness of a proposal shall include the following factors:

- The realism and reasonableness of the cost plan and funding profile for accomplishing the proposed science investigation.

4. Summary of Key Information

Expected program budget for first year of new awards	See Section 2.5
Number of new awards pending adequate proposals of merit	One or more
Maximum duration of awards	See Section 2.5
Due date for Notice of Intent to propose (NOI)	June 15, 2012
Due date for proposals	August 31, 2012
Planning date for start of investigation	December 3, 2012
Page limit for the central Science section of proposal	20 pp plus 5 pp for Euclid Science Team proposers; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the astrophysics 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 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	NNH12ZDA001N-EUCLID
NASA point of contact concerning this program	Richard Griffiths Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: 202-358-1605 E-mail: Richard.E.Griffiths@nasa.gov

D.11 ASTROPHYSICS EXPLORER U.S. PARTICIPATING INVESTIGATORS

Amended October 11, 2012. Investigations involving the European Space Agency (ESA) Euclid and Jupiter Icy Moons Explorer (JUICE) missions are not solicited through this ROSES Appendix. See Section 2.2.1 for more information.

1. Scope of Program

1.1 Introduction

This ROSES program element for Astrophysics Explorer U.S. Participating Investigator (APEX USPI) is released in conjunction with the Second Stand Alone Mission of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO) Program Element Amendment (PEA) L: Astrophysics Explorer Mission of Opportunity. The purpose is to solicit potential Astrophysics Explorer Mission of Opportunity (MO) investigations in which investigators participate as a Co-I for an instrument, experiment, or technology demonstration that is being built and flown by a sponsor agency other than NASA.

Proposals submitted in response to this solicitation must comply with the requirements in this ROSES-2012 NRA and in this Astrophysics Explorer USPI program element appendix. Proposals submitted in response to this solicitation are not required to comply with the requirements in the SALMON-2 AO.

Proposals submitted in response to the SALMON-2 AO PEA L solicitation will be reviewed at the same time by the same science review panels as proposals submitted in response to this ROSES program element for Astrophysics Explorer U.S. Participating Investigators.

A single selection meeting will select proposals, and all Explorer selections will be funded from the same Explorer future mission budget; there is no separate budget for Explorer USPIs.

1.2 Background

NASA's strategic goals in Astrophysics are to "Discover how the universe works, explore how the universe began and developed into its present form, and search for life elsewhere." Further information on NASA's strategic goals may be found in NASA Policy Directive (NPD) 1001.0A, *The 2011 NASA Strategic Plan*, available through NODIS or the Program Library.

The NASA Science Mission Directorate (SMD) addresses these strategic goals by conducting programs of astrophysics science designed to address the following science research objectives:

- Understand the origin and destiny of the universe and the nature of black holes, dark energy, dark matter, and gravity;
- Understand the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today; and,
- Generate a census of extra-solar planets and measure their properties.

Further information on the goals and objectives of NASA's astrophysics programs may be found in the *2010 Science Plan for NASA's Science Mission Directorate*, available at http://science.nasa.gov/about-us/science-strategy/ or through the Program Library.

1.3 Science and Program Objectives

NASA solicits proposals for Explorer USPI investigations that address any astrophysics objective as outlined in Section 1.2 of this program element. Investigations that address NASA goals in other areas, such as Earth science, planetary science, or heliophysics, are not solicited in this program element.

2. Programmatic Considerations

2.1 Proposal Opportunity Period and Schedule

The schedule that applies to this Explorer USPI program element is given in Section 3.

A Preproposal Workshop will be held by teleconference in accordance with the schedule in Section 3 of this program element. Further information, including logistics, will be available at the 2012 Astrophysics Explorer Mission of Opportunity Homepage (http://soma.larc.nasa.gov/astrophysics/) prior to the Preproposal Workshop.

2.2 Proposal Requirements and Constraints

2.2.1 Type of Investigation

A proposed investigation as a U.S. Participating Investigator on a non-NASA space mission may be as a 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, scientific analysis and/or research of the data returned, and/or development of innovative data analysis techniques. A U.S. Participating Investigator 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. Regardless of the nature of the U.S. Participating Investigator role, an investigation proposed under this category must be for a science or technology investigation and must include some meaningful data analysis component, archiving of the complete data set, and the publication of science results in the peer reviewed literature. All aspects of the investigation through publication must be within the proposed cost.

Investigations involving the European Space Agency (ESA) Euclid and Jupiter Icy Moons Explorer (JUICE) missions are not solicited through this USPI Appendix to ROSES. Partner Mission of Opportunity (PMO) and/or USPI investigations for those missions are invited through other NASA solicitations, which may be found at http://nspires.nasaprs.com/ [Amended October 11, 2012].

Investigations requiring the provision of flight hardware are not solicited through this USPI solicitation. Investigations requiring the provision of flight hardware may be proposed as a Partner Mission of Opportunity (PMO) proposal through the "Astrophysics Explorer Mission of Opportunity" described in Program Element Appendix L of the SALMON-2 AO.

A proposed investigation as a USPI on a non-NASA mission or instrument may take any form that clearly and demonstrably enhances the scientific output of the mission, benefits the U.S. scientific community, and enables U.S. astrophysics science community access to a highly valued scientific data set.

The proposed investigations can vary in duration, to include just the prime science mission phase, or to begin at the post confirmation development phase (e.g., for calibration analysis) through the prime mission operational phase, depending on the science requirements of the investigation. All investigations shall include adequate time for data analysis and archiving following the conclusion of the prime mission phase.

This program element solicits new investigations only. Proposals whose intent or purpose is to extend or directly supplement existing investigations already funded for approved space flight missions or other NASA-supported research programs are not appropriate for this program element. 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 proposed research is distinct from their existing efforts.

2.2.2 Cost Constraints

For individual investigators, the cost for selected proposals is expected to be on the order of $125K per selected investigation per year through the prime science mission phase, plus one year for additional data analysis and archiving for the baseline scientific investigation. For a team of investigators, the cost is expected to be on the order of $125K per investigator per year, up to a maximum combined team total of on the order of $1M per year, through the prime science mission phase, plus one year for additional data analysis and archiving.

Proposals must include archiving data such as raw data, reduced data (Level 2), instrument calibration data, observation geometry ancillary data, and derived products at an appropriate data archive.

NASA reserves the right to make no selection if there are no proposals of appropriate merit.

2.2.3 Duration of Award

Proposals should be for the entire duration of the proposed investigation. This may be no more than through the prime science mission, plus one year for additional data archiving for the baseline scientific investigation. The budget justification in the body of the proposal should cover this entire period. Awards will be for a maximum of five years.

If the proposed investigation is for more than five years, then a continuation proposal may be submitted for a new award covering a period of up to five additional years. The progress and accomplishments of the initial five years of the investigation will be reviewed as part of the decision making process for the continuation award. The budget for only the first five years of the investigation should be entered into the NSPIRES or Grants.gov <http://Grants.gov> electronic budget forms.

2.2.4 Technical Requirements and Constraints

In addition to the requirements given in ROSES, all proposed investigations must also demonstrate: (1) their formal relationship with the sponsoring agency's mission (e.g., selected participant, invited participant, or proposed participant); (2) the status of the mission within the sponsoring agency (i.e., Preliminary Study (Pre-Phase A); Concept Study and Technology Development (Phase A); Preliminary Design and Technology Completion (Phase B); Final Design and Fabrication (Phase C); System Assembly, Integration and Test, and Launch (Phase D); Operations and Sustainment (Phase E)), including the level of commitment that the sponsoring agency has made to complete development; (3) a description of the type and the characteristics of the data from this investigation, as well as any ancillary science data, that will be archived as part of this investigation, and a description of the arrangements and resources included in the proposal to ensure the timely delivery of the necessary data in the required format; and (4) a detailed explanation of how the astrophysics science community benefits from this participation.

2.3 Proposal Evaluation Factors

Proposers are reminded that the evaluation criteria for this solicitation are given in the *NASA Guidebook for Proposers* (see Section 3 below for reference). These criteria are intrinsic merit, relevance to NASA's strategic goals and objectives, and cost realism and reasonableness. In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion "intrinsic merit" specifically includes the following factors:

2.3.1 Scientific Merit of the Proposed Investigation

The information provided in a proposal will be used to assess the intrinsic scientific merit of the proposed investigation. The factors for scientific merit include the following:

- Factor A-1. Compelling nature and scientific priority of the proposed investigation's science goals and objectives. This factor includes the clarity of the goals and objectives; how well the goals and objectives reflect program, Agency, and National priorities; the potential scientific impact of the investigation on program, Agency, and National science objectives; and the potential for fundamental progress, as well as filling gaps in our knowledge relative to the current state of the art.
- Factor A-2. Programmatic value of the proposed investigation. This factor includes the unique value of the investigation to make scientific progress in the context of other ongoing and planned missions; the relationship to the other elements of NASA's science programs; how well the investigation may synergistically support ongoing or planned

missions by NASA and other agencies; and the necessity for a space mission to realize the goals and objectives.

- Factor A-3. Likelihood of scientific success. This factor includes how well the anticipated measurements support the goals and objectives; the adequacy of the anticipated data to complete the investigation and meet the goals and objectives; and the appropriateness of the mission requirements for guiding development and ensuring scientific success.

This evaluation will result in narrative text, including specific major and minor strengths and weaknesses, as well as an appropriate adjectival rating for the scientific merit of the investigation.

2.3.2 Scientific Implementation Merit and Feasibility of the Investigation

The information provided in a proposal will be used to assess merit of the plan for completing the proposed investigation, including the scientific implementation merit, feasibility, resiliency, and probability of scientific success of the proposed investigation. The factors for scientific implementation merit and feasibility include the following:

- Factor B-1. Merit of the instruments and mission design for addressing the science goals and objectives. This factor includes the degree to which the proposed mission will address the goals and objectives; the appropriateness of the selected instruments and mission design for addressing the goals and objectives; the degree to which the proposed instruments and mission can provide the necessary data; and the sufficiency of the data gathered to complete the scientific investigation.
- Factor B-3. Merit of the data analysis, data availability, and data archiving plan. This factor includes the merit of plans for data analysis and data archiving to meet the goals and objectives; to result in the publication of science discoveries in the professional literature; and to preserve data and analysis of value to the science community. Considerations in this factor include assessment of planning and budget adequacy and evidence of plans for well-documented, high-level data products and software usable to the entire science community; assessment of adequate resources for physical interpretation of data; reporting scientific results in refereed journals; and assessment of the proposed plan for the timely release of the data to the public domain for enlarging its science impact.
- Factor B-5. Probability of science team success. This factor will be evaluated by assessing the experience, expertise, and organizational structure of the science team. The role of each Co-Investigator will be evaluated for necessary contributions to the proposed investigation; the inclusion of Co-Is who do not have a well defined and appropriate role may be cause for downgrading of the proposal.

This evaluation will result in narrative text, including specific major and minor strengths and weaknesses, as well as an appropriate adjectival rating for the scientific implementation merit and feasibility of the scientific investigation.

2.4 Award Management

Awards will likely be executed directly from NASA Headquarters, although NASA reserves the right to implement them through a NASA Center in order to facilitate coordination with related flight projects that the Center may be carrying out.

3. Summary of Key Information

Expected program budget for first year of new awards	See Sections 2.2.2 and 2.2.3 and Section 4.4.1* of SALMON-2 AO PEA L
Number of new awards pending adequate proposals of merit	See Sections 2.2.2 and 2.2.3 and Section 4.4.1* of SALMON-2 AO PEA L
Maximum duration of awards	Through the end of the Prime Mission plus one year for data analysis and archiving.
Preproposal Workshop	September 28, 2012 by teleconference. For more information, see http://soma.larc.nasa.gov/astrophysics/
Due date for Notice of Intent to propose (NOI)	October 12, 2012
Due date for proposals	December 14, 2012
Planning date for start of investigation	No earlier than 9 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 strategic goals and subgoals in NASA's *Strategic Plan*; see Table 1 of ROSES 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 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)

* SALMON-2 Announcement of Opportunity NNH12ZDA006O Program Element Appendix (PEA) L is available through the embedded link above or via NSPIRES at http://nspires.nasaprs.com/ under open solicitations.

Funding opportunity number for downloading an application package from Grants.gov	NNH12ZDA001N-APEXUSPI
NASA point of contact concerning this program	Dr. Wilton T. Sanders Astrophysics Explorer Program Scientist Mail Suite 3W39 NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1319 E-mail: wilton.t.sanders@nasa.gov

D.12 THEORETICAL AND COMPUTATIONAL ASTROPHYSICS NETWORKS (TCAN)

Amended November 26, 2012. This Amendment announces a joint solicitation between NSF and NASA for proposals for Theoretical and Computational Astrophysics Networks. The open window for proposal submission is February 1-14, 2013 via NSF's proposal submission page, FastLane at https://www.fastlane.nsf.gov/. Proposals must be submitted by 5 pm proposer's local time on February 14, 2013. For more information see the NSF solicitation at http://go.usa.gov/Yehz.

1. Scope of Program

The *New Worlds, New Horizons* report of the Astro2010 Decadal Survey observed that key challenges in theoretical astrophysics "are of a scale and complexity that require sustained, multiinstitutional collaborations," but that there was "no mechanism to support these coordinated efforts at the needed level in the U.S." National Science Foundation's (NSF's) Division of Astronomical Sciences (AST) and NASA's Astrophysics Division (APD) agree that theory and computation are highly complementary "pillars of science," and that major progress in one can enable progress in the other. NSF/AST and NASA/APD have, therefore, initiated the Theoretical and Computational Astrophysics Networks (TCAN) program with the following goals:

- To support coordinated efforts in fundamental theory and computational techniques in order to make TCAN groundbreaking advances in astrophysics;
- To strengthen theoretical and computational astrophysics in the U.S. by uniting researchers in collaborative networks that cross institutional and geographical divides; and
- To advance the training of the future workforce of theoretical and computational scientists.

A network is a combination of nodes and connections. A node is a group of researchers at an existing institution, along with the local resources (e.g., computational, educational, communications) that sustain them. A connection is a significant exchange of expertise or capabilities between nodes (e.g., exchange of personnel, web-based training, sharing of access to resources). Multiple connections between nodes, that enable an integrated and focused collaborative effort, constitute a network. The TCAN program will support research networks with three or more nodes at distinct institutions. Proposals must demonstrate clear management structure and clear protocols for communication, planning, distribution of effort, and tracking of progress. Supported projects will develop new theoretical and/or computational paradigms directly addressing key "frontier" questions in astrophysics. In cases where code will be produced for community use, projects will develop a transition plan to maintain and sustain it.

TCAN projects are expected to target fundamental issues in theoretical and computational astrophysics and to display a depth and breadth of concept qualitatively beyond those typical of the existing NSF AAG and NASA ATP programs. Prospective proposers are strongly urged to contact the cognizant program officers in either or both agencies to discuss the suitability of their projects for the TCAN program before preparing their proposals.

2. Information for NASA proposers

2.1 Award Information

Estimated number of awards: Pending availability of funds, and depending on the quality and scope of submitted proposals, it is anticipated that a total of four to six projects will be funded by both agencies, starting in FY 2013 for a nominal three-year period.

Anticipated Funding Amount**:** $2,000,000 to $3,000,000 (program total per year anticipated in FY 2013, 2014, and 2015 from both NSF and NASA).

2.2 Proposal Submission

2.2.1 *NSF Submission Requirements*

Proposers are required to prepare and submit all proposals for this program solicitation through use of the NSF FastLane system. Detailed instructions regarding the technical aspects of proposal preparation and submission via FastLane are available at: http://www.fastlane.nsf.gov/a1/newstan.htm. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or E-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section 4 of this ROSES element.

Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the guidelines specified in the January 2013 version of the NSF Grant Proposal Guide (GPG), which is available on the NSF website at: http://www.nsf.gov/pubs/policydocs/pappguide/nsf13001/gpg_index.jsp. Note that the GPG sets out specific rules on acknowledgement of prior support, contents of biographical sketches, etc., which differ from those for ROSES.

Proposals to the TCAN program must be submitted as Collaborative Proposals. Collaboratively linked proposals are submitted by multiple organizations but share a single Project Summary and Project Description. One proposal of the linked set is designated as the "lead," and the lead submitting organization should coordinate the submission activities of the others, as set out in the GPG. In particular, the lead organization must be the first one to start its proposal in Fastlane. Each major node in the TCAN network should prepare its own proposal as part of the linked set. In special circumstances, funding of minor nodes may be proposed by way of subawards; however, networks must consist of at least three major nodes having comparable roles.

2.2.2 *NASA Centers and NASA Rules*

Federally Funded Research and Development Centers (FFRDCs) (including those funded by NSF) and NASA centers will be eligible to submit proposals as components of multi-institution collaborative sets. Proposals from non-NSF-funded FFRDCs or NASA centers will be eligible for funding only by NASA. In order for any component of a collaborative project to be eligible for NSF funding, the lead proposal of the collaborative set must be from an organization that is eligible for NSF funding. Thus, all components of a collaborative project in which the lead proposal is from a non-NSF-funded FFRDC or NASA center will be eligible for funding only by NASA.

An individual may appear as Principal Investigator (PI) or co-PI on no more than one proposal in response to this solicitation. NASA does not allow proposals with co-PIs. Proposers for NASA funding should check the GPG carefully for the definitions of proposal personnel.

Relevance to NASA Astrophysics: Only proposals that show direct relevance to the goals of NASA's Astrophysics Division, by facilitating the interpretation of data from space astrophysics missions or by leading to predictions that can be tested with space astrophysics observations, will be eligible for NASA funding. Consistent with those goals, TCAN proposals that deal strictly or predominantly with Solar System objects or solar-terrestrial interaction studies, including solar energetic particles, will not be eligible for NASA funding.

Computing support: NASA will not provide support through TCAN for substantial computing facilities or resources or for education and public outreach. Proposers who receive an award from NASA will have the opportunity to apply for computing time on the two NASA high-performance computing facilities at the Goddard Space Flight Center's Computational and Information Sciences and Technology Office and in the Ames Research Center's Advanced Supercomputing Division.

Collaboration with China: No NASA funds can be used to support proposals that 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. For more on this see Public Law 112-55, Section 539(a) and the FAQ at http://science.nasa.gov/researchers/sara/faqs/prc-faq-roses-2012/.

Annual Reports: Investigators receiving awards from NASA will submit their progress reports as required in the NASA award documentation.

3. Review and Selection Process:

A uniform review process will be conducted by NSF, in consultation with NASA, for all proposals received responding to this solicitation. One or more review panels, consisting of experts in the field, will be assembled, supplemented by additional nonpanelist reviewers as needed. The number and topical focus of panels will be determined according to the number and topical areas of the proposals received. NASA Program Managers will attend the review panel(s). Reviewers will be asked to formulate a Theoretical and Computational Astrophysics Networks (TCAN) recommendation to either support or decline each proposal. A summary rating and accompanying narrative will be completed and submitted by each reviewer. In all cases, reviews are treated as confidential documents. The Program Officer(s) assigned to manage the proposal review will consider the advice of reviewers and will formulate a recommendation.

Note that the reviewers will be asked to evaluate proposals according to NSF's two review criteria of Intellectual Merit and Broader Impact. Accordingly, proposals must address both of these criteria, in the summary and in the main text.

In consultation with NASA, NSF will select collaborative projects to be funded following the review process. A *project* may be funded by either agency individually or by both agencies jointly; if the latter, each individual component *proposal* in the collaborative project will be funded by only one agency. Subsequent grant administration procedures will be in accordance with the individual policies of the awarding agency.

For those selected proposals identified as candidates for NASA funding, NSF will provide all

unattributed reviews to NASA. The submitter will be asked to withdraw the proposal from NSF and resubmit the proposal to NASA in accordance with that agency's award process. Submitters will not be allowed to increase the proposed budget or change the scientific content of the proposal resubmitted to NASA for funding consideration. Any resulting awards will be based on selection criteria and themes specified in this solicitation.

4. Summary of Key Information

Expected total program budget for first year of new awards	$2M - $3M (See Section 2)
Number of new awards pending adequate proposals of merit	4 - 6 (See Section 2)
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	Not applicable
Due date for proposals	The Fastlane submission window will open on Feb. 1, 2013 and close at 5 pm (submitting institution's time zone) on Feb. 14, 2013
Planning date for start of investigation	5-10 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pp, see Section II of NSF solicitation.
Relevance	This program is relevant to the astrophysics 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 Section 1 and NSF Solicitation at: http://go.usa.gov/Yehz
Detailed instructions for the preparation and submission of proposals	See Section V of NSF Solicitation
Submission medium	Electronic proposal submission is required in PDF format; no hard copy is required. See the January 2013 version of the *GPG*, http://www.nsf.gov/pubs/policydocs/pappguide/nsf13001/gpg_index.jsp
Web site for submission of Notice of Intent to propose (NOI)	Not applicable
Web site for submission of proposal via FastLane	https://www.fastlane.nsf.gov/ 1-800-673-6188; fastlane@nsf.gov
Web site for submission of proposal via Grants.gov	Option not available

NASA point of contact for this program	Joan Centrella Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-2522 E-mail: Joan.Centrella@nasa.gov
NSF Point of contact	Thomas S Statler Telephone: (703) 292-4910 E-mail: tstatler@nsf.gov

D.13 KEPLER MISSION PARTICIPATING SCIENTISTS

1. Description of the Opportunity

1.1 Proposal Opportunity

This program element solicits proposals for the Kepler Participating Scientist Program (PSP). The Kepler PSP is designed to fund community investigations that advance the goals of the Kepler Mission during its extended phase. Participating Scientists may pursue data processing and analysis tasks, exoplanet candidate follow-up observations, completeness and reliability studies, characterization of the stellar target sample, etc.

The Kepler PSP is complementary to, but distinct from, the Kepler Guest Observer (GO) program. The Kepler GO program offers members of the scientific community the opportunity to pursue research in any area of astrophysics through observations of stellar and/or nonstellar targets that fall within the Kepler field-of-view, but are not included in the Kepler target list. Kepler GOs are solicited under Appendix D.7 of the ROSES 2012 NRA.

The next Kepler PSP solicitation is planned for Spring 2016.

1.2 The Kepler Mission

The Kepler Mission was selected under NASA's Discovery Program and represents the Agency's first mission dedicated to the discovery of extra-solar planets. Kepler's three and one half year prime mission phase began shortly after its launch on March 6, 2009. In April 2012, based on the recommendations of the 2012 Senior Review of Operating Missions, the Astrophysics Division extended the Kepler mission for two years through Fall 2014. In addition, for budget planning purposes only, the Astrophysics Division has tentatively allocated funding that would carry Kepler mission operations for an additional two years (i.e. through Fall 2016). However, extension of Kepler mission operations beyond the current two-year extended mission will be contingent upon the results of the 2014 Senior Review of Operating Missions.

Kepler continuously monitors over 100,000 stars in a ~100 square degree FOV proximate to the constellation of Cygnus (RA 19h 22m 40s, Dec. 44° 30' 00"). The majority of the monitored stars are of spectral type F5 and later, while the remaining targets consist of earlier dwarfs and giants, as well as other astrophysical targets selected via the GO program. The Mission is designed to achieve a photometric precision of 20 parts-per-million (ppm) on a mv=12 magnitude G2V star for a 6.5-hour integration using differential photometry. All observations have at least a 30-minute temporal resolution. A small number of observations are monitored at a one-minute cadence to better resolve transits and to allow stellar acoustic (p-mode) measurements and other science.

The nominal magnitude range for Kepler is 9th to 15th apparent visual magnitude, but stars as bright as 5th magnitude and as faint as 20th magnitude have been successfully observed. The photometry is performed using a broad bandpass ranging from 430 to 890 nm. There are neither changeable filters nor dispersing elements. Because of its very stable focal plane, Kepler's

precision for relative star centroid positions is better than 1 milliarcsecond on planetary transit timescales. The primary scientific objectives of the Kepler key project during the extended mission phase are tightly focused on determining the frequency and orbital distribution of the smallest exoplanet candidates ($R<2.5R_{Earth}$). These objectives include:

- Continuing the mission's ongoing exoplanet survey and providing a vetted catalog of exoplanet candidates;
- Executing a limited follow-up observing program that provides reconnaissance spectroscopy, high-resolution imaging, and radial velocity information for the exoplanet candidates with $R<2.5R_{Earth}$ and
- Providing a determination of η_{Earth} using Kepler data and products.

To this end, the Kepler Extended Mission goals require scientific work to:

- Characterize the size and orbital distributions of small planets ($R<2.5R_{Earth}$);
- Identify correlations between the characteristics of planetary systems and their host stellar systems; and
- Provide a statistically significant determination of the frequency of Earth-size planets in and near the habitable zone of their host stars.

A detailed discussion of the Kepler Extended Mission and its scientific objectives can be found at http://www.nasa.gov/mission_pages/kepler/main/index.html and http://kepler.nasa.gov.

1.3 Kepler Extended Mission Activities

During its extended mission phase, Kepler will have no formal science team. Unfunded working groups, open to the community, have been formed to address key scientific areas. These working groups will help identify and evaluate exoplanet candidates, coordinate and perform small-planet follow-up observations, address small-planet completeness and reliability, improve stellar classification, study transit timing variations, exploit asteroseismology, catalog eclipsing binaries, etc. The details of and contact information for these working groups can be found at the Kepler Science Center web page (http://keplergo.arc.nasa.gov/index.shtml).

The Kepler project will be providing funding for a small set of follow-up observers to perform critical mission functions. These observers focus on follow-up and characterization of small planet candidates utilizing spectroscopy and hi-resolution imaging. Prospective Kepler Participating Scientists who plan to propose activities that would contribute to the follow-up observing program are strongly encouraged to discuss their planned program with the Kepler Project Scientist to avoid duplication of efforts. Contact information is provided in Section 4 below.

There is no exclusive use period attached to any Kepler data during the extended mission.

2. Role of Participating Scientists

PSPs are expected to address one or more of the scientific goals of the Kepler Extended Mission. Work related to Kepler data, but outside of the key project's focus on small planets ($R<2.5R_{earth}$) and the associated extended mission goals, is not appropriate for the PSP program. Such work may be appropriate for the Kepler Guest Observer Program (ROSES 2012, Appendix D.7), the Astrophysics Data Analysis Program (ADAP; next solicited under the ROSES 2013 NRA), or the Origins of Solar Systems Program (next solicited under the ROSES 2013 NRA). Prospective proposers should consult those solicitations to determine which is most appropriate for their planned investigation.

The selected Participating Scientists will be expected to coordinate their activities with the Kepler Project and the appropriate working groups. All data, products, analyses, and results obtained by a Participating Scientist are considered public information. They shall be suitably reduced, analyzed, and documented, and will be required to be delivered (reduced data and results) in a timely fashion on a schedule proposed by the Participating Scientist and coordinated with the Kepler Project.

The proposed investigations can be analytical or observational in nature. Investigations must involve research activities that directly relates to the detection, characterization, or understanding of Kepler–identified extra-solar planets with an estimated radius $<2.5\ R_{Earth}$, or that otherwise complement the scientific goals of the Extended Mission. Priority for selection will be determined by the programmatic relevance of the proposed investigation to the Kepler extended mission key project, 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 to the scientific objectives of the Kepler extended mission key project.

Some possible PSP programs include (but are not necessarily limited to):

- Detection of small, nontransiting planets or mass determinations for small planets through the study of transit-timing variations;
- Development of alternate photometric methods, light-curve detrending analyses; or transit search algorithms in an open-source environment for community use;
- Characterization and removal of systematic biases, target selection effects, background contamination, and pipeline detection efficiency to inform completeness and reliability estimates for the Kepler planetary candidate sample; and
- Observations and analyses that provide improved stellar parameters for Kepler-observed stars.

The abstracts for the successful Kepler Participating Scientists in Cycles 1 and 2 are available at http://keplergo.arc.nasa.gov/PSP.shtml. The Cycle 2 investigations were funded for fiscal years 2012 and 2013, and end September 30, 2013. Current Participating Scientists seeking a renewal appointment must provide a clear description of the progress and achievements realized under their previous award and state how their new efforts focus on the Kepler Extended Mission goals.

3. Programmatic Information

3.1 Period of Performance and Availability of Funds

Proposers should provide budgets and justification for participation in the Kepler mission with a period of performance beginning on October 1, 2013. This start date is contingent on funding availability. It is expected that investigators will propose for three years of PSP support running through September 30, 2016. Proposers are cautioned that the final year of funding is contingent upon the results of the 2014 Senior Review. If the decision is made not to continue Kepler beyond the current two-year extended mission, spacecraft operations would end in Fall 2014, and project activities would be closed out by Fall 2015. Consequently, proposers should address how their project could be brought to an orderly conclusion after two years if mission operations are significantly curtailed or ended beyond the current two-year extended mission.

It is anticipated that the annual budget for the PSP will be approximately $1.0M, sufficient to support the selection of seven to ten Participating Scientist investigations. Because Participating Scientist research programs are individual investigations, no support for Co-Is is permitted in the budget. Limited funding for students or postdoctoral positions is permitted. Annual award funding is contingent upon availability of funds and annual assessment of performance and relevance of the research effort to the Kepler mission and program requirements.

3.2 Additional Proposal Requirements

General proposal requirements are given in the *Summary of Solicitation* for this NRA, as well as the *NASA Guidebook for Proposers*. In addition to these general requirements, proposals must identify key projected milestones, accomplishments, and deliverables during each year of the proposed investigation.

3.3 Evaluation Criteria

Evaluation criteria are given in Section C.2 of the *NASA Guidebook for Proposers*. These criteria are intrinsic merit, relevance, and cost realism/reasonableness. In addition to the factors for intrinsic merit given in the *NASA Guidebook for Proposers*, the intrinsic merit of a proposal shall include the following factors:

- Degree to which the scientific ideas and unique theoretical and analytical capabilities proposed meet the scientific objectives of the Kepler extended mission;
- Reasonableness and realism of identified key projected milestones, accomplishments, and deliverables during each year of the proposed investigation; and
- Past performance in research programs connected to the Kepler project, if appropriate.

Proposers are also reminded that programmatic relevance to the extended mission's focus on small planets will represent an important factor in prioritizing investigations for selection.

3.4 Selection of Participating Scientists

Selection of Kepler Participating Scientist investigations is the responsibility of the Astrophysics Division of the Science Mission Directorate at NASA Headquarters. The Kepler Program Scientist will be responsible for the evaluation of proposals, with selection decisions made by the Astrophysics Division Director.

4. Summary of Key Information

Expected annual program budget for new awards	~$1.0M
Number of new awards pending adequate proposals of merit	~10
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	January 18, 2013
Due date for proposals	March 1, 2013
Planning date for start of investigation	October 1, 2013
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must specifically address how the scientific ideas and unique theoretical and analytical capabilities proposed meet the scientific objectives of the Kepler extended mission.
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 Responding to a NASA Research Announcement – 2012* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
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	NNH12ZDA001N-KPS

NASA points of contact for technical questions regarding the Kepler extended mission and key science project activities	Dr. Steve B. Howell Kepler Project Scientist NASA Ames Research Center Moffett Field, CA 94025 Telephone: (650) 604-4238 Email: steve.b.howell@nasa.gov
NASA point of contact for programmatic information regarding this solicitation	Dr. Douglas Hudgins Kepler Program Scientist Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0988 Email: douglas.m.hudgins@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 NRA. At the time of the initial release of this NRA, there are three such programs:

The Topical Workshops, Symposia, and Conferences program element (Appendix 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, Heliophysics, and Planetary Science Divisions.

The Origins of Solar Systems program (Appendix E.3) solicits basic research proposals to conduct scientific investigations related to understanding the formation and early evolution of planetary systems and to provide the fundamental research and analysis necessary to detect and characterize other planetary systems.

The Opportunities in the SMD Education and Public Outreach program (Appendix E.4) supports proposals for investigations or projects that use SMD content and support NASA education and public outreach objectives. It solicits proposals that address substantial and substantive educational needs or problems and offer solutions of significant impact.

Any other cross-division programs that are defined during calendar year 2012 will be issued as amendments to ROSES, typically 90 days in advance of their established Proposal Due Dates. Such new programs will be managed by only one SMD Program Officer as designated in the "Summary of Key Information" section that concludes each program element; the Program Officer will be organizationally located in one of the SMD divisions, and all questions may be directed to him/her. At the time of selection, the designated Selecting Official will consult all of the SMD science divisions that have programmatic interest in the program.

E.2 TOPICAL WORKSHOPS, SYMPOSIA, AND CONFERENCES

June 22, 2012: Appendix E.2, Topical Workshops, Symposia, and Conferences, has been modified to remove the instruction that proposers should directly contact NASA's Lunar and Planetary Institute regarding logistical and technical assistance.

March 1, 2012: The Summary Table in this call and Tables 2 and 3 of the ROSES-12 Summary of Solicitation have been updated to establish that the close date for these programs is March 31, 2013. Submissions will be accepted on a rolling basis until that date, after which it is expected that next year's ROSES will be available and accepting proposals.

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, Heliophysics, 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 on-line 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. For example, ROSES Appendix B.6, *Living With a Star: Targeted Research and Technolog*y, solicits proposals to foster the development of a research community that cuts across traditional discipline boundaries and addresses system-wide problems central to understanding and modeling the Sun-Solar System connection. Such proposals must be submitted in response to B.6, rather than this program element.

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 this year's ROSES; 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 Heliophysics Relevance

Proposals for workshops, symposia, conferences, or scientific/technical meetings in Heliophysics should be carried out in support of NASA Strategic Goal 2.2: "Understand the Sun and its interaction with Earth and the solar system" from the Science Mission Directorate Science Plan for 2010 (http://nasascience.nasa.gov/about-us/science-strategy). The recommended priorities of the heliophysics community are also discussed in the 2009 Heliophysics Roadmap"Solar and Space Physics of a New Era" (http://science.nasa.gov/media/medialibrary/2010/03/31/Heliophysics_Roadmap_2009_tagged-quads.pdf). The Heliophysics elements that support activities of this type are the Geospace Science, Solar and Heliospheric Physics, and Theory programs. Meeting proposals appropriate to these programs should be submitted in accordance with the instructions in this Appendix. ROSES Appendix B.6, *Living With a Star: Targeted Research and Technolog*y, separately solicits proposals to foster the development of a research community that cuts across traditional discipline boundaries and addresses system-wide problems central to understanding and

modeling the Sun-Solar System connection. Such proposals must be submitted in response to B.6, rather than this program element.

3.2 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 Strategic Subgoal 3A: "Study Earth from space to advance scientific understanding and meet societal needs" from the Science Mission Directorate Science Plan for 2010 (http://nasascience.nasa.gov/about-us/science-strategy). 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/ or in the Summary Information table at the end of a ROSES program element description.

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 over 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.

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.

If the resulting award means that NASA will be the primary sponsor of a conference (where both "conference" [1] and "primary sponsor" [2] are defined in NID 9312.3 and below), then the proposal must clearly state this fact. The NASA Authorization Act of 2008, Public Law 110-422, requires that NASA 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 conference (e.g., use of non-Federal facilities, charging of registration fees). NASA-sponsored conferences require the filing of a NF 1784 form by the NASA sponsor before committing non-refundable funds for any costs associated with the conference.

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[1] A "conference" is a meeting (a) held for consultation, exchange of information, or discussion; (b) having speakers or discussion panels focusing on matters of interest to and involving participation of a range of attendees from multiple agencies and/or nongovernmental entities; (c) at least part of which is held at a non-NASA facility; and (d) which is neither a NASA internal meeting (including operational meetings -- if the sole purpose of the meeting is to discuss NASA business, such as scientific, technical, business, or programmatic actions, plans, or priorities for a specific NASA program, project, or mission support matter, then the meeting is not a conference) nor formal training.

[2] NASA is considered a "sponsor" if it funds costs for hosting (e.g., facility rental) or underwriting (e.g., financial support to another sponsor of the conference, brand awareness at the event, etc.) that are more than de minimis in amount. NASA is considered a "primary sponsor" only if it is the principal sponsor of the event, or one of the principal co-sponsors if there are multiple sponsors. Where NASA and one or more other sponsors split the cost, or NASA pays (to the best of its information) approximately the same as the other largest payers of hosting costs, it is considered one of the primary sponsors. However, where the largest contributor pays

substantially more in hosting costs than NASA (e.g., over twice what NASA pays), NASA is not considered a "primary" sponsor.

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 midnight on March 31, 2013 **[Changed March 1, 2012]**
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	NNH12ZDA001N-TWSC
NASA point of contact concerning this program	Max Bernstein Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0879 Email: max.bernstein@nasa.gov

E.3 ORIGINS OF SOLAR SYSTEMS

1. Scope of Program

The Origins of Solar Systems program solicits basic research proposals to conduct scientific investigations related to understanding the formation and early evolution of planetary systems and to provide the fundamental research and analysis necessary to detect and characterize other planetary systems. These investigations may involve analytical and numerical modeling, laboratory research, and observational studies in the following areas: star formation and the relationship to planetary system formation, solar nebula processes, accumulation and dynamical evolution, analysis of primitive materials, and the detection and characterization of other planetary systems.

The investigations supported through this program are expected to directly support the goal of understanding the formation of planetary systems. Therefore, proposals to the Origins of Solar Systems program should clearly fall into one or more of the following categories:

- Observations related to the formation and evolution of planetary systems;
- Theoretical investigations related to the formation and evolution of planetary systems;
- Studies of chemical and atomic processes related to the formation of planetary systems;
- Investigations to detect extra-solar planets;
- Characterization of extra-solar planets to;
  - aid in the detection of new extra-solar planets and/or
  - explain observations of extra-solar planets, and/or
  - improve understanding of the origins of planetary systems.

  Caveat: Studies of extra-solar planets that do not lead to observables and/or testable hypotheses (e.g., the study of a range of parameters in and of themselves) do not belong in this program. For example, proposals to model the atmospheres of extra-solar planets that do not have an explicit link to an observable should be sent to the Planetary Atmospheres program element (PATM, Appendix C.6), which includes investigations of the atmospheres of extra-solar planets.

The Origins of Solar Systems program values the potential of interdisciplinary efforts to solve key scientific questions. To achieve this goal, proposals involving joint research efforts by investigators from different scientific communities are encouraged. Examples are, studies of nebular chemistry and dynamics to understand the composition of primitive volatile-rich Solar System bodies or collaborations between observational astronomers and modelers to study the initial collapse of a protostellar cloud to form a nebula.

Ground-based observations may be made at any currently operating ground-based facility, public or private, including those supported by NASA.

For more information about the type of research previously supported by this program, abstracts for currently funded investigations are available online at http://nspires.nasaprs.com/ (select "Selected Proposals").

2. Programmatic Information

2.1 Coordination Between Planetary Science and Astrophysics Research Programs

The Origins of Solar Systems program supports research needed to advance our knowledge of the structure, formation, and evolution of our own solar system, as well as other planetary systems. For administrative purposes, investigations aimed primarily at finding and characterizing extra-solar planetary systems will be managed by the Astrophysics Research Program, and are not eligible for the PME, see Section 2.5. The remainder of the Origins of Solar Systems program will be managed by the Planetary Science Research Program.

2.2 Exclusions: Investigations of Signals from Intelligent Life

Research aimed at identification and characterization of signals from extra solar intelligent life is covered by the Astrobiology: Exobiology and Evolutionary Biology (EXO, Appendix C.17) and Astrobiology Science and Technology Instrument Development (ASTID, Appendix C.19) program elements. Proposals in this research area should be submitted to those ROSES elements.

2.3 Duration of Awards

The periods of performance of investigations for this research element may range from one to four years. Most awards will have a duration of three years, but a fourth year will be funded if the need for the longer duration is sufficiently justified.

2.4 Overlap with Other Programs

The breadth of this call inevitably results in overlap in subject matter between this and other ROSES programs. For example, identical proposals to study the chemistry of meteorites are often submitted to this program and to the Cosmochemisty program element (Appendix C.2). Proposers are encouraged to choose one or the other and not send proposals to both. If proposals that are essentially identical are sent to both this program and Cosmochemisty we intend to review the proposal in only one of the two programs.

2.5 Additional Funding for Relevant Instrumentation Construction or Upgrade

The Planetary Major Equipment (PME) program element described in Appendix C.23 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 Research 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 Appendix C.23. Two types of instrumentation requests are permitted. (1) A PME request for the planetary division may be made as a special section that is appended to a new research proposal to the Origins 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. (2) A stand-alone PME proposal for the planetary division may be prepared and submitted to the Origins program. Such

a stand-alone proposal must be explicitly affiliated with an existing "parent" award in the program in order to be considered for selection. See Appendix C.23 for details on how to prepare both types of PME requests. Proposals on exoplanet detections, which are managed by the astrophysics division, do not allow PME requests. Astrophysics hardware investigations belong in the APRA program element (Appendix D.3).

2.6 Availability of High-End Computational Resources

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 Origins of Solar Systems 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.

2.7 Selecting Official

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. Summary of Key Information

Expected program budget for first year of new awards	~ $ 2-3 M
Number of new awards pending adequate proposals of merit	~ 20-30
Maximum duration of awards	4 years; shorter term proposals (1-3 years) are typical; fourth year must be well justified.
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Due date for proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Planning date for start of investigation	January 1, 2013
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 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 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 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	NNH12ZDA001N-OSS
NASA points of contact concerning this program	Henry Throop Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1364 Email: HQ-OSS@mail.nasa.gov Mario R. Perez Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1535 Email: mario.perez@nasa.gov

E.4 OPPORTUNITIES IN EDUCATION AND PUBLIC OUTREACH FOR EARTH AND SPACE SCIENCE

NOTICE: NASA does not intend to solicit research proposals under this program element under ROSES-2012. We expect to solicit under this call in ROSES-2013.

1. Background

NASA's founding legislation, the Space Act of 1958, directs the Agency to expand human knowledge of Earth and space phenomena and to preserve the role of the United States as a leader in aeronautics, space science, and technology. High achievement in science, technology, engineering, and mathematics (STEM) education and public scientific literacy is essential to the accomplishment of NASA's mission.

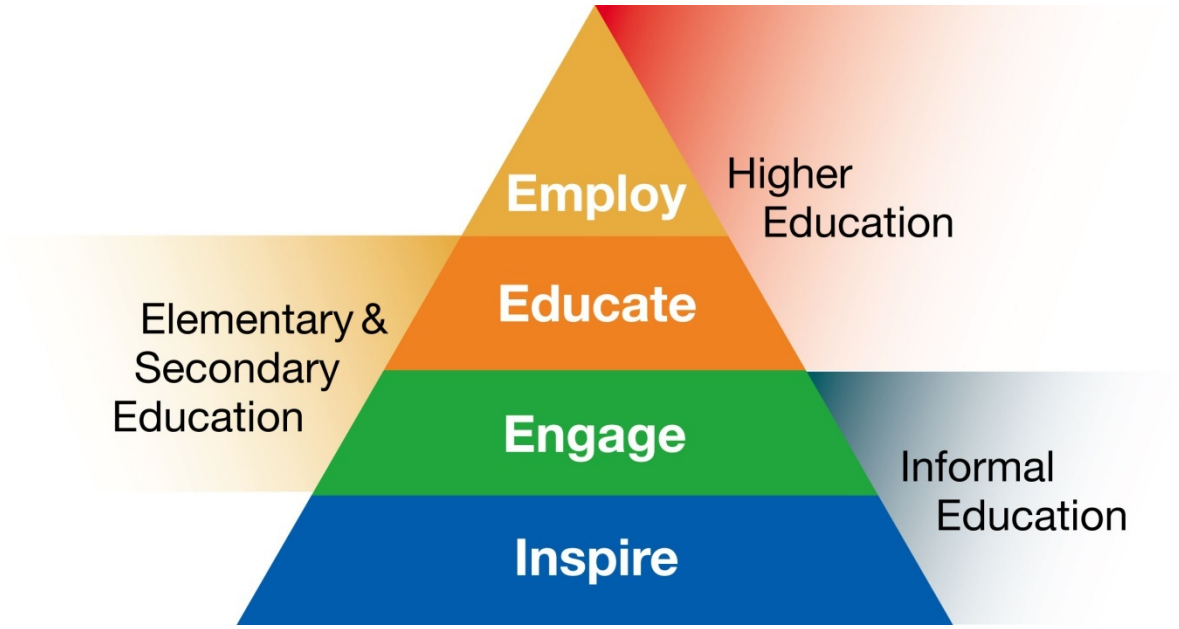
The NASA Science Mission Directorate's (SMD's) vision for Education and Public Outreach is:

> *To share the story, the science, and the adventure of NASA's scientific explorations of our home planet, the solar system, and the universe beyond, through stimulating and informative activities and experiences created by experts, and delivered effectively and efficiently to learners of many backgrounds via proven conduits, thus providing a return on the public's investment in NASA's scientific research.*

Hereafter the phrase "education and public outreach (E/PO)" will refer to activities addressing the teaching and learning of science, technology, engineering, and mathematics at the undergraduate, secondary, and elementary levels (including hands-on experiences for students), informal education, as well as public understanding and engagement in science and technology using unique resources derived from NASA Earth and space sciences.

SMD has a portfolio of investments (E/PO project activities) in Higher Education, Elementary and Secondary Education, Informal Education, and Outreach. It is a major contributor to the overall NASA education and outreach effort through development and dissemination of new educational and outreach products that utilize SMD science discoveries and by providing opportunities for students and educators, citizen scientists, and the public to engage in authentic experiences working with our data and our research communities.

The Education Strategic Framework (depicted below) provides a conceptual basis for examining, guiding, and coordinating the NASA education portfolio.



NASA is particularly interested in encouraging individuals (as students, educators, parents, civil leaders, etc.) engaged in a NASA educational project in one part of the Framework to connect or move up to activities in another part of Framework. The primary aim is to contribute to the Nation's STEM education and improve scientific literacy. A more detailed discussion of the Education Strategic Framework is discussed in the *NASA Education Strategic Coordination Framework: A Portfolio Approach* available at http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Strategic_Coordination_Framework.html.

In addition to education, outreach is an essential aspect of the SMD program. It directly connects to many aspects of NASA Public Affairs and NASA education efforts. It often provides an inspirational spark for participants to seek out education opportunities. The SMD Outreach Goal is to stimulate interest in science, engineering, and technology relevant to NASA SMD. Outreach can be directed at any audience, including students, teachers, citizen scientists, and the general public.

2. Scope of Program

This Opportunities in Education and Public Outreach for Earth and Space Science (EPOESS) solicitation is for project activities utilizing SMD content supporting NASA education and public outreach (E/PO) objectives. It solicits proposals that address substantial and substantive educational or outreach needs or problems and offer solutions of significant impact. Project activities are expected to be relevant to NASA SMD Education and Outreach portfolio. This relevance should be clearly demonstrated in the proposal. This program element is expected to issue additional solicitations approximately every 12-24 months.

NASA SMD Education and Outreach Portfolio	
Portfolio Area	**Project Activity Categories**
Higher Education	• Competency-building education and research based on NASA SMD activities that develops qualified undergraduate and graduate students who are prepared for employment in STEM disciplines at NASA, industry, and higher education. • Opportunities for groups of postsecondary students to engage in authentic NASA SMD related, mission-based research and development activities. • Developing NASA SMD related course resources for integration into STEM disciplines. • Improving the ability of targeted institutions to compete for NASA SMD research and development work.
Elementary and Secondary Education	• Providing professional development and training opportunities to educators, equipping them with the skills and knowledge to attract and retain students in STEM disciplines and deeper content understanding and/or competence and confidence in teaching STEM disciplines. • Providing curricular support resources that use NASA SMD content to a) enhance student skills and proficiency in STEM disciplines; b) inform students about STEM career opportunities; and/or c) communicate information about NASA's mission activities. • Providing K-12 students with authentic first-hand opportunities to participate in NASA SMD mission activities, thus inspiring interest in STEM disciplines and careers or providing opportunities for family involvement in K-12 student learning in STEM areas.
Informal Education	• Informal education resources that use SMD content to 1) enhance participant skills and proficiency in STEM disciplines; 2) inform participants about STEM career opportunities; and 3) communicate information about NASA's mission activities. • Activities to improve the competency and qualifications of STEM informal educators, enabling informal educators to effectively and accurately communicate information about NASA SMD activities and access NASA SMD data for programs and exhibits. • Activities to develop and support qualified informal educators with experience in NASA SMD mission and related activities; or engaging informal educators using NASA SMD content to 1) enhance participant skills and proficiency in STEM disciplines; 2) inform participants about STEM career opportunities; and 3) communicate information about NASA's SMD mission activities.

Outreach	• Activities to increase interest in science, engineering, and technology careers relevant to NASA SMD; • Activities to increase understanding by the general public of SMD science, engineering, and technologies; • Activities to increase participation of citizen scientists in SMD education opportunities; • Activities to increase public engagement in improving science, mathematics, engineering, and technology education in the United States.

Given the many accomplishments in NASA Earth and space science education and public outreach in recent years, the program places particular emphasis on systemic and/or sustainable impact from SMD investments. Project activities must have a clear linkage to the needs of the formal or informal educational systems or outreach audiences. Sources of information about SMD education and public outreach activities and products include:

- *Science Plan for NASA's Science Mission Directorate 2010* (a.k.a. *SMD Science Plan 2010*) (http://nasascience.nasa.gov/about-us/science-strategy);
- The SMD E/PO program overview for proposers (http://nasascience.nasa.gov/researchers/education-public-outreach);
- The SMD E/PO program overview for educators (http://nasascience.nasa.gov/educators);
- The 2006 NASA Education Portfolio Data Call Report (http://www.strategies.org/Portfolio/FinalReport.html);
- The 2006 EPOESS projects (http://nspires.nasaprs.com/external/viewrepositorydocument/cmdocumentid=123678/EPOESS06%20Selection%20Abstracts%20with%20Space%20Math.pdf);
- The 2008 EPOESS projects (http://nspires.nasaprs.com/external/viewrepositorydocument/cmdocumentid=168538/EPO08 Selections.pdf);
- The 2009 EPOESS projects (http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId=%7B7F8B751D-4D39-7BEC-6ECB-9E44050FFF3F%7D&path=open);
- The 2010 EPOESS projects (http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={A32CA5E9-D401-41BF-8835-039073515824}&path=open);
- The 2011 EPOESS projects (http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={174AAEEF-AF11-4A2A-D094-DCC0FD1120D6}&path=open;
- *SMD EPOESS Guide v2.0, Explanatory Guide to Proposal Evaluation Factors for ROSES Program Element: Opportunities in Education and Public Outreach for Earth and Space Science (EPOESS)* at http://nasascience.nasa.gov/researchers/education-public-outreach/explanatory-guide-to-smd-e-po-evaluation-factors;
- *SMD Education and Public Outreach Help Guide v1.0* at http://nasascience.nasa.gov/researchers/education-public-outreach/explanatory-guide-to-smd-e-po-evaluation-factors.

It should be noted that this program element is only one of several ways that SMD invests in education and public outreach. Proposers are encouraged to take advantage of SMD E/PO investments in products, dissemination mechanisms, and opportunities to work with ongoing mission and nonmission E/PO projects. Proposed project activities should not duplicate existing project activities, but should complement existing E/PO project activities embedded in missions or ongoing EPOESS project activities.

Project activities that may be proposed to other SMD E/PO opportunities will not be considered under this program element. Examples of opportunities that are not solicited include: competitive research support for faculty and early-career scientists sponsored under ROSES, graduate research support sponsored under the NASA Earth and Space Science Fellowship (NESSF) Program, education and outreach activities embedded in flight missions, and E/PO supplements to individual research awards selected under ROSES.

This particular solicitation is focused on education and outreach activities in support of the SMD Earth Science, Heliophysics, Planetary Science, and Astrophysics Divisions. Proposals that address science learning needs across the Divisions are encouraged; however, proposals may target the content of a single Division (see Section 2.1 for an opportunity for Heliophysics specific proposals).

Projects may address any of the Project Activity Categories. In 2012, SMD encourages proposals in the following areas:

- In the Higher Education Outcome, efforts that would strengthen the teaching and learning of science and engineering at the undergraduate level (including minority-serving institutions and community colleges) using SMD science content and mission data and efforts that would increase the number of underrepresented minorities with graduate degrees certified to teach in the science, technology, engineering and mathematics (STEM) disciplines at the secondary level. Of particular interest are efforts that provide preservice K-12 and community college educators with research-intensive experiences on NASA Earth or space science projects.

- In the Elementary and Secondary Education Outcome, SMD is particularly interested in efforts that provide systemic STEM professional development opportunities for middle school educators utilizing SMD education resources and science and mission data.

- In the Informal Education Outcome, SMD encourages proposals that increase utilization of SMD resources in out-of-school time or after school programs. Participatory exploration efforts that utilize SMD science data are of particular interest.

- In the Outreach Outcome, SMD encourages efforts that lead to increased utilization of its education resources by formal and informal education providers. Collaborations or partnerships with community-based organizations such as Parent Teacher Associations, amateur astronomy clubs, citizen science groups, business associations, etc. are particularly encouraged.

2.1 Heliophysics Specific Proposals

The Heliophysics Division encourages the submission of education and public outreach proposals that specifically pertain to and emphasize the system-science of Heliophysics. Proposals on all levels of engagement, as outlined in Section 2, are requested. The Heliophysics Division encourages a "multimission" approach to mission E/PO activities, given the very broad nature of the science regimes studied. The range of studies undertaken in Heliophysics is immense and includes:

- Studies of geomagnetic storms (magnetic storms on Earth due to solar activity) produce the aurora, which can affect the terrestrial power-grid, and telecommunications;
- Studies of the harsh conditions in the space environment, which may pose significant risks for the journey of exploration;
- The variability of the Sun in every wavelength, and the manner by which that variability manifests itself in the solar magnetic field, bulk plasma flow (the solar wind), and energetic particles. These variations occur on timescales from fractions of a second to hundreds of years and longer; and
- The study of the Sun, interplanetary space, planetary magnetospheres, and most of the rest of the universe are made up of plasma, and how this plasma interacts with, and how it is coupled to, electromagnetic forces.

A more inclusive discussion of the system science is given in the most recent Heliophysics Division roadmap *("2009 Heliophysics Roadmap"*) at http://nasascience.nasa.gov/about-us/science-strategy/Heliophysics_Roadmap_2009_tagged-quads.pdf and in the SMD Science plan *("SMD Science Plan for 2007-2016")* at http://nasascience.nasa.gov/about-us/science-strategy/Science_Plan_07.pdf.

The amount of new funding for ~ 6 Heliophysics specific awards is anticipated to be ~ $650K.

3. Programmatic Information

3.1 General Information

3.1.1 *Period of Performance*

E/PO investigations or projects will be selected for a period of performance beginning in FY 2013. The periods of performance for SMD E/PO investigations or projects may range from one to four years. Most selected proposals will have a duration of three years, but four-year proposals may be selected if the need for the longer duration is sufficiently well justified. Heliophysics specific proposals may be for one to three years.

3.1.2 *Anticipated Available Funding*

The anticipated total amount of funds available for new awards under this solicitation is approximately $2.65M per year over the four-year period. This solicitation is open to a wide range of proposed costs from a few $10Ks for small focused project activities to $100Ks for

large-scale project activities. Existing project activities must be clearly identified if the proposed E/PO activity leverages the capabilities of existing SMD project activities.

3.1.3 *Travel to Annual SMD E/PO Community Forum Meeting*

Budgets must include travel to the annual NASA SMD Forum meeting appropriate for the proposal science content. All selected E/PO programs are strongly encouraged to become contributing members of the SMD E/PO Community. This community consists of four Forums, each centered on one of the SMD science themes (Earth Science, Heliophysics, Planetary Science, and Astrophysics). The Forums work closely with SMD to support and coordinate the activities of the SMD E/PO community. As part of their activities, each forum holds an annual two-day meeting. Awardees will be assigned to the Forum which most closely aligns with their science content. Awardees are expected to participate in their Forum's annual meeting and should budget appropriately. See the Cost section of the SMD EPOESS Guide v2.0 for further information. If travel to this meeting will be supported by other funding, the PI should state so in the proposal. For more information about the Forums, see the *SMD E/PO Help Guide*.

3.1.4 *Evaluation and Institutional Review Board*

Awardee institutions have the responsibility for budgeting and documenting compliance with Code of Federal Regulations 14 CFR§1230, commonly referred to as "the Common Rule for the Protection of Human Subjects." Research to develop NASA-themed exhibits, programs, curriculum products, etc. may involve full human subjects review through an Institutional Review Board (IRB) or it may be exempt. An IRB also certifies when research is exempt. Note that an awardee cannot exempt him/herself. Research using surveys, observational or ethnographic methods, cognitive and educational tests, etc. is "exempt" unless two conditions apply: 1) the information would allow subjects to be identified, and 2) disclosure of the data would reasonably place the subject at risk of harm. It is anticipated that most Education and Outreach activities will be exempt. The PI, however, should begin the process as soon as the proposal is submitted to determine whether any proposed research activities require IRB approval or is exempt. For further information, see the section on Evaluation in the *SMD EPOESS Guide v2.0*.

3.1.5 *Product Review*

Projects which result in a product for formal or informal education audiences must submit their product to the SMD Education Product Review. The Review accepts both hardcopy and electronic materials. This review is held quarterly and consists of separate panels of scientists and educators. It does not take the place of a proposer's own formative evaluation of their materials. In their project timelines, proposers must account for submitting materials to the Product Review and for the potential revision of their materials based on the Review outcome. For further information, see the section on Evaluation in the *SMD EPOESS Guide v2.0*.

3.2 Technical Reporting Requirements

The following deliverables shall be required of awarded proposals. In cases where subaward arrangements exist, consolidated reports are the responsibility of the PI. In this context, "Annual" refers to a twelve-month task effort that commences at award.

An Annual Progress Report is due 60 days prior to the anniversary date of every grant and cooperative agreement, except for the final year, when a final report, called a Summary of Research, is due within 90 days after the expiration date of the award; see Provisions 1260.22 and 1260.151(d) in the *Grants and Cooperative Agreement Handbook*.

In addition, the project activity must collect, analyze, and report output and outcome data to a common NASA database to determine project activity effectiveness and meet the requirements of stakeholders. Instructions on submitting this information will be provided with the selection notice. It is anticipated that this will be nominally a five person-day per year effort to format and submit the data.

As described above (section 3.1.4) and in the SMD *EPOESS Guide v2.0*, awardees must submit evaluation protocols to an Institutional Review Board. As part of their reporting, PI's should provide a copy of the result of their IRB review (including exemptions) to the EPOESS program manager.

3.3 Evaluation and Selection of Proposals

Proposers are reminded that the evaluation criteria for this solicitation are given in Section C.2 of the *NASA Guidebook for Proposers* (see below for reference). These criteria are intrinsic merit, relevance to NASA's strategic goals and objectives, and cost realism and reasonableness. In addition to these factors, E/PO proposals may also be evaluated on the Program Balance Factors of Pipeline and Diversity. All these factors, and indicators of alignment to these factors are described in the *SMD EPOESS Guide v2.0* at http://nasascience.nasa.gov/researchers/education-public-outreach/explanatory-guide-to-smd-e-po-evaluation-factors

Proposers are strongly encouraged to review the *SMD EPOESS Guide v2.0*. In particular, this Guide provides discussion of requirements for SMD E/PO projects. These include a clear demonstration of the target audience's need for the project activity, the active involvement of the science/technology community, in partnership with the education and outreach community, and project activity evaluation. *Proposals to extend previously funded SMD E/PO efforts are also required to provide evaluation results of the prior effort.*

4. Summary of Key Information

Expected program budget for first year of new awards	TBD
Number of new awards pending adequate proposals of merit	TBD
Maximum duration of awards	4 years (3 years for Heliophysics specific)

Due date for Notice of Intent to propose (NOI)	TBD
Due date for proposals	TBD
Planning date for start of investigation	TBD
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 the discussion of the relevance evaluation factor in the *SMD EPOESS Guide v2.0* (http://nasascience.nasa.gov/researchers/education-public-outreach/explanatory-guide-to-smd-e-po-evaluation-factors).
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	TBD
Web site for submission of proposal via Grants.gov	TBD
Funding opportunity number for downloading an application package from Grants.gov	TBD
NASA point of contact concerning this program	James Lochner Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358- 3858 Email: james.c.lochner@nasa.gov

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