B.7 HELIOPHYSICS DATA ENVIRONMENT ENHANCEMENTS

NOTICE: Proposals to this program will continue to be taken by the two-step process in which the Notice of Intent is replaced by a required Step-1 proposal submitted by an Authorized Organizational Representative (AOR). Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 (full) proposal. The title, science goals, and investigators cannot be changed between the Step-1 and Step-2 proposals. Step-1 proposals will be checked for compliance, but will not be peer reviewed. All Step-1 proposers will be permitted to submit a Step-2 proposal, unless the Step-1 proposal has been determined to be noncompliant with program requirements. See Section 3 for details.

Proposers to this program element are not required to provide a data management plan via the NSPIRES cover page question. Instead, that is superseded by instructions in the Sections below that place more detailed descriptions into the body of the Scientific/Technical/Management Section of proposals. See Sections 2.2 and 2.3, below.

1. Introduction

The Heliophysics Data Environment Enhancements (H-DEE) program is a component of the Heliophysics Research Program and proposers interested in this program element are encouraged to see the overview of the Heliophysics Research Program in B.1 of this ROSES NRA.

The goal of the H-DEE program is to enable breakthrough research in Heliophysics by providing both a state of the art data environment necessary to maximize the scientific return of the NASA missions.

These studies are carried out in support of the Heliophysics strategic goals and subgoals in NASA's 2014 *Strategic Plan* and Chapter 4.1 of the NASA *2014 Science Plan* (http://nasascience.nasa.gov/about-us/science-strategy). The recommended priorities of the Heliophysics community are also discussed in the National Research Council Decadal Strategy for Solar and Space Physics report, *Solar and Space Physics: A Science for a Technological Society* (http://www.nap.edu/catalog/13060/solar-and-space-physics-a-science-for-a-technological-society). Note particularly the sections dealing with the "DRIVE" initiative, more specifically "R" and "I," and the discussion in Appendix B of the Decadal linked above.

The H-DEE program encompasses the data environment needs throughout Heliophysics, including Solar, Heliospheric, and Geospace Sciences (Magnetosphere and Ionosphere/Thermosphere/Mesosphere [ITM]).

As part of a mission-oriented agency, the Heliophysics Research Program seeks to fund those efforts that directly impact NASA missions or interpretation of their data. Therefore, investigations that are judged to be more appropriate for submission to other Federal agencies, even if of considerable merit, will not be given high priority for funding through this solicitation.

2. Heliophysics Data Environment Enhancements (H-DEE)

The basic building blocks of the NASA Heliophysics Data Environment are well-documented, carefully calibrated, and easily used data products, typically the result of the reduction of numbers from spacecraft telemetry to the physical quantities that enter the equations we use to model space plasmas. Many such datasets were produced before the era of standard formats and inexpensive storage devices, and others have been served by recent missions in a variety of ways from specialized web sites. One aspect of this call solicits proposals to upgrade older datasets that are of continuing value (Data Upgrades) and to support the continued serving of data from recent missions in the context of groups that understand the data and can help with its use (Resident Archives). As NASA mission data become better documented and formatted in standard ways, the need for Resident Archives continues to decrease, although in cases where data use is still demonstrably high and the products are complex, there may still be utility in supporting these intermediate archives for some time before the data transition to a Final Archive.

As detailed in the Heliophysics Scientific Data Management Policy (found at http://hpde.gsfc.nasa.gov), which gives further information about the Heliophysics Data Environment (HPDE), the Final Archive for Space Physics data, where the data will be preserved and served for the long-term, is the NASA Space Physics Data Facility. Solar data are handled by NASA's Solar Data Analysis Center (SDAC), although the specific archiving arrangements are currently being dealt with on a case-by-case basis. Proposers working with solar data should expect to work with SDAC, the Heliophysics Data and Model Consortium (HDMC), and NASA Headquarters on a long-term plan. (The HDMC oversees work under the H-DEE grants.)

In recent years, NASA HP has developed standard ways of registering, and thereby enabling, searches for HP data. Most HP data products are now described in terms of the Space Physics Archive Search and Extract (SPASE) Data Model (see http://www.spase-group.org/ for information on SPASE and http://heliophysicsdata.gsfc.nasa.gov for a "public face" to the registry) that provides a uniform terminology and an associated registry service. Registration of data products can be done directly by the data provider, but the SPASE group should be able to provide descriptions, as needed. Thus, people undertaking data projects under this call should determine what product will require SPASE descriptions and, as needed, contact the SPASE group or the HP Data Archives to develop a plan for providing SPASE descriptions.

A frequent problem with past data is that it has been stored in a wide variety of idiosyncratic formats for various reasons. A major goal of Data Upgrade proposals will be to put data in uniform, sustainable formats. For solar physics data, this should be Flexible Image Transport System (FITS), and for space physics data Common Data Format (CDF) is generally the format of choice. Some Ionosphere, Thermosphere, Mesosphere (ITM) data are closely allied to Earth Sciences, and thus, NetCDF is appropriate. ASCII is acceptable as a "format," as long as the files are well described, but the self-documenting formats are to be preferred. Resident Archives should work toward these formats as well, and some portion of their budget may be devoted to this.

In summary, the Data Upgrades subelement of this program solicits proposals designed to upgrade existing Heliophysics data products to improve the quality, utility, and accessibility of datasets relevant to Heliophysics research. Possible upgrades could include (but are not limited to) placing datasets online, translating datasets into more readily accessible hardware and/or software formats, improving the data quality, providing data access and interpretation tools, and improving metadata. Note that the term "dataset" can apply not only to data products derived directly from NASA-funded instruments or other instrumentation, but also to higher-level datasets derived from the results of data analyses, data assimilation, and modeling.

Also solicited are proposals for Resident Archives (RAs), 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. These are intended to continue access to data with expert help until the data are sufficiently documented for independent use and are moved to a Final Archive. When RA access is no longer deemed necessary, the final legacy data files will be served from one of the Final Archives, namely the Space Physics Data Facility (SPDF) and the Solar Data Analysis Center (SDAC—see above). The increasingly common practice of entering mission data into HP final archives in standard formats before the mission is over has reduced the need for RAs, which were primarily intended to avoid the loss of access to data that had often occurred when past HP missions terminated. Arguments for the need for RAs should be framed in this context.

Returning this year after a number of years' absence is a call for Value Added Enhancements to the HPDE. The HPDE infrastructure, established over the last decade by the HP Archives and the "VxOs" (Virtual Observatory for subfield "x"; e.g., Virtual Solar Observatory), is now making possible enhanced capabilities such as the Internet retrieval of most datasets directly by user applications; the uniform plotting and manipulation of data from many sources in a single application; the retrieval and plotting of data in a wide range of formats; the search for datasets by time, region, measurement type, time resolution, etc., and their subsequent retrieval; the direct comparison of measured and simulated quantities; and the generation of multisource movies of events using Internet data sources. Some of these capabilities have become established and are now funded as infrastructure. However, other applications are possible, and this call invites innovate plans for exploiting current and planned HPDE capabilities. Much is still to be done, for example, to efficiently exploit the huge data volumes being generated by current spacecraft and simulations. There will be no restrictions on the type of enhancement or its scope, except to say that it must fit within the funding guidelines, it must make use of existing or planned HPDE infrastructure, and the wider the range of researchers likely to use the capability the better.

2.1 Programmatic Considerations

Proposals must discuss the relationship of the proposed effort to the present, as well as anticipated, state of knowledge in the field, to the anticipated readiness of needed technologies, to the relevant datasets that should be available from any related planned missions, and to any related NASA community research efforts.

All proposals to this call should address two general areas:
I. Science Rationale. The science rationale includes:

a. Key objectives and their scientific importance;
b. Relationship to NASA strategic plans and the HP data policy; and
c. Uniqueness or scientific advantages of the proposed approach compared to alternatives.

II. Architecture and Implementation Approach. The architecture and implementation approach includes:

a. Technical approach and its requirements and feasibility;
b. Data products or other resources supported or enhanced;
c. Metadata and documentation of products and required ancillary data or enhancements;
d. Infrastructure and constraints assumed in place at the time of implementation;
e. Use of standard data formats; and
f. Compatibility with the Space Physics Archive Search and Extract (SPASE) Data Model.

All proposals are expected to result in significant enhancements and products within the grant period. The total funding available for awards will be approximately $1M, with about half of the money going toward Value Added Enhancements. 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. Value Added Enhancement proposals can be for up to three years, and they must clearly justify whatever level of funding is requested.

Submitting a proposal to this solicitation implies that if an award is made, a copy of any data product will be made public, preferably via one of the two discipline archives: the Space Physics Data Facility (SPDF), or the Solar Data Analysis Center (SDAC). Any proposal that would create a data product should include a brief data sharing plan regarding how it would be publicly archived. Proposers that include a plan to archive data should allocate suitable time for this task.

Proposers to this program element are not required to provide a data management plan via the NSPIRES cover page question. Instead, that is superseded by instructions in the sections below that place more detailed descriptions into the body of the Scientific/Technical/Management section of proposals. See Sections 2.2 and 2.3, below.

2.2 <u>Data Upgrades Proposals</u>

Funding in this area is intended to support small, short-term (typically one year) awards to improve the quality, utility, and accessibility of datasets relevant to Heliophysics research. Priority will be given to those proposals from data providers of NASA-sponsored datasets, but other data relevant to HP research will be considered.

A proposal for a Data Upgrade MUST include explicit subheadings as given in each of the bulleted points below, with a discussion of each topic indicated (explicitly note if not applicable):

- *Products to be Produced*: A clear description of the products to be produced, including the time span covered; the physical quantities to be included with their temporal and/or spatial resolution; and the format(s), coordinate system(s), and processing level(s) (e.g., calibrated in physical units or not, the former being far preferable).
- *Scientific Utility*: An argument for why the datasets involved were scientifically useful in the past and for how the proposed upgrade will make them more useful in the future. Specific research projects should be mentioned, along with an assessment of whether these will bring qualitatively new insights. This should be supported by, e.g., refereed publications or other citations and uses by people outside the original PI team.
- *Demonstration of Improvement*: A demonstration that the proposed upgrade represents a significant improvement in the quality and/or utility of the data, its format, and/or its accessibility. “Before and after” graphs are especially helpful, and the validation of techniques and results must be discussed.
- *Current Data Status*: The current status of the data and a demonstration that the data can still be retrieved from their current storage medium.
- *Data Description*: A statement of the current data volume, the expected data volume after processing, and the fraction of the data expected to be recovered.
- *Metadata Plan*: A plan for providing required metadata and ancillary data and descriptions needed for independent scientific usability. A plan for providing SPASE descriptions of products, usually in conjunction the SPASE group or a data center, should be included.
- *Archive and Dissemination Plan*: A clear discussion of how the resource will be placed in an HP Data Archive for general access or otherwise made easily available.
- *Need for Resources*: A discussion that demonstrates that the requested resources are necessary and sufficient for success in achieving the proposed upgrade. If the product is ongoing, the plan for supporting the continuation should be stated.

The discussion of each of these points may be brief, but each point must be clearly addressed, and addressing these points is all that is required for a proposal. The titles of proposals submitted to this portion of the solicitation must contain the words "Data Upgrade." The Scientific/Technical/Management section (including figures) of proposals submitted to this portion of the solicitation shall be no more than five pages.

2.3 Resident Archive 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 Resident Archive proposal must include:
- A statement of the scope of the RA, including the data products and services to be included.

- Arguments for why the data should still be served by the Principal Investigator (PI) team or a closely associated team knowledgeable about the data, rather than directly deposited in a Final Archive. These should demonstrate the science value of the data to qualitatively significant ongoing or future investigations as indicated, e.g., by refereed publications, specific research project suggestions, and/or the use of the data by researchers outside the proposing team.
- A description of how the RA will ensure that the mission data are served to the general community in an efficient and scientifically useful manner consistent with the community data environment guidelines. While level zero data plus on-the-fly processing may be used for serving, it is expected that a set of "legacy products" in physical units and accessible formats will also be available and served.
- A plan to maintain the integrity of the data by safeguarding against data loss; this could be achieved by a number of approaches, including the use of mirror sites, backup storage at the HP Data Archives or elsewhere, as well as with such tools as checksums. (See the criteria for a good archive in the HP Data Policy, Appendix F, Section F.4.)
- A statement of the relationship of the RA to the HPDE 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 Archives, 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 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 Resident Archive 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 Resident Archive. The Scientific/Technical/Management section (including figures) of proposals submitted to this portion of the solicitation should be no more than ten pages.

2.4 Value Added Enhancement Proposals

Proposals in this area will be for periods of performance from one to three years. The number of value-added enhancement proposals awarded will be consistent with available funding and the levels requested in the selected investigations.

A proposal for a value-added enhancement to the HPDE should include:

- An argument for why the enhancement is scientifically important to a broad range Heliophysics researchers.
- Evidence that the enhancement is new and will likely be used, with use cases and supporting evidence.
- A clear link to the HP Data Environment and in particular the details of how the enhancement will inherently use the capabilities of the HDPE infrastructure (i.e., standard formats for data and metadata and existing or planned data access and service APIs). The relationship of the enhancement to the SPASE data model should be stated.
- Evidence that the enhancement is required and would not, for example, be better done as a one-time effort by a data provider and that it is not already being implemented by another project (including possibly at another agency or in another country) or by an HP Data Archive.
- An argument for why the enhancement is located at provider sites, some other site(s), or would be a downloadable tool; any or all of the above are possible.
- A plan with an estimate of associated costs that states what capabilities would be provided for the long term (beyond the grant period), including assurances of longevity. This could involve using a continuing non-NASA site or the integration with HP Data Archives.
- A plan for implementation of the enhancement that will lead to useful results within the proposed time and that states why the requested resources are necessary and sufficient for success. It is expected that the project will produce results that the community can use and test well before the end of the project, both to be helpful to the community and to assure that the development meets real user needs.
- A plan for community input and feedback on the utility and functionality of the enhancement and for the incorporation of the feedback into the development process.

The titles of proposals submitted to this portion of the NRA should contain the words "Value Added Enhancements." The Scientific/Technical Management Section (including figures) of proposals submitted to this portion of the NRA should be no more than 15 pages.

3. Submission and Evaluation Process

3.1 Step-1 Proposals

To streamline the proposal process (submission, evaluation, and administration), this program uses a two-step proposal submission process. The overall description of a two-step process can be found in Section IV. (b) vii of the ROSES *Summary of Solicitation*.

A Step-1 proposal is required and must be submitted electronically by the Step-1 due date (see below and Tables 2 and 3 in the *ROSES Summary of Solicitation*). Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program. The Step-1 proposal must be submitted by the organization Authorized Organizational Representative (AOR). No budget or other elements are required. Only proposers who submit a Step-1 proposal are eligible to submit a full proposal. Full (Step-2) proposals must contain the same science goals proposed in the Step-1 proposal. In addition, the Step-1 proposal title and investigators (Principal Investigator, and Co-Investigators, Collaborators, Consultants, and Other Professionals) may not be changed 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.

3.1.1 Step-1 Proposal Format and Content

The Step-1 proposal is restricted to the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages. It should include the following information:

- A description of the science goals this proposal is enabling and that are appropriate for Heliophysics investigations.
- A brief description of the methodology to be used to address the science goals and objectives.

The NSPIRES system for proposal submission requires that Step-1 proposals include a summary (i.e., abstract) describing the proposed work as outlined above. The proposal summary is entered directly into a text field in NSPIRES. No PDF attachment is required or permitted for Step-1 proposal submission. All information will be entered within the 4000 character Proposal Summary text box on the NSPIRES web interface cover pages. Proposers will be notified by E-mail when they are able to submit their Step-2 proposals.

3.1.2 Step-1 Evaluation Criteria

NASA may determine Step-1 proposals to be noncompliant based on the requirements listed in Section 2 and its subsections. PIs of noncompliant proposals will not be eligible to submit the associated Step-2 proposal and will receive a letter to this effect.

3.1.3 Request for Reviewer Names

Proposers are strongly encouraged to provide names and contact information for up to five experts qualified to review their proposal. These experts must not be from the institutions of the PI or Co-Is or stand to benefit financially from the selection (or otherwise) of the proposal. This information can be supplied via the SARA web page at http://science.nasa.gov/researchers/suggested-reviewers/.

3.2 Step-2 Proposals

A Step-2 (full) proposal must be submitted electronically by the Step-2 due date (see below and Tables 2 and 3 in the *ROSES Summary of Solicitation*). The Step-2 proposal must be submitted by the organization Authorized Organizational Representative (AOR). A budget and other specified information is required. The Step-2 proposal title, Principal Investigator, and all Co-Investigators, Collaborators, Consultants, and Other Professionals must be the same as those in the Step-1 proposal. Step-2 proposals must contain the same scientific goals proposed in the Step-1 proposal.

Proposers must have submitted a Step-1 proposal to be eligible to submit a Step-2 proposal. Proposers that have received a noncompliant letter are not eligible to submit a Step-2 proposal.

Proposers may be asked to provide mail-in reviews for one to three proposals in this competition. Much of the science expertise lies in the PI/Co-I community, because increasingly, much of the Heliophysics community proposes. In order to maintain a high caliber review process, it is important to get the additional mail-in reviews to cover all proposals fairly.

3.2.1 Step-2 Proposal Format

Proposers should refer to the PDF entitled "How to submit a Step-2 proposal" that will appear under "Other Documents" on the NSPIRES page for this program after the Step-1 proposal due date. The process for preparation and submission of the Step-2 (full) proposals is that for any other ROSES proposal. Guidelines for content and formatting of Step-2 full proposals are specified in the *NASA Guidebook for Proposers* and the *ROSES Summary of Solicitation*.

Proposals should include the following within their Scientific/Technical/Management section: clear descriptions of (1) specific Heliophysics scientific problems that could be addressed with the ground-based data, upgraded data, or archived data in conjunction with other HSO resources (2) the importance of the problems, and (3) the details of the technical approach to providing the promised data or archival enhancements. Proposals should be clear on how data will be made to conform to the Heliophysics Data Policy.

3.2.2 Step-2 Evaluation Criteria

Step-2 proposals that are not complaint with format requirements may be rejected without review. See Section IV (b) ii of the *ROSES Summary of Solicitation* and the *NASA Guidebook for Proposers* for details. (1) If applicable for this solicitation, proposers must select the subelement that is appropriate for their intended proposal; proposals that are not appropriate for the chosen subelement may be declared noncompliant. (2) Proposals outside the scope of this solicitation may be declared noncompliant.

Compliant proposals will be evaluated according to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*. These criteria are intrinsic scientific and technical merit, relevance to NASA’s objectives, and cost realism/reasonableness.

The evaluation of scientific and technical merit will include:

- Compelling nature and scientific priority of science goals enabled by and appropriate for future investigations, including the importance of the problem within the broad field of Heliophysics; the unique value of the investigation to make scientific progress in the context of current understanding in the field, and the importance of carrying out the investigation now.
- Appropriateness and feasibility of the methodology, including the appropriateness of the selected data, models, and analysis for completing the investigation and the feasibility of the methodology for ensuring scientific success.

Based primarily on these two factors within merit, the evaluation will consider the overall potential science impact and probable success of the investigation.

Relevance will be judged by whether the proposal addresses the goals and objectives of the particular activity: Data Upgrade vs. Resident Archive vs. Value-Added Enhancements. Each proposal must demonstrate that the investigation is appropriate for the specific activity selected.

Cost realism/reasonableness will include assessing the amount of work to be accomplished versus the amount of time proposed. Open-ended proposals or those with a large number of science questions to be addressed typically do not fare well in this evaluation. Only necessary Co-Investigators and Collaborators should be included, and their specific roles in the investigation must be clearly laid out. Use of Collaborators whose only role is advisory is discouraged.

4. Available Funds

It is anticipated that approximately $1M will be made available to support new selections for Data Environment Enhancements, to be divided more-or-less equally between Upgrades/RAs and Value Added Enhancements. It is expected that about 10-12 new selections will be made with funds of the next fiscal year, with between one and four being for Value Added Enhancements (VAEs).

5. Summary of Key Information

Expected program budget for first year of new awards	$1M H-DEE
Number of new awards pending adequate proposals of merit	~10-12
Maximum duration of awards	For Data Upgrades: 1 year For Resident Archives: 2 years For Value Added Enhancements: 3 years (but a shorter duration is encouraged).
Due date for Step-1 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.

Due date for full Step-2 proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	6 months after Step-2 proposal due date.
Page limit for the central Science-Technical-Management section of proposal	H-DEE: See Section 2.; see also Chapter 2 of the *NASA Guidebook for Proposers.* Data Upgrade Proposals: 5 pages; Resident Archive Proposals: 10 pages; Value Added Enhancement Proposals: 15 pages.
Relevance	This program is relevant to the Heliophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
Web site for submission of Step 1 and Step 2 proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH16ZDA001N-HDEE
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