OMB Approval Number 2700-0087

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

HEADQUARTERS

SCIENCE MISSION DIRECTORATE

300 E STREET, SW

WASHINGTON, DC 20546-0001

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES – 2007 (ROSES-2007)

NASA RESEARCH ANNOUNCEMENT (NRA)

SOLICITING BASIC AND APPLIED RESEARCH PROPOSALS

NNH07ZDA001N

CATALOG OF FEDERAL DOMESTIC ASSISTANCE (CFDA) NUMBER: 00.000

ISSUED: FEBRUARY 16, 2007

PROPOSALS DUE
STARTING MAY 1, 2007
THROUGH APRIL 11, 2008

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES (ROSES) – 2007

EXECUTIVE SUMMARY

This National Aeronautics and Space Administration (NASA) Research Announcement (NRA), entitled *Research Opportunities in Space and Earth Sciences (ROSES) – 2007*, 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, and suborbital rocket 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 three 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 number or teaming arrangements. Cost sharing is encouraged but not required. 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 programs in the Appendices of this solicitation.

Education and Public Outreach (E/PO) is an important objective of NASA. All proposers selected for an award through this NRA are encouraged to submit an ancillary proposal for an E/PO activity to be carried out during the award's period of performance.

Details of the solicited programs are given in the Appendices of this NRA. Proposal due dates are given in Tables 2 and 3 of this NRA. Interested proposers should monitor http://nspires.nasaprs.com or subscribe to the SMD electronic notification system for additional new programs or amendments to this NRA through February 2008, at which time release of a subsequent ROSES NRA is planned.

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES (ROSES) – 2007

TABLE OF CONTENTS

SUMMARY OF SOLICITATION

	Page
I. Funding Opportunity Description	1
(a) Strategic Goals of NASA's Research Program	1
(b) Research Programs of NASA's Science Mission Directorate	2
(c) Opportunities for Education and Public Outreach	3
(i) Overview	3
(ii) E/PO Opportunities	3
(iii) Supplemental E/PO Awards for ROSES Investigators	4
(d) NASA-Provided High-End Computing (HEC) Resources	5
(e) NASA Safety Policy	6
(f) Availability of Funds for Awards	6
(g) Significant Changes from ROSES-2006	6
II. Award Information	7
(a) Funding and Award Policies	7
(b) Successor Proposals and Resubmissions	8
III. Eligibility Information	8
(a) Eligibility of Applicants	8
(b) Number of Proposals and Teaming Arrangements	9
(c) Cost Sharing or Matching	9
IV. Proposal and Submission Information	9
(a) Proposal Instructions and Requirements	9
(b) Content and Form of the Proposal Submission	10
(i) Electronic Proposal Submission	10
(ii) Proposal Format and Contents	11
(iii) Additional ROSES Requirement for Budget Format	12
(iv) Submission of Proposals via NSPIRES, the NASA Proposal Data System	13
(v) Submission of Proposals via Grants.gov	14
(vi) Notice of Intent to Propose	16
(vii) The Two-Step Proposal Process and the Two-Phase Proposal Process	16
(c) Proposal Submission Due Dates and Deadlines	17
(d) Proposal Funding Restrictions	18
(e) Proposal Requirements for Relevance	19
V. Proposal Review Information	19
(a) Evaluation Criteria	19
(b) Review and Selection Processes	20
(c) Selection Announcement and Award Dates	20
(d) Processes for Appeals	20
(i) Ombudsman Program	20
(ii) Protests	21

VI. Award Administration Information 21
(a) Notice of Award 21
(b) Administrative and National Policy Requirements 21
(c) Award Reporting Requirements 21
VII. Points of Contact for Further Information 21
VIII. Ancillary Information 22
(a) Announcement of Updates/Amendments to Solicitation 22
(b) Electronic Submission of Proposal Information 22
(c) Electronic Notification of SMD Research Solicitations 23
(d) Archives of Past Selections 23
(e) Meeting Geospatial Standards 23
IX. Concluding Statement 24
TABLE 1. NASA Strategic Goals and Research Objectives 25
TABLE 2. Solicited Research Programs (in order of proposal due dates) see note
TABLE 3. Solicited Research Programs (in order of Appendices A–E) see note

Note: Tables 2 and 3 of this NRA are posted as separate documents at http://nspires.nasaprs.com/ (select "Solicitations" then "Open Solicitations" then "NNH07ZDA001N").

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES (ROSES) – 2007

TABLE OF CONTENTS

APPENDICES

APPENDIX A. EARTH SCIENCE RESEARCH PROGRAM

A.1	Overview	A.1-1
A.2	Land-Cover/Land-Use Change	A.2-1
A.3	Carbon Cycle Science	A.3-1
A.4	Terrestrial Ecology	A.4-1
A.5	Ocean Biology and Biogeochemistry	A.5-1
A.6	Physical Oceanography	A.6-1
A.7	Ocean Surface Topography Science Team	A.7-1
A.8	Cryospheric Science	A.8-1
A.9	NASA Energy and Water Cycle Study	A.9-1
A.10	Terrestrial Hydrology	A.10-1
A.11	Atmospheric Composition: Aura Science Team	A.11-1
A.12	Atmospheric Composition: Science Advisory Group for the Glory Science Mission	A.12-1
A.13	Tropospheric Chemistry: Arctic Research of the Composition of the Troposphere from Aircraft and Satellites	A.13-1
A.14	Wind Lidar Science	A.14-1
A.15	Accelerating Operational Use of Research Data	A.15-1
A.16	Earth Surface and Interior	A.16-1
A.17	EarthScope: The InSAR and Geodetic Imaging Component	A.17-1
A.18	Airborne Instrument Technology Transition	A.18-1
A.19	Space Archaeology	A.19-1
A.20	Decision Support through Earth Science Research Results	A.20-1
A.21	New Investigator Program in Earth Science	A.21-1
A.22	Advancing Collaborative Connections for Earth System Science	A.22-1
A.23	Making Earth System Data Records for Use in Research Environments	A.23-1
A.24	Advanced Information Systems Technology	A.24-1
A.25	Advanced Component Technology	A.25-1
A.26	Instrument Incubator	A.26-1
A.27	Data Rights and Related Issues	A.27-1

APPENDIX B. HELIOPHYSICS RESEARCH PROGRAM

B.1	Overview	B.1-1
B.2	Solar and Heliospheric Physics	B.2-1
B.3	Geospace Science	B.3-1
B.4	Heliophysics Theory	B.4-1
B.5	Heliophysics Guest Investigators	B.5-1
B.6	Living With a Star Space Environment Testbeds	B.6-1
B.7	Living With a Star Targeted Research and Technology	B.7-1
B.8	Living With a Star Targeted Research and Technology: Strategic Capability	B.8-1
B.9	Virtual Observatories for Heliophysics Data	B.9-1

APPENDIX C. PLANETARY SCIENCE RESEARCH PROGRAM

C.1	Overview	C.1-1
C.2	Cosmochemistry	C.2-1
C.3	Sample Return Laboratory Instruments and Data Analysis	C.3-1
C.4	Planetary Geology and Geophysics	C.4-1
C.5	Planetary Astronomy	C.5-1
C.6	Planetary Atmospheres	C.6-1
C.7	Outer Planets Research	C.7-1
C.8	Lunar Advanced Science and Exploration Research	C.8-1
C.9	New Horizons at Jupiter Data Analysis	C.9-1
C.10	Cassini Data Analysis	C.10-1
C.11	Discovery Data Analysis	C.11-1
C.12	Mars Data Analysis	C.12-1
C.13	Mars Fundamental Research	C.13-1
C.14	Mars Instrument Development Project	C.14-1
C.15	Mars Technology Project	C.15-1
C.16	Planetary Instrument Definition and Development	C.16-1
C.17	Astrobiology: Exobiology and Evolutionary Biology	C.17-1
C.18	Planetary Protection Research	C.18-1
C.19	Astrobiology Science and Technology Instrument Development and Mission Concept Studies	C.19-1
C.20	Astrobiology Science and Technology for Exploring Planets	C.20-1
C.21	In-Space Propulsion	C.21-1
C.22	Fellowships for Early Career Researchers	C.22-1
C.23	Planetary Major Equipment	C.23-1

APPENDIX D. ASTROPHYSICS RESEARCH PROGRAM

D.1	Overview	D.1-1
D.2	Astrophysics Data Analysis	D.2-1
D.3	Astronomy and Physics Research and Analysis	D.3-1
D.4	Astrophysics Theory and Fundamental Physics	D.4-1
D.5	GALEX Guest Investigator – Cycle 4	D.5-1
D.6	FUSE Guest Investigator – Cycle 9	D.6-1
D.7	Swift Guest Investigator – Cycle 4	D.7-1
D.8	Suzaku Guest Observer – Cycle 3	D.8-1
D.9	GLAST Guest Investigator – Cycle 1	D.9-1
D.10	Kepler Mission Participating Scientists	D.10-1

APPENDIX E. CROSS-DIVISION RESEARCH PROGRAM

E.1	Overview	E.1-1
E.2	Applied Information Systems Research	E.2-1
E.3	Origins of Solar Systems	E.3-1

Note: Any amendments to the Table of Contents for Appendices A through E may be found in Table 3 of this NRA.

RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES (ROSES) – 2007

SUMMARY OF SOLICITATION

I. FUNDING OPPORTUNITY DESCRIPTION

(a) Strategic Goals of NASA's Research Program

The National Aeronautics and Space Administration's (NASA's) Mission,

> *To pioneer the future in space exploration, scientific discovery, and aeronautics research,*

and the Vision for Space Exploration, whose fundamental goal is

> *To advance U.S. scientific, security, and economic interests through a robust space exploration program,*

allow the science objectives of the NASA Science Mission Directorate to be clearly defined as the orderly pursuit of the agency's strategic goals.

Responsibility for achieving several of NASA's strategic goals and outcomes (see Table 1) belongs to SMD, including those to:

- Study planet Earth from space to advance scientific understanding and meet societal needs;
- Understand the Sun and its effects on Earth and the solar system;
- Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space; and
- Discover the origin, structure, evolution, and destiny of the universe and search for Earth-like planets.

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

- *The 2006 NASA Strategic Plan*, available at http://www.nasa.gov/about/budget (also at http://www.nasa.gov/pdf/142302main_2006_NASA_Strategic_Plan.pdf);
- *The Science Plan for NASA's Science Mission Directorate (2007-2016)* (hereafter the *NASA Science Plan*), available at http://science.hq.nasa.gov/strategy; and
- *The Vision for Space Exploration*, available at http://www.nasa.gov/mission_pages/exploration/main.

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. Therefore, proposers to this NASA Research Announcement (NRA) are expected to provide a short

statement in their proposals that demonstrates the relevance of the proposed research to one or more of these NASA strategic goals, science outcomes, and the *NASA Science Plan* (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 the Moon and Mars.

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* subsection 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 as the controlling agent of the space environment of the Solar System, especially the Earth. 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 and outcomes:

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

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://education.nasa.gov/pdf/151156main_NASA_Booklet_final_3.pdf).

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://science.hq.nasa.gov/research/epo.htm and at http://science.hq.nasa.gov/education. These sites include the *Explanatory Guide to E/PO Evaluation Criteria* (December 2006), strategic planning and implementation documents, catalog or directory of E/PO resources, list or abstracts of selected E/PO awards, etc.

(ii) E/PO Opportunities

Three opportunities to participate in SMD's E/PO programs are included in this NRA. The first is the opportunity to receive supplemental E/PO awards by the Principal Investigators (PIs) of selected investigations (see Section I(c)(iii) below). The second is the opportunity for early-career scientists and engineers in Earth science to participate in the *New Investigator Program in Earth Science* (see Appendix A.21). The third is the opportunity for early-career scientists and engineers in planetary science to participate in the *Fellowships for Early Career Researchers* (see Appendix C.22).

Other opportunities to participate in SMD's E/PO programs are not included in this NRA, but are posted separately at http://nspires.nasaprs.com; these include the NASA Earth and

Space Science Fellowship (NESSF) Program for graduate students, E/PO opportunities embedded in SMD missions and programs, and opportunities to provide E/PO support to the scientific and educational enterprise inside and outside of NASA, as well as to develop systematic and sustainable educational efforts.

(iii) Supplemental E/PO Awards for ROSES Investigators

Supplemental E/PO awards are used to encourage engagement and participation by research scientists themselves in education and scientific communication by adding an E/PO component to their "parent" research investigations. The scope of the supplemental E/PO awards include all aspects of higher, elementary/secondary, and informal education and public outreach, except student support at the undergraduate, graduate, and postdoctoral levels which is either already a part of the parent research award or provided in other competitive opportunities (e.g., NESSF, Hubble Fellows, etc.) Efforts promoting participation of underrepresented groups in Earth and space science studies at all levels of education and strengthening such learning in minority serving institutions are encouraged.

In order to propose an E/PO activity as a supplement to a research proposal submitted in response to this NRA, the proposer must follow these instructions:

- An E/PO proposal may be submitted only by a proposer whose research proposal is selected for funding through this NRA (hereafter called the "parent research award"), as well as those who hold a parent award selected through any previous Science Mission Directorate, Office of Space Science (OSS), or Office of Earth Science (OES) NRA that has at least 15 months remaining in its period of performance at the time of the submission of the E/PO proposal.
- The cost cap for an E/PO proposal by an individual NRA investigator is $15K per year.
- A "Collaborative E/PO Proposal" option is available that allows several SMD-funded researchers to collectively carry out a more ambitious, expansive E/PO program, with a cap of ≤$50K per year, not to exceed $125K over the nominal three-year lifetimes of the parent awards. The supplemental E/PO funds are added to a single research award of the consortium of proposing investigators.
- To ease the burden of NASA's administration of such small supplemental awards, the total period of performance for any E/PO award is limited to that of its parent research award (for institutional and collaborative awards, this limit applies to the research award to which the supplemental E/PO funding is added.)
- A selected investigator has two windows of opportunity to submit an E/PO proposal: (i) no later than 90 days after the date of the letter of selection for the parent award, which anticipates starting the E/PO activity early in the first year of the parent award; or (ii) not less than 90 days in advance of the yearly anniversary date of the parent award, which anticipates starting the E/PO activity at the time of the next yearly funding supplement for the parent award.

Further details and guidance on preparing and submitting a proposal for E/PO funding under this SMD NRA, or any previous OES or OSS NRA, may be found at

http://science.hq.nasa.gov/research/guidelines.html. Questions and/or comments and suggestions about this SMD E/PO program are welcome and may be directed to:

Ms. Doris Daou
ROSES E/PO Project Lead
Science Mission Directorate
NASA Headquarters
Washington, DC 20546
E-mail: HQ-SMD-ROSES-EPO@hq.nasa.gov
Telephone: 202-358-0422

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

SMD provides a specialized computational infrastructure to support its research community. High-performance computing resources are available from two major computing facilities, namely, the Computational and Information Sciences and Technology Office (CISTO) (http://cisto.gsfc.nasa.gov) at NASA's Goddard Space Flight Center (GSFC), and the NASA Advanced Supercomputing (NAS) Division (http://www.nas.nasa.gov) at NASA's Ames Research Center (ARC). Each facility maintains high-end computer platforms with significant capacity for data storage.

The main computing platforms at GSFC are an SGI Altix system with 1152 processors and a Linux Network cluster consisting of 256 dual core processors. These systems will support computational modeling tasks ranging from a single processor to as large as 256 processors. The computing system at ARC consists of twenty, 512-processor SGI Altix systems. Each system is tightly coupled and is configured to support large computational tasks. Tasks requiring at least 64 processors will be given preference in scheduling computing time on this system.

Additional computational resources include user services in code porting and performance tuning, scientific data visualization, and data transfer.

Any need for these specific computing resources for the proposed research must be explicitly described in the proposal, including 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 (number of runs times number of processors per run times number of hours required 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 request and whether it is an appropriate utilization of a highly constrained resource.

Successful investigations selected for funding will be considered for an allocation of the requested NASA HEC resources needed for their investigation, but the fully requested

level cannot be guaranteed. SMD will make every attempt to satisfy the needs in the context of the overall set of requirements, constraints, and science priorities.

After a proposal is selected for funding, the PI shall formally request the computing and/or computational resources from the NASA High-End Computing Program (http://www.hec.nasa.gov). The requests will be for one year and nontransferable. PIs may make large requests, greater than 100,000 aggregated computing hours, at any time during the year, but requests will be considered only twice a year (November and April). Small requests of less than 100,000 aggregated computing hours may be allocated throughout the year.

For further information contact either of the following:

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

Mr. Joseph H. Bredekamp
Heliophysics Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546
E-mail: Joe.Bredekamp@nasa.gov
Telephone: 202-358-2348.

(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 ROSES-2006

Proposers should be aware of the following significant changes in this NRA from ROSES-2006.

- The *NASA Science Plan* has been published, and proposers must reference the science questions and research objectives in the *NASA Science Plan* to demonstrate relevance to NASA (Section I(a) and Table 1).
- All proposing organizations must register in NSPIRES and all participating organizations must be listed on the *Cover Page*. All participants in the proposal must register in NSPIRES. In the proposal, participants must list the organization

through which they are participating in the proposed investigation (Section IV(b)(i)).

- Specific requirements have been set on the creation of PDF files for upload, particularly PDF files created from TeX or LaTeX (Section IV(b)(ii)).
- The requirements for the proposal budget have been expanded and clarified (Section 2.3.10 of the *NASA Guidebook for Proposers*). The additional requirements for budgets placed on ROSES proposals have been clarified (Section IV(b)(iii) of this NRA).
- The full cost budget instructions for NASA Centers have been revised to reflect changes in NASA's implementation of full cost accounting (Section IV(d)).
- A description of the available appeals process has been added (Section V(d)).

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-2006. All proposers are urged to read this NRA and the 2007 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. Any deviation from the usual maximum duration for awards of three years will also be noted (a few program elements may specify only one year for activities of limited scope to as long as five years for extensive, comprehensive studies).

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 further below and Section 2.3.10 of the *NASA Guidebook for Proposers*[1]) 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 inter-agency transfers depending on the nature of the submitting

[1] The *Guidebook for Proposers Responding to a NASA Research Announcement* (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.

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. 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://ec.msfc.nasa.gov/hq/library/v-reg.htm).

(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. Note that the instructions regarding successor proposals in the *NASA Guidebook for Proposers* have changed from past years. Proposers are strongly encouraged to review them.

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.

III. Eligibility Information

(a) Eligibility of Applicants

Participation in this program is open to all categories of U.S. and non-U.S. organizations, including educational institutions, industry, not-for-profit institutions, the Jet Propulsion Laboratory, as well as NASA Centers and other U.S. 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*).

[2] The *NASA Grants and Cooperative Agreement Handbook* (hereafter referred to as the *Grants Handbook*) is at http://ec.msfc.nasa.gov/hq/grcover.htm.

(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) 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 V(a) below.

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* (hereafter referred to as the *NASA Guidebook for Proposers*), located at http://www.hq.nasa.gov/office/procurement/nraguidebook. By reference, the 2007 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 web page.

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 VII 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. 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.
- Each individual team member (e.g., PI, co-investigators, etc.), including all personnel named on the proposal's electronic cover page, must specify an organizational affiliation. The organizational affiliation specified must be the organization through which the team member is 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.

Generically, an electronic proposal consists of one or more electronic forms, including an electronic cover page and one or more attachments. The attachments contain all sections of the proposal, including the science/technical/management section, as well as all required and allowed appendices; see Section IV(b)(ii) below for further requirements.

Submission of electronic proposals via either NSPIRES or Grants.gov requires a fundamental change in proposal submission procedure over previous years. In particular, 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 organization representative (AOR), must submit the electronic proposal (forms plus attachments). Coordination between the PI and his/her AOR on the final editing and submission of the proposal materials is facilitated through their respective accounts in NSPIRES and/or Grants.gov.

(ii) Proposal Format and Contents

All proposals submitted in response to this NRA must include the appropriate required electronic forms available through either of two proposal submission systems, NSPIRES or Grants.gov.

The science/technical/management section and other required sections of the proposal must be submitted as searchable, unlocked PDF files that are attached to the electronic submission using one of the proposal submission systems. Proposers must comply with any 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/attachments that are specifically requested in either this NRA or in the *NASA Guidebook for Proposers* will be permitted; proposals containing unsolicited appendices/attachments 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 elements 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.

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.

(iii) Additional ROSES Requirement for Budget Format

SMD has adopted a uniform policy concerning the review of proposals submitted in response to this ROSES NRA with regard to the cost evaluation criterion described in Appendix C of the *NASA Guidebook for Proposers*. It is SMD policy to have cost realism and cost reasonableness evaluated according to the match (or mismatch) between proposed objectives and the proposed resources required, including work effort and other proposed costs, and not according to the total cost. The peer review will evaluate the proposed budget and budget justification for cost realism. NASA program personnel will evaluate the proposed budget and budget justification for cost reasonableness, total cost, and comparison of the proposed cost to available funds.

In order to allow this division of review responsibilities, NASA will provide limited but sufficient proposal budget information to the peer review (work effort and personnel, other direct costs including procurements and subawards/subcontracts) while reserving certain proposal budget details for NASA's use (costs of direct labor, indirect costs, total costs).

Therefore, SMD places additional requirements on the submission of proposals in response to this ROSES NRA. Where the requirements in this NRA conflict with requirements and instructions found elsewhere (e.g., in the *NASA Guidebook for Proposers*, NSPIRES instructions, or Grants.gov instructions), the requirements in this NRA have precedence. It is important that all proposers responding to this ROSES NRA follow these additional instructions carefully to enable an appropriate evaluation of their proposals.

In addition to the budget summary information provided in the NSPIRES or Grants.gov Cover Page forms, all proposers are required to include more detailed budgets and budget justifications, including detailed subcontract/subaward budgets, in a format of their own choosing in the *Budget Justification*. For this NRA, this additional budget must be divided into three parts, the "*Budget Justification: Narrative*" and the "*Budget Justification: Details*," both as described in Section 2.3.10 of the *NASA Guidebook for Proposers*, and the "*Total Budget,*" a requirement specific to this ROSES NRA.

The *Budget Justification: Narrative* includes the *Table of Proposed Work Effort* and the description of facilities and equipment, as well as the rationale and basis of estimate for all components of cost including procurements, travel, publication costs, and all subawards/subcontracts. The *Table of Proposed Work Effort* must include the names and/or titles of all personnel (including postdoctoral fellows and graduate students) necessary to perform the proposed investigation regardless of whether these individuals require funding from the current proposal. The number of person-months each person is expected to devote to the project must be given for each year. The *Budget Justification: Details* must include the detailed proposed budget including all of the Other Direct Costs and Other Applicable Costs specified in the *NASA Guidebook for Proposers*. For this NRA, the *Budget Justification: Narrative* and the *Budget Justification: Details* should not specify the Total Estimated Cost, the cost of Direct Labor, or any Administrative Costs (e.g., overhead).

The *Total Budget* file must specify the complete set of cost components including all costs discussed in the *Budget Narrative* and *Budget Details*, as well as the Total

Estimated Cost, cost of Direct Labor, and Administrative Costs (overhead). The *Total Budget* document will not be provided to the peer review, but will used by NASA in the evaluation of total cost and comparison of the proposed cost to available funds.

The required *Budget Justification: Narrative* and *Details* section of the proposal may be incorporated into the proposal document as these will be provided to the peer review (for submission via NSPIRES, the *Budget Justification: Narrative* and *Details* must be incorporated into the single proposal PDF file). Regardless of whether the proposal is submitted via NSPIRES or Grants.gov, proposers to ROSES must provide the *Total Budget* in a file called "totalbudget.pdf," which is uploaded as a separate attachment in either NSPIRES or Grants.gov.

Note that failure to provide sufficient budget justification and data in the *Budget Narrative* (including the *Table of Proposed Work Effort*) and the *Budget Details*, recognizing that the peer review will not have access to the Total Estimated Cost, the cost of Direct Labor, and Administrative Costs (e.g., overhead), will prevent the peer review from appropriately evaluating the cost realism of the proposed effort. A finding by the peer review of "insufficient information to properly evaluate cost realism" will be considered a weakness of the proposal. Inconsistent budget information between these budget descriptions will also be considered a weakness of the proposal.

(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). Note that this database system has been changed from that used prior to 2005 for NASA Office of Earth Science and Office of Space Science research proposals. In order to submit a proposal via NSPIRES, this NRA requires that the proposer register key data concerning the intended submission with NSPIRES; NSPIRES is accessed 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.

All proposals submitted via NSPIRES in response to this NRA 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; and a *Budget Summary* of the proposed research effort. 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 that contains the complete proposal, including the science/technical/management section and budget justification (but not the *Total Budget*), 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 and attachments (with the exception of the *Total Budget* -- see Section IV(b)(iii) above) must be included in the PDF file(s) and should not be uploaded as separate attachments, unless specified otherwise in the program element description in the Appendices to this NRA. The *Total Budget* must be uploaded as a separate attachment in a file named "totalbudget.pdf." 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. Any warnings or errors that NSPIRES might generate as part of the element check concerning seemingly missing data should be ignored after verifying that the material is included in the single electronic proposal document.

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 E-mail to nspires-help@nasaprs.com or by telephone to (202) 479-9376, Monday through Friday, 8:00 a.m. – 6:00 p.m. Eastern Time.

(v) Submission of Proposals via Grants.gov

In furtherance of the President's Management Agenda, 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.

In order to submit a proposal via 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. 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 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. 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 00.000.
- Complete the required Grants.gov forms including the SF424 (R&R) Application for Federal Assistance, 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. Program-specific forms may be found by clicking on the hyperlink in the NASA Other Project Information form or by directly accessing http://nspires.nasaprs.com/grants.gov. Directions for accessing and submitting program-specific forms, if there are any, are provided in 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*). Upload sections as separate PDFs as prompted by Grants.gov.
- Submit the proposal via the authorized organization representative (AOR); the PI may not submit the application to Grants.gov unless he/she is an AOR.

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

Additional instructions for formatting and submitting proposals via Grants.gov may be found in Sections 2 and 3 of the *NASA Guidebook for Proposers*. Instructions for the use of Grants.gov may be found in the *Grants.gov User Guide* at http://www.grants.gov/CustomerSupport. Instructions for NASA-specific forms and NASA program-specific forms may be found in the application package and at http://nspires.nasaprs.com/Grants.gov. For any questions that cannot be resolved with the available online help menus and documentation, requests for assistance may be directed by E-mail to support@grants.gov or by telephone to (800) 518-4726.

(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 E-mail 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 NOI is an extended synopsis (length not to exceed ~2000 words) of the intended research that is considered a Step-1 proposal. When employed, Step-1 proposals are submitted via NSPIRES (located at http://nspires.nasaprs.com) 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 merit and relevance 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, encouraged to submit a full Step-2 proposal by the proposal due date established for that program element. Note that a Step-2 proposal may be submitted regardless of whether or not a Step-1 proposal is submitted and whether or not

submission of a Step-2 proposal is encouraged by NASA as a result of the Step-1 proposal review.

Grants.gov does not provide Step-1 capability; therefore, Step-1 proposals must be submitted via NSPIRES regardless of whether the Step-2 proposal will be submitted via NSPIRES or Grants.gov. Step-2 proposals are to be submitted in full compliance with the *NASA Guidebook for Proposers* discussed in Section IV(a) above.

This ROSES-2007 NRA contains one program element that is soliciting proposals using a two-step process: Land Cover/Land Use Change (Appendix A.2).

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 is 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 must be submitted via NSPIRES 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 Appendix to this ROSES NRA.

This ROSES-2007 NRA contains several guest investigator/guest observer program elements using the two-phase proposal process: GALEX Guest Investigator (Appendix D.5), FUSE Guest Investigator (Appendix D.6), Suzaku Guest Observer (Appendix D.8), and GLAST Guest Investigator (Appendix D.9).

(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 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.
- 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 the allowability of costs, 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.
- Profit for commercial organizations is not allowable under grant or cooperative agreement awards but is allowable under contract awards.
- 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*).
- The following instructions 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 based on full-cost accounting and consistent with the current implementation of simplified full cost accounting for the requested year of performance. Proposal budgets from NASA Centers must include all costs that will be paid out of the resulting award. Costs which will not be paid out of the resulting award, but are paid from a separate NASA budget (e.g. 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 direct civil service labor, travel, and other direct charges (including procurements and contractor labor) to the proposed research task should be included.
- 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*). To enable NASA to properly evaluate the relevance of proposals submitted in response to this solicitation, proposals must contain a statement of the relevance of the proposed work to NASA objectives as stated in the latest version of the *NASA Strategic Plan* and the *NASA Science Plan* (see Section I(a)). This statement need not exceed a quarter page of text and is to be included in the introduction to the science/technical/management section of the proposal. This short statement of relevance to NASA objectives is in addition to the proposal's longer and more detailed discussion addressing the specific goals of a particular research program element.

Note that this NRA references NASA's 2006 strategic goals and objectives (see Section I(a) and Table 1).

V. 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 factors include factors evaluated by peer reviewers, as well as 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 SMD, as given in Table 1.
- Cost data for U.S. proposals will be evaluated both by peer review (for cost realism) and by NASA program personnel (for cost reasonableness, total cost, and comparison to available funds) as discussed in Section IV(b)(iii) above. Proposers must follow the budget requirements in Section 2.3.10 of the *NASA Guidebook for Proposers*, as modified in Section IV(b)(iii) of this NRA.
- Cost sharing is not part of the evaluation criteria (see Section III(c) 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 Selecting Official. Unless otherwise specified, the Associate Administrator for the Science Mission Directorate (or his/her delegate) is the Selecting Official for cross-division program elements.

(c) Selection Announcement and Award Dates

Selections are typically announced between 150 days and 220 days after the proposal due date for proposals. 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 date. After 150 days past the proposal due date for which a proposal was submitted, proposers may contact the responsible Program Officer listed at the conclusion of that program element description in the appendices for the status of the selection activity.

Those proposers not selected will be notified 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) 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
Telephone: 202-358-0445.

(ii) Protests

Only prospective offerors seeking contract awards under this NRA have the right to file a 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.

VI. 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.

VII. POINTS OF CONTACT FOR FURTHER INFORMATION

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

Dr. Paul Hertz
Chief Scientist
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546
Telephone: (202) 358-0986
E-mail: paul.hertz@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.

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

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

VIII. 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 as posted at its homepage at http://nspires.nasaprs.com (select "Solicitations" then "Open Solicitations" then "NNH07ZDA001N") 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. Although NASA SMD will also send an electronic notification of any such amendments to all subscribers of its electronic notification system (see Section VIII(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 "NNH07ZDA001N" 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 E-mail and telephone, difficulty may arise at any point on the Internet, 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).

(c) Electronic Notification of SMD Research Solicitations

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

NRAs issued by SMD are synopsized on Grants.gov (http://www.grants.gov) at the time they are released. This ROSES-2007 NRA will be synopsized upon its release. Amendments to this NRA that create new proposal opportunities will also be synopsized at the time of their release.

(d) 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 of investigations selected through previous solicitations (issued after January 1, 2005) are available at http://nspires.nasaprs.com (select "Solicitations", then "Past Solicitations").

(e) 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) meets 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).

IX. 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 VII above.

Michael H. Freilich
Director
Earth Science Division

Richard Fisher
Director
Heliophysics Division

James L. Green
Director (Acting)
Planetary Science Division

Richard Howard
Director (Acting)
Astrophysics Division

Mary L. Cleave
Associate Administrator
Science Mission Directorate

TABLE 1. NASA STRATEGIC GOALS AND RESEARCH OBJECTIVES

TABLE 1A. NASA'S STRATEGIC GOALS[3]

Strategic Goal 1: Fly the Shuttle as safely as possible until its retirement, not later than 2010.

Strategic Goal 2: Complete the International Space Station in a manner consistent with NASA's International Partner commitments and the needs of human exploration.

Strategic Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

- Strategic Sub-goal 3A Study Earth from space to advance scientific understanding and meet societal needs.
- Strategic Sub-goal 3B Understand the Sun and its effects on Earth and the solar system.
- Strategic Sub-goal 3C Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.
- Strategic Sub-goal 3D Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.
- Strategic Sub-goal 3E Advance knowledge in the fundamental disciplines of aeronautics, and develop technologies for safer aircraft and higher capacity airspace systems.
- Strategic Sub-goal 3F Understand the effects of the space environment on human performance, and test new technologies and countermeasures for long-duration human space exploration.

Strategic Goal 4: Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.

Strategic Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

Strategic Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.

[3] From *The 2006 NASA Strategic Plan*; see Section I(a) for reference

TABLE 1B. NASA'S SCIENCE QUESTIONS AND RESEARCH OBJECTIVES[4]

Strategic Sub-goal 3A: Study planet Earth from space to advance scientific understanding and meet societal needs.

NASA's Science Questions

- How is the global Earth system changing?
- What are the primary causes of change in the Earth system?
- How does the Earth system respond to natural and human-induced changes?
- What are the consequences for human civilization?
- How will the Earth system change in the future?

NASA's Research Objectives

3A.1 Understand and improve predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition.

3A.2 Enable improved predictive capability for weather and extreme weather events.

3A.3 Quantify global land cover change and terrestrial and marine productivity, and improve carbon cycle and ecosystem models.

3A.4 Quantify the key reservoirs and fluxes in the global water cycle and improve models of water cycle change and fresh water availability.

3A.5 Understand the role of oceans, atmosphere, and ice in the climate system and improve predictive capability for its future evolution.

3A.6 Characterize and understand Earth surface changes and variability of Earth's gravitational and magnetic fields.

3A.7 Expand and accelerate the realization of societal benefits from Earth system science.

[4] From *The Science Plan for NASA's Science Mission Directorate (2007-2016)*; see Section I(a) for reference

Strategic Sub-goal 3B: Understand the Sun and its effects on Earth and the solar system.

NASA's Science Questions

- How and why does the Sun vary?
- How do planetary systems respond?
- What are the impacts on humanity?

NASA's Research Objectives

3B.1 Understand the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium

3B.2 Understand how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields

3B.3 Develop the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers.

Strategic Sub-goal 3C: Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.

NASA's Science Questions

- How did the Sun's family of planets and minor bodies originate?
- How did the solar system evolve to its current diverse state?
- What are the characteristics of the solar system that lead to the origin of life?
- How did life begin and evolve on Earth and has it evolved elsewhere in the solar system?
- What are the hazards and resources in the solar system environment that will affect the extension of human presence of human presence in space?

NASA's Research Objectives

3C.1 Learn how the Sun's family of planets and minor bodies originated and evolved.

3C.2 Understand the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds.

3C.3 Identify and investigate past or present habitable environments on Mars and other worlds, and determine if there is or ever has been life elsewhere in the solar system.

3C.4 Explore the space environment to discover potential hazards to humans and to search for resources that would enable human presence.

Strategic Sub-goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

NASA's Science Questions

- What are the origin, evolution, and fate of the universe?
- How do planets, stars, galaxies, and cosmic structure come into being?
- When and how did the elements of life and the universe arise?
- Is there life elsewhere?

NASA's Research Objectives

3D.1 Understand the origin and destiny of the universe, phenomena near black holes, and the nature of gravity.

3D.2 Understand how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe.

3D.3 Understand how individual stars form and how those processes ultimately affect the formation of planetary systems.

3D.4 Progress in creating a census of extra-solar planets and measuring their properties.

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

*See Sections IV(b)(vi) and IV(b)(vii) for a discussion of Notice of Intent (NOI) vs. a Step-1 proposal.

APPENDIX	PROGRAM	NOI/Step-1* DUE DATE	PROPOSAL DUE DATE
A.12	Atmospheric Composition: Science Advisory Group for the Glory Science Mission	N/A	5/1/2007
B.5	Heliophysics Guest Investigators	3/16/2007	5/11/2007
A.14	Wind Lidar Science	3/16/2007	5/16/2007
A.18	Airborne Instrument Technology Transition	3/16/2007	5/16/2007
C.4	Planetary Geology and Geophysics [1][2]	3/23/2007	5/16/2007
C.2	Cosmochemistry [1][2]	3/22/2007	5/18/2007
D.10	Kepler Mission Participating Scientists	3/16/2007	5/18/2007
A.20	Decision Support through Earth Science Research Results	3/15/2007	5/25/2007
C.11	Discovery Data Analysis [2]	3/26/2007	5/25/2007
E.3	Origins of Solar Systems [1]	4/9/2007	5/25/2007
C.10	Cassini Data Analysis	4/5/2007	5/30/2007
C.5	Planetary Astronomy [1][2]	4/12/2007	5/31/2007
C.22	Fellowships for Early Career Researchers (current fellows)	N/A	5/31/2007
A.22	Advancing Collaborative Connections for Earth System Science	3/15/2007	6/1/2007
D.4	Astrophysics Theory and Fundamental Physics	4/6/2007	6/1/2007
A.3	Carbon Cycle Science	4/6/2007	6/6/2007
D.6	FUSE Guest Investigator – Cycle 9	4/13/2007	6/8/2007
A.8	Cryospheric Science	4/16/2007	6/15/2007
A.11	Atmospheric Composition: Aura Science Team	4/30/2007	6/15/2007
A.13	Tropospheric Chemistry: Arctic Research of the Composition of the Troposphere from Aircraft and Satellites	4/16/2007	6/15/2007
C.6	Planetary Atmospheres [1][2]	4/18/2007	6/15/2007
D.9	GLAST Guest Investigator – Cycle 1	4/20/2007	6/15/2007
A.9	NASA Energy and Water Cycle Study	4/18/2007	6/18/2007
D.2	Astrophysics Data Analysis	4/27/2007	6/22/2007
D.5	GALEX Guest Investigator – Cycle 4	4/27/2007	6/22/2007
A.6	Physical Oceanography	4/27/2007	6/28/2007
B.4	Heliophysics Theory	4/27/2007	6/29/2007

APPENDIX	PROGRAM	NOI/Step-1* DUE DATE	PROPOSAL DUE DATE
C.3	Sample Return Laboratory Instruments and Data Analysis	4/27/2007	6/29/2007
C.14	Mars Instrument Development Project	5/7/2007	7/6/2007
C.13	Mars Fundamental Research [1][2]	5/16/2007	7/18/2007
B.3	Geospace Science	5/11/2007	7/20/2007
A.16	Earth Surface and Interior	5/25/2007	7/25/2007
A.19	Space Archaeology	5/15/2007	7/25/2007
C.16	Planetary Instrument Definition and Development	6/8/2007	8/3/2007
C.18	Planetary Protection Research	6/26/2007	8/7/2007
A.17	EarthScope: The InSAR and Geodetic Imaging Component	6/8/2007	8/10/2007
A.4	Terrestrial Ecology	6/15/2007	8/15/2007
A.21	New Investigator Program in Earth Science	6/29/2007	8/31/2007
B.7	Living With a Star Targeted Research and Technology	7/27/2007	8/31/2007
B.8	Living With a Star Targeted Research and Technology: Strategic Capability	7/27/2007	8/31/2007
C.12	Mars Data Analysis [2]	7/13/2007	9/7/2007
A.15	Accelerating Operational Use of Research Data	7/6/2007	9/18/2007
C.17	Astrobiology: Exobiology and Evolutionary Biology [1][2]	7/19/2007	9/20/2007
A.2	Land-Cover/Land-Use Change	6/11/2007	10/1/2007
A.10	Terrestrial Hydrology	8/1/2007	10/1/2007
A.7	Ocean Surface Topography Science Team	8/31/2007	10/31/2007
C.22	Fellowships for Early Career Researchers (current fellows)	N/A	10/31/2007
C.7	Outer Planets Research [1][2]	8/31/2007	11/2/2007
D.7	Swift Guest Investigator – Cycle 4	9/14/2007	11/9/2007
B.9	Virtual Observatories for Heliophysics Data	9/12/2007	11/15/2007
B.6	Living With a Star Space Environment Testbeds	9/14/2007	11/16/2007
D.8	Suzaku Guest Observer – Cycle 3	9/14/2007	11/30/2007
B.2	Solar and Heliospheric Physics	12/7/2007	2/8/2008
D.3	Astronomy and Physics Research and Analysis	3/3/2008	4/11/2008

APPENDIX	PROGRAM	NOI/Step-1* DUE DATE	PROPOSAL DUE DATE
C.22	Fellowships for Early Career Researchers (new applicants)	See Program Element of Interest [2]	
C.23	Planetary Major Equipment	See Program Element of Interest [1]	
A.5	Ocean Biology and Biogeochemistry	TBD	TBD
A.26	Instrument Incubator	TBD	TBD
C.8	Lunar Advanced Science and Exploration Research	TBD	TBD
C.9	New Horizons at Jupiter Data Analysis	TBD	TBD
E.2	Applied Information Systems Research	TBD	TBD
C.15	Mars Technology Project	Solicitation pending decision	
C.19	Astrobiology Science and Technology Instrument Development and Mission Concept Studies [2]	Solicitation pending decision	
C.20	Astrobiology Science and Technology for Exploring Planets [2]	Solicitation pending decision	
C.21	In-Space Propulsion	Solicitation pending decision	
A.23	Making Earth System Data Records for Use in Research Environments	Not solicited this year	
A.24	Advanced Information Systems Technology	Not solicited this year	
A.25	Advanced Component Technology	Not solicited this year	
A.27	Data Rights and Related Issues	N/A	N/A

Notes:
[1] The proposals for program element *Planetary Major Equipment* (C.23) 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); Mars Fundamental Research (Appendix C.13); Astrobiology: Exobiology and Evolutionary Biology (Appendix C.17); and Origins of Solar Systems (Appendix E.3).
[2] 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); Discovery 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 Instrument Development (Appendix C.19); and Astrobiology Science and Technology for Exploring Planets (Appendix C.20).

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

* See Sections IV(b)(vi) and IV(b)(vii) for a discussion of Notice of Intent (NOI) vs. a Step-1 proposal.

APPENDIX	PROGRAM	NOI/ Step-1* DUE DATE	PROPOSAL DUE DATE
A.2	Land-Cover/Land-Use Change	6/11/2007	10/1/2007
A.3	Carbon Cycle Science	4/6/2007	6/6/2007
A.4	Terrestrial Ecology	6/15/2007	8/15/2007
A.5	Ocean Biology and Biogeochemistry	TBD	TBD
A.6	Physical Oceanography	4/27/2007	6/28/2007
A.7	Ocean Surface Topography Science Team	8/31/2007	10/31/2007
A.8	Cryospheric Science	4/16/2007	6/15/2007
A.9	NASA Energy and Water Cycle Study	4/18/2007	6/18/2007
A.10	Terrestrial Hydrology	8/1/2007	10/1/2007
A.11	Atmospheric Composition: Aura Science Team	4/30/2007	6/15/2007
A.12	Atmospheric Composition: Science Advisory Group for the Glory Science Mission	N/A	5/1/2007
A.13	Tropospheric Chemistry: Arctic Research of the Composition of the Troposphere from Aircraft and Satellites	4/16/2007	6/15/2007
A.14	Wind Lidar Science	3/16/2007	5/16/2007
A.15	Accelerating Operational Use of Research Data	7/6/2007	9/18/2007
A.16	Earth Surface and Interior	5/25/2007	7/25/2007
A.17	EarthScope: The InSAR and Geodetic Imaging Component	6/8/2007	8/10/2007
A.18	Airborne Instrument Technology Transition	3/16/2007	5/16/2007
A.19	Space Archaeology	5/15/2007	7/25/2007
A.20	Decision Support through Earth Science Research Results	3/15/2007	5/25/2007
A.21	New Investigator Program in Earth Science	6/29/2007	8/31/2007
A.22	Advancing Collaborative Connections for Earth System Science	3/15/2007	6/1/2007
A.23	Making Earth System Data Records for Use in Research Environments	Not solicited this year	
A.24	Advanced Information Systems Technology	Not solicited this year	
A.25	Advanced Component Technology	Not solicited this year	
A.26	Instrument Incubator	TBD	TBD
A.27	Data Rights and Related Issues	N/A	N/A
B.2	Solar and Heliospheric Physics	12/7/2007	2/8/2008

APPENDIX	PROGRAM	NOI/ Step-1* DUE DATE	PROPOSAL DUE DATE
B.3	Geospace Science	5/11/2007	7/20/2007
B.4	Heliophysics Theory	4/27/2007	6/29/2007
B.5	Heliophysics Guest Investigators	3/16/2007	5/11/2007
B.6	Living With a Star Space Environment Testbeds	9/14/2007	11/16/2007
B.7	Living With a Star Targeted Research and Technology	7/27/2007	8/31/2007
B.8	Living With a Star Targeted Research and Technology: Strategic Capability	7/27/2007	8/31/2007
B.9	Virtual Observatories for Heliophysics Data	9/12/2007	11/15/2007
C.2	Cosmochemistry [1][2]	3/22/2007	5/18/2007
C.3	Sample Return Laboratory Instruments and Data Analysis	4/27/2007	6/29/2007
C.4	Planetary Geology and Geophysics [1][2]	3/23/2007	5/16/2007
C.5	Planetary Astronomy [1][2]	4/12/2007	5/31/2007
C.6	Planetary Atmospheres [1][2]	4/18/2007	6/15/2007
C.7	Outer Planets Research [1][2]	8/31/2007	11/2/2007
C.8	Lunar Advanced Science and Exploration Research	TBD	TBD
C.9	New Horizons at Jupiter Data Analysis	TBD	TBD
C.10	Cassini Data Analysis	4/5/2007	5/30/2007
C.11	Discovery Data Analysis [2]	3/26/2007	5/25/2007
C.12	Mars Data Analysis [2]	7/13/2007	9/7/2007
C.13	Mars Fundamental Research [1][2]	5/16/2007	7/18/2007
C.14	Mars Instrument Development Project	5/7/2007	7/6/2007
C.15	Mars Technology Project	Solicitation pending decision	
C.16	Planetary Instrument Definition and Development	6/8/2007	8/3/2007
C.17	Astrobiology: Exobiology and Evolutionary Biology [1][2]	7/19/2007	9/20/2007
C.18	Planetary Protection Research	6/26/2007	8/7/2007
C.19	Astrobiology Science and Technology Instrument Development and Mission Concept Studies [2]	Solicitation pending decision	

APPENDIX	PROGRAM	NOI/ Step-1* DUE DATE	PROPOSAL DUE DATE
C.20	Astrobiology Science and Technology for Exploring Planets [2]	Solicitation pending decision	
C.21	In-Space Propulsion	Solicitation pending decision	
C.22	Fellowships for Early Career Researchers (new applicants)	See Program Element of Interest [2]	
	Fellowships for Early Career Researchers (current fellows)	N/A	5/31/2007 or 10/31/2007
C.23	Planetary Major Equipment	See Program Element of Interest [1]	
D.2	Astrophysics Data Analysis	4/27/2007	6/22/2007
D.3	Astronomy and Physics Research and Analysis	3/3/2008	4/11/2008
D.4	Astrophysics Theory and Fundamental Physics	4/6/2007	6/1/2007
D.5	GALEX Guest Investigator – Cycle 4	4/27/2007	6/22/2007
D.6	FUSE Guest Investigator – Cycle 9	4/13/2007	6/8/2007
D.7	Swift Guest Investigator – Cycle 4	9/14/2007	11/9/2007
D.8	Suzaku Guest Observer – Cycle 3	9/14/2007	11/30/2007
D.9	GLAST Guest Investigator – Cycle 1	4/20/2007	6/15/2007
D.10	Kepler Mission Participating Scientists	3/16/2007	5/18/2007
E.2	Applied Information Systems Research	TBD	TBD
E.3	Origins of Solar Systems [1]	4/9/2007	5/25/2007

Notes:
[1] The proposals for program element *Planetary Major Equipment* (C.23) 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); Mars Fundamental Research (Appendix C.13); Astrobiology: Exobiology and Evolutionary Biology (Appendix C.17); and Origins of Solar Systems (Appendix E.3).
[2] 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); Discovery 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 Instrument Development (Appendix C.19); and Astrobiology Science and Technology for Exploring Planets (Appendix C.20).

APPENDIX A. EARTH SCIENCE RESEARCH PROGRAM

A.1 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 suborbital (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 agencies that can use the generated information in environmental forecasting and in policy and resource management. 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 under the National Science and Technology Council), such as the U.S. Climate Change Science and Technology Programs, the U.S. Group on Earth Observations, the Ocean Action Plan, the U.S. Weather Research Program, the EarthScope Program, and NASA-National Oceanic and Atmospheric Administration (NOAA) 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 3.1 to study planet Earth from space to advance scientific understanding and meet societal needs (see the *2006 NASA Strategic Plan*)**.** In particular, it addresses the more specific Science Outcomes (see the *NASA Science Plan*), 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://science.hq.nasa.gov/strategy/past.html. The most up-to-date description of the Earth Science Research Program may be found in the *NASA Science Plan* at http://science.hq.nasa.gov/strategy. A decadal study for the satellite component of NASA's Earth science activities has been carried out by the National Academy of Sciences (NAS) and will be available at http://www.nap.edu/catalog/. An interim report of this study, *Earth Science and Applications from Space: Urgent Needs and Opportunities to Serve the Nation*, is available from the NAS at http://www.nap.edu/catalog/11281.html.

Research is solicited in three major areas for the Earth Science Research Program: research and analysis, 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 emphasizes the development of partnerships with other organizational entities, most notably other agencies of the U.S. Government, to facilitate the use of NASA-produced science data products into their decision-support systems in order to improve the quality of forecasts, policy, and/or resource management that they produce. 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 suborbital 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 addition, there are several cross-cutting elements included within this appendix. These include one instrument science team (Ocean Surface Topography Science Team, Appendix A.7), one mission science team (Atmospheric Composition: Aura Science Team, Appendix A.11), one instrument advisory team (Atmospheric Composition: Science Advisory Group for the Glory Mission, Appendix A.12), one on accelerating research use of operational data, which emphasizes but is not restricted to weather (Accelerating Operational use of Research Data, Appendix A.15), and one cross-cutting element on technology transfer between focused technology and research programs for airborne instruments (Airborne Instrument Technology Transition, Appendix A.18). There is also one additional element (Space Archaeology, Appendix A.19) which does not fit neatly into the Focus Area structure, but which represents a unique opportunity for utilizing NASA data for novel activities.

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. Programs in Land-Cover and Land-Use Change (Appendix A.2), Carbon Cycle Science (Appendix A.3), Terrestrial Ecology (Appendix A.4), and Ocean Biology and Biogeochemistry (Appendix A.5), are solicited under the Carbon Cycle and Ecosystems Focus Area in ROSES 2007.

The goals of the Carbon Cycle and Ecosystems Focus Area are to:

- document and understand how the global carbon cycle, terrestrial and marine ecosystems, and land cover and use are changing;
- quantify global productivity, biomass, carbon fluxes, and changes in land cover; and
- provide useful projections of future changes in global carbon cycling, land cover and use, and terrestrial and marine ecosystems for use in ecological forecasting and in improving climate change predictions.

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.

Four program elements in this NRA directly support the carbon cycle and ecosystems Focus Area:

- Land-Cover and Land-Use Change (Appendix A.2);
- Carbon Cycle Science (Appendix A.3);

- Terrestrial Ecology (Appendix A.4); and
- Ocean Biology and Biogeochemistry (Appendix A.5)

Topics relevant to the Carbon Cycle and Ecosystems Focus Area are included in the following program elements solicited in this NRA:

- Atmospheric Composition: Aura Science Team (Appendix A.11);
- Accelerating Operational Use of Research Data (Appendix A.15); and
- Airborne Instrument Technology Transition (Appendix A.18).

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 may have global impacts. 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 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:

- Physical Oceanography (Appendix A.6);
- Ocean Surface Topography Science Team (Appendix A.7); and
- Cryospheric Science (Appendix A.8).

Topics relevant to the Climate Variability and Change Focus Area are included in the following program elements solicited in this NRA:

- Atmospheric Composition: Aura Science Team (Appendix A.11);
- Atmospheric Composition: Science Advisory Group for the Glory Science Mission (Appendix A.12);
- Accelerating Operational Use of Research Data (Appendix A.15); and
- Airborne Instrument Technology Transition (Appendix A.18).

2.3 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://watercycle.gsfc.nasa.gov. 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; Appendix A.9), for which more information can be found at http://gwec.gsfc.nasa.gov/, and specific research projects are sought as a separate program element. 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 National Applications areas of Water Management, Disaster Management, and Agricultural Efficiency. 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."

Two program elements in this NRA directly support the water and energy cycle Focus Area:

- NASA Energy and Water Cycle Study (NEWS; Appendix A.9); and
- Terrestrial Hydrology (Appendix A.10)

Topics relevant to the Water and Energy Cycle Focus Area are also included in the following program elements solicited in this NRA:

- Atmospheric Composition: Aura Science Team (Appendix A.11);
- Atmospheric Composition: Science Advisory Group for the Glory Science Mission (Appendix A.12);
- Accelerating Operational Use of Research Data (Appendix A.15); and
- Airborne Instrument Technology Transition (Appendix A.18).

2.4 Atmospheric Composition

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. The ability of the atmosphere to integrate surface emissions globally on time scales from weeks to years couples several environmental issues, including global ozone depletion and recovery and its impact on surface ultraviolet radiation, climate forcing by radiatively active gases and aerosols, and global air quality. Thus, atmospheric chemistry and associated composition are central aspects of Earth system dynamics.

NASA's research for furthering our understanding of atmospheric composition is geared to providing an improved prognostic capability for 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.

The Atmospheric Composition program has three elements solicited in this NRA:

- Atmospheric Composition: Aura Science Team (Appendix A.11);
- Atmospheric Composition: Science Advisory Group for the Glory Science Mission (Appendix A.12); and
- Tropospheric Chemistry: Arctic Research of the Composition of the Troposphere from Aircraft and Satellites (Appendix A.13).

While the recompetition of the Aura science team will emphasize the Atmospheric Composition Focus Area, it is worth noting that Aura science has the potential to contribute to all of the other Focus Areas, so it is listed as a contributing element for each of them in this appendix.

Topics relevant to the Atmospheric Composition Focus Area are also included in the following program elements solicited in this NRA:

- Accelerating Operational use of Research Data (Appendix A.15); and
- Airborne Instrument Technology Transition (Appendix A.18).

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). These centers 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 Tropospheric Cloud System and Processes (TCSP) 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 suborbital 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 two ROSES elements directed most specifically for the Weather Focus Area during the current fiscal year are:

- Wind Lidar Science (Appendix A.14); and
- Accelerating Operational use of Research Data (Appendix A.15).

Topics relevant to the Weather Focus Area are also included in the following program elements solicited in this NRA:

- Atmospheric Composition: Aura Science Team (Appendix A.11); and
- Airborne Instrument Technology Transition (Appendix A.18)

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.

Two program elements are solicited in this NRA that are directed specifically towards the Earth Surface and Interior Focus Area:

- Earth Surface and Interior, (Appendix A.16); and
- EarthScope: the InSAR and Geodetic Imaging Component (Appendix A.17).

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

- Atmospheric Composition: Aura Science Team (Appendix A.11); and
- Airborne Instrument Technology Transition (Appendix A.18).

A cross-cutting element potentially supporting all of the Focus Areas and serving as a bridge to the technology program (see section 4.5 below) is an Airborne Instrument Technology Transition Program (Appendix A.18). This element is designed to support the completion of airborne instruments whose development has begun and been largely, but not totally, completed under the Instrument Incubator Program (see section 4.5 and Appendix A.26) or other instrument-development activities. This solicitation has the potential to lead to funding in any of the program elements, so it is identified as a contributing element to all the Focus Areas.

One additional element that does not fit neatly into the Focus Area structure is one on Space Archaeology (Appendix A.19). This element builds largely on research carried out at NASA's Marshall Space Flight Center and provides an opportunity for the broader community to propose innovative studies that can utilize space-based remote sensing data to help identify regions of interest for archaeological studies and to facilitate interactions between remote-sensing scientists and archaeologists so that they can better make use of available data, tools, and techniques to support research in archaeology.

3. Applied Sciences

The primary goal of the NASA Applied Sciences Program is to extend the use of Earth Science Research Program results to serve society by informing decision support with enhanced knowledge, information, and technology. NASA forms partnerships with public, academic, and private organizations to pursue innovative approaches for benchmarking the use of Earth Science Research Program results in decision-support tools. The Applied Sciences Program focuses on facilitating the integration of observations from Earth-observing systems and predictions and forecasts from Earth System and Earth-Sun science models into the decision-making processes of partnering

agency and national organizations. Additional information is accessible at http://science.hq.nasa.gov/earth-sun/applications.

NASA employs a systems engineering approach—involving evaluation, validation and verification, and benchmarking—to identify science results of value to partner organizations (e.g., Government, not-for-profit, and private-sector companies), develop prototype products, address systems integration issues with the partners, and document the capacity of integrated system solutions to be adopted or adapted for operational use. Outcomes for partner organizations include the use of project results, such as prototypes and benchmark reports, to enable expanded use of Earth science products and enhance their decision-support capabilities. The program's impacts include enhanced decision-support tools that have economic and environmental security benefits. Through the process of benchmarking beneficial uses and applications of Earth science measurements and technology, the Applied Sciences Program enables significant scientific and technological returns on the Federal investments in NASA research and development of aerospace science and technology.

NASA focuses on 12 application topics of national priority: Agricultural Efficiency, Air Quality, Aviation, Carbon Management, Coastal Management, Disaster Management, Ecological Forecasting, Energy Management, Homeland Security, Invasive Species, Public Health, and Water Management.

NASA works with organizations that have decision-support tools and policy and management responsibilities associated with the 12 application topics. Activities are underway in each of the applications of national priority. For example, in Disaster Management, NASA works with the National Oceanographic and Atmospheric Administration (NOAA) to integrate innovative scientific knowledge and technologies to improve warnings and predictions of hurricanes, tornadoes, and other severe weather events.

The Applied Sciences Program solicits proposals through the Decision Support through Earth Science Research Results Program (Appendix A.20).

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 suborbital 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 next generation of explorers. 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.

The SMD Education and Public Outreach (E/PO) Program is designed to utilize NASA's unique capabilities and information technology to support NASA's educational goals in elementary/secondary, higher, and informal education. The E/PO Program works collaboratively with educators, as well as educational institutions and organizations to catalyze action at a scale great enough to ensure impact nationally and internationally. The E/PO Program also ensures the alignment of all endeavors in education and outreach with the NASA Education operating principles for Customer Focus, Content, Pipeline, Diversity, Evaluation, and Partnership/Sustainability. The *NASA Education Strategy* at http://www.education.nasa.gov/about/strategy and the SMD E/PO program at http://science.hq.nasa.gov/education provide further information and describe the considerable resources in Earth and space science education.

While some of the Earth Science Research Program education and outreach activities are embedded in and competitively selected as part of the flight and research programs, others issue program announcements periodically. What has historically been known as the Earth System Science Fellowship (ESSF) Program for training of graduate students in Earth System Science, is now being combined into a single, directorate-wide NASA Earth and Space Science Fellowship (NESSF) program, which was solicited outside of ROSES, with proposals having been due February 1, 2007. The New Investigator Program (NIP) in Earth Science (Appendix A.21), which is directed towards scientists within five years of their receipt of a terminal degree, is solicited this year. In responding to the NIP announcement, proposers must include both a research component and an education/outreach component, with the approximate contributions of these activities to the rating being 2/3 and 1/3, respectively.

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 require multiple temporal and spatial scales, emphasize the need for having a range of data products, and place stringent requirements on NASA for its data processing, archival, and data dissemination activities. These products and services

will be variously useful to multiple classes of users, from sophisticated scientific users to other Government and private sector entities that use NASA's information for policy and resource management decisions and including scientifically attentive members of the public who utilize data and information for general information and recreation.

NASA's data and information management activities are described in NASA's *2003 Earth Science Strategy* at http://science.hq.nasa.gov/strategy.

Two program elements in the area of data and information management are included in this NRA: the Advancing Collaborative Connections for Earth System Science (ACCESS; Appendix A.22) and the Making Earth System data records for Use in Research Environments (MEaSUREs) Program (Appendix A.23). The latter is not being solicited this year, but is being included to emphasize a continuing commitment to this activity (which was previously called the Research, Education, Applications, and Solutions Network).

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.

The 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 for the advancement of Earth system modeling and data assimilation. No program elements for computational science are solicited in this NRA, however those interested are encouraged to consult the Applied Information Systems Research (AISR) element defined in the appendix (Appendix E.2) for Cross-Division Research Program activities. There will be some elements of interest to Earth science researchers in that the Earth Science Division intends to support a small number of high-quality and relevant Earth science-related proposals may be submitted to that element.

4.4 Suborbital Science

The Earth Science Research Program suborbital science program provides access to airborne and balloon-based platforms that can be used to obtain measurements of the

Earth. Suborbital 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. Suborbital 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, and P-3B, as well as several independently owned aircraft, including but not limited to those operated by other Federal agencies. Current experiments with new platforms include access in FY 2006 to the Aerosonde and Altair unmanned aerial vehicles (UAVs), as well as the innovative Proteus platform. By working with the Aeronautics Mission Directorate of NASA, SMD hopes to pioneer new types of suborbital missions that capitalize on NASA's unique expertise in platforms, sensors, and aeronautical operations.

The FY 2008 Call Letter for Flight Requests supporting approved investigations is expected to be released in April 2007. ROSES-2007 program elements that solicit suborbital-platform-based research include:

- Carbon Cycle Science (Appendix A.3);
- Ocean Biology and Biogeochemistry (Appendix A.5);
- Tropospheric Chemistry: Arctic Research of the Composition of the Troposphere from Aircraft and Satellites (Appendix A.13); and
- Airborne Instrument Technology Transition (Appendix A.18).

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. Requirements for advanced technology development are based on requirements articulated in the *2003 Earth Science Enterprise Strategy* at http://science.hq.nasa.gov/strategy (in particular, see pages 43-45 of this document for appreciable detail).

The Earth Science Research Program identified technology requirements using a collaborative process of dialog between scientists, engineers, and technology experts, which is recorded and made available through a highly accessible database (http://estips.gsfc.nasa.gov/). This database provides a basis for the management of the Earth Science technology investment portfolio.

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 facilitated to establish connections between developers of maturing technologies and scientific investigators proposing new observing or modeling approaches, and also in response to open solicitations. 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 maintains several program lines through which technology investments are competed and that cover a range of technology readiness levels (TRLs):

- Advanced Information Systems Technology Program (Appendix A.24);
- Advanced Component Technology (Appendix A.25); and
- Instrument Incubator Program (Appendix A.26).

All three technology program elements are included but are not solicited this year.

A.2 LAND-COVER/LAND-USE CHANGE

1. Scope of Program

1.1 Introduction

The Land-Cover/Land-Use Change (LCLUC) Program is an interdisciplinary science program in the Earth Science Research Program of the Science Mission Directorate. LCLUC is part of the Carbon Cycle and Ecosystems Focus Area. It also has strong links to the Terrestrial Hydrology Program of the Water and Energy Cycle Focus Area. See the Earth Science Research Program Overview (Appendix A.1) for a description of Earth science Focus Areas.

LCLUC Goals are to:

- Develop the capability to perform repeated global inventories of land-use and land-cover from space,
- Develop the scientific understanding and models necessary to simulate the processes taking place,
- Evaluate the consequences of observed and predicted changes,
- Further the understanding of the consequences of land-use and land-cover changes on environmental goods and services, the carbon and water cycles and the management of natural resources, and
- Improve understanding of human interaction with the environment and thus provide a scientific foundation for sustainability, vulnerability, and resilience of land systems and their use.

LCLUC Key Science Questions are:

- Where are land cover and land use changing, what is the extent and over what time scale?
- What are the causes and what are the consequences of LCLUC?
- What are the projected changes of land use and land cover and their potential impacts?
- What are the impacts of climate variability and changes on LCLUC and what is the potential feedback?

Proposers to this program element are encouraged to read Appendix A.1 for an overview of how the LCLUC Program fits into the Earth Science Research Program. Also, prospective proposers to this LCLUC program are strongly encouraged to pay special attention to the description and science questions of the Land-Use and Land-Cover Change (LULCC) element discussed in Chapter 6 of the *U.S. Climate Change Science Program (CCSP) Strategic Plan* found at http://www.usgcrp.gov/usgcrp/ProgramElements/land.htm.

1.2 Major Strategic International Programs/Projects Supported by the LCLUC Program

Through its research projects, NASA will continue to contribute to international programs and activities, which help meet the agency's programmatic goals. LCLUC currently identifies four international projects whose research goals are closely aligned with those of the LCLUC program.

1.2.1 The Global Terrestrial Observing System (GTOS) GOFC-GOLD Project

Global Observation of Forest and Land-Cover Dynamics (GOFC-GOLD) Project, sponsored by several agencies including NASA, is a coordinated international effort to coordinate ongoing space-based and *in situ* observations of forests and other vegetation cover for the sustainable management of terrestrial resources and in support of global change science, in particular to obtain an accurate, reliable, quantitative understanding of the terrestrial carbon budget (http://www.fao.org/gtos/gofc-gold/). The essence of the GOFC-GOLD implementation strategy is to develop and demonstrate operational forest monitoring at regional and global scales by conducting pilot projects and developing prototype products within three primary themes: Land-Cover Characteristics and Changes, Fire Monitoring and Mapping, and Land-Cover Biophysical Processes.

The NASA LCLUC program provides opportunities to characterize and quantify the rates of change in land cover and land use, including fires, within the GOFC-GOLD framework through the use of space-based observations.

1.2.2 The IGBP/IHDP Global Land Project (GLP)

The GLP is a joint research project of the International Geosphere-Biosphere Programme (IGBP) and the International Human Dimensions Programme (IHDP) (http://www.globallandproject.org/). The *GLP Science Plan* represents the research framework for the coming decade for land systems. The GLP is designed to better integrate the understanding of the coupled human-environment system, which reflects the recognition of the fundamental nature of how human activities on land are affecting feedbacks to the Earth as an integrated system and the response of the human-environment system to global change. The GLP research planning builds upon the extensive heritage of IGBP global networks of scientists, data, and disciplinary understanding, particularly from the Global Change and Terrestrial Ecosystems (GCTE) project and the Land Use/Cover Change (LUCC) project sponsored by IGBP and IHDP. The GLP has three objectives that provide the framework for the research:

- To identify the agents, structures, and nature of change in coupled human-environment systems on land and quantify their effects on the coupled system;
- To assess how the provision of ecosystem services is affected by these changes; and
- To identify the character and dynamics of vulnerable and sustainable, coupled human-environment land systems to interacting perturbations, including climate change.

The objectives of the NASA LCLUC program have considerable overlap with the three thematic areas outlined by the GLP: the causes and nature of land system change, the consequences of land system change, and integrating analysis and modeling for land sustainability.

1.2.3 The Northern Eurasia Earth Science Partnership Initiative (NEESPI)

The NEESPI is an External Project of the International Geosphere-Biosphere Program (IGBP). It is a multidisciplinary program of internationally supported Earth systems science research that has as its foci issues in northern Eurasia that are relevant to regional and global scientific and decision-making communities (see http://neespi.org/). This part of the globe is undergoing significant changes—particularly those changes associated with a rapidly warming climate in this region and with important changes in governmental structures since the early 1990s and their associated influences on land use and the environment across this broad expanse of the Earth. The NEESPI research strategy intends to capitalize upon a variety of remote sensing and other tools and implement a general modeling framework linking socioeconomic factors, crop, pollution, land use, ecosystem, and climate models with observational data to address the key research questions within northern Eurasia.

Proposers to the NASA LCLUC Program are encouraged to pay special attention to the LCLUC-related components of the NEESPI Science Plan found at http://neespi.org/. Especially relevant to the NASA LCLUC Program are the following science questions:

- What has been the role of anthropogenic impacts on producing the current status of the ecosystem, both through local land use/land cover modifications and through global gas and aerosol inputs? What are the hemispheric scale interactions, and what are the local effects?
- How will future human actions affect the Northern Eurasia and global ecosystems? How can we describe these processes using a suite of local, regional, and global models?
- What will be the consequences of global changes for regional environment, the economy, and the quality of life in Northern Eurasia?

1.2.4 The Monsoon Asia Integrated Regional Study (MAIRS)

The Monsoon Asia Integrated Regional Study (MAIRS) is an Integrated Regional Study project under the Earth System Science Partnership (ESSP), which includes IGBP, IHDP, World Climate Research Program (WCRP) and DIVERSITAS programs (see http://www.mairs-essp.org). The region of Monsoon Asia covers South, Southeast, and East Asia. Having the highest population density of the world, this region has experienced one of the most rapid changes in the past decade and is likely to undergo further rapid development in the coming years. Human activities in the monsoon Asia region significantly affect environmental conditions, both regionally and globally.

The MAIRS goal is to better understand how human activities in the region are interacting with and altering natural variability of atmospheric, terrestrial, and marine components of the monsoon system; to contribute to the provision of a sound scientific basis for sustainable development of monsoon Asia; and to develop a predictive capability of estimating changes in global-regional linkages in the Earth system and to project the consequences of such changes.

The key science questions are:

- What will the Monsoon Asian region be like in 50 years?
- What will be the consequences of these projected changes for the welfare of the Asia region? and
- What will be the consequences of these changes for the Earth system?

1.3 Solicited Research

The focus of this solicitation is to contribute to the US CCSP in achieving the Goal 4 in its list of priorities to understand the sensitivity and adaptability of different natural and managed ecosystems and human systems to climate and related global changes. There are two components to the current solicitation.

The first component (hereafter referred to as "Projections") is focused on the science question of the LULCC strategic plan: "What are the environmental, social, economic and human health consequences of current and potential LCLUC over the next 5 to 50 years?" Determining the effects of land-use and land-cover change on the Earth system depends on an understanding of past land-use practices, current land-use and land-cover patterns, and projections of future land use and cover, as affected by human activities, population size and distribution, economic development, technology, and other factors. Proposals are solicited to improve predictive models for land-cover or land-use change as related to climate change, regional carbon budgets, water resources, ecosystems, population density, or biodiversity. We encourage methodological advances needed to improve land-use and land-cover change models and innovative methods for projecting LCLUC patterns and characteristics, including strategies for integrating ground-based data, socioeconomic and demographic statistics and remotely sensed measurements. Proposals, which explicitly include elements of social science within the models, will be preferred over strictly biogeophysical proposals that claim a societal benefit. Note that the LCLUC program is contributor to the Global Earth Observation System of Systems (GEOSS) process; therefore, it is desirable that proposals are tied to one or more of the nine GEOSS societal needs (http://www.earthobservations.org).

The NASA LCLUC program will only support proposals with a strong remote sensing component. For NASA's purposes, the use of data from U.S. Earth-observing satellites is a high priority. However, the use of non-U.S. and commercial satellites having accessible and relevant databases are also encouraged.

A note for the proposals on Northern Eurasia: The awarded projects whose geographic area is within the NEESPI domain and having in-country scientist collaboration will become members of the NEESPI International Science Team. Studies of environmental and human impacts related to LCLUC near the Arctic Circle will contribute to the International Polar Year program (http://www.ipy.org).

A budget for travel to at least one-per year NEESPI or MAIRS meetings overseas in addition to project-related travel should be included in the proposal budget. 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)). However, supplies and services can be purchased from foreign investigators to facilitate the research activities by U.S. investigators, providing any purchased goods or services do not constitute research.

The second component of this solicitation (hereafter referred to as "Landsat") addresses a key CCSP priority of collection, archival, and subsequent scientific use of global Landsat data for 2-3 years circa 2005. This activity is based on the NASA-US Geological Survey effort referred to as the Mid-Decadal Global Land Survey (MDGLS). The MDGLS project is gradually moving from Phase I (collection and archival) to Phase II, which includes scene selection and orthorectification. The current solicitation is focused on Phase III, which will generate higher-level products, such as land cover/land cover change. The LCLUC program will support prototyping and validation of MDGLS Phase III products and scientific use of these data to help achieving the goals of the CCSP and the international programs listed in Section 1.2. More information on MDGLS can be found at http://lcluc.umd.edu/mdgls/index.html.

To achieve the ultimate goal of analyzing land-cover change through the last decades, this solicitation will consider proposals on land-cover classifications and land-cover change based on earlier Landsat orthorectified data, a.k.a. "Geocover datasets," developed for the 1970's, 1990, and 2000. Access to Geocover data and their structure are described on the following websites: http://www.landsat.org/, http://glcf.umiacs.umd.edu/pdf/Landsat_GeoCover_Tutorial.pdf, http://edc.usgs.gov/products/satellite/PERSMarch_04_313-322.pdf, and http://www.mdafederal.com/digital-imaging/image-products-services/geocover-ortho-landsat-products/. Priority will be given to proposals with the goals to develop continental-scale products.

The use of the Land Cover Classification System (LCCS) for further intercomparison studies is strongly recommended for proposals that will produce land classification. A description of LCCS can be found at http://www.fao.org/DOCREP/003/X0596E/X0596E00.HTM.

Additionally, the "Landsat" component welcomes proposals that would contribute to the Landsat data gap studies. Both Landsat-5 and -7 have experienced technical problems during the past three years. In 2-3 years they will exhaust their fuel capacity. Moreover, mechanical problems may shorten the lifetime of either satellite, which will lead to a data gap. This may occur anytime from present (if the current sensors fail) and will extend until the next Landsat mission (not earlier than 2011). To mitigate this potential data gap,

NASA and USGS are investigating the use of foreign Landsat-class data in the interim period. There is no sensor in space that can replace Landsat. There are differences in spectral capability, spatial resolution, viewing geometry, etc. The current solicitation welcomes proposals exploring our scientific potential in using non-Landsat data versus the current Landsat capabilities. Topics could include cross-calibration of Landsat and foreign Landsat-class data, intercomparison of land cover and other biogeophysical products based on various data sources, including their in situ validation, exploring the limitations of fewer spectral wave bands, investigating the limitations of coarser resolution and wider range of viewing geometry, and other relevant studies of the potential and limitations in using Landsat-class data in lieu of the currently available Landsat observations.

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 with annual funding contingent upon the submission of satisfactory progress reports and available funding. The “Landsat” component proposals will be funded for not more than a two-year period with LCLUC products becoming available during late 2008-early 2009.

2.2 Funding Available for Support of Selected Proposals

The total annual budget for the LCLUC program is approximately $7.5 M. About $1.5M per year from the NASA LCLUC program is expected to be available for the support of 5-7 new investigations selected from proposals submitted in response to this solicitation under the “Projections” component. NASA expects to fund 1-2 team proposals in the $350-400K range and 4-5 proposals in the $200-250K range. Additional $2M will be available for up to two years to support 5-7 new investigations under the "Landsat" component. NASA expects to fund 3-4 proposals in the $350-400K range for generating MDGLS Phase III higher-level products and 2-3 proposals in the $150-200K range for contributing to the Landsat data gap study.

Pending the availability of funds through the Federal budget process for Fiscal Year 2008, NASA expects to make selections in late 2007. Anticipated starting dates for selected projects will be in February-March, 2008.

2.3 The Two-Step Proposal Procedure

To streamline the proposal process and relieve the work load on NASA, the community of interested proposers, and those that NASA solicits for aid in reviewing proposals, the LCLUC program is invoking a two-step proposal procedure (see also Section IV(b)(vii) of this NRA’s *Summary of Solicitation*). For this process, the Notice of Intent (NOI) to propose takes the form of a Step-1 proposal (length not to exceed ~4000 characters including spaces and no special characters) for the intended research. Grants.gov does not

provide Step-1 capability; therefore, Step-1 proposals must be submitted electronically via NSPIRES by the NOI/Step-1 Due Date (see Tables 2 and 3 in this NRA's *Summary of Solicitation*) regardless of whether the Step-2 proposal will be submitted via NSPIRES or Grants.gov.

NSPIRES will be open for the submission of Step-1 proposals starting ~30 days in advance of the NOI/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 and relevance 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 NOI/Step-1 Due Date that they are, or are not, encouraged to submit a full Step-2 proposal.

A separate Step-1 proposal must be submitted for each intended (and thus corresponding) Step-2 proposal. Note that, because the Step-1 proposal review will not involve any budget evaluations, and since no funds will be distributed as part of the Step-1 process, formal budget estimates and submission by an Authorized Organizational Representative (AOR) are not required for Step-1 proposals.

To electronically submit a Step-1 proposal, log into the system at http://nspires.nasaprs.com, complete the NOI/Step-1 form by inserting the text of the Step-1 proposal into the Proposal Summary/Abstract text box. The Step-1 proposal should contain a single-sentence project summary followed by a brief (not to exceed ~4000 characters including spaces and no special characters), text-only description of the investigation to be proposed that includes the anticipated cooperating investigators, organizations, agencies, and/or companies (see the template below for further guidance). To facilitate the work by reviewers on Step-1 proposals the following abbreviated template is suggested for use.

- Show your knowledge of previous research carried out worldwide on the subject, may give a reference to a Web site with more details.
- Emphasize responsiveness, i.e., to which topic of the solicitation the proposal belongs and what NASA remote sensing assets are being used.
- Indicate whether it is a new topic for the proposing team or it is based on previous work pursued by that team or by some other researchers; indicate what new is being proposed as compared to the latest achievements on this topic.
- If new or improved methods, datasets, and/or models are proposed to be developed, then make a clear statement what is the new potential versus its (their) current capabilities.
- Outline expected outcomes, what will be contribution to this area of research, and what deliverables are proposed.

Step-1 reviews will not be available until after the two-step process is finished. Proposers will receive written notification no later than eight weeks after the submission of their Step-1 proposals that they are, or are not, encouraged to submit Step-2 full proposals based on reviews of their Step-1 proposals.

Step-2 (full) proposals should provide more details on methodology and elaborate on the proposed work but, for consistency and to ease the burden of reviewing, it is preferable that they follow the same structure as for the Step-1 proposals.

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).

Note: Anyone who submits a Step-1 proposal is eligible to submit a Step-2 proposal, regardless of whether or not it was encouraged by NASA. Submission of a Step-1 proposal is not required in order to submit a Step-2 proposal; however, reviewers of Step-1 proposals will not be allowed to submit Step-2 proposals. The submission of a Step-1 proposal is not a commitment to submit a Step-2 proposal. Step-2 proposals should contain the same scientific goals proposed in Step-1.

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, and identify the agency or combination of agencies best suited to funding the proposals recommended for awards. The funding recommendations will then be forwarded to a Selecting Official for confirmation. NASA then will announce the official selection of proposals for award.

Reviews of the Step-2 (full) proposals will be sent to the proposers together with their letters of acceptance/rejection. Reviews of Step-1 proposals and any other feedback from NASA management can be obtained only after the full two-step procedure is finished by contacting the NASA point-of-contact listed below.

3. Summary of Key Information

Expected annual program budget for new awards	~ $3.5M
Number of new awards pending adequate proposals of merit	~ 10-14
Maximum duration of awards	3 years (for "Projections"), 2 years (for "Landsat")
Due date for Step-1 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Due date for Step-2 proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.

NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or research objective(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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 Step-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 Step-2 proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of Step-2 proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH07ZDA001N-LCLUC
NASA point of contact concerning this program	Dr. Garik Gutman Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0276 E-mail: ggutman @nasa.gov

A.3 CARBON CYCLE SCIENCE

1. Scope of Program

This announcement offers opportunities for new and successor Carbon Cycle Science investigations within the NASA Earth Science Program and the U.S. Department of Agriculture (USDA) Cooperative State Research, Education, and Extension Services (CSREES) National Research Initiative Competitive Grants Program (NRI). NASA and USDA-CSREES seek proposals to improve understanding of changes in the distribution and cycling of carbon among the active land, ocean, and atmospheric reservoirs. Of special interest are the factors that affect changes in the sources and sinks for atmospheric carbon dioxide (CO_2) and methane (CH_4) and carbon management to slow increases of these greenhouse gases.

NASA Earth Science Research Program goals in 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. Climate Change Science Program (CCSP) activities, including the U.S. North American Carbon Program (NACP) and the Ocean Carbon and Climate Change Program (OCCC).

NASA Applied Sciences projects extend the products of Earth science research and the tools associated with that research, including observations, measurements, predictive models, and systems engineering, to meet societal needs beyond NASA Earth Science Research Program objectives. Carbon management is one of 12 applications of national priority addressed by the NASA Applied Sciences Program. Projects exploit NASA carbon cycle research results and related capabilities to enhance 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.

The USDA-CSREES mission is to advance knowledge for agriculture, the environment, human health and well being, and communities. The purpose of CSREES's NRI is to support research, education, and extension grants that address key problems of national, regional, and multistate importance in sustaining all components of agriculture. USDA research seeks to determine the significance of agricultural systems (including farm, crop, forest, and range lands) in the global carbon cycle and to identify agricultural and forestry activities that can contribute toward reducing atmospheric concentrations of greenhouse gases.

2. Carbon Cycle Research Themes

NASA and USDA-CSREES carbon cycle research contributes toward the goals of the CCSP (http://www.usgcrp.gov/) and the U.S. Ocean Action Plan (http://ocean.ceq.gov/actionplan.pdf) by providing critical scientific information about the movement of carbon in the environment and potential near- and long-term changes in the carbon cycle, including the role of and implications for societal actions. U.S. carbon cycle research addresses two broad questions:

- How large and variable are the dynamic reservoirs and fluxes of carbon within the Earth system and how might carbon cycling change and be managed in future years, decades, and centuries?
- What are our options for managing carbon sources and sinks to achieve an appropriate balance of risk, cost, and benefit to society?

In this solicitation, NASA requests proposals to use satellite observations effectively in studies to address these questions. Proposals within four research themes are of interest to NASA:

1. Global carbon cycle modeling and analysis;
2. Regional studies that provide critical understanding of and offer to reduce major uncertainties about the global carbon cycle;
3. Studies of the carbon cycle implications of ocean acidification; and
4. Decision-support systems for carbon management.

The USDA-CSREES requests proposals to conduct regional carbon studies in North America under research themes two and four.

Additionally, NASA and USDA-CSREES will consider successor proposals to advance the results of projects selected under the 2004 Carbon Cycle Science NASA Research Announcement (NRA-04-OES-01; http://nspires.nasaprs.com/external/; click on "selected proposals" and search on 2004.) toward synthesis at continental, ocean basin, and global scales.

2.1 Global Carbon Cycle Modeling and Analyses Theme

The carbon cycle is an integrated global system, and a complete understanding of changes in atmospheric CO_2 and CH_4 concentrations requires study of global carbon sources and sinks and their dynamics at relevant temporal scales. Models are primary tools for integration and scaling of information and for predicting future conditions. Better global models are required to improve the portrayal of carbon cycle dynamics and the processes that control them, as well as to couple the cycling of carbon to other processes within Earth system models.

NASA requests proposals for new or improved carbon models that are more comprehensive in treating significant processes and drivers, including those involving or

stemming from human activities. These advanced carbon models should address time scales of decades to centuries and seek to realistically portray processes occurring over longer time-scales such as plant growth, mortality, and decomposition; changes in land use and vegetation type; disturbance and recovery cycles; succession; carbon export to the deep ocean; or responses to changes in the thermohaline circulation of the ocean. Models that integrate across spatial scales, and up to the global scale, are of interest. Proposals for advanced carbon models should utilize satellite remote sensing data either to drive the model or for model evaluation (i.e., calibration or validation).

Carbon data assimilation or data fusion to ingest atmospheric measurements, satellite observations, and data from terrestrial and aquatic *in situ* networks provide formal means of integrating diverse data within carbon cycle models. The ability to understand the processes and mechanisms underlying assimilation results rests on the veracity and detail of models within assimilation or fusion systems. NASA requests proposals to extend carbon data assimilation or data fusion schemes by incorporating models of major carbon cycle components with substantially improved detail, realism, and accuracy in the representation of key processes that determine magnitudes and distributions of sources and sinks for carbon and carbon cycle dynamics affecting CO_2 or CH_4 concentrations. NASA also is interested in proposals to develop new carbon data assimilation or data fusion approaches that are truly innovative over existing schemes.

Proposals for carbon modeling and data assimilation must make substantial and critical use of NASA satellite remote sensing data.

The Orbiting Carbon Observatory (OCO), an Earth System Science Pathfinder mission expected to launch in September 2008, will provide measurements of atmospheric column CO_2 at spatial and temporal resolutions that allow more detailed estimation of sources and sinks for atmospheric CO_2 (http://oco.jpl.nasa.gov/). In this solicitation, NASA is interested in proposals to prepare the scientific community for analysis of OCO data. Such work might anticipate needs for improved atmospheric transport and inversion models, extended validation activities, or to develop data assimilation and data fusion approaches tailored specifically to OCO data and the estimation of atmospheric carbon sources and sinks. Proposed work might create or make use of simulated data or surrogate data products (e.g., observations from the Atmospheric InfraRed Sounder (AIRS) on Aqua, the Tropospheric Emission Spectrometer (TES) on Aura, Japan's Interferometric Monitor for Greenhouse Gases (IMG), or the European Space Agency's Scanning Imaging Absorption SpectroMeter for Atmospheric CHartographY (SCIAMACHY)). Proposals should complement, not duplicate, work undertaken by instrument science teams.

2.2 Regional Studies to Reduce Major Global Carbon Cycle Uncertainties Theme

NASA requests proposals for regional carbon cycle studies where critical understanding can be achieved to reduce major uncertainties about the global carbon cycle. Proposals should focus on regions of the Earth (land, ocean, or integrated terrestrial-aquatic systems) and on carbon cycling processes that can cause significant changes in fluxes of

CO_2 or CH_4 to the atmosphere or in the size and longevity of important carbon sources and sinks. To be of interest, such studies must take advantage of unique NASA capabilities and/or make substantial use of remote sensing observations. An understanding of the errors associated with measurement and quantification must accompany these research results.

The northern high latitudes, inclusive of boreal and arctic ecosystems, are one region of specific interest. These areas are experiencing significant changes and are projected to respond strongly to future climate change. Changes in the carbon dynamics of these regions may have profound feedbacks to climate through altered productivity and decomposition rates, melting permafrost, aquatic transport and transformation of carbon, and changes in albedo and the surface energy budget. Proposals for regional studies at northern high latitudes should include appropriate linkages to and address the requirements of the NACP (http://www.nacarbon.org/), Northern Eurasia Earth Science Partnership Initiative (NEESPI; http://neespi.org/; also see Appendix A.2 of this NRA, sections 1.2.3 and 1.3, for information about requirements for NEESPI participation), or the International Polar Year (IPY; http://www.ipy.org/).

In this solicitation, NASA is interested only in regions that are large enough to be significant in continental- to global-scale carbon budgets either in terms of area (generally areas greater than 1,000,000 km^2) or in terms of atmospheric exchanges and changes in carbon stocks.

USDA-CSREES requests proposals addressing the contributions of North American agriculture, forestry, and land-use and land-cover change to greenhouse gas fluxes; CO_2, CO, and CH_4 are of particular interest. USDA-CSREES is also interested in proposals to investigate carbon storage and exchange within North American agricultural, silvicultural, and rangeland systems. Predictive model results that inform policies regarding carbon in agricultural and forestry sectors are of interest. Projects that coordinate with observational and experimental facilities such as National Science Foundation (NSF) Long-Term Ecological Research (LTER) sites, Free-Air CO_2 Enrichment (FACE) experiments, AmeriFlux, and proposed Critical Zone sites, as well as those established by NACP field campaigns are particularly encouraged.

2.3 Ocean Acidification Theme

The oceans play a critical role in the global carbon cycle and in Earth's climate. A variety of processes interact among land, ocean, and atmosphere (the Earth System), and the interplay of these processes' impacts and feedbacks on ocean chemistry. Changes in ocean chemistry, as a result of both natural and anthropogenic factors, translate to ocean biology and ocean ecosystems. One poorly understood area in need of study is ocean acidification, particularly as may result from environmental change. NASA welcomes proposals for studies that address our understanding of ocean acidification and the impacts and feedbacks on ocean chemistry and biology, including the impact of increasing or high CO_2 concentrations on ocean chemistry and ecology, such as the oceans' ability to take up CO_2. Other interests include the biotic partitioning of carbon

and how ocean processes affect and constrain where in the ocean CO_2 may be sequestered. To the extent possible, predictions of changes and quantification of ocean acidification on the broad ocean system, especially carbon dynamics, with the associated errors, are encouraged.

All studies proposed in response to this solicitation should make substantial use of NASA suborbital or satellite remote sensing data. An understanding of the errors associated with measurement and quantification must accompany these research results.

2.4 Carbon Management Theme

NASA requests proposals to address decision support for carbon management in North America, especially projects that link science results from projects related to the NACP with decision-support tools of operational users. Projects must include one or more of the following programmatic elements:

1. A review of science results from carbon cycle research to identify outcomes with potential impact on specific decision-making processes;
2. Development and evaluation of prototypes that demonstrate the potential of observations from NASA space-based systems, output from NASA predictive models, or models that use observations from NASA space-based systems to improve the performance of decision-support processes or tools; or
3. Incorporation of NASA observations from space-based systems or output from predictive models in decision-support tools of partner agencies or organizations and benchmarking the performance of the decision-making process with the NASA enhancements.

Proposals are also sought for carbon cycle science research if the need for the research is demonstrated to address a specific decision-making process. The research should include the use of NASA space-based observations and conclude with a demonstration of a prototype.

The key characteristic of the Applied Sciences Program is the identification of a decision-support tool or process used by the operational partner. When developed to its fullest extent, an Applied Sciences project documents the performance of a decision-making process before and after the integration of enhancements based on NASA research results and associated tools. In response to the recognized difficulty of finding partner agencies and candidate decision-support tools or processes, the Program also supports projects that systematically review NASA Earth science research results to identify outcomes with potential impact on decision-making processes and projects that develop and evaluate prototype solutions.

USDA-CSREES will also consider carbon management projects that integrate research activities and results with decision support tools and extension activities. Proposed

extension activities should lead to measurable behavior change or adoption of technology in an identified audience or stakeholder group.

3. Programmatic Information

3.1 Evaluation and Selection of Proposals

3.1.1 NASA and USDA-CSREES Cooperation

All proposals will be submitted to a NASA-led peer review process in accordance with the guidelines provided in this solicitation and the *NASA Guidebook for Proposers*. NASA and USDA-CSREES will collaborate in the planning and conduct of the peer review. This peer review will be followed by a programmatic review in which NASA and USDA-CSREES program officers will assess program balance across the highly-rated proposals and evaluate any logistical, implementation, cost, or management concerns. The NASA and USDA-CSREES program officers will recommend for selection the proposals that best address the objectives of this solicitation within resource constraints. The NASA and USDA-CSREES program officers will also recommend the division of funding responsibilities between the two agencies consistent with each agency's mission (see section 3.1.2 on evaluation criteria below). Co-funding is possible, and NASA and USDA-CSREES reserve the option of funding co-investigator institutions either as a subaward of the principal investigator institution's award or as a separate award directly to the co-investigator institution.

The funding recommendations will be forwarded to each participating agency's Selecting Official for confirmation. The Selecting Official for USDA-CSREES will be the Research Director, Competitive Programs. The Selecting Official for NASA will be the Director, Earth Science Division. NASA will announce the official selection of proposals for award, recognizing the agency or agencies that have agreed to be responsible for funding.

Proposals that USDA-CSREES has agreed to be responsible for will be forwarded to that agency for final negotiations and implementation of awards. Respondents selected for funding by USDA-CSREES may be asked to submit additional documentation to satisfy USDA-CSREES funding compliance and certification requirements.

3.1.2 Evaluation Criteria

Proposals will be evaluated according to the criteria specified in section C.2 of the *NASA Guidebook for Proposers*. In addition, the evaluation of intrinsic merit for a proposal that addresses the theme on decision-support systems for carbon management (Section 2.4) shall consider the soundness of the systems engineering proposed to extend NASA observations, measurements, and models to enhance existing decision support tools.

Evaluation of a proposal's relevance also will consider the potential contribution to the mission of USDA-CSREES (see Section 1) in addition to its contribution to the NASA mission.

Evaluation of the relevance of a proposal that addresses the theme on decision-support systems for carbon management (Section 2.4) shall include the following additional factors:

- the alignment with the objectives and approach of the NASA Applied Sciences Program and its carbon management program element or the alignment with the objectives and approach of the USDA-CSREES NRI Integrated Authority (see the 2007 NRI Request for Applications at http://www.csrees.usda.gov/funding/rfas/pdfs/07_nri.pdf; Part II,C,3. Integrated Projects); and
- the potential to transfer successful enhancements of decision support tools into the operational procedures of a user organization.

3.2 Programmatic Information Specific to NASA:

3.2.1 High-End Computing 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 apply for computing time on either of two NASA computing facilities at Goddard Space Flight Center's Computational and Information Sciences and Technology Office or at Ames Research Center's Advanced Supercomputing Division.

3.3 Programmatic Information Specific to USDA-CSREES

3.3.1 Eligibility

For *research projects*, the eligibility requirements for the NRI are as follows: except where otherwise prohibited by law, State agricultural experiment stations, all colleges and universities, other research institutions and organizations, Federal agencies, national laboratories, private organizations or corporations, and individuals are eligible to apply for and to receive a competitive grant.

For *integrated projects*, the eligibility requirements for the NRI are as follows: except where otherwise prohibited by law, State agricultural experiment stations, all colleges and universities, research foundations maintained by colleges or universities, private research organizations with established and demonstrated capacities to perform research or technology transfer, Federal research agencies, and national laboratories are eligible to apply for and receive a competitive grant.

3.3.2 Level of Funding Available

USDA-CSREES plans to provide $1.6 million over three years with the typical budget for a project not to exceed $600,000 over three years.

3.3.3 Legislative Authority

The authority to support research projects through the USDA-CSREES program is contained in 7 U.S.C. 450i(b). Under this authority, subject to the availability of funds, the Secretary may award competitive research grants, for periods not to exceed five years, for the support of research projects to further the programs of the USDA.

Section 401 of the Agricultural Research, Extension and Education Reform Act of 1998 (AREERA) authorizes the Secretary of Agriculture to establish a research, extension, and education competitive grants program to address critical emerging U.S. agricultural and rural issues related to future food production; environmental quality and natural resource management; farm income; or rural, economic and business and community development policy. In addition, the Secretary of Agriculture is authorized to make grants that address priority mission areas related to: (1) agricultural genomics, (2) food safety, food technology, and human nutrition, (3) new and alternative uses and production of agricultural commodities and products, (4) agricultural biotechnology, (5) natural resource management, including precision agriculture, and (6) farm efficiency and profitability, including the viability and competitiveness of small and medium-sized dairy, livestock, crop, and other commodity operations.

This program is listed in the Catalog of Federal Domestic Assistance under 10.206, National Research Initiative Competitive Grants Program, Carbon Cycle Science.

3.3.4 Current and Pending Support

For proposals funded by USDA-CSREES, the agency requires that the Current and Pending Support information be submitted for all Project Directors (PDs) and Senior/Key Persons regardless of percentage of effort.

3.3.5 Limit on Indirect Costs for USDA-CSREES Awards

Section 709 of the FY 2006 Consolidated Agricultural Appropriations Act (Public Law 109-97) limited indirect costs to 20 percent of the total Federal funds provided under each award. CSREES anticipates that the FY 2007 Agricultural Appropriations Act will include a similar limitation. Therefore, when preparing budgets, applicants should limit their requests for recovery of indirect costs to the lesser of their institution's official negotiated indirect cost rate or the equivalent of 20 percent of total Federal funds awarded. Another method of calculating the maximum allowable is 25 percent of the total direct costs. Please note that if the 2007 Agricultural Appropriations Act contains a different indirect cost limitation, CSREES will contact each successful applicant to apply the correct rate prior to the award of a grant.

3.4 Summary of Key Information

Expected annual program budget for new awards	~ $7–9M
Number of new awards pending adequate proposals of merit	~30–40
Maximum duration of awards	3 years
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.
NASA or USDA-CSREES strategic objective(s) which proposals must state and demonstrate relevance to	Proposals for NASA funding must address one or more strategic goals or strategic outcomes from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA. Proposals for USDA-CSREES funding must address one or more of the USDA-CSREES objectives listed in section 1 of this Appendix (A.3).
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 – 2007* 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. 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	NNH07ZDA001N-CARBON

Lead and NASA Earth Science Research Program point of contact concerning this program	Dr. Diane Wickland (Lead) Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0245 E-mail: Diane.E.Wickland@nasa.gov
NASA Applied Sciences point of contact concerning this program	Mr. Ed Sheffner Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0239 E-mail: Edwin.J.Sheffner@nasa.gov
USDA point of contact concerning this program	Dr. Nancy Cavallaro Competitive Programs USDA Cooperative State Research, Education and Extension Service Mail Stop 2241 Washington, DC 20250 Telephone: (202) 401-5176 E-mail: ncavallaro@crees.usda.gov

A.4 TERRESTRIAL ECOLOGY

1. Scope of Program

NASA Terrestrial Ecology research addresses changes in Earth's carbon cycle and ecosystems using space-based observations. The focus is on land-based ecosystems, changes in their structure and functioning, and their roles in supporting human life and maintaining planet Earth's habitability.

The goal of NASA's Terrestrial Ecology research is 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 (including changes in biodiversity), 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 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

The NASA Terrestrial Ecology Program seeks the following types of research investigations:

- Subelement 1: Focused studies to document the scientific foundation and requirements for new remote-sensing measurements from space (1) of vegetation physiological properties and plant functional types and (2) to complement and fill gaps among ongoing investigations of vegetation three-dimensional (3-D) structure, biomass, and disturbance measurements that evaluate technological options and data analysis methodologies;

- Subelement 2: Integrative studies that significantly advance the results of prior Terrestrial Ecology research toward meaningful answers to NASA's and the U.S. Climate Change Science Program's (CCSP's) carbon cycle and ecosystems research questions; and

- Subelement 3: Studies to develop and implement advanced ecological models or ecological model components focused on incorporating all major drivers, especially the human system drivers, of ecosystem function and all relevant processes that affect ecosystem function.

2.1 Subelement 1: Scientific Basis for New Remote Sensing Observations

2.1.1 Physiology and Functional Types

Current ecological, biogeochemical cycling, and climate models are limited by a lack of quantitative information on the variety, distribution, abundance, and temporal variability of plant groups with important physiological and ecological functions (e.g., photosynthetic pathways, growth rates, nitrogen fixers, invasive species). Examples of required information relevant to ecosystem function include: transfer of carbon through ecosystems, nitrogen content of vegetation canopies as an indicator health and decomposition rate, and detection of stress in terrestrial vegetation.

Research is solicited to evaluate and document the scientific basis for new space-based measurements of vegetation physiological properties and important terrestrial plant functional types. Of particular interest are attributes that can be derived through the analysis of continuous, high-resolution spectra spanning the visible, near infrared, and shortwave infrared portions of the electromagnetic spectrum. These attributes include plant biochemical absorption features such as pigments, nitrogen-related features, and cellulose; vegetation canopy water content; fractional cover of vegetation components (live, dead, senescent vegetation); growth forms; and photosynthetic pathways (i.e., C-3 and C-4).

2.1.2 Vegetation 3-D Structure, Biomass, and Disturbance

Research is solicited to complement ongoing investigations to scientifically evaluate the technological options and data analysis methodologies for new space-based measurements of vegetation 3-D structure, biomass, and disturbance. Researchers selected under the Remote Sensing Science for Carbon and Climate program element of the ROSES-2005 NASA Research Announcement (NNH05ZDA001N; the list of selected proposals can be found at http://nspires.nasaprs.com/, select “Solicitations,” select “Past Solicitations”) have identified specific research needs beyond the scope of their selected investigations. This solicitation calls for proposals to fulfill those specific needs. Of particular interest are: (1) studies to develop and evaluate algorithms and analysis strategies that address the merger of lidar and radar measurements (data fusion); (2) studies to quantify the effects of sampling design and measurement accuracy, frequency, and resolution on the ability to improve our quantitative knowledge of global carbon dynamics and ecosystem structure and function; and (3) studies to explore how remotely sensed structural measurements (canopy height, vertical profile, volume) will be used in carbon and ecosystem models and to document measurement requirements that derive from the requirements of those models..

2.1.3 Additional Requirements

Principal Investigators selected under subelement 1 will be expected to participate in science working groups dedicated to integrating the results of their studies and documenting science requirements for the new measurements. At least one domestic trip

per year for science working group activity should be included in the proposal's budget plan.

Research supported under subelement 1 will be expected to address uncertainties associated with proposed measurements and/or information-extraction algorithms and to quantify errors.

2.2 Subelement 2: Integrative Studies

This solicitation provides opportunities for integrative research relevant to the goals and objectives of the Terrestrial Ecology program element that will significantly advance the results of prior Terrestrial Ecology research toward meaningful answers to NASA's and relevant CCSP carbon cycle and ecosystems research questions (see chapters 7 and 8 of the Strategic Plan for the U.S. CCSP at http://www.climatescience.gov/Library/stratplan2003/final/). Funds are available for a few new or successor proposals that offer either to conduct a new or to enhance an ongoing synthesis of past research results. Proposals must explain the significant advance in scientific understanding anticipated and its relevance in terms of its likely societal impact. Research supported under subelement 2 will be expected to address uncertainties and quantify errors. Substantive use of remote sensing data is required.

2.3 Subelement 3: Advanced Ecological Models

More realistic and robust ecosystem models are needed to advance toward an improved understanding of integrated Earth system function. There is great potential to improve our capacity to model and understand change in the Earth system by focusing on incorporating all of the major drivers, especially the human system drivers, as well as key processes, into current or new ecological models. The incorporation of socioeconomic information will be essential to that progress. The most pressing need is to improve the realism of (1) regional and global ecological models and (2) ecological component models that couple to climate, hydrological, and/or atmospheric models. Funds are available for development of one or more new models or model components. Only models that make substantive use of satellite remote-sensing data will be considered.

2.4 Other Considerations

Investigators interested in proposing integrative studies (Subelement 2) or advanced ecological models (Subelement 3) to address carbon cycle science questions relevant to the topics solicited in the Carbon Cycle Science program (see Appendix A.3) should propose under the Carbon Cycle Science program element rather than under this Terrestrial Ecology program element.

3. Summary of Key Information

Expected annual program budget for new awards	~ $2-3M
Number of new awards pending adequate proposals of merit	~ 8-20
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-TE
NASA point of contact concerning this program	Dr. Diane Wickland Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0245 E-mail: Diane.E.Wickland@nasa.gov

A.5 OCEAN BIOLOGY AND BIOGEOCHEMISTRY

The Ocean Biology and Biogeochemistry Program will be competed in late 2007. The program will solicit research in conjunction with the Suborbital Science Program. Through a future ROSES amendment, the Ocean Biology and Biogeochemistry Program will focus on development of a portable suborbital platform sensor that can be deployed on an aircraft or UAV to complement space-based data and meet the needs of NASA's Ocean Biology and Biogeochemistry research program.

1. Scope of Program

The Ocean Biology and Biogeochemistry Program supports a number of research objectives, including the U.S. Climate Change Science Program (http://www.climatescience.gov/) and its strategic plan (http://www.climatescience.gov/Library/stratplan2003), which address aspects of Carbon Cycle and Ecosystem research from space. The program is also responsive to the *U.S. Ocean Action Plan* objectives (http://ocean.ceq.gov/actionplan.pdf).

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 the observation of aquatic optical properties from space, aircraft, and other suborbital platforms. Various physical and biological oceanographic mechanisms (e.g., conditions that lead to phytoplankton blooms, global oceanographic impacts, and feedbacks of climate change on air/sea CO_2 flux) cause much of the spatial and temporal variability of phytoplankton and other trophic levels, as well as carbon species in the ocean. Thus, by determining the nature of the space/time variability of aquatic optical properties that may be translated into ocean color observations, e.g. phytoplankton chlorophyll *a* and functional groups, significant progress will be made towards understanding the ocean's role in the global biogeochemical cycling and ecological modeling. Ecological models will advance our understanding of the role of the ocean (and climate feedbacks) in the changing Earth system. Ocean Biology and Biogeochemistry research mainly supports the Carbon Cycle and Ecosystem Focus Area, and one-page roadmap figures (see http://science.hq.nasa.gov/strategy/roadmaps/) for each of the Earth science focus areas portray a strategy for a decade of progress through 2015 based on a suite of systematic observations and specific programmatic elements.

Appendix A.1 provides an overview of how the Ocean Biology and Biogeochemistry Program fits into the Earth Science Research Program of NASA's Science Mission Directorate.

2. Description of Solicited Research

In 2007, Ocean Biology and Biogeochemistry Program funding will be made available for relevant research under a joint solicitation with the Suborbital Science Program to be released later in calendar year 2007 as an amendment to this ROSES-2007 NRA.

3. Programmatic Information

Questions about the Ocean Biology and Biogeochemistry Program may be directed to the Program Officer:

Dr. Paula S. Bontempi
Earth Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-1508
E-mail: paula.s.bontempi@nasa.gov

A.6 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). Analyses in the area of longer time-scale coupled atmosphere-ocean modes of variability, particularly the Meridional Overturning Circulation of the Atlantic Ocean, are sought to catalyze future observing system development and to more fully understand the ocean's role in climate predictability.

- *Understanding and estimation of sea-surface temperature and salinity.* NASA is playing a central role in providing the next generation of data products for sea surface temperature through the Global Ocean Data Assimilation Experiment (GODAE) High-Resolution Sea Surface Temperature (GHRSST) pilot project (http://www.ghrsst-pp.org) and for sea-surface salinity through the Aquarius/SAC-D mission (http://aquarius.nasa.gov). Proposals are sought which characterize and/or reduce uncertainties in these data products, utilize prototype

products to constrain ocean general-circulation models, or interact directly with the GHRSST and Aquarius projects to prepare for exploitation of data products. Such interaction may be conducted through Jorge Vazquez (JPL GHRSST Project Scientist; jv@pacific.jpl.nasa.gov) for GHRSST or Gary Lagerloef (Aquarius Principal Investigator; lager@esr.org) for Aquarius.

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.

2. Programmatic Information

Total funds available for work selected under this solicitation are approximately $2M per year for three years.

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 annual program budget for new awards	~ $2M
Number of new awards pending adequate proposals of merit	~ 10-15
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-PO
NASA point of contact concerning this program	Dr. Eric Lindstrom Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-4540 E-mail: Eric.J.Lindstrom@nasa.gov

A.7 OCEAN SURFACE TOPOGRAPHY SCIENCE TEAM

1. Scope of Program

The joint NASA/CNES Ocean Surface Topography Science Team (OSTST) supports basic research and analysis activities associated with joint satellite altimetry missions (TOPEX/Poseidon (TP), Jason-1, and Ocean Surface Topography Mission) and other ocean altimetry data sets. This solicitation calls for U.S. and non-European proposals for the Science Team. A similar announcement will be made by the Centre National d'Etudes Spatiales (CNES) for European proposals, and a joint selection and announcement will be coordinated by the two agencies in early 2008.

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. Specifically, this announcement seeks proposals to utilize the growing time series of multiple satellite altimeters. The team will also be involved in scientific preparations for the Ocean Surface Topography Mission (OSTM), a cooperative mission between NASA, CNES, the National Oceanic and Atmospheric Administration (NOAA), and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) planned for launch in June 2008. This solicitation also includes intercalibration/validation analyses of the Jason/OSTM missions during and after the verification phase. Special emphasis will be given to proposals that stress the use and application of satellite altimetry to basic research and operational projects in physical oceanography and related fields consistent with the strategic goals of NASA's Earth Science Program as part of its focus area on climate and climate variability.

The research themes of the OSTST are:

- To support studies in physical oceanography utilizing Jason/OSTM mission data, as well as the combined 15-year TP/Jason data, preferably jointly with other satellite and *in situ* data and/or models, in support of both basic research and operational applications. Analyses of the full altimetric time series (from 1992) are now capable of resolving the large-scale redistribution of heat and mass in the upper ocean and exchanges with the atmosphere and cryosphere can be explored in combination with other data sets. Such projects may cover a wide range of studies of coastal and open ocean circulation, including intraseasonal-to-interannual variability, global mean sea level variations, ocean waves propagation, low-frequency tides, gravity waves, wind/wave generation, etc. Many of these studies may be related to larger projects such as Climate Variability (CLIVAR – http://www.usclivar.org), Global Ocean Observing System (GOOS – http://www.ioc-goos.org), National Ocean Partners Program (NOPP – http://www.nopp.org), and the international Argo *in situ* profiling float program (http://www.argo.ucsd.edu).

- To support studies of higher-resolution merged altimetric data sets (including but not limited to Jason and OSTM) for the purpose of examining the role of the mesoscale

eddies and western boundary currents in the general circulation of the ocean. It is expected that such studies will be pathfinders in setting scientific requirements for next-generation, wide-swath altimetric measurements.

- To complete comparison studies between Jason and OSTM. This includes details on the Precise Orbit Determination (POD) assessment, role of the water vapor correction as provided by the passive microwave radiometers, as well as influence of other corrections (ionosphere, sea-state bias, barotropic effect), and a precise characterization of the errors involved in an OSTM altimeter measurement. This also includes development and assessment of new geophysical algorithms and/or models likely to improve the quality of the data. The error budget for OSTM must be completed relative to our updated knowledge of Jason, based upon a comprehensive analysis of all of the inter-calibration/validation measurements during the coincident orbit phase and after. This error evaluation will also serve in the analysis of the respective data streams of the mission. Both follow-on studies and new proposals that identify needed error analyses are anticipated in this category.

- To explore operational applications of satellite altimetry with a requirement for near real-time delivery of data and data products. These include but are not limited to: seasonal-to-interannual climate prediction, local weather forecasting, oil exploration/operations, oil spill mitigation, coastal currents, shipping, fisheries, marine meteorology and marine recreation.

- To investigate the use of gravity mission data with altimeter data for improving the understanding of the mean ocean circulation and barotropic variability.

- To execute the calibration and validation of the baseline measurement of the OSTM, to develop and assess dedicated techniques, in particular taking advantage of the possible overlap of Jason and OSTM or by proposing palliative methods if there is no overlap.

- To support complementary studies on ice sheet and sea ice monitoring, lake and inland water studies, large river mouth survey, and marine geoid. Such studies can use altimetry, but also additional data including the accurate geodesic point positioning provided by the highly performing POD systems (Doris, GPS, laser) on TP and Jason.

2. Programmatic Information

NASA will fund only U.S. investigators to the OSTST and, through a separate announcement, CNES will provide support to French investigators to the OSTST. However NASA and CNES seek to maximize the scientific output of the OSTST through a strong partnership with international investigators and agencies. To this end, proposals that are coordinated with other related and ongoing international programs are encouraged. For non-French and non-U.S. proposals, proposers must seek and secure appropriate sources of funding from appropriate national authorities. It is essential for

proposers to document the funding sources required to enable their proposed OSTST investigations.

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

3. Summary of Key Information

Expected annual program budget for new awards	~ $4.5M
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 *Summary of Solicitation* of this NRA.
Due date for proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-OSTST
NASA point of contact concerning this program	Dr. Eric Lindstrom Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-4540 E-mail: Eric.J.Lindstrom@nasa.gov

A.8 CRYOSPHERIC SCIENCE

1. Scope of Program

This announcement offers opportunities for new and successor Cryospheric Science investigations within the NASA Earth Science Program. NASA seeks proposals that will improve our understanding of the properties of land and sea ice and that will stimulate investigations of the land and sea ice cover and their interaction with the ocean and atmosphere.

NASA's Cryospheric Science program focuses on understanding changes in the Earth's land and sea ice cover and determining the effects of these changes on the Earth system. Model simulations and recent observations suggest that the ice-covered regions of the Earth are among the most sensitive to climate change. In view of the potential importance of the recent changes in the Arctic sea ice cover to global climate, and in the mass balance changes of the Greenland and Antarctic ice sheets to climate and sea level, NASA seeks to understand the mechanisms that control these changes, and their associated implications for the Earth system.

2. Cryospheric Science Research Themes

The research themes included in this Cryospheric Science solicitation are as follows:

- The effect of the decreasing Arctic sea ice cover on the underlying ocean, the surrounding land and atmosphere, and on the climate of the northern hemisphere;

- The mass balance and dynamics of the Antarctic and Greenland ice sheets, as well as of the smaller northern and southern hemisphere glaciers that are of consequence to sea level change; and

- The interaction of the Southern Ocean with the Antarctic sea ice cover and with the ice shelves and outlet glaciers of the Antarctic ice sheet.

To this end, NASA’s strategy is to call for studies of (a) the northern and southern hemisphere ice-covered oceans to determine their response to climate change and (b) the Greenland and Antarctic ice sheets as well as the smaller significant glaciers to determine their dynamics, mass balance, and contributions to sea-level change. NASA's Earth Science Research Program places emphasis on the productive interaction between activities related to observations, modeling, and to field campaigns, including those funded under the International Polar Year (IPY).

For Arctic sea ice, it is important to understand the role of the changes in its extent, concentration, thickness, and dynamics on the ocean circulation and the climate of the northern hemisphere. This understanding will make it possible to examine the feedback mechanisms associated with sea ice cover and the surrounding land, ocean, and atmosphere, and should lead to improved climate predictions, as well as a quantitative

assessment of the 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) and those from the RADARSAT Geophysical Processor System (http://www-radar.jpl.nasa.gov/rgps/radarsat.html).

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. For example, the Gravity Recovery and Climate Experiment (GRACE) satellite has measured the recent mass loss from the Greenland ice sheet, and Interferometric Synthetic Aperture Radars (SARs) have permitted the measurements of the velocities of the Greenland peripheral glacier outflows. Given the crucial role of certain northern hemisphere glaciers and the Greenland ice sheet to sea level rise, our goal is to continue advancing our understanding of land ice processes, and to make significant progress in reconciling the differences among the various estimates of the ice sheet mass balances.

For the Southern Ocean and the Antarctic ice sheet, our concern is with the dynamics and mass balance of the ice sheet, the potential instability of the west Antarctic ice sheet, the interaction of the warming ocean with the ice shelves, and the role of sea ice and polynyas in modifying the properties of the underlying ocean. Space- and aircraft-based observations that determine the state of the bottom of the ice sheet, such as the recent surface changes that are attributed to the movement of water under the ice sheet, and those that permit sub ice bottom profiling, will also be considered in this solicitation. There is also a need to assess the likelihood of rapid ice sheet response to the large changes that have been observed in some outlet glaciers. The goal here is to use space based assets and complimentary surface observations where necessary to determine the time-varying response of the outlet glaciers and their associated ice shelves to climate change, their interaction with the ocean and associated sea ice, and how changes in these outlet glaciers affect the stability of the interior ice sheet.

3. Programmatic Information

Total funds available for work selected under this solicitation are approximately $3M per year for three years.

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

4. Summary of Key Information

Expected annual program budget for new awards.	~ $3M
Number of new awards pending adequate proposals of merit	~ 15
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Due date for proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or research objective(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-CRYO
NASA point of contact concerning this program	Dr. Seelye Martin Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0746 E-mail: seelye.martin-1@nasa.gov

A.9 NASA ENERGY AND WATER CYCLE STUDY

NOTICE

It is anticipated that an amendment to this NRA will be released at least 90 days prior to the proposal due date of this program element. The amendment will indicate which, if any aspects of NEWS will be strongly emphasized in this solicitation cycle. The amendment may also contain updates to the expected funding or project number levels.

1. Scope of Program

1.1 Programmatic Overview

The U.S. Climate Change Science Program (CCSP) has established the water cycle goals of the Nation's climate change program (see the CCSP 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://science.hq.nasa.gov/strategy/road_arch.html), 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://wec.gsfc.nasa.gov. Interested collaborators with NEWS are specifically recommended to read the implementation plan that is 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.

1.2 Description of Solicited Research

The NEWS investigations selected through this solicitation will be focused and served by a "NEWS Science Integration Group" comprised of scientists whose primary responsibility is to support NEWS investigations and integrate their research results to address NASA Earth Science questions. This group will:

- Serve as an interface to NASA products and resources and help coordinate and integrate the results of the NEWS investigations;
- Work with NEWS investigations to implement their results into a larger coordinated project, such as a NASA model, data system, etc; and
- Provide a pathway for the results of NEWS investigations to be implemented and retained as NASA activities.

In the NEWS context, "integration" means that resources must be specifically combined and applied to diagnose the key exchange processes within the energy and water cycles. Also, rigorous analyses of uncertainties are important to establish benchmarks of knowledge for observations and prediction parameters. These processes and parameters must necessarily include: radiative/heat exchanges, the transport of water vapor (in the atmosphere) and liquid water (i.e., runoff and river discharge into the ocean). Also emphasis is also to be placed on the main water transformations, such as evaporation from the surface (both land and ocean), snowmelt, and the formation of clouds and precipitation. Surface-atmosphere interactions (including the atmospheric boundary layer) and cloud processes are crucial areas of research.

Abstracts describing current NEWS projects are available at http://gwec.gsfc.nasa.gov. It is important that those seeking to respond to this announcement consider how to best interlace and interact scientifically with these investigations, while avoiding duplications.

Selected NEWS investigations will be expected to interact proactively with the entire NEWS team to optimize progress toward integrating NASA Earth Science resources (e.g. satellite data products, model and computational resources, ongoing research activities, etc.) to make decisive progress toward the NEWS challenge. This activity may require some modification of proposed tasks to optimize integration (e.g., by identifying and eliminating areas of potential overlap) and fill NEWS team gaps as they become apparent. Such find tuning of research objectives will require frequent communication via telephone conferences and/or attending at least two NEWS team meetings per year, which should be budgeted in the proposal.

2. Programmatic Information

2.1 Funding

It is anticipated that approximately $1.5M per year may be available to support approximately 6 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 Fiscal Years 2007 and 2008. NASA expects to make selections in September 2007. Proposal start dates should be no earlier than November 1, 2007.

2.2 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 uses and outcomes anticipated if the study is successful.

The determination of a proposal's relevance shall also include the following factor:

- The importance of the technological approach studies and/or the methodologies developed to advance the goals of the Water and Energy Cycle roadmap and the NEWS roadmap (see http://science.hq.nasa.gov/strategy/roadmaps/).

3. Summary of Key Information

Expected annual program budget	~$1.5M
Number of new awards pending adequate proposals of merit	~6
Maximum duration of awards	3 years; shorter term proposals are acceptable

Due date for Notices 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
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or research objective(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook.
Page limit for the central Science-Technical-Management section of proposal	15 pages; see also Chapter 2 of the *NASA Guidebook for Proposers*
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	NNH07ZDA001N-NEWS
NASA point of contact concerning this program	Dr. 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

A.10 TERRESTRIAL HYDROLOGY

NOTICE

It is anticipated that an amendment to this NRA containing supplementary or clarifying information, including which, if any, aspects of terrestrial hydrology will be strongly emphasized in this solicitation cycle and updates to the expected funding or project number levels will be issued for this program element. Such an amendment will be issued at least 90 days prior to the proposal due date.

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 2.3 of Appendix A.1 for a description of Earth science focus areas).

The 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. 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 involving the Soil Moisture Experiments (SMEX), Cold Land Processes Experiment (CLPX), and community working groups for soil moisture, cold land processes, and surface water processes. A complete description of the THP is located at http://thp.gsfc.nasa.gov/. A description of the soil moisture, cold land processes, and surface water processes working groups can be found through this Web site.

1.1 Research to Address Current Issues in NASA's Terrestrial Hydrology Program

Current research includes observational and modeling studies designed to understand large-scale dynamics of the terrestrial hydrosphere, including improving the observation, understanding, and prediction of the magnitude, trend, timing, and partitioning of terrestrial water stores and fluxes. Examples of terrestrial stores include water contained in the soil, subsurface, snowpack, rivers, lakes, and wetlands. Fluxes involve movement of water between these reservoirs, as well as the atmosphere, cyrosphere, and ocean reservoirs.

Specific research foci that may be pursued in subsequent years by this program may include but not be limited to the following:

- Development of the scientific basis for observing and modeling large-scale terrestrial water-storage dynamics with emphases on how these processes are affected by the heterogeneity of soil, vegetation, precipitation, and topography and their interaction with various biogeochemical cycles.
- Enhancement of hydrologic model capability and performance through modern data assimilation techniques to incorporate remotely sensed observations, which may include efforts to resolve spatial scale discrepancies between *in situ* and satellite observations, as well as those with hydrologic and climate model resolutions.
- Remote sensing of hydrologic fluxes, states, and parameters, e.g., development of new and innovative remote sensing techniques, including combined active and passive microwave observations, to improve the understanding of the variability of the terrestrial hydrosphere.
- Scientific justification of new measurements, both those involving satellites and possible long duration suborbital platforms. Research may include development of Observing Simulation System Experiments (OSSEs) and/or other investigations that support, for example:
  i) The application of new technologies for remote sensing hydrologic quantities and for terrestrial hydrologic interpretation;
  ii) Studies on appropriate spatial and temporal sampling scales of new sensors for satisfying specific scientific objectives; and/or
  iii) Understanding the enhancement on prediction systems by potential missions.

Research efforts are encouraged to leverage off of various NASA system components, including Earth observations from Terra, Aqua, and the Gravity Recovery and Climate Experiment (GRACE), along with available field-experiment data. Assistance obtaining data from field experiments supported by THP can be found at the program's website at http://thp.gsfc.nasa.gov/.

2. Programmatic Information

2.1 Funding

It is anticipated that approximately $1M per year may be available to support approximately 4-5 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 Fiscal Years 2007 and 2008. NASA expects to make selections in February 2008. Proposal start dates should be no earlier than March 1, 2008.

2.2 Evaluation of Proposals

Proposals will be evaluated according to the criteria specified in section C.2 of the *NASA Guidebook for Proposers*. The determination of a proposal's intrinsic merit shall also take into account the following additional factor:

- Significance of the scientific uses and outcomes anticipated if the study is successful.

The determination of a proposal's relevance shall also take into account the following additional factor:

- The importance of the technological approach studies and/or the methodologies developed to advance the goals of the Water and Energy Cycle Roadmap (see http://science.hq.nasa.gov/strategy/roadmaps/) and/or the goals of the THP and its working groups.

3. Summary of Key Information

Expected annual program budget for new awards	~$1M
Number of new awards pending adequate proposals of merit	~4-5
Maximum duration of awards	3 years
Due date for Notices 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
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or research objective(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook
Page limit for the central Science-Technical-Management section of proposal	15 pages; see also Chapter 2 of the *NASA Guidebook for Proposers*

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	NNH07ZDA001N-THP
NASA point of contact concerning this program	Dr. 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

A.11 ATMOSPHERIC COMPOSITION: AURA SCIENCE TEAM

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. The ability of the atmosphere to integrate surface emissions globally on time scales from weeks to years couples several environmental issues, including global ozone depletion and recovery and its impact on surface ultraviolet radiation, climate forcing by radiatively active gases and aerosols, and global air quality. Thus, atmospheric chemistry and associated composition are a central aspect of Earth system dynamics. NASA's research for furthering our understanding of atmospheric composition is geared to providing an improved prognostic capability for 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.

This solicitation seeks proposals for the analysis of satellite remote-sensing data, especially data generated by the Earth Observing System (EOS) Aura satellite, as well as composition measurements made by other satellites associated with the "A-Train": Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) and Aqua. These proposals should enable our research in the area of stratospheric and tropospheric chemistry, as well as improve the measurements of aerosols and trace gases, and determining the impacts of trace gasses on climate and air quality. The proposals should specifically address the use of the satellite data. The solicitation goals include:

- Developing new or significantly improving existing data products from the EOS Aura instruments using the Level 2 data.
- Using Aura data to track changes in stratospheric and tropospheric chemistry, determine the exchange of trace gases between the stratosphere and troposphere, and estimate the transport properties of the stratosphere and upper troposphere.
- Using Aura data along with other satellite trace gas data sets to map emissions and quantify the role of long-range transport and export of trace gases important to air quality,
- Using Aura data to determine the effects of air pollutants such as ozone and aerosols on climate,

In addition, this solicitation seeks Interdisciplinary Research in Trace Gases—proposals that will combine measurements from Aura and other satellites, suborbital campaigns, ground-based measurements, and models to advance the science described above.

Activities that are <u>not</u> included in this NRA are:

- A-Train (Aura, CALIPSO, Aqua) instrument algorithm maintenance, incremental algorithm improvement, data product validation, and the production of standard data products
- Development of models used to analyze data sets. Models of this type are developed under the MAP program

2. Summary of Key Information

Expected annual program budget for new awards.	~ $5.5 M
Number of new awards pending adequate proposals of merit	~ 30
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-AST

NASA points of contact concerning these programs:	Dr. Philip DeCola Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0768 E-mail: pdecola@nasa.gov Dr. Michael Kurylo Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0237 E-mail: Michael.J.Kurylo@nasa.gov Dr. Hal Maring Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1679 E-mail: hal.maring@nasa.gov

A.12 ATMOSPHERIC COMPOSITION: SCIENCE ADVISORY GROUP FOR THE GLORY MISSION

1. Scope of Program

1.1 Background

The Earth Science Research Program supports scientific investigations 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 (see Appendix A.1 for a description of Earth science Focus Areas). 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. This solicitation, for FY 2008 funding, will provide support for new awards in one area of atmospheric composition research.

1.2 Science Advisory Group for Glory Mission

Proposals are solicited for participation in the Science Advisory Group for the Glory Mission. The NASA Glory Mission will support the U.S. Climate Change Science Program and is intended to continue and improve upon long-term monitoring of two key forcings influencing global climate. One of the mission principal objectives is to determine the global distribution of detailed aerosol and cloud properties with unprecedented accuracy, thereby facilitating reliable quantification of the aerosol direct and indirect effects on climate. The other is to continue the 28-year record of satellite-based measurements of total solar irradiance and thereby enable the quantification of the effect of solar variability on the Earth's climate. These objectives will be met by deploying two state-of-the-art science instruments on an Earth-orbiting satellite: the Aerosol Polarimetry Sensor (APS) and the Total Irradiance Monitor (TIM). For more information see the Glory Mission web site http://glory.gsfc.nasa.gov/.

Members of the Science Advisory Group will attend two science team meetings per year and provide expert input on (i) optimization and testing of the APS and TIM photometric and polarimetric calibration approaches; (ii) development of research-level and operational retrieval and data processing algorithms, (iii) strategies for the validation of the APS and TIM science products, and (iv) various aspects of science data handling, utilization, and assimilation into chemical transport and global circulation models.

The basis for the expert input on the topics listed above will be the proposer's knowledge and experience as well as small-scale data handling, analysis and/or modeling studies

supported as part of the activities of the Science Advisory Group. By way of example, the contributions from members of the Science Advisory Group might include, but are not limited to evaluation of factors affecting TIM calibration, refining APS data retrievals, providing input on sampling and measurement strategies for long-term ground-based and shorter-term aircraft-based validation efforts, development of potential ways of using APS data as physical constraints in model assessments of the aerosol direct and indirect effects, and recommendations as to optimizing data archival to maximize utility of Glory data.

Proposals will be evaluated on the basis of the proven capabilities of the principal investigator as well as approaches and activities proposed to address the topics of interest listed above.

2. Programmatic Information

2.1 Budget and Schedule Requirements

Proposals for support for up to 2 years will be considered and should not exceed $50K per year.

2.2 Notices of Intent to Propose

No Notices of Intent to propose (NOIs) are requested for this program element.

2.3 Page Limit

The page limit for the central Science-Technical-Management section of proposal is 5 pages. This limit replaces the default page limits given in Chapter 2 of the *NASA Guidebook for Proposers*.

3. Summary of Key Information

Expected annual program budget for new awards.	~ $600K
Number of new awards pending adequate proposals of merit	~ 15
Maximum duration of awards	2 years
Due date for Notice of Intent to propose (NOI)	No Notices of Intent are requested for this program element.
Due date for proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
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. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.

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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Page limit for the central Science-Technical-Management section of proposal	5 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
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	NNH07ZDA001N-GSAG
NASA points of contact concerning these program	Dr. Hal Maring Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1679 E-mail: hal.maring@nasa.gov

A.13 TROPOSPHERIC CHEMISTRY: ARCTIC RESEARCH OF THE COMPOSITION OF THE TROPOSPHERE FROM AIRCRAFT AND SATELLITES

1. Scope of Program

1.1 Background

The Earth Science Research Program supports scientific investigations within the Atmospheric Composition Focus Area that contribute to the understanding of the sources, transformation, and transport of trace species and aerosols in the Earth's atmosphere (see Appendix A.1 for a description of Earth science Focus Areas). The research strategy in atmospheric composition encompasses an end-to-end approach for instrument and experiment design, data collection, analysis, interpretation, and diagnostic studies. NASA expects to provide the necessary monitoring and evaluation tools for assessing the impact of atmospheric composition on climate change and air quality that take into account the feedbacks on local, regional, and global scales. 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.

This solicitation program element, for FY 2008 funding, will provide support for new awards enabling integrated science and validation through the combination of satellite and airborne observations associated with the research activity described below.

1.2 Arctic Research of the Composition of the Troposphere from Aircraft and Satellites

The Tropospheric Chemistry Program is planning an integrated A-Train science and validation experiment to coincide with other International Polar Year (IPY) activities to include investigations affiliated with POLARCAT (Polar Study using Aircraft, Remote Sensing, Surface Measurements, and Models of Climate, Chemistry, Aerosols, and Transport; http://zardoz.nilu.no/~andreas/POLARCAT/). The IPY is targeted at providing an international and interdisciplinary approach to understanding the behavior of polar regions and their role in the broader Earth System, including the oceans, atmosphere, biosphere, cryosphere, and land surface. NASA's space-based observations of the Earth's polar regions constitute a significant resource for studies to further this research.

Plans for the Arctic Research of the Composition of the Troposphere from Aircraft and Satellites (ARCTAS) campaign include a spring (March-April 2008) and a summer (June-July 2008) deployment of the DC-8, although exact timing and bases of operations are still being deliberated based on science considerations. Although scientifically desirable, participation by the J-31 and B-200 aircraft is yet to be determined. Suborbital flights will be highly coordinated with A-Train observations to provide opportunities for integrated science and science-based validation.

To enable a better understanding of the Arctic troposphere and processes influencing climate and air quality, the ARCTAS observations and sampling strategy will focus on four scientific themes:

1. Long-range transport of pollution to the Arctic including arctic haze, tropospheric ozone, and persistent pollutants;
2. Boreal forest fires and their implications for atmospheric composition and climate;
3. Aerosol radiative forcing from arctic haze, boreal fires, surface-deposited black carbon, and other perturbations, with an aim to improve the synthesis of multisensor aerosol observations from space; and
4. Chemical processes with focus on ozone and aerosols, including particular attention to the chemistry of halogen and hydrogen oxide radicals and to stratosphere-troposphere exchange.

Further details on ARCTAS scientific objectives and implementation, as well as measurement priorities can be found in the ARCTAS white paper which can be found at http://cloud1.arc.nasa.gov/arctas/.

2. Programmatic Information

2.1 Programmatic Priorities

Proposals requesting support for both *in situ* and remote-sensing measurements to be deployed on the NASA DC-8, J-31, and B-200 will be considered under this solicitation, although participation by the J-31 and B-200 will be subject to the availability of sufficient funds.

Highest priority will be given to instruments consistent with mission objectives and with a proven performance heritage. It is not appropriate to propose for significant new instrument development under this call; however, consideration will be given for minor modifications and improvements to existing instruments as may be required to address mission goals.

For model investigations, participation in the field deployment to facilitate flight planning and implementation of the science plan is essential. Only those proposals that are critical to mission implementation will be considered.

Satellite teams are also solicited to participate in the field by providing near real-time observations and interpretation to guide flight planning and by establishing specific calibration/validation needs for incorporation into aircraft flight plans.

For modeling and satellite proposals requesting additional support for post mission analysis, priority will be given to research plans that provide for the synthesis of airborne and satellite observations.

Proposers should acknowledge any overlap between post mission activities and ongoing funded research as well as planned proposals to opportunities under Atmospheric Composition: Aura Science Team (Appendix A.11).

2.2 Funding Guidelines

Proposals may request up to three years of funding to cover the costs of preparation, integration (in the case of measurement teams), field deployment, data processing, analysis, and interpretive modeling. Personnel support at an appropriate and justifiable level related to these activities will be considered. While it is not possible to accurately budget travel costs until deployment sites are finalized, proposers should submit a workforce plan for the deployment that includes the total number of personnel and their respective schedules for participation in the aircraft integration and two 4-week field intensives.

2.3 Summary of Key Information

Expected annual program budget for new awards.	~ $6-8M
Number of new awards pending adequate proposals of merit	~ 40
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-ARCTAS
NASA point of contact concerning this program:	Dr. James Crawford Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0915 E-mail: James.H.Crawford@nasa.gov

A.14 WIND LIDAR SCIENCE

1. Scope of Program

Measurement of global wind profiles is recognized as a primary unmet observational requirement for improving weather forecasts by the World Meteorological Organization, the large collection of nations planning the Global Earth Observation System of Systems (GEOSS), the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Integrated Program Office (IPO), and NASA in its Weather Research Roadmap. The wind field plays a unique dynamical role in forcing the mass field to adjust to it at all scales in the tropics and at smaller scales in the extratropics. Direct observation of the global wind field would be extremely valuable for numerical weather prediction, as well as scientific diagnostics of large-scale atmospheric transport, weather systems, and boundary layer dynamics in Earth's atmosphere. Because of the lack of reliable, sufficiently dense, and accurate wind observations, uncertainties in model-derived estimates of divergent flow component of the global atmospheric circulation constitute a serious limitation in our understanding of the global energy cycle and the atmospheric transport of water, energy, and chemical species.

Space-based lidar observations of atmospheric winds constitute a significant challenge in terms of sensitivity, accuracy, and spatial coverage. NASA has classified tropospheric wind profiling as high-priority science and invested in four different wind profiling instrument development efforts through its Instrument Incubator Program (IIP). A description of these IIP projects can be found at the Earth Science Technology Office (ESTO) website; (http://esto.nasa.gov/files/solicitations/IIP_04/IIP04_winners.html). Several documents describing different aspects of the conceptual space-based lidar mission can be found at the bottom of http://space.hsv.usra.edu/LWG/Index.html.

2. Proposal Opportunity

NASA is considering a space-based Wind Lidar mission and has initiated a mission-concept study. In this solicitation, NASA is seeking the following investigations to prepare for a potential Global Winds measurement mission:

1. Examine Geoscience Laser Altimeter System (GLAS) and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) lidar data to update the background and enhanced aerosol backscatter coefficient profiles used in performance prediction simulations of both the coherent-detection and direct-detection Doppler wind lidars, which are expected to comprise the instrument in a space-based global winds mission. Also, update the modeling of high thin clouds and the porosity to laser beams of opaque clouds.
2. Study how to utilize the velocity and ranging information that will come from orbiting Doppler lidars to improve the value of cloud motion winds and scatterometer ocean surface winds.
3. Perform Observing System Simulation Experiments (OSSEs) using a nature run such as the European Centre for Medium range Weather Forecasts (ECMWF)

nature run. Specify the characteristics of the wind measurements expected from a satellite based wind mission and use these characteristics in the OSSEs. Examine how the Doppler lidar wind data are synergistic with the data from other current or planned sensors. Examine whether the Doppler lidar wind data are able to replace the data from any current sensor.

4. Experimentally study the statistics of the vertical wind from ground-based observations. Use an existing direct-detection or coherent-detection Doppler wind lidar to take vertical wind data at regular intervals spanning a year. Develop climatology vs. season and time of day and altitude of the vertical wind magnitude, vertical wind turbulence, vertical wind shear, and aerosol backscatter (relative).
5. Conduct an intercomparison of several coherent and direct detection Doppler lidars at the Lidar Intercomparison Facility (LIF) at NASA Langley Research Center in Hampton, VA. (The LIF permits up to four lidars to be aimed upward into the atmosphere at a six-degree elevation angle along parallel lines to each other, which is important to fundamental wind velocity measurement investigations.) Examine any lack of agreement among the various Doppler lidars to identify both signal-level and calibration problems in the Doppler lidars' hardware and software. Proposals that include multiple Doppler lidars are preferred, but proposals that include only one lidar may be considered if several complementary proposals are received.
6. Separately investigate the importance of each individual component of the orbiting wind mission measurement requirements (e.g., velocity accuracy, vertical resolution, cross-track separation of the two horizontal wind profiles, along-track measurement repeat distance, maximum design horizontal wind speed, etc.). Study, using OSSEs or other means, the impact on the science product of relaxing each individual measurement requirement by different percentages (e.g., relaxing the maximum velocity error from 3 m/s to 4, 5, 6, etc m/s). Use the results to prioritize the measurement requirements where possible. Repeat this procedure for various applications such as hurricane track and intensity prediction, in addition to model assimilation for Numerical Weather Prediction.

In view of the limited funding available for this ROSES program element, please note that NASA is not committed to funding all the investigations described above. NASA may also consider proposals based on other compelling scientific questions/priorities related to this ROSES program element. However it remains up to the proposers to articulate in their proposals the benefits and priority of any investigation addressing science topics beyond the list provided above.

3. Summary of Key Information

Expected annual program budget for new awards	~$1M per year
Number of new awards pending adequate proposals of merit	~ 5-6

Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-WLS
NASA point of contact concerning this program	Dr. Ramesh Kakar Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0240 E-mail: ramesh.k.kakar@nasa.gov

A.15 ACCELERATING OPERATIONAL USE OF RESEARCH DATA

1. Scope of Program

1.1 Background

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 parameters. 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 collaborate with the operational centers to analyze, assess, and increase the impact of NASA data in the operational environments (e.g., models), particularly in the areas of weather, climate and ecological forecasting (e.g., fisheries).

1.2 Weather and Climate

NASA and NOAA are involved in two substantial activities to encourage more rapid use of NASA research results in NOAA's operational activities: the Joint Center for Satellite Data Assimilation (JCSDA; http://www.jcsda.noaa.gov/) and the Short-term Prediction Research and Transition Center (SPoRT; (http://www.ghcc.msfc.nasa.gov/sport/). The JCSDA was established by NASA and NOAA in July 2001 to accelerate and improve the quantitative use of research and operational satellite data in weather and climate, ocean and environmental analysis, and prediction models. The Department of Defense (DoD) has since joined NASA and NOAA in supporting the JCSDA. The NASA Marshall Space Flight Center and NOAA National Weather Service (NWS) Southern Region established SPoRT in February 2002 to accelerate the infusion of NASA observations, data assimilation, and modeling research into the NWS Advanced Weather Interactive Processing System (AWIPS) to improve weather forecasts and decision-making at the regional and local level on times shorter than 24 hours.

This solicitation enhances the scope of the JCSDA and SPoRT centers, focuses on the final phases of the transition process, and provides an opportunity for scientists to work with operational centers on the transition of research results into the operational environment.

1.3 Ecological Forecasting

Advances can be made in existing ocean ecological forecasts by assimilating the growing multi-scale physical, chemical, and ecological remotely sensed observations in to regional and global ecosystem models. The diversity of marine organisms and their intricate interactions create the vitality of marine ecosystems, bestow upon these ecosystems resilience to environmental change, and are of tremendous value toward human health, commerce, and recreation. Healthy marine ecosystems rely on a diversity of biological, chemical, and physical processes that function at different spatial scales. Current and developing measurement and monitoring capabilities include global remote sensing, and provide observational data across the entire range of ecologically relevant scales. With these data, significant advances can now be made in regional ecological modeling to oceanographic operational forecasting, but significant developments are needed to effectively assimilate the growing observational database and to realize their practical forecasting potential. Thus, as basic research unfolds, new understandings of ocean ecosystem structure, productivity, and the interdependence of living marine resources on our planet are realized; parallel advances must be made in assimilating these new observations and insights into models that advance the state of the art in ecological forecasting.

2. Programmatic Information

2.1 Identify Prior Research Results

Proposers must identify prior research results that show the potential positive impact of the NASA research data on the operational forecast. The citation of one or more peer-reviewed papers in which positive results have been reported is considered to be the minimum requirement.

2.2 Transition to Operational Centers

In order to accelerate the operational use of research data, proposers must identify a clear and direct connection with the operational centers. Proposers are encouraged to communicate with the JCSDA, SPoRT, and operation centers to identify possible projects. To ensure the appropriate interface exists at the operational centers, Letters of Support are required to verify the participation of and resource requirements for the centers to be involved in the proposed investigation (for detailed instructions, see Section 2.3.9 of the *NASA Guidebook for Proposers.)* When applicable, their costs must be included in the proposed budget. The points of contact are:

NOAA / operational global model related activities
Dr. Stephen Lord
Phone: 301-763-8000, extension 7202
E-mail: stephen.lord@noaa.gov

NOAA / short-term weather forecast related activities
Dr. Jason Tuell
Phone: 301-713-1809, extension 112
E-mail: jason.tuell@noaa.gov

Joint Center for Satellite Data Assimilation (JCSDA)
Dr. John Le Marshall
Phone: 301-763-8000, extension 7800
E-mail: john.lemarshall@noaa.gov

Short-term Prediction Research and Transition Center (SPoRT)
Dr. Steven Goodman
Phone: 256-961-7891
E-mail: steven.goodman@nasa.gov

2.3 Transition Schedule

Proposers must establish a transition schedule with the aim to fully transition the operational use of NASA research data to an operational center within two years of the inception of the project.

2.4 Peer Review

A single peer-review process will be used to evaluate all proposals in response to this solicitation. Representatives from the operational centers will participate in the review process in an *ex officio* capacity.

2.5 Performance Reporting

In addition to required annual progress reports, the selected projects are expected to report transition progress quarterly.

3. Summary of Key Information

Expected annual program budget for new awards	Up to $2M
Number of new awards pending adequate proposals of merit	~ 8
Maximum duration of awards	2 years
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.

NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Page limit for the central Science-Technical-Management section of proposal	15 pages; see also Chapter 2 of the *NASA Guidebook for Proposers*
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	NNH07ZDA001N-AOU
NASA point of contact concerning this program	Dr. Tsengdar Lee Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0860 E-mail: tsengdar.j.lee@nasa.gov Dr. Paula S. 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.16 EARTH SURFACE AND INTERIOR

1. Scope of the 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 Research Program.

> *1) 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 Extremely Low Frequency/Ultra-Low Frequency (ELF/ULF) network measurements are also being studied to gain a better understanding of the physics of the earthquake cycle.

> *2) 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 the Gravity Recovery and Climate Experiment (GRACE), Oersted, SAC-C, and the Challenging Mini-Satellite Payload for Geoscientific Research and Applications Program (CHAMP)—and soon COSMIC, the Gravity field and steady-state Ocean Circulation Explorer (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 tsunamis and the sounding of the deep interior of the Earth.

> *3) Response: How is global sea level affected by natural variability and human induced change in the Earth System?*

The sea-level change measurements reveal an increasing rate of rise that now exceeds 3.0 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.

> *4) 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 Interferometric Synthetic Aperture Radar (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.

1.2 The ESI Strategic 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 strategic 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* is available from The National Academies Press (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 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. Programmatic Information

2.1 Solicitation for ESI related Research

Proposals that respond to this solicitation must identify one or more of the six scientific challenges identified within *Living on a Restless Planet* and explain in succinct language how the proposal will advance the state of knowledge in these scientific areas through the advancement of space-based or airborne observations, the analysis of these observations, and/or new modeling capabilities.

Researchers are encouraged to submit proposals that address one or more of the following:

- Advance the observational priorities set forth in *Living on a Restless Planet;*
- Leverage existing or planned space-based and airborne observational capabilities and remote sensing data sets;
- Utilize observational infrastructures such as the EarthScope Program and Asia-Pacific Natural Laboratory, the Global Geodetic Observing System (GGOS), WInSAR, International GNSS Service, International Very Long Baseline Interferometry (VLBI) Service, and the International Laser Ranging Service; and/or
- Support interdisciplinary research within the Science Mission Directorate such as techniques that might be applied on the Earth as a developmental step in the exploration of our solar system and its evolution.

Finally, we encourage the submission of proposals that advance the objectives of the International Polar Year, International Heliophysical Year, International Year of Planet Earth, and Electronic Geophysical Year within the context of ESI related research. Proposers are also directed to the EarthScope: the InSAR and Geodetic Imaging Component program (Appendix A.17) for EarthScope specific geodetic imaging proposals.

2.2 Summary of Key Information

Expected annual program budget for new awards	~ $3.5 M
Number of new awards pending adequate proposals of merit	~16
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or research objective(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-ESI

NASA point of contact concerning this program	Dr. John L. LaBrecque Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1373 E-mail: John.LaBrecque@nasa.gov

A.17 EARTHSCOPE: THE INSAR AND GEODETIC IMAGING COMPONENT

1. The EarthScope Program

The EarthScope Program is managed by the National Science Foundation in coordination with the U.S. Geological Survey and NASA. Proposers are referred to www.EarthScope.org and the *Review of EarthScope Integrated Science* (National Academy of Science, 2001, http://www.nap.edu/books/0309076447/html/) for additional information on EarthScope. EarthScope is an Earth science program to explore the four-dimensional structure of the North American continent. The EarthScope Program provides a framework for broad, integrated studies across the Earth sciences, including research on fault properties and the earthquake process, strain transfer, magmatic and hydrous fluids in the crust and mantle, plate boundary processes, large-scale continental deformation, continental structure and evolution, and composition and structure of the deep-Earth.

A series of community meetings and workshops beginning in 1999 culminated in the publication of EarthScope science (March 2002) and facility construction (October 2001) plans. The integrated science plan developed by the community, *EarthScope: Scientific Targets for the World's Largest Observatory Pointed at the Solid Earth*, identified and discussed scientific targets for EarthScope program. NASA's participation in the EarthScope program seeks to advance the development and application of space geodesy and space geodetic imaging for the study of geodynamics and associated natural hazards as a central theme. Specifically, NASA is advancing the technology, algorithms, and infrastructure in support of the Plate Boundary Observatory and is leading a multiagency effort to develop the Interferometric Synthetic Aperture Radar (InSAR) and Geodetic Imaging component of EarthScope.

2. Scope of this Announcement

This is the first NASA solicitation to specify support for research proposals addressing the InSAR or Geodetic Imaging Component of EarthScope. This announcement seeks to strengthen the role of remote sensing in the determination of crustal dynamics and geologic history through the development and application of geodetic imaging technologies. Geodetic imaging is the precise metrology of the Earth surface via remote sensing techniques to yield measurements of an area's topography and its surface deformation. The three principal techniques currently ascribed to geodetic imaging are InSAR, altimetric Light Detection and Ranging (LiDAR), and stereo-optical imaging.

3. Programmatic Information

3.1 Solicitation for EarthScope Imaging- (ESI) Related Research

This solicitation is open to all proposals that seek to address the EarthScope goals through the demonstration and application of geodetic imaging technologies. The proposals that respond to this solicitation must explain in succinct language how the

proposal will advance the scientific objectives of the EarthScope program in general and the InSAR and Geodetic Imaging component of EarthScope in particular.

A limited amount of funding for the development of new databases through field programs will be considered and preference will be given for the demonstration and application of new NASA developed geodetic imaging instrumentation including the UAVSAR (http://esto.nasa.gov/obs_technologies_uavsar.html) and high altitude lidar swath mapping instrumentation expected to become available for research use in 2008. Budgets should specify all costs associated with the proposal including, where appropriate, data acquisition costs. Field acquisition costs will be funded whenever possible through other sources separate from the resources allocated to this announcement. Contributions from other sources, such as cost sharing from other agencies or institutions, are encouraged.

3.2 Summary of Key Information

Expected annual program budget for new awards	~ $1.8M
Number of new awards pending adequate proposals of merit	~ 9
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or research objective(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-ESGIC
NASA point of contact concerning this program	Dr. John L. LaBrecque Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1373 E-mail: John.LaBrecque@nasa.gov

A.18 AIRBORNE INSTRUMENT TECHNOLOGY TRANSITION

1. Scope of Program

NASA's Earth Science Research Program is an end-to-end program 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 suborbital (surface, balloon, aircraft) and/or space-based platforms; uses the results to increase basic process knowledge; and incorporates results into complex computational models that can be used to more fully characterize the present state and future evolution of the Earth system. The NASA Suborbital Science Program, within the Earth Science Program, is responsible for providing airborne systems that further science and advance the use of satellite data. This is accomplished primarily through focused field experiments for process studies, calibration and validation of satellite sensors, and even evaluation and risk retirement of new satellite instrument concepts. This solicitation provides an opportunity for the integration of existing instruments, developed under the NASA Instrument Incubator Program (IIP) or similar programs, onto any available platform supported by the NASA Suborbital Science Program (http://suborbital.nasa.gov/platforms/platforms.html). This solicitation addresses only existing instruments, i.e. no funding is available for the development of new instrumentation.

A description of the IIP projects can be found at the Earth Science Technology Office (ESTO) website (http://esto.nasa.gov/solicitations.html). The IIP supports proposals for technology development activities leading to new system and subsystem level suborbital and space-based measurement techniques to be developed in support of Earth science research and applications. The IIP is designed to reduce the risk of new, innovative instrument systems so that they can be successfully used in future science solicitations in a fast-track acquisition environment. For some of the IIP proposals, a field demonstration on an airborne platform is part of the plan. However, in a number of cases, the end product is a laboratory breadboard or an engineering model. This proposal opportunity provides the capability for converting an IIP end product into a useful suborbital instrument that can participate in field experiments and in the calibration and validation of satellite instruments. Conversion of other partially developed instruments into useful suborbital instruments can also be supported by this program.

2. Program Requirements

2.1 Additional Evaluation Factor

All proposals must provide a description of the instrument, a description of its current status, and a clear assessment of what it will take to finish and make it suitable for regular airborne use by the research and analysis programs and/or satellite calibration/validation activities. This means that the instrument would be able to be used under a wide variety of conditions, with high reliability, including in "campaign" mode in which multiple flights would be made over short duration periods, potentially from remote locations in

which there would be only limited time and resources available to make any modifications and/or repairs needed between flights. Since flights could take place under potentially challenging conditions (extreme cold, turbulence, etc.) the instruments should be able to withstand the rigor of regular use and should be able to be integrated as part of a multi instrument payload and not interfere with the other instruments that may be part of the airborne payloads.

As stated in the *NASA Guidebook for Proposers*, proposals will be selected for funding on the basis of intrinsic merit, relevance to NASA Earth Science objectives, and cost realism and reasonableness. In addition to the factors given in this *NASA Guidebook for Proposers*, it is understood that relevance includes the degree to which the proposed investigation specifically supports the objectives of at least one of the following Earth Science Focus Areas (see Appendix A.1 for a description of Earth science Focus Areas):

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

2.2 Available Funding and Period of Performance

Typically, each proposal will consist of a two-year effort with the majority of the funding required during the first year. In rare cases, the period of performance may extend into a third year of funding. It is expected that the finished instrument will be ready to use through the regular research and analysis programs and/or satellite calibration/validation activities. Subsequent funding for the use, maintenance, and/or upgrading of the instrument for these purposes should be able to be submitted to the ROSES elements to be included in future years for the research and analysis programs and/or those focused on calibration/validation activities. No successors to proposals submitted under this element will be considered in any future solicitations for this element.

3. Summary of Key Information

Expected annual program budget for new awards	~$2.5M first year, ~$1.5M second year, ~$1.0M third year
Number of new awards pending adequate proposals of merit	~ 5-6
Maximum duration of awards	3 years, though 2 years is expected (see Section 2.2)
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.

NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-AITT
NASA point of contact concerning this program	Dr. Ramesh Kakar Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0240 E-mail: ramesh.k.kakar@nasa.gov

A.19 SPACE ARCHAEOLOGY

1. Scope of Program

The NASA Space Archaeology Program has the scientific objective to use the unique vantage point of space to improve our understanding of past human settlement patterns and the relationships between the natural environment and cultural adaptations as functions of time and space. The major goals of this program are:

- To accelerate archaeological discovery and understanding through access to and analysis of remotely-sensed data obtained from space borne and airborne platforms; and
- To facilitate the infusion of technological expertise and capacity in remote sensing into archaeological research by fostering multidisciplinary collaborative relationships.

The NASA Space Archaeology Program integrates aspects of research contributing to many of the Earth science research objectives listed in the *NASA Strategic Plan* and the *NASA Science Plan*. Proposals must 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.

Cultures have blossomed, flourished, and then faded, sometimes abruptly, as societies have sought to optimize exploitation of the natural environment (climate, weather, physiography, hydrology, and biotic and mineral resources). A better understanding of how these cultures succeeded and/or failed to adapt to local, regional, and global change is of profound significance to the present as societies grapple with adaptation to a changing world. Space-based observations coupled with advances in digital image analysis, Geographic Information Systems (GIS), Global Positioning System (GPS) technology, and computer modeling provide the opportunity for the archeologist to discover, understand, and protect the world’s human legacy that is threatened by accelerating land cover/land use changes. The vantage point of space and NASA’s role in provision of unique data sets that extend our observational capacity beyond the limits of

our human senses provides the basis for this research solicitation to complement research opportunities currently afforded by other means.

Remote sensing has long been used by used by archaeologists to survey potential archaeological sites and to better understand the spatial relationships of cultural features to each other and the natural environment. The traditional use of optical data acquired from aircraft or balloons is now supplemented by a vast quantity of data routinely provided by numerous satellites launched and operated by NASA, other international space agencies, and private industry. In addition, NASA archives contain large quantities of potentially useful data from specialized airborne campaigns. While private commercial satellites tend to provide high-resolution spaceborne surrogates for airborne optical data, the NASA research satellites (http://science.hq.nasa.gov/missions/earth.html) and those of other international space agencies generally collect data over a very broad range of the electromagnetic spectrum and at a coarser spatial resolution covering a broader spatial extent (regional-scale). The aerial vantage point lays out the spatial organization of archeological sites within the context of their environmental settings and leads to the realization that everything in an ancient landscape has meaning and interconnection. These data sets and their derived products can be used at the regional level to model the ecological context and dynamics of past settlements as cultures modified and reacted to changes in the natural environment and to provide critical information for improved preservation and sustainable development of cultural heritage sites.

The NASA Space Archaeology Program solicits proposals that incorporate remote sensing observations in the following focus areas:

- Regional landscape analysis and modeling relating human settlement patterns and subsistence strategies to environmental factors derived from remote sensing (i.e., climate, topography, hydrology, vegetation cover, etc.); and
- Protection and preservation of cultural heritage sites and/or planning for the sustainable development of cultural resources.

Proposals must incorporate use of remotely sensed data and/or derived products from NASA and/or data from other international space agencies with missions providing types of data not available from NASA. A comprehensive list of NASA satellites and derived data sets can be found at http://science.hq.nasa.gov/missions/earth.html. Examples of unique data sets from international space agencies include those obtained by synthetic aperture radar data such as RADARSAT-1 from the Canadian Space Agency (CSA), JERS-1 and ALOS PALSAR from the Japanese Aerospace Exploration Agency (JAXA), and ERS-1/2 and Envisat ASAR from the European Space Agency (ESA). Proposals may also request access to the NASA archives of airborne data (http://suborbital.arc.nasa.gov/missions/data_archives.html). Requests for new satellite data acquisitions are acceptable, particularly for those instruments that acquire data on a demand basis (ASTER, Hyperion ALI, ALOS PALSAR, etc.). However, there will be only limited opportunities at best for new airborne data acquisitions as part of transit flights on other planned deployments of NASA supported aircraft and instrumentation

(http://suborbital.arc.nasa.gov/). This solicitation cannot be used as the justification for a stand-alone airborne campaign.

Working-level collaborations are encouraged between NASA investigators at NASA centers and other researchers located at university departments, laboratories, and other institutions. Collaborations are encouraged between departments at individual institutions and between institutions. Interdisciplinary collaboration is also encouraged with scientists in such areas as climate modeling, geology, soil science, hydrology, and land processes. Opportunities for collaboration with NASA are available through NASA's Education Program such as the NASA Earth and Space Science Fellowship Program and the NASA Faculty Fellowship Program (http://www.asee.org/nffp/general.cfm). In addition, several NASA Centers have Visiting Investigator Programs and Guest Investigator Programs that provide opportunities for collaborative research.

This announcement is intended to support acquisition of and access to remotely sensed data for archaeological research as well as the use and analysis of that data and/or derived data sets. This announcement is not intended to support studies that seek to use spaceborne sensor data merely as surrogates for airborne optical data (i.e., airphotos). This opportunity is not intended to support extensive fieldwork such as excavation; though the proposed research could complement on-going or new field investigations funded from other sources. Note that the proposal submission date has been intentionally chosen to facilitate coordination with the National Science Foundation (NSF) Archaeology Program solicitation (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=11690&org=NSF). However, NASA and NSF have independent evaluation and selection processes.

2. Programmatic Information

2.1 Funding

It is anticipated that approximately $500K per year may be available to support approximately seven new investigations. Periods of performance of up to three years may be proposed. This announcement is not intended to fund extensive field work (such as excavation) or major equipment purchases for remote sensing or image processing and analysis.

Funds for this solicitation will be pending the Federal budget process for Fiscal Years 2007 and 2008. NASA expects to make selections in December 2007. Proposal start dates should be no earlier than January 1, 2008.

2.2 Summary of Key Information

Expected annual program budget for new awards	~$500K
Number of new awards pending adequate proposals of merit	~7

Maximum duration of awards	3 years
Due date for Notices 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
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or research objective(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook
Page limit for the central Science-Technical-Management section of proposal	15 pages; see also Chapter 2 of the *NASA Guidebook for Proposers*
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	NNH07ZDA001N-SAP
NASA point of contact concerning this program	Mr. M. Craig Dobson Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0254 E-mail: Craig.Dobson-1@nasa.gov

A.20 DECISION SUPPORT THROUGH EARTH SCIENCE RESEARCH RESULTS

1. Scope of Program

1.1 Overview

The Applied Sciences Program within the NASA Earth Science Division manages this activity. This solicitation seeks proposals:

> To integrate NASA Earth science research results into decision support systems serving applications of national priority and to document improvements in the performance of the decision support systems.

The overall objective of these projects is the sustained use of geosciences products and NASA Earth science research by operational organizations in their decision-making activities to benefit the nation and society.

1.2 Program Objectives

The NASA Earth Science Division serves NASA's goal to "Study Earth from space to advance scientific understanding and meet societal needs" (NASA Strategic Subgoal 3A). To that goal, the NASA Applied Sciences Program serves the NASA objective "to expand and accelerate the realization of societal benefits from Earth system science" (NASA Strategic Outcome 3A.7). Section I(a) and Table 1 of the *Summary of Solicitation* of this NRA have references to the *2006 NASA Strategic Plan* and *NASA Science Plan.*

The Applied Sciences Program enables the use of results from NASA Earth science research in operational decision support systems[1] (DSS) that organizations employ to serve their management, business, and policy responsibilities. The overarching purpose of the Applied Sciences Program is to showcase the value of NASA Earth science research and technology and to maximize the societal benefits of the nation's investments in the NASA Earth science research program.

NASA Earth science research results include Earth science measurements (particularly NASA spacecraft observations), outputs and predictive capabilities from Earth science models (particularly models that use NASA spacecraft observations), algorithms, visualizations, new knowledge about the Earth system, and other techniques and geosciences products. In conducting its research mission, the NASA Earth Science Division utilizes validated commercial remote sensing data products whenever those products can achieve the scientific objectives and are cost effective.

---

[1] Generally, decision support systems are interactive, computer-involved systems that provide organizations with methods to retrieve and summarize information, analyze alternatives, and evaluate scenarios to gain insight on critical factors, sensitivities, and consequences of potential decisions. Types of decision support systems might include early warning systems, planning tools, forecasts, resource allocation tools, etc.

The Program supports projects that have national impact, including regional and international activities, if they have U.S. national importance. The Program primarily supports projects involving organizations with national perspectives that have established networks to broad sets of end users and established constituencies at regional, state, local, and tribal levels. Examples of such national organizations include Federal agencies and national/regional associations (e.g., Western Governors Association, American Water Resources Association, Coastal States Organization)[2]. The Program partners with a given national organization to identify, make, and quantify improvements to the DSS, and the partner extends the DSS and/or the improvements broadly to its constituents.

The Program focuses on extending Earth science research results to decision support systems in twelve areas of national priority:

Agricultural Efficiency	Air Quality	Aviation
Carbon Management	Coastal Management	Disaster Management
Ecological Forecasting	Energy Management	Homeland Security
Invasive Species	Public Health	Water Management

Each of these national applications has priority topics articulated in Section 5 of this appendix.

Results from projects selected through this solicitation may constitute part of NASA's contributions to interagency, national, and international programs (e.g., U.S. Group on Earth Observations (USGEO), the international Group on Earth Observations (GEO), Climate Change Science Program (CCSP), Ocean Action Plan, and Climate Change Technology Program (CCTP)). The Program encourages teams to familiarize themselves with these and similar programs in designing a project.

The NASA Applied Sciences Program's website (http://science.hq.nasa.gov/earth-sun/applications) includes more information that describe the program and its goals and provides links to other information that may support the development of a proposal.

1.3 Systems Approach

The Applied Sciences Program employs an "end-to-end" systems approach to extend Earth science research results as inputs to DSSs. The Program works together with national organizations that operate DSS to serve their mandated responsibilities and support their constituents at state, local, or tribal levels. Where research results are evaluated to have potential application, NASA and the partner organizations collaborate (in cooperation with private, academic, nonprofit, and other entities) on the systems integration and assimilation of the products into the DSSs.

Note: The NASA Applied Sciences Program – through this solicitation or otherwise – does not build nor fund the creation or development of DSSs for operational entities. The Program support projects that *enhance the performance* of existing DSSs and decision-

[2] The Program's website (http://science.hq.nasa.gov/earth-sun/applications) provides links to a small sample of national organizations related to each national application.

making processes through the integration of NASA Earth science products. For this solicitation, the DSS in a proposal must already be in existence and/or in development by the end user organization by January 1, 2007.

Figure 1 illustrates the Integrated System Solutions (ISS) architecture that the Applied Sciences Program uses to depict the contributions of Earth observations and models to organizations' decision-making activities. A complete description and downloadable version of this chart is available at the Program's website.

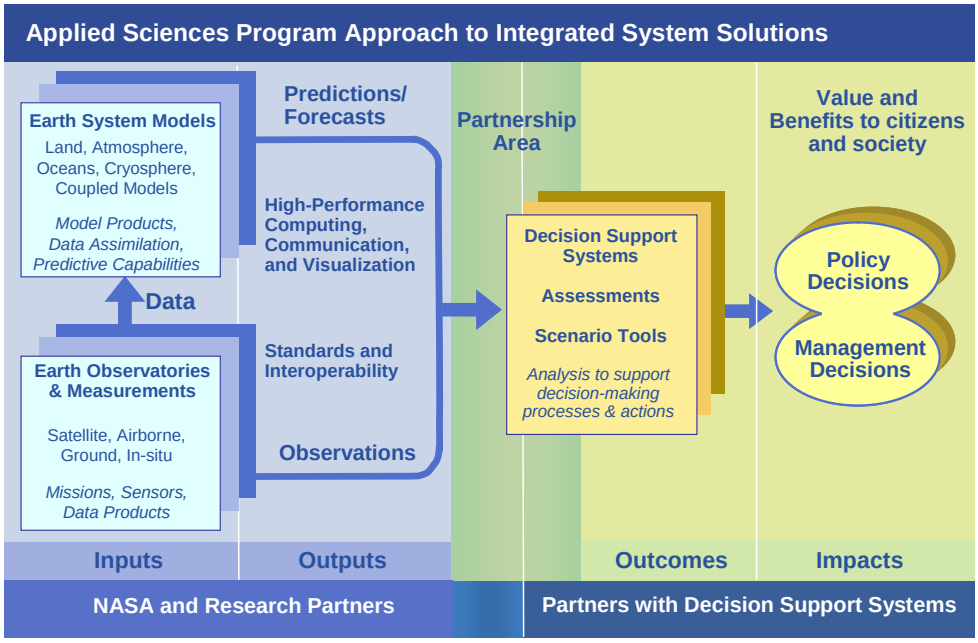

Figure 1. Integrated Systems Solutions Architecture

The Program's primary outputs include (a) "prototypes" to demonstrate the potential for integration of Earth science products in the DSSs and (b) "benchmark reports" to document the project, system configuration, and especially the improved performance of a DSS through the use of the Earth science products. The prototypes and benchmark reports are meant to facilitate the transition, adoption, and sustained use of the results in the DSSs and decision-making processes of user organizations. The Program's primary outcomes are the routine, sustained uses of NASA Earth science products in user organizations' policy, business, and management decisions to serve society. The impacts are the resulting socioeconomic benefits from the improved decisions.

The Program's website (http://science.hq.nasa.gov/earth-sun/applications) includes more information on the systems engineering approach and other aspects of the program that may assist in preparing a proposal.

2. Category of Projects

The Applied Sciences Program supports one category of projects through this solicitation:

- ISS projects for applications of national priority.

2.1 Integrated System Solution

The Program seeks results-oriented projects focused on the integration of Earth science research results into operational DSSs related to one or more of the twelve applications of national priority. This solicitation is flexible enough to accept application concepts and solutions at various stages of maturity. Projects should fit into the scope of the Program described in Section 1 of this appendix.

The objective of a proposed ISS project must be to assess the potential for NASA Earth science research results to integrate into and improve the DSS and associated policy, business, or management decisions. The projects should pursue innovative uses and integration of an array of Earth science results and develop and test prototype configurations to improve the DSS.

Proposed projects should be national in scope, have national impact, or have explicit plans to distribute results and improvements nationally. The projects should work to improve a DSS developed centrally by a national organization and disseminated widely for use at state, regional, local, and tribal levels, so the benefits can be accrued broadly across the nation. In some cases, the decisions and DSSs may be inherently regional (i.e., multiple states) or international in nature. In such a case, the proposal must establish the national importance of the regional or international decision making[3].

Proposals must include a transition plan to enable the successful adoption of the techniques and products by the user community, so use of the Earth science results will continue after the project completion and independent of NASA funding.[4] Proposals should demonstrate a strong interest and commitment by the end users of the DSS to adopt the results from the proposed work. Proposals may include methods for Federal agencies to transition project results by their regional offices for further extension to State, local, and tribal entities.

In identifying Earth science results to improve the DSS, proposal teams are encouraged to use NASA Earth science research results produced partially or wholly with

[3] Projects that propose to focus on a local area (e.g., city, county, portion of a US State, or single state) must identify the commitment and established plan to extend the application solution broadly, must establish the national importance and impact of the issue, and must include the distribution activities in the proposal. Statements of potential value are not sufficient.

[4] The Program recognizes that the exact specifics of a transition depend on the results achieved in the project. However, projects must describe ideas and activities appropriate to the specific user community and indicative of the commitment by the organization(s) using the decision support system.

commercial remote sensing and geospatial information. Proposals may blend commercial remote sensing and geospatial information with NASA Earth science measurements to integrate into and improve the DSS. Commercial remote sensing data that has been validated by the Joint Agency Commercial Imagery Evaluation (JACIE; http://www.asd.ssc.nasa.gov/programs.aspx) in support of NASA Earth science research grants should be considered NASA Earth science research results.

Note: Section 4.4 of this appendix provides guidance on specific information to include in a proposal, and Section 4.6 of this appendix specifies reporting requirements for projects.

2.2 Specific Suggestions and Considerations

The Program strongly encourages projects to use an array of Earth science research results, including multiple spacecraft observations, geophysical parameters, and Earth system models and predictive capabilities. The Program encourages project teams to consider and use products from recently-launched NASA missions (e.g., Ice, Clouds, and Land Elevation Satellite (ICESat), Aura, Gravity Recovery and Climate Experiment (GRACE), CloudSAT, and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO)) as well as simulated products from upcoming, planned missions (e.g., Ocean Surface Topography Mission (OSTM), Aquarius, NPOESS Preparatory Project (NPP), Glory, Global Precipitation Measurement (GPM), Landsat Data Continuity Mission (LDCM), and Orbiting Carbon Observatory (OCO)).

The Applied Sciences Program website includes other specific suggestions that proposing teams may wish to review and consider in developing a proposal.

3. Programmatic Information

The Program seeks proposals for new projects that fall within the scope of the ISS projects description. Based on proposal review, program balance, and availability of funds, NASA may not necessarily fund projects in all of the twelve national applications. Projects will begin in Fiscal Year 2008.

Total Amount of Funding (FY08-10)	$15-30M total ($5-12.5M per annum)
Anticipated Number of Awards	16 – 45 projects
Expected Range of Award per project	$240K - $320K per annum
Period of Performance	up to 3 years
Expected Project Start Date	On or before January 1, 2008
Contributions from Partner Organizations	Strongly encouraged. However, partner funding does not count toward funding level guidelines.

4. Amendments and Clarifications to the *Summary of Solicitation*

The following information provides clarifications or amendments to the *Summary of Solicitation* of this NRA. The information below supersedes direction provided in the respective sections of the *Summary of Solicitation*.

4.1 Funding Policies: Changes to Section II(a) of the *Summary of Solicitation*

This solicitation is for new awards. NASA will not accept proposals for successor proposals to solicited projects whose periods of performance are ending nor proposals for supplemental funding of existing, solicited projects in response to this solicitation. Awards will be in the form of grants, cooperative agreements, contracts, and intra- or inter-agency transfers. The Applied Sciences Program prefers cooperative agreements for the ISS projects; proposing teams may request a specific type of award. A NASA awards officer will determine the appropriate award instrument for each proposal selection.

For cooperative agreements, the proposal should describe the support envisioned from NASA. NASA will work with the awardees regarding Earth research results, observations, models, data management issues, interoperability standards, and other relevant activities. NASA expects to work with the awardees regarding the systems engineering approach, results workshops, and guidance on benchmarking standards. NASA capabilities in support of the science, systems engineering, and interoperability standards are available at the NASA Centers, as described in the NASA Earth Science Strategic Plan at http://science.hq.nasa.gov/strategy.

4.2 Eligibility of Applicants: Changes to Section III(a) of the *Summary of Solicitation*

Teams of organizations and collaborations spanning organizational sectors (e.g., academia, private, Federal, public, nonprofit, etc.) and expertise (e.g., technical, management, scientific, etc.) are strongly encouraged and recommended[5]. When Federal agencies are part of a proposal team, the Program strongly encourages non-Federal organizations (e.g., companies, academic institutions, nonprofits) to also be part of teams.

End user organizations (e.g., organizations that use the DSS to support their decision-making responsibilities) must be explicitly identified and involved as active collaborators, participants, and/or leaders in the team. If a project involves Federal agencies and/or national organizations that make improvements centrally to a widely used DSS that other end-user organizations will employ, then representatives of the end-user organizations must be actively involved in the project design and execution.

[5] A primary purpose of a multi-sector teaming approach is to build skill and capacity in the community and to support the sustained use of Earth science results, especially after the completion of NASA project funding.

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

Contributions and cost sharing from proposing institutions and partner organizations is highly encouraged but not required. The Program accepts in-kind contributions during the course of the project as cost sharing. 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.

4.4 Proposal Format and Contents: Changes to Section IV(b)(ii) of the *Summary of Solicitation*

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 or
.....Grants.gov (includes budget summary)
Proposal Summary .....300 words (included in cover page)
Table of Contents 1
Decision Support System – Description and Baseline Performance.....2
Earth Science Research Results 1
Technical/Scientific/Management Section (including charts/figures/tables).....12
- Integrated System Solution Chart (required)
- Figures and Tables (as appropriate; integrated into text if possible)
Transition Approach/Activities 1
Performance Measures 1
Anticipated Results/Improvements 1
Project Management Metrics.....1
Schedule 1
Statements of Commitment – Co-Is .....as needed
Letters from End-User Organizations ..... 4, one-page letters
Budget Justification: Narrative and Details .....as needed
Facilities and Equipment (if applicable) 1
Curriculum Vitae: Principal Investigator 2
Each Co-Investigator 1
Current/Pending Support .....as needed
References and citations.....2

Proposal Summary
In addition to the information listed in the *NASA Guidebook*, this section must explicitly state which of the twelve applications of national priority the proposal relates to (if more than 2, then only identify the top 3). For the primary national application(s) related to the project, this section should state how the project responds and relates to the priorities identified in Section 5 of this appendix.

Decision Support Overview/Baseline
This section must explicitly identify and describe the DSS to be enhanced in the project. The description should discuss the DSS and the management/policy topic or issue that it serves (e.g., water resources allocation, energy load forecasting, and fishery stock rebuilding), including any quantitative information regarding its use. This section must identify and describe the end-user organization(s) and their responsibility and/or mandate to address the topic/issue.

This section should answer the following questions: What is the end-users' current basis for decision making? What is the DSS? Who uses the DSS? How do they use it in their decision-making process? What analyses, actions, and decisions does the DSS support? What measures/metrics do the DSS-users employ to determine the value or quality of their decision making and the DSS? What are the reasons and needs for improving the DSS? What is the pre-project (aka, baseline) state of the end-users' decision-making activities and their use of the DSS?

This section must quantify the pre-project, baseline performance of the decision support system, using the end-users' measures as well as other quantitative measures the team plans to employ throughout the project to track progress.

Earth Science Research Results
This section must identify the array of Earth science research results (Section 1.2 of this appendix) that the proposal seeks to integrate into and improve the DSS. Proposals must be specific. For spacecraft observations, proposals should include the spacecraft, sensor, data product, and other specific information. For proposals involving Earth science models, this section should identify the inputs to the models as well as the predictions, forecast products, or other products from the models. For proposals involving NASA Earth science research results produced with commercial remote sensing data and geospatial information, proposals must identify the commercial inputs and sources. For proposals blending commercial products with NASA products, proposals should identify all the data and products.

Technical/Management/Scientific Section
As the main body of the proposal, this section should cover the following material:

- Relevance of the proposed work to NASA's *Strategic Goals and Outcomes* given in Table 1 in the *Summary of Solicitation* of this NRA;
- Objectives of the proposed activity;
- Technical approach and methodology to be employed, including discussion of the innovative aspects;
- Rationale for NASA Earth research results to be integrated, including discussion of innovative aspects and potential impact to decision making;
- Design of an integrated system solution to improve the DSS
- Systematic approach to integrate Earth science results into the DSS;
- Approach to develop and test the integrated system solution and address integration problems (technical, computational, organizational, etc.);

- Approach to characterize uncertainty in the integrated system and DSS outputs;
- Approach to quantify improvements in the system performance;
- Approach to quantify (or quantitatively estimate) the socioeconomic value and benefits from the resulting improvements in decision making;
- Management approach and structure, plan of work, partnership arrangements, and the expected contribution, roles, and responsibilities of the team members;
- 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.

The proposal must include a populated version of an ISS diagram that depicts the project; diagrams should be as detailed and specific as possible; a version to download is available at http://science.hq.nasa.gov/earth-sun/applications.

Transition Approach/Activities
This section should articulate the transition plan, including specific activities to enable the end-users to adopt the DSS enhancements and sustain their use of the Earth science products within the timeframe of the project. For projects below the national level, this section must describe the activities to extend the results broadly.

Performance Measures
This section must articulate the measures (both quantitative and qualitative) the team will use to determine the outcomes, results, and value of the project. The measures should establish the potential improved performance of the DSS through the integration of the Earth science research results. The measures should include those that the DSS-users employ as well as those used to establish the baseline performance of the DSS. The Program website has information and examples of performance measures.

Anticipated Results
This section must describe the expected results from the project. This section should articulate the expected quantitative improvement(s) over the "baseline" performance of the DSS. This section should estimate the expected improvement(s) in decision making enabled from the enhanced DSS and the associated socio-economic benefits from the improved decision making. This section should be as specific, descriptive, and quantitative as possible.

This section should identify how the expected results will contribute to the specific goals and objectives of the related national application. This section should also identify how the project results might support NASA contributions to interagency and international programs, especially NASA contributions to the GEO and USGEO societal benefit areas, 2007-2009 task plan, and/or USGEO near-term opportunities.

Project Management Metrics
This section should articulate the metrics and indicators the project team will use to monitor the progress toward the project's objectives and milestones. The team should use these metrics to identify and track problems and to determine if the project is on schedule, on budget, on task, etc. The Program website has information and suggestions

about performance measures. *Note: Meetings (number of, frequency of, etc.) do not qualify as project management metrics.*

Statements of Commitment
In addition to the brief statements from Co-Is required per Section 2.3.10 of the *NASA Guidebook for Proposers*, this section may include up to 4, one-page letters of commitment 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 statements or letters must be addressed to the PI and included in the proposal. The Program website has suggestions about information to include in the end users letters of commitment.

Budget
The NASA Science Mission Directorate has adopted commercial data purchases as a mainstream way of acquiring research-quality data, as these commercial capabilities become available. Per NASA policy, NASA encourages the use of commercially available data sets by Principal Investigators as long as it meets the scientific requirements and is cost-effective. In addition to the budget guidance in the *Summary of Solicitation*, the proposal should identify the commercial data sources intended for use and details on the associated cost.

4.5 Evaluation Criteria: Subfactors for Section V(a) of the *Summary of Solicitation* and Section 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:

- Overall ability to showcase the value and benefits of NASA Earth science research;
- Overall ability to address a topic of national importance;
- Overall ability to address one or more of the Program’s national applications and the priority topics identified in Section 5 of this appendix;
- Overall ability to employ Earth science research results (including those using commercial data and geospatial information) to make valuable, substantive improvements to the DSS and decision-making processes;
- Overall ability to employ NASA Earth science model products, observations from recent NASA Earth science spacecraft and sensors, and simulated products from future planned NASA Earth science sensors;
- Overall ability to achieve the routine, sustained use of NASA Earth science results by the operational entity in their DSS and processes;
- The national breadth and impact of the project (preference is given to projects with broader impact to many regions, States, localities, and tribal entities);
- Overall ability for project results to support NASA contributions to GEO, USGEO, and other interagency and international organizations NASA supports; and

- Extent of the socio-economic value and benefits (estimated or actual) realized from NASA Earth science results (including those integrated with commercial data and geospatial information) to improve DSSs and decision making.

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

- Overall quality of the project design, innovation, and thoroughness in implementation to achieve project goals and meaningful results;
- Characterization and quantification of the baseline performance of the DSS and end users' decision making;
- Overall plan and ability to integrate Earth science results to the DSS and address technical integration and interoperability issues;
- Overall plan and ability to use an array of Earth science research results (including ones using commercial data and geospatial information, if applicable);
- Overall plan and ability to use Earth science model outputs and model predictive capabilities, especially NASA-sponsored models or models using NASA spacecraft measurements;
- Overall plan and ability to employ NASA Earth science spacecraft measurements, especially those from more recent NASA Earth science missions and sensors and/or simulated products from future planned missions;
- Extent of teaming across sectors (public, private, academic, non-profit, etc.), the extent of non-Federal organizations participation in the project, and the extent of involvement of user organization(s) in the proposed project;
- Overall plan and ability to employ systems engineering principles;
- Overall plan and ability to characterize uncertainty in the integrated system and DSS outputs;
- Overall plan and ability to determine, demonstrate, and quantify improvements to the performance of the DSS (baseline vs. improved states of the DSS); and
- Overall ability to quantitatively assess the value of NASA Earth science results in the DSS, the associated decision making, and the resulting societal benefits.

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

- The degree to which the proposed project follows a well-constructed plan and approach to manage the project;
- Overall plan and ability to identify and use effective project management metrics; and
- Overall plan and ability to identify and use effective performance measures.

Cost sharing is not part of the 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 4.3 of this appendix and Section III(c) of the *Summary of Solicitation.*

4.6 Award Reporting Requirements: Changes to Section VI(c) of the *Summary of Solicitation*

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 is the responsibility of the lead organization. The proposed budget should provide for these reporting requirements.

Quarterly Reports – Financial and Performance

Quarterly reports should provide an overall, summarized assessment of the project with summarized information on the following: major activities and accomplishments of preceding 3 months, schedule status, assessment of project development (and basis for that assessment), project management metrics, planned vs. actual financial activity, and performance measures. The report should be approximately 1-2 written pages, with the actual length depending on the level of activity. The report should indicate any changes to the ISS diagram. The first report should include a project plan for technical, schedule, and resource activities for the project; the first report may include discussion of issues or needed clarifications identified in the contract negotiations.

Projects to may include a one-page chart with four sections (a.k.a., quad chart) to communicate Major Accomplishments and performance measures; Major milestones; Risks, risk mitigations, and project metrics; and, Issues and action items to address. The Program will work with the project team on an appropriate format.

Demonstrations and Prototypes

Projects should plan for at least two demonstrations to show technical results and status: At least one demonstration should show the configuration and performance of the prototype, and at least one demonstration should show the use and performance of the enhanced DSS in the end users' operational environment. Plans for delivery of project prototypes, algorithms, etc. to NASA and partner agencies should be consistent with the *NASA Data and Information Policy*. This policy is available at http://eospso.gsfc.nasa.gov/ftp_docs/handbook99.pdf.

Final Report / Benchmark Report

The final report should be a benchmark report to address the following:

- Analysis of DSS performance with the Earth science results compared to the baseline (i.e., performance "with and without" the Earth science results);
- System configuration diagram;
- Results of feasibility evaluation(s) and issues encountered and resolved during verification and validation;
- Integration issues and interoperability issues encountered and resolved;
- Robust documentation of procedures and guidelines describing the steps to access, integrate, and utilize the Earth science research results;
- Lessons learned;

- Quantitative and qualitative enhancements to the DSS and related decision making;
- Resource estimate for the user organizations' adoption and sustained use of the Earth science products;
- Recommendations and remaining issues facing the sustained use of the Earth science data in the enhanced DSS by the partner agency and end users; and
- Quantitative and qualitative socio-economic benefits (actual or estimated) from the improved decision making enabled by the project and enhanced DSS.

The *Grant and Cooperative Agreement Handbook - Exhibit G* references the standard required reports for cooperative agreements (http://ec.msfc.nasa.gov/hq/grcover.htm); specific reporting requirements, if different from above, will be articulated in the cooperative agreement.

Workshop

The project should plan to travel and participate in a Program-sponsored results conference to disseminate the lessons learned from the project as widely as feasible. The Applied Sciences Program will coordinate this activity with project team during the course of the project; however, the project should budget accordingly to attend this event.

Distribution of Reports and Presentation Packages

During contract negotiation, NASA representatives will discuss methods, including electronic reporting, to transmit the reports and presentation packages. The NASA Shared Services Center (NSSC) will also solicit and archive the annual reports and final report.

5. Priority Topics for the Twelve National Applications

This section provides a brief description of the scope of activity and priority topics desired through this solicitation for each of the twelve applications of national priority (listed in reverse alphabetical order).

Points of contact for each of these applications are listed in Section 6 of this appendix, and the program plans for the applications are available at http://science.hq.nasa.gov/earth-sun/applications. Proposal teams should contact the points of contact with questions or for clarifications.

5.1 Priority Topics

5.1.1 Water Management

The Water Management program extends Earth science results to enhance DSSs related to water quantity and quality, and the program has organized its activities around four themes: Water Quality, Water Delivery and Irrigation, Drought, and Flow and Flood Forecasting. In this solicitation, the program requests proposals related to Drought and Water Quality.

For drought-related projects, the program strongly suggests that proposals focus on enhancing DSSs related to short-term drought forecasts and seasonal predictions (rather than monitoring current conditions). Proposers should become familiar with the USGEO activity on drought, including the National Integrated Drought Information System (NIDIS). The program specifically encourages proposals that use GRACE data and associated modeling efforts to improve DSSs in the management and long-term planning of aquifers and underground water storage. The program requests projects related to the USDA Drought Insurance Program. For water quality projects, the program allows activities from coastal to inland waters, including the Great Lakes. In addition to promoting the use of model products, the program strongly encourages innovative projects to improve water management DSSs through direct spacecraft measurements of water quality.

In cooperation with Energy Management, the program strongly encourages projects related to renewable energy activities/DSSs that utilize water management products (e.g., hydropower). Given the program's current portfolio, the program specifically discourages proposals focused on flooding. In addition, projects proposing to use Moderate Resolution Imaging Spectroradiometer (MODIS) and Landsat must use other sensors (especially more recent or upcoming sensors) and model products in addition to these. The Program strongly encourages all projects to involve an array of Earth science models and sensors, including under-represented missions in the water management portfolio, such as GRACE, Jason-1, and CloudSat, and it encourages proposals to consider future sensors, such as Aquarius, NPP, and OSTM.

5.1.2 Public Health

The Public Health program extends Earth science research results to enhance DSSs for public health, medical issues, and environmental health issues. The program’s foci of partnerships with the public health community are their DSSs known as Epidemiologic Surveillance Systems in the areas of infectious disease, environmental health, and emergency response and preparedness.

In this solicitation, the program specifically requests proposals in the areas of asthma/respiratory health, avian influenza, oceans and human health, and emergency response/preparedness (including bioterrorism). Given the Public Health program's current portfolio, the program discourages proposals focused on malaria.

5.1.3 Invasive Species

The Invasive Species program extends Earth science research results to enhance DSSs related to the control of invasive species. For this solicitation, the program requests proposals to support priorities established by the National Invasive Species Council (NISC) and/or priorities addressed by one or more of the agencies represented on the NISC and responsible for invasive species management, especially EPA, USGS and

USDA. Proposals must address the decision-making processes of the operational user(s) and may also include one or more of the following components:

- Development of predictive maps, national in scale, of the potential extent of high-priority species (where the "priority species" is determined by the NISC and/or partner agency/agencies);
- Increases in efficiencies (i.e., the speed and accuracy) of monitoring and mapping associated with the decision-making processes; and/or
- Increases in the precision and accuracy of invasive species maps, and integration of the precision and accuracy information into the decision support system.

To the extent possible, proposals should make use of existing or developing tools, such as the National Invasive Species Forecasting System (http://www.niiss.org) or the NISC Invasive Species Compendium (http://www.cabi.org/compendia.asp). The program encourages proposals that enhance, through the use of NASA Earth science results and related capabilities, projects awarded and in progress, or under consideration, through separate solicitations proffered by other Federal agencies, such as EPA, USGS and USDA.

5.1.4 Homeland Security

The Homeland Security program extends Earth science research results for terrorism response and homeland security preparedness, response, and mitigation. For this solicitation, the Homeland Security program specifically requests proposals focused on air plume transport and dispersion, aquatic or hydrologic contamination prediction or monitoring, and food security/insecurity monitoring or prediction. Thus, proposals to Homeland Security may also be associated with the Air Quality, Water Management, or Agricultural Efficiency applications, and the proposals should identify their dual-use nature.

The program especially encourages proposals involving products from recent NASA missions (such as GRACE, CloudSAT, CALIPSO, and Aura). The program encourages proposals to consider future systems (such as OSTM, OCO, LDCM, Aquarius, Glory, GPM, and NPP) through simulated products or direct data sets, depending on scheduled launch date. The program strongly advises proposals that involve products from NASA "extended mission" satellites and/or foreign satellites to also involve products from recent or future NASA systems.

5.1.5 Energy Management

The Energy Management program extends NASA Earth science research results (historical, near real-time, and forecasted) to support energy management decisions and scenarios related to energy production, energy efficiency, greenhouse gases, and energy-related carbon sequestration. The program endeavors to maintain alignment with the GEO Energy societal benefit area and the CCTP Strategic Plan (http://climatetechnology.gov).

In this solicitation, the program specifically encourages proposals focused on enhancing DSSs related to energy supply and load forecasting, climate change impacts on the energy sector, and distributed energy generation, particularly renewable energy, including hydroelectric and ocean energy (e.g., wave, tidal). In cooperation with Water Management, the program strongly encourages projects related to renewable energy activities/DSSs that utilize water management products (e.g., hydropower).

In addition to recent NASA sensors, the program encourages proposals to consider the use of upcoming NASA missions (such as Aquarius, Glory, OCO, and GPM; actual or simulated data sets) as well as Earth science model products and predictive capabilities.

5.1.6 Ecological Forecasting

The Ecological Forecasting Program extends NASA Earth science research results to enhance DSSs related to predictions and impacts of environmental change on terrestrial and aquatic ecosystems for the purposes of biodiversity conservation and sustainable development. For this solicitation, the Ecological Forecasting program requests proposals in the areas of regional conservation and sustainable development, protected area management, and marine fisheries forecasting.

For regional conservation and sustainable development projects, the program seeks proposals that will provide additional capabilities to Mesoamerican Regional Visualization and Monitoring System (SERVIR), especially enhancements to its biodiversity conservation applications (http://servir.nsstc.nasa.gov/). This solicitation also seeks proposals that will extend the SERVIR approach to regions outside Central America.

For protected area management projects, the program seeks proposals to improve existing DSSs for monitoring and assessing biodiversity at regional, national, or international scales. Proposed projects should involve U.S. government agencies and/or international organizations with mandates for biodiversity monitoring and assessment. The program strongly encourages proposals to align with GEO and its Biodiversity societal benefit area and to support U.S. contributions to GEO Work Plan, which calls for the implementation of strategies for biodiversity observation and monitoring that would enable assessments of the trends in and distributions of species and ecosystems of conservation merit.

For marine fisheries projects, the program seeks proposals focused on enhancing existing DSSs related to the management of living marine resources, such as stock assessments and habitat classifications. The program encourages projects to include representatives of NOAA Fisheries and/or U.S. Regional Fishery Management Councils. The program encourages proposals to include and utilize NASA-supported Earth science ecological models. This topic area is managed jointly with the Coastal Management program.

Ecological forecasting requires the application of both observations and models. Proposals with an exclusive focus on satellite observations and lacking the use of ecological models and/or Earth system models will not be responsive to this solicitation.

5.1.7 Disaster Management

The Disaster Management program extends Earth science results for disaster management preparedness, prediction, risk, response, and mitigation in the areas of wildfire, drought, earthquakes, tsunami, volcanoes, deformation/landslide, hurricanes/tropical storms, severe storms, tornadoes, lightning, and flooding.

For this solicitation, the program encourages proposals focused on enhancing the NOAA National Weather Service Advanced Weather Interactive Processing System (AWIPS) Next Generation System (aka, AWIPS-II) for disaster management applications.

For this solicitation, the program also encourages proposals focused on enhancing DSSs for disaster management applications in an international context. The program encourages proposals associated with Africa and addressing issues of sustainability. The Disaster Management website (link on the Applied Sciences Program site) includes information on example DSSs, and proposals are not limited to those. Projects focusing on international activities should have one or more Federal agency partner(s) on the team.

The program especially encourages proposals involving products from recent NASA missions (such as GRACE, CloudSAT, CALIPSO, and Aura). The program encourages proposals to consider future systems (such as OSTM, OCO, LDCM, Aquarius, Glory, GPM, and NPP) through simulated products or direct data sets, depending on scheduled launch date. The program strongly advises proposals that involve products from NASA "extended mission" satellites and/or foreign satellites to also involve products from recent or future NASA systems.

5.1.8 Coastal Management

The Coastal Management program extends Earth science research results to DSSs addressing issues associated with coastal and oceanic environments (including estuaries, near-shore, marine, large inland waters, reefs, etc.). The program has focused its activities to five areas: coastal hazards, resource management (particularly living marine resources), ecosystem management, water quality, and coastal planning associated with sea level change. For this solicitation, the program encourages proposals to enhance existing DSSs in all five areas.

In resource management, the program strongly encourages projects focused on enhancing DSSs related to the management of marine fisheries, such as stock assessments. The program encourages these fisheries proposals to incorporate NASA-supported Earth science ecological and geophysical models. This topic area is managed jointly with the Ecological Forecasting program. In hazards, the program encourages projects addressing hypoxia and encourages projects involving the US Coast Guard (e.g., search and rescue).

In planning, the program encourages projects on planning associated with sea level change impacts (e.g., subsidence, intrusion, inundation); these projects should incorporate products and predictive capabilities from NASA-supported Earth science models. In Ecosystem management, the program encourages projects related to wetlands/estuaries management and restoration. In water quality, the program encourages projects related to urban/coastal pollution as well as innovative projects to improve DSSs through direct spacecraft measurements of water quality (in conjunction with Water Management).

Since coastal issues are often regional in nature, the Coastal program will accept proposals focused on regional DSSs. In these cases, the proposed project must articulate the national importance of the regional area. Since the program's portfolio currently includes significant efforts focused on the Gulf of Mexico and harmful algal blooms, the program strongly requests projects focusing on other regions and topics. The program discourages projects that focus exclusively on coastal mapping.

The program strongly encourages all proposals to use Earth system models and model predictive capabilities. The program strongly suggests that proposers familiarize themselves with priorities identified in the U.S. Ocean Action Plan (http://ocean.ceq.gov/actionplan.pdf) and the related Subcommittee on Integrated Management of Ocean Resources (SIMOR; http://ocean.ceq.gov/about/simor.html).

5.1.9 Carbon Management

The goal of carbon management is to affect the carbon cycle through resource management decisions and/or development and implementation of policies that lead, in the near term, to the stabilization of, and, in the long term, to the reduction of carbon compounds in the atmosphere that contribute to global warming. The Carbon Management program element supports this goal through projects that integrate NASA Earth science research results into carbon management decision-making processes and DSSs.

For this solicitation, the program strongly encourages proposals with one or more of the following components:

- Use of existing NASA-supported tools for terrestrial carbon and ecosystem evaluations (e.g., Carbon Query and Evaluation Support Tools (CQUEST) and Terrestrial Observation and Prediction System (TOPS)) in carbon management decision processes that impact carbon management at regional to national levels;
- Extend NASA Earth science capabilities to existing decision support systems and processes related to carbon management; and/or
- Enhance carbon management DSSs employed at the state to regional level that are supported and distributed by a national agency, organization, or user network.

In addition, the program strongly encourages proposals to assess and incorporate contributions from recent and upcoming missions and Earth system models.

5.1.10 Aviation

The Aviation program extends Earth science research results to support the National Airspace System (NAS), specifically in the areas of safety, capacity, security, and environmental issues.

For this solicitation, the Aviation program specifically requests proposals in the areas of Numerical Weather Prediction (NWP) enhancement and space weather. Space weather proposals should focus on enhancing partner-owned decision support tools that concern radiation impacts on the crews and passengers of long-range aircraft.

In addition, the program encourages proposals to align with the "Next Generation Air Transportation System" Plan submitted to Congress in December 2004 by the inter-agency Joint Planning and Development Office (http://www.jpdo.aero).

5.1.11 Air Quality

The Air Quality program extends Earth science research results to air quality DSSs, and the program focuses its activities according to four themes: use of Earth science products in support of Air Quality Planning, Forecasting, Emissions Inventories, and Compliance (with air quality standards and policies). Generally, planning activities are targeted at assessments, policy development, implementation plans, and control strategies to improve air quality; emissions inventory activities focus on enhancing emissions inventories for enhancement of and use in air quality DSSs. The program primarily focuses on efforts directly or indirectly related to the criteria pollutants.

For this solicitation, the program requests proposals focused on air quality Compliance, Planning, Emissions Inventories, and particular aspects of Forecasting. In Forecasting, the program principally requests proposals focused on enhancing the Global Forecasting System. Since the program's portfolio currently includes significant MODIS-based aerosol activities, the program discourages forecasting proposals focused narrowly on MODIS-based aerosol/Particulate Matter (PM) forecasting (including VIIRS). In Planning, the program encourages a broad range of project concepts, including activities related to regional haze as well as use of land characteristics in air quality DSSs. In Compliance, the program encourages a broad range of project concepts, including activities to use Earth science results to support accountability efforts and assess policy effectiveness in addition to compliance assistance.

Since the program's portfolio already includes significant MODIS-based aerosol activities, the program discourages proposals focused narrowly on MODIS-based aerosol/PM forecasting. The program encourages proposals involving multiple Regional Planning Organizations, Federal agencies, and/or major national associations, such as the National Association of Clean Air Agencies. The program strongly encourages proposals to consider simulated products from upcoming missions.

5.1.12 Agricultural Efficiency

The Agricultural Efficiency program extends NASA Earth research results to support DSSs and processes used to monitor and manage agricultural resources. For this solicitation, the Agricultural Efficiency program encourages proposals that focus on one or more of the following components:

- Incorporate NASA climate model products and related observations, measurements and data products to initialize and calibrate existing models for crop stage development and crop productivity and yield predictions;
- Enhance existing agricultural efficiency DSSs employed at the state to regional level that are supported and distributed by a national agency, organization, or user network;
- Use NASA capabilities in international efforts related to agricultural decision support, including USGEO and GEO. Projects focusing on international activities should involve one or more U.S. Federal agency partner(s) on the team; and/or
- Incorporate on-going and completed Earth science results that support more timely, accurate and accessible observations critical to agriculture, including land cover, field boundaries and total crop land area, crop stage or phenology, and crop residue.

In addition, the program strongly encourages proposals to assess and incorporate contributions from recent and upcoming missions to enhance existing DSSs and decision support processes and/or improve the performance of existing crop models used in decision support. The program is especially interested in proposals that interact with NASA Earth science research focus areas and other Applied Sciences program elements that overlap with agricultural issues.

5.2 Additional information

The NASA Applied Sciences Program collaborates with the U. S. Department of Agriculture (USDA) on the identification and integration of NASA Earth science capabilities into decision support systems of operational agencies within USDA. Working groups have identified priority Earth science requirements and application candidates for eight of the applications of national priority. Information is available at: http://www.asd.ssc.nasa.gov/pships/usda.aspx. For projects proposing to these priorities, the Applied Science Program encourages the use of NASA Earth modeling capabilities.

6. Summary of Key Information

Expected program budget for new awards	See Section 3 of this appendix.
Number of new awards	See Section 3 of this appendix.
Maximum duration of awards	3 years
Due date for Notice of Intent	See Tables 2 and 3 in the *Summary of Solicitation* (as amended) of this NRA

Due date for Proposals	See Tables 2 and 3 in the *Summary of Solicitation* (as amended) of this NRA
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or research objective(s) from Table 1 in the *Summary of Solicitation* of this NRA. See Section 1.2 of this appendix. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
General information and overview of this solicitation	See *Summary of Solicitation* of this NRA.
Detailed instructions for the preparation and submission of proposals	*Guidebook for Proposers Responding to NASA Research Announcement – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/. See also Section 4.4 of this appendix for content guidance and amendments.
Page length for the central Science-Technical-Management section of Proposal	See Section 4.4 of this appendix and also Chapter 2 of *NASA Guidebook for Proposers*. Proposers are required to generate an Integrated System Solutions diagram to portray and illustrate their project (see http://science.hq.nasa.gov/earth-sun/applications for an example and a version to download)
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	NNH07ZDA001N-DECISIONS
Point of contact concerning this program	Mr. Marty Frederick Applied Sciences Program Earth Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0913 E-mail: martin.frederick-1@nasa.gov
Additional points of contact for the twelve National Applications	National Applications – General Information on Integrated System Solutions Lawrence Friedl Telephone: (202) 358-1599 E-mail: Lawrence.A.Friedl@nasa.gov

	Agricultural Efficiency, Carbon Management, Invasive Species Edwin Sheffner Telephone: (202) 358-0239 E-mail: Edwin.J. Sheffner@nasa.gov Air Quality, Coastal Management, Water Management Lawrence Friedl Telephone: (202) 358-1599 E-mail: Lawrence.A.Friedl@nasa.gov Aviation, Public Health John Haynes Telephone: (202) 358-4665 E-mail: jhaynes@nasa.gov Disaster Management, Homeland Security Stephen Ambrose Telephone: (202) 358-0851 E-mail: sambrose@nasa.gov Ecological Forecasting Woody Turner Telephone: (202) 358-1662 E-mail: Woody.Turner@nasa.gov Energy Management Richard Eckman Telephone: (757) 864-5822 E-mail: Richard.S.Eckman@nasa.gov

A.21 NEW INVESTIGATOR PROGRAM IN EARTH SCIENCE

1. Scope of Program

1.1 Introduction

The New Investigator Program (NIP) in Earth Science is designed to encourage the integration of Earth system research and education 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 and outreach activities and/or interdisciplinary endeavors from which the community of practitioners in Earth, space, and environmental sciences can benefit. The research Focus Areas appropriate for the NIP are (see Appendix A.1 for a description of Earth Science Focus Areas):

- 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, 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.

The NIP in Earth Science was originally 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[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 NRA (for ROSES-2007 that is after January 1, 2002).

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 NASA is encouraged before proposal submission.

- 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.

NIP awardees are not eligible for supplemental Education and Public Outreach awards as described in Section I(b) of the *Summary of Solicitation* for this NRA.

[1] The lawful status of permanent residency refers to the receipt of a U.S. Permanent Resident Card (also referred to as the Green Card). U.S. citizenship or lawful permanent residency must be established at the time of the award. 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, to be provided in the form of "education grants," range between $80-$120K per year for a period of up to three years, subject to satisfactory progress and availability of funds. Proposals submitted in response to this announcement will be competing for approximately $2.0M per year beginning in Fiscal Year 2007.

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. 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 *Summary of Solicitation* for this NRA 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 activities that 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 Education 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 the forming of inquiry minds and the harnessing of exploration, inspiration, and awe. The Education Plan should address a real educational need and does not have to

address all aspects of college, elementary/secondary, and informal education. 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 and outreach (see http://science.hq.nasa.gov/education/catalog/). Expenditures to enable such participation of the PI in an educational endeavor may command up to 25% of the total proposed budget. Student support to graduate and/or undergraduate students 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 educational expertise in the educational 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 educational 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 in Appendix C of the *NASA Guidebook for Proposers* apply to the NIP proposals with the following clarifications:

- For the Research Plan, 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: long-term commitment to the applicant's career development by the employing institution.
- For the Education Plan, the specific factors for the evaluation criteria (Intrinsic Merit, Relevance to NASA's Objectives, and Cost) are described at http://science.hq.nasa.gov/research/guide.pdf 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 Plan.

3. Summary of Key Information

Expected annual program budget for new awards	~ $2M
Number of new awards pending adequate proposals of merit	~ 20
Maximum duration of awards	Up to 3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or research objective(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Page limit for the central Science-Technical-Management section of proposal	20 pp; see also Chapter 2 of the *NASA Guidebook for Proposers*
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	NNH07ZDA001N-NIP
NASA point of contact concerning this program	Dr. Ming-Ying Wei Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0771 E-mail: Ming-Ying.Wei-1@nasa.gov

A.22 ADVANCING COLLABORATIVE CONNECTIONS FOR EARTH SYSTEM SCIENCE

1. Scope of the Program

1.1 Programmatic Description

The objective of NASA's Advancing Collaborative Connections for Earth System Science (ACCESS) Program is to enhance and improve existing components of the distributed and heterogeneous data and information systems infrastructure that support NASA's Earth science research goals. ACCESS projects increase the interconnectedness and reuse of key information-technology (IT) software and services in use across the broad spectrum of Earth system science investigations. The ACCESS Program supports the deployment of data and information systems and services that enable the freer movement of data and information within a distributed environment of providers and users, and the exploitation of needed tools and services to aid in measurable improvements of Earth science data access and data usability. Awarded projects help to improve NASA's heterogeneous data system components by leveraging proven information technologies, protocols, and practices. Selectees under the ACCESS solicitation are expected to rapidly bridge specific gaps in existing information systems and services that support NASA Earth science investigations.

The ACCESS Program welcomes and encourages the novel deployment and reuse of existing technological solutions for the support of Earth science data and information needs. Proposals offering wholly new IT development efforts or those comprising significant risk due to the immaturity of the technical components are not recommended for the ACCESS Program. The ACCESS Program welcomes infusion of mature technologies to supply new tools or services within the scope of this solicitation.

Proposers should note that this ACCESS solicitation is not a duplicative call for activities described in other ROSES-2007 solicitations, including Earth science research and science data product generation under the MEaSUREs solicitation (Appendix A.23), Integrated System Solutions and Solution Network development through the Applied Sciences Decision Support through Earth Science Research Results solicitation (Appendix A.20), education-related projects such as the New Investigator Program in Earth Science (Appendix A.21), or information systems research solicited through the Earth Science Technology Office's (ESTO's) Advanced Information Systems Technology program (Appendix A.24).

ACCESS-awarded projects focus exclusively on the use of high technology readiness level (TRL) technology components for improving Earth science data systems (generally TRL 6 and above).

1.2 Solicited Areas of Interest

Pursuant to ACCESS program goals, the following areas of interest will inform proposers of the IT and data services sought in this solicitation and illustrate the types of proposals that are deemed responsive to this call.

The ACCESS solicitation for this 2007 call is focused on developing additional data system infrastructure and services to enhance the specific topic areas listed below. NASA's Earth Science Division has been actively promoting a more distributed and heterogeneous data and information system architecture to support the growing demands and needs of a diverse and increasingly IT-sophisticated Earth science user community. These technical areas identified for further development represent NASA's emphasis on leveraging near-term targets for significant data system improvements that are clearly tied to improving and augmenting data access and use of NASA Earth science data. There is significant overlap in the technologies and approaches described below so proposers should use these descriptions to guide the development of a work plan that may satisfy one or more of these topic areas.

- Improve NASA Earth science data interoperability to facilitate the transparent access and/or manipulation of heterogeneous and distributed data by science users. Emphasis should be given to the needs of specific science communities to discover and access multiple data types needed for science research.
- Transition and deploy existing Earth science research analysis tools and software using a web-based "Service Oriented Architecture" (SOA) paradigm so to enhance their reuse (encapsulation) potential for other science domains and improve overall awareness and access of these tools by a broad community. Elegant tool and service design that is simple and intuitive to use is increasingly valuable to evolving our data and information systems.
- Increase users' ability to customize their discovery, access, delivery, manipulation, and/or preferred format of NASA Earth science data and information. Allow users to dynamically alter their web-based working environments to create a virtual workspace where Earth science data, information, and related services can be populated and organized. We also encourage the deployment of these user customization tools be developed within a SOA context of loosely coupled services that are composable and extensible.
- Facilitate the movement of Earth science data products and/or science information into venues where discovery and access can be accomplished via common public search and access tools. Proposers should leverage current NASA data system capabilities to improve the ability of users to discover NASA data and services specific to their research needs. Tools that are able to work across Earth science disciplines are encouraged.

1.3 Persistence of ACCESS Tools and Services

The ACCESS Program awards are intended to help bear the costs of technological deployment of needed tools and services rather than as an ongoing funding source for the

maintenance of these tools and services. It is critical that proposals address the tool or service life cycle and means for continued operation once ACCESS deployment resources end. The argument for simplicity of tools and services goes beyond ease of use to low maintenance costs for persistence. NASA recognizes that the use of COTS (commercial-off-the-shelf) and GOTS (Government-off-the-shelf) software, software developed through open source licensing, and other 'freeware,' are of equal consideration for use in ACCESS projects. While it is not always possible to plan with certainty the life cycle of these technologies, proposers should address the likely scenario and make a case for the utility and uptake of these tools and services by the communities they are intended to serve.

2. Programmatic Information

2.1 Proposal Submission and Evaluation

In addition to the required content given in the *NASA Guidebook for Proposers*, ACCESS proposals must address these additional factors:

- The ACCESS Program, while focusing on IT deployment, is based on serving the science community. Proposal teams that comprise representation of both IT experts and Earth scientists are essential.
- Proposals should be tied directly to an Earth science research issue(s) or investigations with a clear objective and work plan for technology execution and deployment.
- Proposals should identify the main Science Focus Area to be served by the technical work proposed. These are:
    - Climate Variability and Change;
    - Carbon Cycle and Ecosystems;
    - Earth Surface and Interior;
    - Atmospheric Composition;
    - Weather; and
    - Water and Energy Cycle.
- The period of award for these projects is two years. While in some instances an additional year of funding may be awarded, proposal work plans and deliverables described must be limited to two years.
- Work plans should include the current state of practice/application for the tool or service proposed and identifies the improvements or augmentation that will result from the two year ACCESS award.
- If the proposal is leveraging or extending past work funded by the ACCESS Program, the relevancy to this current ACCESS solicitation should be made clear.
- Proposals submitted in response to this solicitation should provide an operations concept for continuance of the tools and services developed for the ACCESS Program. Proposers should review the *NASA Data Rights and Related Issues* document (see Appendix A.27) to include plans for the future state of their information system software rights.

- Proposals should discuss the overall software or tool's effective total life-cycle cost of development and follow-on maintenance.

In addition, proposals selected by the ACCESS Program will be asked to have representation on one or more Earth Science Data System Working Groups (ESDSWGs). All ACCESS proposals must identify which ESDSWGs they wish to have representation on and should also budget a quarter-time (.25) FTE for these activities (see http://esdswg.gsfc.nasa.gov/ for additional information). Proposals should also include a small travel budget for annual ESDSWG meetings. Note, this is an ACCESS Program requirement and thus is not subject to project waivers or negotiation.

2.2 Award Type and Funding

The funding vehicle for any award under this solicitation will be a Cooperative Agreement (CA). Proposers should be aware of the differences between a CA and a grant. For additional information, proposers should review the *NASA Grant and Cooperative Agreement Handbook* (http://ec.msfc.nasa.gov/hq/grcover.htm). Proposers may wish to discuss this form of agreement with their institutions prior to submission of an ACCESS proposal.

This solicitation expects to provide approximately $3.5M per year for approximately seven to seventeen funded projects for a two-year cooperative agreement period, with an option for a third year extension. Proposers that plan on seeking a third year's funding must submit a project plan midway through year two. Additional information on possible third-year activities will be provided to all awardees at a later date. All work funded under this ACCESS solicitation must be completed within two years from the CA start date.

It is expected that approximately $200K - $500K per year will be provided for each ACCESS award. The maximum award will not exceed $500K per year. Proposal budgets for ACCESS projects will vary commensurate with the scale and scope of the activities proposed. Only the most substantive projects with broad scope (satisfying multiple topic areas) should propose budgets near the maximum yearly funding limit.

3. Summary of Key Information

Expected total program budget for new awards	~ $3.5M
Number of new awards pending adequate proposals of merit	~ 7-17
Maximum duration of awards	2 year, possible third year extension (see Section 2.2)
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.

NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Page length for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the *NASA Guidebook for Proposers5*
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	NNH07ZDA001N-ACCESS
Point of contact concerning this program	Dr. Francis Lindsay Earth Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1757 E-mail: francis.lindsay-1@nasa.gov

A.23 MAKING EARTH SYSTEM DATA RECORDS FOR USE IN RESEARCH ENVIRONMENTS

The Making Earth System data records for Use in Research Environments (MEaSUREs) Program will not be competed in 2007. NASA expects to continue to solicit Earth science data products and system capabilities through future MEaSUREs solicitations. However, all funds currently available for these activities are committed to the support of awards selected through prior year solicitations. The MEaSUREs Program is not expected to be competed again for several years.

The overall objective of the Making Earth System data records for Use in Research Environments (MEaSUREs) Program is to select projects providing Earth science data products or services evaluated on their contributions in research and on their contribution to advancing NASA's Earth system "missions to measurements" concept. MEaSUREs may also solicit infusion or deployment of applicable science tools that contribute to data product quality improvement, consistency, merging or fusion, or understanding.

MEaSUREs does not solicit proposals for systems and information technology. Proposers wishing to support the deployment of data and information systems and services; and tools that enhance NASA's data and information systems infrastructure, increase the interconnection of services for research, and enable freer movement of data and information within the distributed system of users and providers, are invited to apply to the Advancing Collaborative Connections for Earth System Science (ACCESS) Program (see Appendix A.22).

MEaSUREs does not solicit proposals for science data products, algorithm development or refinement, or for calibration/validation activities. These research activities are solicited through other Earth Science Research Program opportunities (see Appendix A.1).

For information on this program, contact:

Ms. Martha E. 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.24 ADVANCED INFORMATION SYSTEMS TECHNOLOGY

The Advanced Information Systems Technology Program will not be competed in 2007. The Advanced Information Systems Technology Program is expected to be competed again in 2008.

For information on this program, contact:

Mr. Steven A. Smith
Earth Science Technology Office
Code 407
NASA Goddard Space Flight Center
Greenbelt, MD 20771
Telephone: (301) 286-7336
E-mail: Steven.A.Smith@nasa.gov

A.25 ADVANCED COMPONENT TECHNOLOGY

The Advanced Component Technology Program will not be competed in 2007. The Advanced Component Technology Program is expected to be competed again in 2008.

1. Objectives

To research, develop, and demonstrate component- and subsystem-level technologies that reduce risk, cost, size, mass, and development time of missions and infrastructure. This segment of the overall Earth Science Technology Office (ESTO) program advances core component technologies to a technology readiness level (TRL) that enables their eventual infusion into missions.

2. Program Description

This program brings instrument, platform, and information system components to a maturity level that allows their integration into other NASA technology-development programs such as the Instrument Incubator Program and the New Millennium Program. Some components are directly infused into mission designs by flight projects. Other components "graduate" to other programs for further development. ACT also develops new ways to perform measurements and to process data products to expand research and application capabilities

For information on this program, contact:

Mr. Parminder Ghuman
Earth Science Technology Office
Code 407
NASA Goddard Space Flight Center
Greenbelt, MD 20771
Telephone: (301) 286-8001
E-mail: Parminder.S.Ghuman@nasa.gov

A.26 INSTRUMENT INCUBATOR

NASA expects to release a solicitation in the Instrument Incubator Program in late 2007 or early 2008. The focus areas for this solicitation will depend on the findings and recommendations of the Earth Science Decadal Survey. Any solicitation will be announced at least 90 days prior to the proposal due date.

The Instrument Incubator Program (IIP) fosters the development of innovative remote-sensing concepts and the assessment of these concepts in ground, aircraft, or engineering model demonstrations. Because the NASA Earth Science Research Program is an evolving program, periodic NASA Research Announcements (NRAs), typically issued as program elements within ROSES, will solicit a wide range of instrument development activity that offers proposers flexibility in advancing instrument development.

New and innovative technologies will lead to future flight instruments that are smaller, less resource intensive, less costly, and require less build time. Furthermore, by investing early in the development life cycle of an instrument and demonstrating performance in ground-based or aircraft instrumentation, flight builds will also encounter less development risk and, therefore, less cost and schedule uncertainty.

As promising new technologies emerge from core technology programs in Government, private industry, university, or other nonprofit organizations, proposers are encouraged to incorporate this latest technology into their instrument concepts. NRAs are expected to solicit some combination of feasibility studies; requirements analysis; design; construction of breadboards, prototypes, and engineering models; and laboratory and field demonstrations. While individual NRAs or ROSES elements may focus on specific science questions or may address the whole science program, the IIP provides a continuing source of mature instrument designs merging state-of-the-art technologies with measurement objectives available for use in the next generation of science.

The next IIP NRA is expected to be released in late FY 2007 or early FY 2008. As soon as we receive the information from the Decadal Survey, we will start developing the focus areas for this solicitation.

For information on this program, contact:

Ms. Janice L. Buckner
Earth Science Technology Office
Code 407
NASA Goddard Space Flight Center
Greenbelt, MD 20771
Telephone: (301) 286-0171
E-mail: Janice.L.Buckner@nasa.gov

A.27 DATA RIGHTS AND RELATED ISSUES

1. Introduction

NASA's Earth Science program was established to use the advanced technology of NASA to understand and protect our home planet by using our view from space to study the Earth system and improve prediction of Earth system change. To meet this challenge, NASA promotes the full and open sharing of all data with the research and applications communities, private industry, academia, and the general public. The greater the availability of the data, the more quickly and effectively the user communities can utilize the information to address basic Earth science questions and provide the basis for developing innovative practical applications to benefit the general public. A primary objective of this program is to facilitate the enhancement of the National Information Infrastructure to affect the emergence of an Environmental Information Economy capable of providing for the routine exchange of environmental data and information. To meet the objectives of this program, scientific data product algorithms and data products or services produced through the program shall be made available to the user community on a nondiscriminatory basis, without restriction, and at no more than the marginal cost of fulfilling user requests.

Included below is the Data Rights clause created specifically for this type of partner agreement, which will be part of the Cooperative Agreement between NASA and successful Earth Science Data System solicitation respondents.

2. Rights in Data Clause

The following Rights in Data clause created for NASA's Earth Science Data Cooperative Agreements is used for this Cooperative Agreement and replaces the standard Rights in Data clause (1260.30) of the "NASA Grant and Cooperative Agreement Handbook."

Rights in Data
(December 2006)

A. Introduction

NASA intends to protect Recipient's rights to data that embodies trade secrets or comprises commercial or financial information which is privileged or confidential. No data transfer or "cross fertilization" of concepts will be performed by NASA participants, should two or more cooperative agreements be awarded. While NASA will require that the data that embodies trade secrets or comprises commercial or financial information which is privileged or confidential generated by the Recipient be delivered to NASA for dissemination to employees of NASA, of JPL, and of appropriate support contractor personnel, such data marked with a suitable notice or legend will be protected for the 2-year period of exclusivity set forth in paragraph D.3 of this clause. Support contractor personnel will be provided access to the such data generated as a part of these studies only under suitable protective conditions and use by support contractor personnel will be limited to governmental purposes only.

B. Definitions

1. "*Data*" means recorded information, regardless of form, the media on which it may be recorded, or the method of recording. The term includes, but is not limited to, data of a scientific or technical nature, software and documentation thereof, and data comprising commercial and financial information.

2. "*Computer Data Base*" means a collection of Data in a form capable of being processed and operated on by a computer through the use of a computer program performing the function of storing, manipulating, or formatting. A "computer data base" is not software.

3. "*Metadata*" means information about a Data set provided by the data supplier or the generating algorithm and which provides a description of the content, format, and utility of the Data set. Metadata provide criteria, which may be used to select Data for a particular scientific investigation.

4. "*Object Code*" means machine language, i.e., that programming language directly readable by a computer.

5. "*Software*" means computer programs (a set of statements or instructions, in object code, to be used directly or indirectly in a computer in order to bring about a certain result), source code, source code listings, and design details, algorithms, processes, flow charts, formulae and related material that would enable the software or a functionally equivalent software to be reproduced, recreated, or recompiled, regardless of the form or media on which such information is recorded.

6. "*Software Documentation*" means Data that explain the capabilities of the software, or provide operating instructions for using the software, to obtain the desired results from a computer such as: (a) owner's manuals, (b) user's manuals, (c) installation instructions, (d) operating instructions, and other similar items.

C. Data Products

1. Scientific Data: Earth system science products, with accompanying metadata and quality assessments, made available through production or services provided by the project. Some examples of Scientific Data include: geophysical parameters, such as sea surface temperature, sea surface height, atmospheric pressure/temperature levels, precipitation, atmospheric chemical species and aerosols, ice sheet mass balance, and various terrestrial surface measurements.

2. Scientific Computer Data Base: Collection of Scientific Data.

3. Scientific Software: Scientific software is that software used for processing raw instrument Data into Scientific Data.

4. Information System Software: Software produced as part of the project pursuant to the technology objectives of this Cooperative Agreement that comprises any part of, access to, or management of Data in the data system of the project, or tools that access, manipulate, or analyze Scientific Computer Data Base. Some examples of Information System Software include client/server applications, user interfaces, tools for selecting, manipulating and analyzing Scientific Data, and database management software.

D. Data Rights

1. Data exchanged between NASA and Recipient under this Cooperative Agreement will be exchanged without restriction as to its disclosure, use, or duplication except as otherwise provided below in this clause. In particular, rights in Scientific Data, Scientific Computer Data Bases, and Scientific Software, as defined in paragraph C of this clause, are provided under this paragraph D.1.

2. Background Data: (Recipient's and NASA's)
   a. *Recipient*: In the event it is necessary for Recipient to furnish NASA with Data which existed prior to, or produced outside of, this Cooperative Agreement, and such Data embodies trade secrets or comprises commercial or financial information which is privileged or confidential, and such Data is so identified with a suitable notice or legend, the Data will be maintained in confidence and disclosed and used by NASA and its contractors (under suitable protective conditions) only for the purpose of carrying out NASA's responsibilities under this Cooperative Agreement. Upon completion of activities under this Cooperative Agreement, such Data will be disposed of as requested by Recipient.

b. *NASA:* Earth Observing System Core System (ECS) Software - No license rights to the ECS software are granted or implied by this Cooperative Agreement. ECS software is being provided for Government purposes and may not be used for commercial purposes during or upon completion of this Cooperative Agreement. Upon completion of activities under this Cooperative Agreement, such Data will be disposed of as requested by NASA. Any modification to these rights will be expressly made through a separate written agreement.

3. Data first produced by Recipient:
   a. In the event Data first produced by Recipient in carrying out Recipient's responsibilities under this Cooperative Agreement is furnished to NASA, and Recipient considers such Data to embody trade secrets or comprise commercial or financial information which is privileged or confidential, and such Data is so identified with a suitable notice or legend, the Data will be maintained in confidence for a period of two years after completion of this Cooperative Agreement and be disclosed and used by the Government and its contractors (under suitable protective conditions) only for use as a tool for Government research by or on behalf of the Government during that period. In order that the Government and its contractors may exercise the right to use such Data for the purposes designated above, NASA, upon request to the Recipient, shall have the right to review and request delivery of Data first produced by Recipient. Delivery shall be made within a time period specified by NASA.
   b. In particular, rights in Information System Software, as defined in paragraph C of this clause, are provided under this paragraph D.3, except that object code shall be treated under paragraph D.1 of this clause as Data exchanged without restriction as to its disclosure, use or duplication.
   c. Within one month of the completion of this Cooperative Agreement, the recipient shall provide written documentation of its intent to commercialize "Data first produced by Recipient" under this Cooperative Agreement. If the Recipient intends to commercialize such Data, Recipient shall mark the Data with a suitable notice and NASA shall, to the extent permitted by law, maintain such Data in confidence for a period of two years after completion of this Cooperative Agreement. During the aforementioned restricted period, NASA will disclose such Data to third parties (under suitable protective conditions) only with the Recipient's written approval. After the restricted period expires, NASA shall have the rights specified in paragraph D.1 of this clause.
   d. If the Recipient determines not to commercialize such Data (or otherwise make the data available to the user community, such as "open source"), or if the Recipient fails to provide written documentation indicating its intent to commercialize the Data, Recipient agrees that NASA shall have the rights specified in paragraph D.1 of this clause and all such Data can be made available without restriction as to its disclosure, use or duplication. Alternatively, at NASA's option, NASA may require the recipient to assign any copyright in such Data to NASA or its designee.

4. Data first produced by NASA: Data first produced by NASA in carrying out NASA's responsibilities under this Cooperative Agreement that would embody trade secrets or would comprise commercial or financial information that is privileged or confidential if it had been obtained from the Recipient, will be marked with a suitable notice or legend and maintained in confidence for an agreed period of up to two (2) years after completion of this Cooperative Agreement, with the express understanding that during the aforesaid period such Data may be disclosed and used (under suitable protective conditions) by or on behalf of the Government for Government purposes only, and thereafter for any purpose whatsoever without restriction on disclosure and use. Recipient agrees not to disclose such Data to any third party without NASA's written approval until the aforementioned restricted period expires.

5. Copyright:
   a. In the event Data is exchanged with a notice indicating the Data are protected as a published copyrighted work, or are deposited for registration as a published work in the U.S. Copyright Office, the following paid-up licenses shall apply:
      (i) If it is indicated on the Data that the Data existed prior to, or was produced outside of, this Cooperative Agreement, the receiving party and others acting on its behalf, may reproduce, distribute, and prepare derivative works for the purpose of carrying out the receiving party's responsibilities under this Cooperative Agreement; and
      (ii) If the furnished Data does not contain the indication of paragraph D.5.a.(i) of this clause, it will be assumed that the Data was first produced under this Cooperative Agreement, and the receiving party and others acting on its behalf, shall be granted a paid-up, nonexclusive, irrevocable, world-wide license for all such Data to reproduce, distribute copies to the public, prepare derivative works, and perform publicly and display publicly, by or on behalf of the receiving party. For Data that is computer software, the right to distribute shall be limited to potential users in the United States.
   b. When claim is made to copyright, the Recipient shall affix the applicable copyright notice of 17 U.S.C. 401 or 402 and acknowledgment of Government sponsorship to the Data when and if the Data are delivered to the Government.

6. Oral and Visual Information:

If information which the Recipient considers to embody trade secrets or to comprise commercial or financial information which is privileged or confidential is disclosed orally or visually to NASA, such information must be reduced to tangible, recorded form (i.e., converted into Data as defined herein), marked with a suitable notice or legend, and furnished to NASA within 10 days after such oral or visual disclosure, or NASA shall have no duty to limit or restrict, and shall not incur any liability for, any disclosure and use of such information.

7. Disclaimer of Liability:

Notwithstanding the above, NASA shall not be restricted in, or incur any liability for, the disclosure and use of:

a. Data not identified with a suitable notice or legend as set in paragraphs D.2.a., D.3.a., and D.3.c. of this clause; or
b. Information contained in any Data for which disclosure and use is restricted under paragraphs D.2. or D.3. of this clause, if such information:
   (i) is publicly available at the time of disclosure or thereafter becomes publicly available without breach of this Cooperative Agreement;
   (ii) is known to, in the possession of, or developed by NASA independent of carrying out the NASA's responsibilities under this Cooperative Agreement;
   (iii) is received from a third party having the right to disclose such information without restriction; or
   (iv) is required to be produced or released by the receiving Party pursuant to a court order or other legal requirement.

E. Marking of Data

All Data or Information System Software object code created under this Cooperative Agreement, by NASA or the Recipient shall be marked with the notice provided below.

> Copyright <enter *year of first publication*> <enter *Participant's name* OR *United States Government as represented by the Administrator of the National Aeronautics and Space Administration*, as applicable>. No copyright is claimed in the United States under Title 17, U.S. Code to any U.S. Government created work. This work has been developed under Cooperative Agreement with NASA and the Government has certain rights. This work is released without restriction as to its disclosure, use or reproduction. Software shall not be disassembled, reverse engineered, or made into human readable form.
>
> This work is provided "as is" without any warranty of any kind, either express, implied, or statutory, including, but not limited to, any warranty that the software will conform to specifications, any implied warranties of merchantability, fitness for a particular purpose, and freedom from infringement, and any warranty that the documentation will conform to the software, or any warranty that the software will be error free.
>
> In no event shall NASA be liable for any damages, including, but not limited to direct, indirect, special, or consequential damages, arising out of, resulting from, or in any way connected with this work, whether or not based upon warranty, contract, tort, or otherwise, whether or not injury was sustained by persons or property or otherwise, and whether or not loss was sustained from, or arose out of the results of, or use of, the work provided hereunder.

F. Lower Tier Agreements

Recipient shall include this provision, suitably modified to identify the parties, in all subcontracts or lower tier agreements, regardless of tier, for experimental, developmental, or research work conducted under or in association with this Cooperative Agreement.

APPENDIX B. HELIOPHYSICS RESEARCH PROGRAM

B.1 OVERVIEW

1. Overview

The Heliophysics Research Program of the Science Mission Directorate 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 traditional discipline interests have been:

Solar and Heliospheric Physics, which treats the Sun as a typical dwarf star; as the dominant, time-varying source of energy, plasma, and energetic particles in the solar system; and the origin and behavior of the solar wind, energetic particles, and magnetic fields in the heliosphere and their interaction with the interstellar medium; and

Geospace Science, which treats the physics of magnetospheres, including their formation and fundamental interactions with plasmas, fields, and particles (the Earth's magnetosphere is emphasized, but studies of the magnetospheres of planets, comets, and other primordial bodies are also supported); and the physics of the mesosphere, thermosphere, ionosphere, and aurorae of the Earth, including the coupling of these phenomena to the lower atmosphere and magnetosphere.

The recommended priorities of the heliophysics community are discussed 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), the *Science Plan for NASA's Science Mission Directorate (2007-2016)* (available at http://science.hq.nasa.gov/strategy), and the Heliophysics Roadmap for Science and Technology 2005-2035, *The New Science of the Sun-Solar System Connection*, (http://sec.gsfc.nasa.gov/Roadmap_FINALpri.pdf).

The Heliophysics Research Program supports several types of endeavors, including Supporting Research and Technology (SR&T) and Low Cost Access to Space (LCAS) programs in the various disciplines, the Heliophysics Theory Program, the Guest Investigators Program, and the Living With a Star Program. Generic program descriptions follow immediately below, while specific information can be found in the Heliophysics program elements described in Appendices B.2 through B.9. It is the overall guiding objective of each of these programs to contribute as effectively and directly as possible to the achievement of NASA strategic goals, and priority for selection is given to those proposals that most clearly demonstrate the potential for such contributions.

2. Supporting Research and Technology

Supporting Research and Technology (SR&T) programs support 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 instrument concepts; and laboratory measurements of relevant atomic and plasma parameters, all to the extent they have a clear application to Heliophysics program goals. The Solar and Heliospheric SR&T program is administered as part of the Solar and Heliospheric Physics program element described in Appendix B.2, while the Geospace SR&T program is one component of the Geospace Science program element, which is described in Appendix B.3.

3. Low Cost Access to Space

Low Cost Access to Space (LCAS) programs have as their objectives science investigations that may be completed through suborbital rocket or balloon flight of experimental instrumentation, as well as proof-testing new concepts in experimental techniques that may ultimately find application in free-flying Heliophysics space missions. The LCAS program for solar and heliospheric physics is treated in the Solar and Heliospheric Physics program element in Appendix B.2, and the Geospace LCAS program is treated in the Geospace Science program element in Appendix B.3.

4. Heliophysics Theory Program

The Heliophysics Theory Program (HTP) element, Appendix B.4, supports efforts to attack problems concerning phenomena relating to the Heliophysics program using relatively large "critical mass" groups of investigators that are beyond the scope of the nominally smaller SR&T tasks discussed above. Funding for the HTP is competed in its entirety every three years. Proposals for funding the FY 2008-2009 cycle are being solicited via this NRA.

5. Guest Investigators Program

The Heliophysics Guest Investigators (GI) program is intended to maximize the return from the Heliophysics missions by providing support for research which heavily utilizes mission data. The Heliophysics GI program element is described in Appendix B.5 and this year features a one-time program for STEREO guest investigators.

6. Living With a Star

The Living With a Star (LWS) program offers a number of separate program elements that are focused on those particular aspects of Heliophysics that directly affect life and society. The LWS Space Environment Testbeds (SET) program element, Appendix B.6, supports research activity aimed at understanding the effects of space weather on spacecraft and other technological systems in space and developing engineering solutions to mitigate these effects.

The LWS Targeted Research and Technology (TR&T) program supports a range of research tasks similar in kind to those supported by the SR&T program. In the case of LWS TR&T, however, the goal of the program is to specifically address those aspects of the connected Sun-Earth system that affect life and society where no spacecraft is involved. The LWS TR&T program element is described in Appendix B.7.

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. The LWS Strategic Capability program element is described in Appendix B.8.

7. Virtual Observatories for Heliophysics Data

The Virtual Observatories for Heliophysics Data program particularly targets the integration of the many data services for solar, heliospheric, and geospace physics data necessary to the conduct of research in the Heliophysics field. A secondary part of this program permits holders of heliophysics data to propose for small grants to upgrade their data services in order to participate in one of the several virtual observatories either in existence or proposed. A new part to this program solicits proposals to maintain resident archives of data from previously operating missions. This program element is described in Appendix B.9.

8. General Guidance for Proposals to Heliophysics Programs

Proposals to any of the Heliophysics program elements are expected to present within their Scientific/Technical/Management section a clear description of a specific scientific problem, of how the attack on this problem will be carried out, and of the relevance of the proposed research to NASA's strategic objectives. The development and testing of new instrument concepts, new observing techniques, new models, and/or new data analysis techniques that are pertinent to discipline goals are also supported. However, proposals for such efforts must provide at least a brief explanation of the relationship between such proposed efforts and clearly defined Heliophysics science problems.

Proposals with the intent of extending or directly supplementing investigations selected for current approved space flight missions are not appropriate for this NRA. Investigators who are members of the science teams of ongoing missions (including mission PIs and Co-Is) and who propose to use data from these missions in SR&T efforts proposed through this NRA must clearly delineate between their mission responsibilities and the proposed efforts.

B.2 SOLAR AND HELIOSPHERIC PHYSICS

1. Scope of Program

1.1 Introduction

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 the

- Solar interior,
- Solar photosphere,
- Solar chromosphere and corona,
- Inner heliosphere, and
- Outer heliosphere and the interstellar boundary,

through two main research thrusts, one characterized by nonflight Supporting Research and Technology (SR&T) that may be carried out in the office, observatory, or laboratory setting (see Section 1.2 below) and one carried out by experiment hardware carried as the primary payload 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 1.3 below).

These studies support NASA's strategic goal to understand the Sun and its effects on Earth and the Solar System (see Section I(a) and Table 1 of the *Summary of Solicitation* of this NRA).

Efforts focused on those particular aspects of the Earth-Sun system that directly affect life and society are not appropriate for the Solar and Heliospheric Physics program, but may be appropriate for the Living with a Star Targeted Research and Technology program (see Appendix B.7 in this NRA).

1.2 Solar and Heliospheric Physics Supporting Research and Technology (SR&T)

For purposes of program balance, the NASA SHP program element is organized into a matrix of five techniques, viz.,

- Development of Instrument Concepts (but not major space flight instruments *per se*);
- Ground- and 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. Science research investigations in all matrix categories are invited (e.g., Solar Photosphere/Data Analysis, Outer Heliosphere/Theory-Modeling, etc.). 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), e.g., the Solar Probe. Although no priorities are imposed on these categories, an ideal program is envisaged as a balance among all 25 matrix combinations, consistent with the quality of submitted proposals and their relevance to the current SHP flight programs.

This SR&T program supports investigations involving analyses of existing data or the development of data reduction software that will be demonstrably available in the public domain. Acceptable SR&T investigations include the development of theoretical models and numerical simulation techniques pertinent to solar and heliospheric physics, and, in special cases, the development or coordination of solar and heliospheric ground-based observing capabilities that support NASA SHP flight programs.

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 NRA.

The SHP SR&T 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 databases 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&T work in a timely manner, which NASA reserves the right to confirm.

1.3 Low Cost Access to Space Program in Solar and Heliospheric Physics

The SHP Low Cost Access to Space (LCAS) program is expected to continue to lead the way in the development 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, and sounding rocket-class payloads flown as secondary payloads or on other flights of opportunity. It is emphasized that a proposal for the SHP LCAS program must be for a complete science investigation, including clearly defined scientific goals appropriate for SHP, data analysis, and

publication of results, even if these activities are projected to be done beyond the nominal three-year period of performance for most awards in this program. In a case like this, a follow-on proposal must be submitted for full peer review. The proposal must document the progress made in developing, if not flying, the payload and must project the steps necessary for data acquisition and reduction and the publication of results.

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.

Questions concerning sounding rocket vehicles and operations may be addressed to:

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

Questions concerning balloon operations may be addressed to:

Mr. Craig Purdy
Balloon Office
Code 800
Wallops Flight Facility
National Aeronautics and Space Administration
Wallops Island, VA 23337
Telephone: (757) 824-1453
E-mail: Craig.L.Purdy@nasa.gov

2. Programmatic Information

2.1 Available Funds

Currently, the SHP SR&T program has a distribution of one-, two-, and three-year grants that leaves a portion of the program available for competition each year. Total SR&T program funds in Fiscal Year (FY) 2008 of about $15M will support approximately 110 grants. Available funds and awards expired by FY 2009 will free resources to allow the selection of about 35 new awards from proposals competing under this NRA.

As part of total SR&T funding, the SHP LCAS Program has approximately $1.2M available for a selection made through this NRA of perhaps three LCAS investigation of up to three years duration beginning in early FY 2009.

2.2 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) or program specific form (in Grants.gov) for SHP proposals include a single choice of descriptor (e.g., Theory or Modeling/Solar Chromosphere 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 (see Section IV of this NRA's *Summary of Solicitation* and the *NASA Guidebook for Proposers* for directions).

2.3 Summary of Key Information

Expected annual program budget for new awards	See Section 2.1
Number of new awards pending adequate proposals of merit	See Section 2.1
Maximum duration of awards	3 years; shorter-term proposals are encouraged.
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
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*
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	NNH07ZDA001N-SHP
NASA point of contact concerning this program	Dr. William J. Wagner – SHP Program Officer Heliophysics Division Science Mission Directorate NASA Headquarters Washington DC 20546-0001 Telephone: (202) 358-0911 E-mail: William.J.Wagner@nasa.gov Dr. Eric R. Christian Heliophysics Division Science Mission Directorate NASA Headquarters Washington DC 20546-0001 Telephone: (202) 358-1763 E-mail: Eric.R.Christian@nasa.gov Dr. Alexei Pevtsov Heliophysics Division Science Mission Directorate NASA Headquarters Washington DC 20546-0001 Telephone: (202) 358-1106 E-mail: Alexei.A.Pevtsov@nasa.gov Dr. Arik Posner Heliophysics Division Science Mission Directorate NASA Headquarters Washington DC 20546-0001 Telephone: (202) 358-0727 E-mail: Arik.Posner-1@nasa.gov

B.3 GEOSPACE SCIENCE

1. Scope of Program

1.1 Overview

The Geospace Science (G/Science) program is a component of the Heliophyiscs Research Program and proposers interested in this program element are encouraged to see the overview of the Heliophyiscs Research Program in Appendix B.1 of this NRA.

The goal of the G/Science program is to understand the space that surrounds and 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 outwards 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 Goal 3.2: "Understand the Sun and its effects on Earth and the solar system" from *The 2006 NASA Strategic Plan* (available at http://www.nasa.gov/about/budget) (see Section I(a) and Table 1 in the *Summary of Solicitation* of this NRA). The Heliophysics Division roadmap, *New Science of the Sun-Solar System Connection - Recommended Roadmap for Science and Technology 2005-2035: Open the Frontier to Space Environment Prediction* (available at http://sec.gsfc.nasa.gov/sec_roadmap.htm), is organized around three Research Focus Areas. The G/Science program contributes primarily to the first of these, "Open the Frontier to Space Environment Prediction," which has the goal of understanding "the fundamental physical processes of the space environment - from the Sun to the Earth, to other planets, and beyond to the interstellar medium."

The G/Science program has three components: the Geospace Supporting Research and Technology (G/SR&T) program, the Geospace Instrument Development Program (G/IDP), and the Geospace Low Cost Access to Space (G/LCAS) program. These elements are described below. There is also significant Geospace content in the Heliophysics Theory program (Appendix B.4), the Heliophysics Guest Investigators program (Appendix B.5), and in the Living with a Star Targeted Research and Technology program (Appendix B.7). Brief descriptions of the elements of the G/Science program follow below, while specific information can be found in the individual program element descriptions.

- The G/SR&T program supports 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 instrument concepts; and laboratory measurements of relevant atomic and plasma parameters (Section 1.2 below).
- The G/IDP supports the development of scientific instruments and/or components of such instruments to the point where they may be proposed in response to announcements of future Geospace Science flight opportunities without additional extensive technology development. G/IDP investigations may include the

development of laboratory instrument prototypes, but not of flight hardware (Section 1.3 below).

- The G/LCAS program supports science investigations that must be completed through suborbital flights (Section 1.4 below).

Other related programs are:

- The Heliophysics Theory Program (HTP) attacks problems concerning phenomena relating to heliophysics requiring relatively large critical mass groups of investigators that are beyond the scope of the nominally smaller SR&T tasks (see Appendix B.4 in this NRA). The entire HTP is being competed this year.
- The Heliophysics Guest Investigators Program (HGIP) provides support for research that heavily utilizes mission specific data from currently operating Heliophyiscs Division spacecraft (see Appendix B.5 in this NRA).
- The Living With a Star (LWS) Targeted Research and Technology (TR&T) program supports a range of research tasks similar in kind to those supported by the SR&T program. In the case of LWS TR&T, however, the goal of the program is to specifically address those aspects of Heliophysics that affect life and society (see Appendix B.7 in this NRA).
- Community members interested in studies of planetary magnetospheres should be aware of Appendix C.9 New Horizons at Jupiter Data Analysis, which will solicit research proposals to conduct scientific investigations utilizing data obtained at Jupiter by the New Horizons spacecraft. The final text for Appendix C.9 will be released as an amendment to ROSES 2007 in Fall 2007.

The highest priority for selection in the G/Science program is given to those proposals that most clearly demonstrate the potential for making significant contributions to Research Objectives 3B.1, 3B.2, and/or 3B.3 in the *Science Plan for NASA's Science Mission Directorate (2006)* (see Section I(a) and Table 1 of the *Summary of Solicitation* for this NRA), *especially* those demonstrating direct benefit to NASA *future mission planning*. It should be noted in this regard that upcoming missions with Geospace focus include:

<u>Solar Terrestrial Probes</u>:

- Magnetospheric MultiScale -- whose primary objective is the understanding of the fundamental processes of reconnection, and
- Geospace Electrodynamic Connections -- with a primary objective of understanding the coupling between the ionosphere-thermosphere system and the magnetosphere.

<u>Explorer Program missions with a Geospace focus that are currently in development</u>:

- Aeronomy of Ice in the Mesosphere -- with the overall goal of resolving why Polar Mesospheric Clouds form and why they vary,

- Coupled Ionized and Neutral Dynamics Instrumentation -- which seeks to discover the processes that lead to and promote the growth of equatorial plasma structure,
- Time History of Events and Macroscale Interactions during Substorms -- with the primary objective of understanding the onset and evolution of the macroscale substorm instability, and
- Two Wide-Angle Imaging Neutral-Atom Spectrometers -- which will use stereo imaging of neutral atoms to resolve large-scale magnetospheric structures and dynamics.

Planetary Science Division missions with significant G/Science components:

- Jupiter Polar Orbiter (Juno) -- seeks to understand Jupiter's gross size and structural properties, as well as measure its atmospheric composition, temperature, and deep wind profiles, and
- MErcury Surface, Space ENvironment, GEochemistry and Ranging -- will study the effects of the Sun on the dynamics of Mercury's magnetic field.

Proposals to all of the Geospace elements are expected to present clear descriptions of (1) a specific scientific problem, (2) a method of attack on this problem, (3) the importance of the problem, and (4) the relevance of the problem to NASA's strategic objectives. These descriptions should be presented concisely in the Proposal Summary and they should be discussed more deeply within the proposal Scientific/Technical/Management section.

Objectives that are outside the scope of this G/Science program and should not be proposed include:

- Efforts focused on those aspects of Heliophysics that directly affect life and society are not appropriate for this G/Sciences program but may be appropriate for the Living With a Star program (see Appendices B.7 and B.8 of this NRA); Proposals for the development of space weather prediction capabilities, for example, should be submitted to the LWS program.
- Proposals for efforts intended to maximize the return from ongoing Heliophysics missions that heavily utilize mission specific data from operating spacecraft are more appropriate for the Heliophysics Guest Investigators program (see Appendix B.5).
- Proposals with the intent of extending or directly supplementing investigations selected for current, approved space flight missions are not appropriate for this NRA. Investigators who are members of the science teams of ongoing missions and who propose to use data from these missions in SR&T efforts proposed through this NRA must clearly delineate between their mission responsibilities and the proposed efforts.
- The G/Science program does not support the routine, long-term gathering of observational data.
- The Geospace program is intended to deal primarily with plasma physics. Hence, its scope includes planetary magnetospheres, but not planetary atmospheres. The

G/Science program does not, for instance, study sputtering processes, because the basic physics involved has to do with surface reactions. It does not support studies of the sources of neutral constituents of planetary magnetospheres. On the other hand, studies of the effects of neutral components on processes that are primarily plasma processes are within scope for the program.

- Proposals dealing with the chemistry and/or dynamics of the middle and/or lower terrestrial atmosphere (i.e., below the mesosphere) are not appropriate for this G/Sciences program but may be appropriate for the Atmospheric Composition Focus Area of the Earth Science Research Program (see Appendices A.11, A.12, and A.13 of this NRA).

1.2 Geospace Supporting Research and Technology Program

The G/SR&T program supports individual research tasks that employ a variety of research techniques in pursuit of Geospace program goals. Specifically, the G/SR&T program supports theoretical research, the development and 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. 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 G/Science goals.

One of the requirements that proposals to the G/SR&T program must meet in order to achieve a rating of high scientific merit is that it demonstrate an appropriate and feasible methodology. This includes demonstration that any data to be used are of sufficient quality to provide clear results. It should be noted that this demonstration can seldom be convincingly argued for data that do not yet exist.

It is expected that there will be approximately $1.8M available in FY 2008 to support new G/SR&T investigations selected through this NRA. Annual funding in past G/SR&T programs has averaged $100K per investigation.

1.3 Geospace Instrument Development Program

The G/IDP 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/IDP must address the scientific objectives of the proposed instruments in the context of the specific scientific objectives of candidate future Geospace Science missions.

It is expected that there will be approximately $300K available in FY 2008 to support new G/IDP investigations selected through this NRA. Annual funding in past G/ID programs has averaged $150K per investigation.

1.4 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. See Section 2.2 below for special instructions for proposals in this element of the G/Science program.

In FY 2007 the G/LCAS program supported 11 investigations, with average annual funding of $367K per investigation. It is expected that there will be approximately $850K available in FY 2008 to support new G/LCAS investigations selected through this NRA.

2. Programmatic Information

2.1 Geospace Supporting Research and Technology and Instrument Development Programs

In past years, SR&T-class programs have permitted grants to be made separately to the Principal and Co-Investigators of the same investigation, but at different institutions, in order to avoid the overhead costs associated with subawards. However, this practice has been discontinued 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).

2.2 Geospace/Low Cost Access to Space (LCAS)

Proposals to the G/LCAS program are expected to describe a complete suborbital investigation, including payload construction, launch phase, and data analysis. Proposals should be for whatever time period is required in order to complete the investigation, up to but not exceeding three years' duration. 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.

The total expense associated with a suborbital investigation includes costs for operational support, as well as payload development. Operational support includes the 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. Operational support is funded from a separate budget line, and G/LCAS proposers are not expected to include estimates of operational costs in their proposals. Proposers should, however, be cognizant that the liens on the operations budget associated with proposed payloads will be a factor 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.

All those who intend to propose to the G/LCAS program are strongly urged to discuss prospective investigations with operations personnel at the NASA Wallops Flight Facility to ensure that probable operational costs are properly anticipated. Questions concerning sounding rockets may be addressed to:

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

The information needed by the Sounding Rocket Program Office (SRPO) in order to generate an estimate of the costs associated with the operational requirements for proposed investigation 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. This information will be requested on all G/LCAS proposal cover pages, and cost estimates based on this data will be used in proposal selection. The SRPO is prepared to provide preliminary operations cost estimates to investigators prior to proposal due dates provided that the prospective proposers provide the appropriate information to the SRPO.

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, and Poker Flat Rocket Range (PFRR) in Alaska. The G/LCAS program also accepts proposals for launches with modest operational requirements from the established non-U.S. launch sites at Andoya, Norway, and Kiruna, Sweden. Proposers should note that, in contrast to previous years, in which Poker Flat was open only every other year, it is currently NASA's intention to open this range every year. It is not currently possible to support investigations requiring launch sites other than those listed above. Prospective investigators should note that it is difficult to accommodate investigations with extended launch windows at WSMR.

Sounding Rocket Vehicles. Information on the capabilities of current available vehicles is available at http://www.nsroc.com/front/html/mmframe.html. Proposers are encouraged to consider these capabilities in designing their investigations, but SRPO has the final authority in the choice of which vehicles to be used. G/LCAS proposals shall be based only on operational suborbital launch vehicles provided by the SRPO. Operational vehicles are rocket vehicles that have completed at least one fully successful flight demonstration flight before the G/LCAS proposals are developed/submitted. Proposals requiring the use of vehicles that are under development will not be considered for selection.

Proposals from Multiple Institutions. Proposals for suborbital investigations often involve the development of payloads that require major hardware collaborations from 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 significant 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. 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
    - The PI's work statement and budget, plus appended Task Statements and budgets from all other collaborating Co-I institutions (see further below) as part of its Budget Details.
    - The *Cover Page/Proposal Summary/Budget Summary* of the lead proposal should show only the budget requested by the lead organization.
    - However, the Budget Details of this lead proposal must include a table 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.
    - A clear statement in the first sentence of the *Proposal Summary* that it is the lead proposal.

- Each collaborating Co-I institution proposal must
    - Include, 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's proposed activities.

- Have a *Proposal Title* that is identical to the title of the lead proposal and a *Proposal Summary* that has a clear cross-reference to the PI of the lead proposal in the first sentence.
- Be submitted electronically by the institution's Authorized Organizational Representative, with the Co-I (Institutional PI) from that institution listed as the PI. The submittal must be prefaced with the *Cover Page/Proposal Summary/Budget Summary* and include all materials indicated in the *NASA Guidebook for Proposers*.

Owing to the larger scope and personnel involvement in G/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.

3.0 Summary of Key Information

Expected annual program budget for new awards	G/SR&T: $1.8M G/IDP: $300K G/LCAS: $850K
Number of new awards pending adequate proposals of merit	G/SR&T: 18 G/IDP: 2 G/LCAS: 2
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
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*
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	NNH07ZDA001N-GEO
NASA point of contact concerning this program	Dr. Mary Mellott Heliophysics Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0893 E-mail: Mary.M.Mellott@nasa.gov

B.4 HELIOPHYSICS THEORY

1. Scope of Program

As detailed in the overview of the Heliophysics Research Program in Appendix B.1 of this NRA, Heliophysics is the science that deals with the structure and evolution of the Sun, effects of solar activity on Earth and the planets of the Solar System, space environmental conditions within the Solar System and their evolution, and the interactions of the Solar System with our galaxy. 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.

Heliophysics Theory Program investigations are carried out in support of the NASA strategic goal to understand the Sun and its effects on Earth and the Solar System and the NASA 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 Summary of Solicitation for this NRA).

Proposals to the HTP are expected to present clear descriptions of 1) a specific scientific problem, 2) a method of attack on this problem, 3) the importance of the problem, and 4) the relevance of the problem to NASA's strategic objectives. These descriptions should be presented concisely in the Proposal Summary and they should be discussed more deeply 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 Solar and Heliospheric Physics or Geospace Science programs described in Appendices B.2 and B.3, respectively, of this 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 program (Appendix B.7).

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 $3.3 M, and the average annual FY 2007 funding per group was $360K.

3. Summary of Key Information

Expected annual program budget for new awards	$3.3M
Number of new awards pending adequate proposals of merit	~ 8-9
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-HTP
NASA point of contact concerning this program	Dr. Mary Mellott Heliophysics Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0893 E-mail: Mary.M.Mellott@nasa.gov

B.5 HELIOPHYSICS GUEST INVESTIGATORS

1. Scope of Program

A multiple-year Heliophysics Guest Investigators Program (GIP) is offered for investigations that draw extensively upon the data sets from NASA's Heliophysics space-flight missions. This program is intended to maximize the return from these missions by providing support for research of breadth and complexity beyond those typically being carried out by the presently funded investigations. Since 1997, four Heliophysics Senior Review panels have reviewed the GIP in the context of the activities of the operating missions. The panels have uniformly endorsed a strong GIP to complement the mission-sponsored investigations. (See http://science.hq.nasa.gov/sun/ for the reports of the senior review panels.) In particular, the 2001 Senior Review Panel stated that, "*…the key to meeting [Heliophysics] goals of understanding the Sun-Earth and Sun-Heliosphere systems is the integration of data from multiple missions during scientific analysis.…Most extended [mission]-phase scientific analysis should be funded competitively through a substantial GI program to which mission investigators have full access*."

This year the GIP consists of the traditional general elements, plus a special feature described in Section 2.3 below:

A) Geospace Missions (Section 2.1);
B) Solar and Heliospheric Missions (Section 2.2); and
C) STEREO Guest Investigators (Section 2.3).

Proposals are expected to present clear descriptions of 1) a specific scientific problem, 2) a method of attack on this problem, 3) the importance of the problem, and 4) the relevance of the problem to NASA's strategic objectives. These descriptions should be presented concisely in the proposal summary and they should be discussed more deeply within the proposal Scientific/Technical/Management section.

The GIP emphasizes the use of data from NASA's Heliophysics missions, including those missions with which NASA is an international partner. Investigations using data from multiple spacecraft and those investigations addressing global system problems are of special interest. Investigations may also use theory and modeling to carry out the associated interpretative data analysis.

The use of collaborative data from space sensors or ground observations sponsored by other sources, such as non-Heliophysics NASA missions or sources from other U.S. Government organizations, may be important and necessary for the proposed research. The use of such collaborative data is appropriate if it is clearly demonstrated that the proposed research will rely primarily upon data from one or more of NASA's Heliophysics missions.

Efforts focused on those particular aspects of the Sun-Earth system that directly affect life and society are not appropriate for the Heliophysics GIP but may be appropriate for the Living With a Star Targeted Research and Technology program (see Appendix B.7 in this NRA).

Specific information about the Heliophysics missions, key personnel, and data sets is found at the Heliophysics missions web site, http://sec.gsfc.nasa.gov/sec_missions.htm. There are new capabilities to assist investigators in finding HP data: the Virtual Space Physics Observatory that can be found at http://vspo.gsfc.nasa.gov/ and the Virtual Solar Observatory at http://umbra.nascom.nasa.gov/vso/. Prospective guest investigators must demonstrate that the proposed effort can be accomplished using data that will be available during the period of the award. This may entail contacting the Principal Investigator (PI) team or teams who are familiar with the data in an early stage of the proposal preparation in order to achieve early clarification. The following questions should be clearly addressed in any proposal to the GIP:

- What procedures will the prospective guest investigator follow for obtaining mission data necessary to conduct the proposed investigation?
- If new observations are required, are the proposed observations feasible using data from currently operating missions, and, if so, can they be carried out with a reasonable amount of effort and time?

2. Information on Specific Space Flight Mission Data Sets

This section describes specific terms and conditions relating to proposed Heliophysics GIP investigations on the use of data from individual missions.

2.1 Geospace Missions

Incorporated into this Heliophysics GIP is correlative scientific research, that is, research that involves data analysis, theory, and simulations; that utilizes the data from the ACE, AIM, Cluster, FAST, Geotail, IMAGE, IMP-8, Polar, SAMPEX, SNOE, TIMED, THEMIS, and Wind missions; as well as other suitable space sensors, ground-based observations, and theory investigations.

Note on access to Cluster data: Data equivalent to the Prime Parameter Database from Cluster is available for all experiments either from CDAWeb (http://cdaweb.gsfc.nasa.gov/) or from the individual team web sites. In addition, the public Cluster Active Archive is operational and high-resolution data is being added to that portal (http://caa.estec.esa.int/caa/). Should use of data not publicly available be required for research projects selected under this opportunity, reasonable requests for access to such data will be arranged by the instrument PIs, the NASA Cluster Project Scientist, and the selected investigators.

2.2 Solar and Heliospheric Missions

The missions contributing to the study of the Sun and heliosphere include ACE, Hinode, IMP-8, RHESSI, SOHO, TRACE, Ulysses, Voyager, Wind, and Yohkoh. Proposals are invited as part of the Heliophysics GIP requiring new observations, analysis of existing data, theoretical analysis that seeks to explain observations, and/or ancillary ground-based observations that augment mission data in order to achieve the goals of the investigation. Proposals combining data from these solar and heliospheric missions with other data from active and past missions are especially pertinent and welcome.

2.3 STEREO Guest Investigators

The STEREO mission, launched on October 25, 2005, is making observations of the coronal mass ejection phenomena to elucidate the relevant physics of the initiation, propagation, and related effects. To accomplish this, nearly identically instrumented spacecraft were placed into orbit about the Sun, one leading the Earth and one trailing. Proposals are invited to explain the observations from STEREO through data analyses, modeling, and incorporating observations from other solar and heliospheric missions and ground observations (see Section 1, above).

For more information on the STEREO mission and available data see the mission web site at http://stereo.gsfc.nasa.gov/ and web site for the STEREO Science Center http://stereo-ssc.nascom.nasa.gov/; also contact the STEREO Project Scientist

Dr. Michael Kaiser
Code 695
Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, MD 20771
Telephone: (301) 286-5461
Email: Michael.Kaiser@nasa.gov

The titles of proposals submitted to this portion of the NRA must contain the words "STEREO Guest Investigators."

3. Programmatic Information

3.1 Limitations on Personnel Involved in Active Heliophysics Missions

Proposals whose intent or purpose is to extend or directly supplement existing investigations already funded for approved space flight missions or other Heliophysics research programs are not appropriate for this Heliophysics GIP. Investigators who are members of the science teams of ongoing missions and who propose to use data from those missions must clearly demonstrate that the research proposed is distinct from their existing mission-related research efforts. A PI or a Co-I on a qualifying Heliophysics mission may also propose as a PI or Co-I to this Heliophysics GIP. However, such

Heliophysics mission personnel must include in their proposal a description of their mission responsibilities, which are not to duplicate the research proposed for the Heliophysics GIP.

3.2 Summary of Key Information

Expected annual program budget for new awards	For the sum of awards from elements 2.1 and 2.2: ~$5.5M For the STEREO GI element (2.3): ~ $800K
Number of new awards pending adequate proposals of merit	Total expected awards in 2.1 and 2.2 combined: ~ 45 – 55. The number of awards expected for the STEREO GI element (2.3): 6 - 8.
Maximum duration of awards	3 years; shorter-term proposals are welcome.
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-HGI

NASA point of contact concerning this program	Questions concerning the Geospace missions may be addressed to: Dr. Mary Mellott Heliophysics Division Science Mission Directorate NASA Headquarters Washington DC 20546-0001 Telephone: (202) 358-0893 E-mail: mary.m.mellott@nasa.gov Questions concerning the Solar and Heliospheric Physics missions may be addressed to: Dr. William Wagner Heliophysics Division Science Mission Directorate NASA Headquarters Washington DC 20546-0001 Telephone: (202) 358-0911 E-mail: William.J.Wagner@nasa.gov Questions concerning the STEREO mission may be addressed to: Dr. Madhulika Guhathakurta Heliophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1992 E-mail: Madhulika.Guhathakurta@nasa.gov For general questions about this Guest Investigator Program, please contact the Program Officer: Dr. Charles P. Holmes Heliophysics Division Science Mission Directorate NASA Headquarters Washington DC 20546-0001 Telephone: (202) 358-2224 E-mail: Charles.P.Holmes@nasa.gov

B.6 LIVING WITH A STAR SPACE ENVIRONMENT TESTBEDS

1. Scope of the Program

The Living With a Star (LWS) Space Environment Testbeds (SET) project's goal is to improve the engineering approach to mitigate or accommodate the undesirable effects of solar variability on technological systems. Its investigations are carried out in support of NASA Research Objective 3B.3 (see Section I(a) and Table 1 of this NRA's *Summary of Solicitation*) — specifically research focus areas J.1 and J.4 of the *Heliophysics Roadmap*, "characterize the variability, extremes, and boundary conditions of the space environments that will be encountered by human and robotic explorers" and "understand and characterize the space weather effects on and within planetary environments to minimize risk in exploration activities," respectively (see the *Heliophysics Roadmap* at http://sec.gsfc.nasa.gov/sec_roadmap.htm).

Investigations are sought that produce improved or new design and operations models, guidelines, and databases for investigations from the analysis of existing in-space flight data (data mining). The investigation products should (1) better characterize the environment in the presence of a spacecraft or aircraft and/or (2) perform better predictions of hardware's performance in the space environment. Five focused technology categories have the highest priority: (1) the environment in the presence of the spacecraft; (2) effects on microelectronics technologies; (3) effects on detector and/or sensor technologies; (4) degradation and shielding properties of materials; and (5) spacecraft charging/discharging. Proposals to develop ground-test protocols, new avionics technology, and customer web-access pages, or to acquire ground-test data will not be funded. Candidate investigations with the highest priorities in each focus technology category will be established in the LWS SET pre-NRA Workshop[1]; they are all strongly associated with the objective of the SET project. Proposed investigations not included in the findings of the workshop may be selected provided that funding is available and they have high merit for the SET project.

The proposer should be aware of the differences between SET and the LWS Targeted Research and Technology (Appendix B.7). Proposals under this SET solicitation must be concerned with the interactions at the spacecraft (see http://lws-set.gsfc.nasa.gov/) whereas the Targeted Research and Technology opportunity addresses areas where no spacecraft is present.

---

[1] This workshop will take place on March 29 and 30, 2007 at the Marriott Greenbelt, Greenbelt, MD. Registration, accommodation information, and agenda can be found under the LWS SET website, http://lws-set.gsfc.nasa.gov/. Individuals and/or corporations planning to attend are requested to pre-register by March 21, 2007, by completing the electronic registration form provided under the LWS SET website.

2. Programmatic Considerations

2.1 Minimum Requirements for Proposed Models, Guidelines, and Databases

General. Proposals for prediction models, guidelines, and databases must address technology performance variability during space flight due to changes induced by solar variability. The use of existing in-flight data (data-mining) to develop and/or validate the proposed model, guideline, or database will be used as part of the evaluation criteria. Investigators using inflight data must verify access to any data that are necessary for the proposed research. Costs associated with obtaining and analyzing data must be included in the budget. Sufficient ground-test data must also be available to validate results from flight data analysis.

Measurable deliverable. A significant deliverable(s) must be provided at the end of every year of a one or multiyear proposal in addition to quarterly and annual reports. Examples of deliverables are improved or new design and/or operations models/software, guidelines, and databases that can be used in the engineering analysis of accommodation or mitigation methods for the effects of solar-varying environments on spacecraft or humans. Although the publication of results in peer-reviewed journals and presentations at technical conferences is encouraged, publications are not adequate deliverables if they are not accompanied by software and/or reports.

Software Standards. The following requirements shall be applicable for all models, reports, and databases resulting from proposed efforts:

- ANSI standard programming languages.
- If a model is proposed, two versions of the model should be delivered via CD-ROM:
  - A web-ready, browser client model designed to run on a Windows NT platform using Internet Information Server (IIS) that is compatible with Netscape/Internet Explorer 4.0 or greater.
  - A stand-alone model that will run on a 98/NT Platform.
- No copyrighted software that cannot be distributed (i.e., graphics packages, etc.).
- A designated point of contact to assist SET personnel in installing and testing of software on SET platforms, if necessary (fine-tuning).
- Delivery of both source and executable codes including any necessary scripts.
- Written documentation that includes a final report and user's manual ready for publication; on-line documentation and a help menu are highly recommended.
- Databases should use Microsoft Access 97 or later, be stand-alone, and include all of the following: reports, queries (searches), forms, and programmatic elements.

Beta Testing of Deliverables. All proposals must allow for a two-month (minimum) beta testing schedule before delivery of the product. The beta test must finish at least one month prior to final delivery. This allows for any adjustments that may be identified in the code. All beta tests and identification of testers must be coordinated through the SET Project Scientist.

Software Documentation. The following documentation requirements shall be applicable to the final report, user's manual, and guidelines documents:

- Personal computer format using Microsoft Word 97 or later.
- Delivery of one electronic copy and one hardcopy.
- Delivery time at least one month in advance of the final product for product review.

2.2 Funding Available for New Investigations

The total funding available for the SET portion of this solicitation in FY 2008 is $2M, which will be used to fund multiple awards of up to $500K in value. It is anticipated that funding will be available for one-year continuations subject to satisfying the requirements described below. A solicitation for new investigations is expected to occur yearly.

2.3 Award Information

NASA intends all awards as a result of this NRA, whether with universities or industry, to be in the form of firm-fixed-price contracts with specific deliverables. NASA Centers and other government agencies are eligible to propose, even though they cannot be awarded contracts, and will also be required to produce deliverables.

All multiyear selections will be negotiated as options in the contract. Multiyear proposals must show a clearly defined interim deliverable at the end of each year. The year-end program review for multiyear selections will determine if the "option" (next year) will be exercised.

2.4 Page Limit for Proposals

The page limit for the scientific/technical/management section of the proposal is 10 pages.

2.5 Evaluation of Proposals

Proposers are reminded that the evaluation criteria for this solicitation are given in Appendix C 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. These factors are weighted as follows:

- Intrinsic Merit (weighted 30%),
- Relevance to Program Objectives (weighted 45%), and
- Cost including partnering/leveraging (weighted 25%).

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

- Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal;
- Proposer's capabilities, related experience and past performance, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives;
- The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel critical in achieving the proposal objectives;
- Overall evaluation against the state-of-the-art; and
- Proposer’s important task milestones, methodology for documenting and validating task products, performance metrics, and resource utilization (such as facilities, computational requirements, analysis tools, and personnel) in the task schedule will be evaluated.

In addition to the factors given in the *NASA Guidebook for Proposers*, the evaluation criterion “relevance” specifically includes the following factors:

- The proposer’s explanation of the technology enhancements that a proposal provides to the SET project and how this will be useful to the user community of the SET project; and
- Development of engineering products for use by design and operations organizations; these products are engineering environment definitions, assessment models and databases, design guidelines, and assessments of flight/ground simulation/technology data.

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

- Evaluation of the cost of a proposed effort shall include the realism and reasonableness of the proposed cost together with consideration of available funds. Costs for facility use, model design, and data verification will be evaluated, as applicable.
- The level of partnering/leveraging in the proposals will be evaluated. Partnering/leveraging includes the absorption of costs not included or in excess of the firm-fixed-price of the contract. The quality of the partnering arrangement will be evaluated based upon the efficacy of interfaces demonstrated by the agreements. The authority to commit the team, the physical location of the parties, and the plan to render the differences invisible to the Programs will be considered.

3. Summary of Key Information

Expected annual program budget for new awards	See Section 2.2
Number of new awards pending adequate proposals of merit	See Section 2.2
Maximum duration of awards	2 years; shorter-term proposals are encouraged.
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Page limit for the central Science-Technical-Management section of proposal	10 pp.; see also Chapter 2 of the *NASA Guidebook for Proposers*
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	NNH07ZDA001N-LWSSET
NASA point of contact concerning this program	Dr. Dana A. Brewer Heliophysics Division Science Mission Directorate NASA Headquarters Washington DC 20546-0001 Telephone: (202) 358-1678 E-mail: Dana.A.Brewer@nasa.gov

B.7 LIVING WITH A STAR TARGETED RESEARCH AND TECHNOLOGY

The following material is a DRAFT description of the Living With a Star (LWS) Targeted Research and Technology (TR&T) program. The revised description is expected to be posted in final form by May 2007 upon completion of a 2007 TR&T Steering Committee Report. The final description of this program will be posted 90 days in advance of its proposal due date as given in Tables 2 and 3 of this NRA's *Summary of Solicitation* or else the due date will be extended to allow 90 days. Until that time, questions or comments may be directed to the LWS Program Officer at the address given below.

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 the 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 both directly and via the heliosphere, planetary magnetospheres, and ionospheres. The TR&T program's objectives can be achieved by data analysis, theory, modeling, and the development of tools and methods (e.g., software for data handling). LWS is a crosscutting initiative whose goals relate to all aspects of NASA's Mission, namely (and in no priority order):

- To pioneer the future in space exploration,

  LWS will develop the knowledge needed to provide advance-warning space environment predictions along the path of robotic and human exploration.

  LWS will quantify the physics, dynamics, and behavior of the Heliophysical system over the 11-year solar cycle.

- scientific discovery, and

  LWS will provide understanding of the effects of solar variability on terrestrial climate change and of the causes of solar and magnetospheric disturbances on the Earth's technology infrastructures.

  LWS will engage and motivate the public by supporting a lifetime of learning and discovery about the Sun and its effects on each element of the Solar System.

- aeronautics research

  LWS characterizes those aspects of the Earth's dynamic environment needed to design reliable electronic subsystems for use in air and space transportation systems.

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.[1]

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 NRAs. The most recent report of this Steering Committee is available on the LWS TR&T homepage at the address given above.

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. This current solicitation requests proposals only for the last two of these program elements, as discussed in the following subsections. A separate solicitation will be issued in 2007 at least 90 days prior to the proposal due date soliciting proposals on Strategic Capabilities (see Appendix B.8).

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 NRC Decadal Survey Report* (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

[1] Heliophysics: To understand and predict the causes of space weather by studying the Sun, the heliosphere, and the planetary environment as a single connected system.

- *The TR&T Steering Committee Team Report* http://lws-trt.gsfc.nasa.gov/trt_resources.htm).

1.2 Targeted Investigations

This Targeted Investigations program element is subdivided into the three components described below and, pending the submission of proposals of adequate merit, the approximate portion of resources allocated for each is given in parentheses.

1.2.1 Tools and Methods

The Tools and Methods component supports studies that, by themselves, may not deliver significant new science understanding, but instead deliver tools and/or methods that enable critically needed science advances. Examples include the development of new empirical methods or analysis techniques, such as local helioseismology, that can be used to forecast solar, interplanetary, and geospace activity, and the development of software tools that can identify, retrieve, assimilate, and/or portray data in order to model results from different sources for LWS research and forecasting objectives. Some more examples of tools and methods investigations can be found in the "Feedback from Community" at http://lws-trt.gsfc.nasa.gov/trt_resources.htm.

1.2.2 Independent Investigations

The Independent Investigations component supports studies that are not appropriate for either the Tools and Methods component above or the Focused Science Targets component discussed in the next section. However, simply failing to address these other two components does not necessarily make a project suitable for this Independent Investigations component. Rather, the criteria that determine whether a proposed study should be submitted to this component are its urgency and impact to LWS goals and objectives. Some examples of independent science investigations can be found in the "Feedback from Community" at http://lws-trt.gsfc.nasa.gov/trt_resources.htm.

1.2.3. Focused Science Topics

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 must tackle large-scale problems that cross discipline and technique (e.g., data analysis, theory, modeling, etc.) boundaries; and, second, the TR&T must identify how this new understanding will have a direct impact on life and society. To address these requirements, a set of five Focused Science Topics, as further identified below, have been chosen for emphasis in this solicitation (for further detail, also see the TR&T Steering Committee Report at http://lws-trt.gsfc.nasa.gov/trt_resources.htm). Therefore, while the primary evaluation criteria remain unchanged (see this NRA's *Summary of Solicitation*, Section V(a), and the *NASA Guidebook for Proposers*, Appendix C.2), the criterion for relevance includes relevance to one of these five Focused Science Topics as an essential requirement for selection

within this component. In addition, NASA desires a balance of research investigation techniques for each Topic, including theory, modeling, data analysis, observations, and simulations. 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 (similar to the PIs selected for a NASA hardware mission who form a coordinated science working group). These teams will define a plan for structuring their work into an integrated research program that ideally will address the Focused Science Topic in a much more complete way than any one investigation could by itself. These teams will also define success measures and deliverables for their integrated program, develop strategies for disseminating their results to the science community and NASA, and prepare an integrated final Team Report at the end of the three-year duration of the selected investigations.

Based in part on the peer review, one of the PIs will be identified and asked to serve as the Team Coordinator for the Focused Science Topic for which he/she proposed. These Team Coordinators will take the lead role in organizing their teams, setting up appropriate meetings and interactions, and generally ensuring the success of the project as a whole. The Team Coordinators will also serve as the lead liaison with the LWS Project Office at NASA's Goddard Space Flight Center (GSFC) and LWS Program Office at NASA Headquarters, which together will monitor and assist the progress of each team. The Team Coordinator will receive supplemental funding, as necessary, to support costs associated with these duties. Proposers are encouraged to propose to act as a Team Coordinator 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. This NRA solicits four Focus Topics related to TR&T and one Focus Topic related to Solar Sentinel Mission's science objectives.

The Focused Science Topics appropriate as the objectives for proposals to this LWS TR&T solicitation are as follows:

<u>a. Investigate the Global Distribution, Sources, and Effects of Large Electron Density Gradients at Middle and Low Latitudes</u>

Target description: Large electron density gradients in the middle- and low-latitude ionosphere have a major impact on a variety of technological systems, including navigation, communications, and radar. Recent methods for imaging ionospheric electron density structure using ground-based and space-borne instruments are providing a new observational context for measurements that capture these gradients. Understanding the physical causes of large gradients often requires a "systems-level perspective" of the coupled Sun-Earth system, involving solar-wind, magnetospheric, ionospheric, and thermospheric processes. The interaction of these various physical systems to create the ionospheric features of such major societal impact represents an important frontier of

scientific knowledge and will require imaginative new methods, models, and combinations of data to understand and predict. The focus of this topic is middle- to low-latitudes regions (broadly defined) where technological systems are concentrated.

Goals and measures of success: The goal of soliciting these investigations is to produce an improved scientific understanding and characterization of large electron density gradients in the Earth's middle- and low-latitude ionosphere, leading to improved models that can generate predictions of societal value. We expect to produce a better characterization of the temporal and spatial scales, magnitudes, and global distribution of large gradients, under what conditions they form, and the physical understanding necessary to model such features as a function of the geophysical conditions that create them. Improved prediction capability should be established.

Types of solicited investigations: Proposals that address this topic are expected to exploit observational, theoretical, and modeling approaches that improve characterization and scientific understanding of large electron density gradients in the middle- and low-latitude ionosphere. The research objectives can address one or more of the following areas: 1) improved characterization of the global distribution, dynamics, and lifetimes of large gradient features; 2) theoretical analyses that elucidate how they are generated and related to conditions in the broader geophysical environment; 3) model development of appropriate spatial and temporal resolution to simulate the relevant physical processes; and 4) establishing new empirical or theoretical relationships that will lead to improved modeling and prediction. It is expected that a significant number of submitted proposals will deal with cross-disciplinary topics involving observations and modeling of solar wind, magnetospheric, ionospheric, and thermospheric coupled processes.

b. Effects of Ionospheric-Magnetospheric Plasma Redistribution on Storms

Target description: Large-scale redistribution and restructuring of the ionosphere by storm-induced electric fields promotes massive ion flows into the magnetosphere. An enhanced polar wind, heavy-ion accelerations from the low-altitude cusp and auroral regions, and convective entrainment of an eroding plasmasphere are all consequences of large-scale ionospheric changes that are especially prevalent during intense storms. Magnetospherically entrained ionospheric ions populate the plasmasheet and ring current, modify magnetospheric convection and current systems, and, thereby, couple back into ionospheric plasma electrodynamics. Quantitative understanding of the effects of stormtime ionospheric restructuring on the magnetosphere, and how this feedback evolves with time, is needed to develop forecast-quality models of near-Earth space weather.

Goals and measures of success: The goal for this topic is to establish how the magnetospheric uptake of ionospheric plasma during storms changes as a result of plasma restructuring and how this uptake influences the dynamics and coupling of the magnetosphere and ionosphere, with emphasis on the plasma and geomagnetic field conditions of the inner magnetosphere and the evolution of the ionospheric conductance, temperature, and densities. Measures of success include the identification of principal

mechanistic features and quantitative assessment of their impacts over the range of stormtime conditions and solar wind and Interplanetary Magnetic Field (IMF) drivers.

Types of solicited investigations: Team efforts optimally would encompass complementary theoretical analysis, observational and empirical approaches, both ground-based and *in situ*, and large-scale modeling of the ionosphere and magnetosphere. Nonexclusive topics of interest include: specification and forecasting of plasmasheet and ring current ion composition, energy, and distribution for stormtime solar, ionospheric, and magnetospheric conditions; distribution and rate of magnetospheric intake of ionospheric and plasmaspheric ions during storm conditions; impacts of stormtime ionospheric plasma redistribution on magnetosphere-ionosphere coupling; and energization, transport, and loss of ionospheric ions in the magnetosphere.

c. Predict Emergence of Solar Active Regions Before they are Visible

Target description: A major roadblock for predictive models of space-weather effects has been our inability to forecast the emergence and evolution of large active regions on the Sun. Recent developments in the field of helioseismology show promise for the detection of active regions that emerge and grow on the far side of the Sun and for the detection of preemergence signatures on the front side that may be measurable with several different techniques. This research area has obvious importance for improved space-weather modeling and predictions of the structure of the corona and the heliosphere. Research in this area will greatly enhance the usefulness of the Solar-B and SDO missions.

Goals and measures of success: The goal of this Focused Science Topic is to develop, test, and refine techniques for the detection of active regions before they are visible, the exploration of techniques to determine whether preemergent or newly emerged active regions will grow and become flare-productive, and to explore how such knowledge could be incorporated into downstream predictive models of the outer corona and heliosphere. The prime measure of success for this work will be to demonstrate a statistically significant ability to predict the location of new active regions before they are visible on the surface of the Sun and also their evolution.

Types of Solicited Investigations: It is expected that the focus team will include, but not be limited to, the following types of investigations: The improvement of helioseismic techniques for far side imaging of active regions; the refinement and testing of helioseismic techniques for detecting active regions on the front side of the Sun before they are visible on the surface and for detecting signatures of developing flare-productive active regions; collaborative research between helioseismologists and solar interior modelers on the behavior of magnetic fields and flows expected in preemergent and growing active regions; and the development of techniques to quantitatively assess the predicted impact of a specific newly emerged active region on the global structure of the corona and heliosphere.

d. Solar Origins of Irradiance Variations

Target Description: Solar irradiance is the dominant driver of Earth climate. The variations in this fundamental parameter which are best known are the cyclic changes in total solar irradiance (TSI). In recent years, continuous records of fluctuations in spectral irradiance have also been acquired. These data are now being incorporated in Earth-atmosphere models that include the absorption of different wavelengths of solar irradiation in different atmospheric layers and their coupling to fundamental modes of atmospheric oscillation. The variable solar soft X-ray, EUV, and coronal X-ray emissions play a dominant role in controlling the thermodynamics, chemistry, and ionization state of the terrestrial upper atmosphere, and are largely responsible for the most severe space weather impacts affecting telecommunications and satellite drag.

Progress in nowcasting and forecasting the solar spectrum depends critically on the availability of realistic, physics-based models of the solar activity affecting irradiance. Both total and spectral irradiance variations have been associated with manifestations of solar activity since the availability of the first space-borne measurements of these parameters, but less has been done to understand the physical processes by which solar activity causes these variations. Improved understanding of the detailed properties of solar active regions and solar impulsive events will allow the construction of models that describe the spectrum of the radiation emitted from the Sun under different conditions, and thus indicate where in the terrestrial atmosphere the radiant energies will be deposited.

Goals and Measures of Success: The goals of this Focused Science Topic are to understand how spectral irradiance variations from the Sun are produced and, in particular, to understand the physical processes causing variations in the solar spectral emissions. The prime measure of success for this work would be a substantial improvement in our ability to reproduce multispectral observations of active regions using physics-based models.

Types of Solicited Investigations: It is expected that the focus team will include investigations to model active regions based on first principles; predict the dependence of solar spectral irradiance on key physical parameters such as magnetic topology, field strength, loop length, and velocity patterns; and give a relationship between active region evolution and changes in the solar radiation spectrum.

e. Understand how Flares Accelerate Particles near the Sun (i.e., through Shocks and/or Reconnection) and how they Contribute to Large SEP Events

Target description: Recent studies have shown that energetic particles accelerated during solar flares could make direct and significant contributions above tens of MeV during some large Solar Energetic Particle (SEP) events observed at Earth. However, the basic mechanisms by which particles are accelerated to such high energies in flares are not well understood. Uncertainties in comparing the timing of various forms of solar activity, as well as scattering uncertainties in the inner heliosphere, has made it difficult

to assess the relative contribution of flares to any given large SEP event. To understand and predict solar particle radiation near the Earth and in the heliosphere requires a cross-disciplinary approach from the solar and heliospheric communities. Specifically, it is necessary to utilize remote and *in situ* observations of solar flares and SEP events to test and improve existing analytic and numerical models of particle acceleration in solar flares.

Goals and measures of success: The goal of this topic is to combine theoretical studies, numerical simulations, and remote and *in situ* observations to understand the basic mechanisms by which particles are accelerated to >50 MeV energy in solar flares. The measure of success, and the criterion for proposal selection, is the potential impact of the work in quantifying the limits of various particle mechanisms (e.g, magnetic reconnection, parallel electric-fields, shocks, second-order Fermi acceleration, etc.) and in determining if the flare-accelerated ions could also make direct and significant contributions to the large gradual SEP events observed at Earth.

Types of solicited investigations: Proposals that contribute to our fundamental understanding of the energization and escape of particles accelerated during solar flares using either observations or theoretical analysis are encouraged. Observational studies that seek to characterize the solar origin and key properties (e.g., ion composition, electron association, electromagnetic emission) of SEP events at Earth using remote and *in situ* measurements are also relevant. Analytical and numerical models that seek to predict the energy extent, the observed ion composition, i.e., the enhancements in ^{3}He, heavy and ultra-heavy ions, and the associated spectral forms, are also encouraged. Proposals that seek to quantitatively test the predictions of various numerical and analytical models and determine the relative contributions of flare-accelerated ions to large gradual SEP events are highly relevant. Proposals that combine existing datasets or numerical models with relevant datasets from upcoming missions like STEREO, SDO, and Solar-B are also encouraged. All proposals should specifically address how they will enhance future measurements outlined in the LWS Solar Sentinels Science and Technology Definition Team Report which will be posted on the LWS TR&T homepage at http://lws-trt.gsfc.nasa.gov/trt_resources.htm on or about May 2007.

1.3 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 these infrastructure-building elements: cross-disciplinary workshops, and/or summer schools. Most of these activities will be supported through formal proposals to the TR&T as part of the regular proposal cycle. In all cases, an extra two pages will be allowed to the page limit for the Scientific/Technical/Management section of the proposal (see the *NASA Guidebook for Proposers* discussed 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:

1. The workshop must address a science or technology topic that is both timely and important to the goals of LWS.
2. The workshop topic must be cross-disciplinary in nature and bring together researchers from different disciplines in LWS science.
3. Although there are no restrictions as to where the workshop will be held, it will clearly be advantageous to hold it at a location that is convenient and cost-effective for LWS researchers and students.
4. Workshops that encourage the training of new researchers in LWS system science are strongly encouraged.
5. Workshops that leverage funding from other institutions and agencies are strongly encouraged.

b. Support of LWS Summer Schools for Graduate Students: The details of the summer school (e.g., format, location, duration, etc.) are left to the proposer to define. However, proposals should provide convincing evidence concerning the breadth of the topics to be considered, the means to be taken to assure participation by recognized research/education authorities, and any institutional support that may be forthcoming (note: shared support of this activity is strongly encouraged). One such proposal may be selected for summer school activities not to exceed more than two years during the nominal three-year period of performance for the parent research proposal.

2. Programmatic Information

2.1 Demonstration of Relevance to LWS Objectives

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 factor:

- Proposals will be evaluated on the basis of their feasibility, intrinsic scientific merit, and compliance with requirements to provide public access to any tools and value-added products developed. Proposals should provide a detailed (~1/2 page) description of how the proposed work will benefit the goals and objectives of the LWS program described above and the timetable over which these benefits will accrue. To this end, the LWS program will provide a Web site (http://lwstrt.gsfc.nasa.gov/trt_proposals.htm) that provides links to the abstracts of all selected proposals and their annual progress reports, including developed and tested software and/or refined data products.

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 degree to which the proposed investigation is relevant to one of the five Focused Science Topics described in Section 1.2.3.

To aid in the identification of reviewers, it is essential that the electronically submitted *Cover Page* for LWS TR&T proposals (see further below) include a single choice of program descriptor (i.e., T for Targeted Research or C for Cross Discipline Infrastructure) and the relevant program objective under each descriptor as follows:

- T1 -- Tools and Methods,
- T2 -- Independent Investigations,
- T3a – Electron Density Gradients in Ionosphere,
- T3b --Ionosphere-Magnetosphere Plasma Redistribution,
- T3c –Emergence of Solar Active Regions,
- T3d –Solar Origins of Irradiance Variations, or
- T3e –Particle Acceleration Near the Sun.

In addition, each proposal may additionally include one or more of the following descriptors as appropriate:

- C1 -- Workshop/Campaign, and/or
- C2 -- Summer School

Therefore, a proposal for Particle Acceleration Near the Sun that includes provisions for both a summer school as well as a workshop would be labeled "T3d-C1-C2".

2.2 Summary of Key Information

Expected annual program budget for new awards	TBD
Number of new awards pending adequate proposals of merit	TBD
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.

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 – 2007* 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. 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	NNH07ZDA001N-LWSTRT
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: Madhulika.Guhathakurta@nasa.gov

B.8 LIVING WITH A STAR TARGETED RESEARCH AND TECHNOLOGY: STRATEGIC CAPABILITY

The following material is a DRAFT description of the Living With a Star (LWS) Targeted Research and Technology (TR&T): Strategic Capability program. The description is expected to be posted in final form by May 2007 upon completion of a 2007 TR&T Steering Committee Report. The final description of this program will be posted 90 days in advance of its proposal due date as given in Tables 2 and 3 of this NRA's *Summary of Solicitation* or else the due date will be extended to allow 90 days. Until that time, questions or comments may be directed to the LWS Program Officer at the address given below.

1. Scope of Program

1.1 Overview

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 identified these models and their integration as strategic capabilities that are critical for the TR&T program and recommended that they be funded as a distinct program element within the TR&T.

Strategic goals of immediate concern to NASA's LWS program have been identified in the LWS TR&T Steering Committee 2006 Report. This year we are soliciting only one Strategic Capability. This topic was chosen to reflect the fact that in the next five years we will have high-resolution, high-cadence solar observations from unique vantage points in the heliosphere, such as STEREO, Solar-B, and SDO, for assimilation into models. As observations from other new missions become available we will be concentrating on those strategic areas.

1.2. Strategic Goal: 3D Model of an Active Region Coronal Magnetic Field

1.2.1 Capability Description

A quantitative 3D model for the slowly evolving magnetic field of a complex active region.

1.2.2 LWS Strategic Need

A primary objective of LWS is to enable the development of physics-based modeling of the Sun-Heliosphere and Sun-Earth systems. Since the energy source for the most destructive space weather throughout the Solar System is the magnetic field of a complex active region, a clear prerequisite for LWS to meet its objective is a robust model for this field. An accurate physics-based model for the 3D structure and slow evolution of the field and, especially, its free energy, is essential if we are to understand and predict the onset and development of Coronal Mass Ejections (CME)/Eruptive Flares. An active region field model is also essential for understanding and predicting the solar UV/XUV emission that drive Earth's upper atmosphere. Furthermore, a robust model for the active region field would be an invaluable research tool for advancing our basic understanding of the photosphere–corona–heliosphere coupling. Given that Solar-B and SDO will be delivering revolutionary new observations of the photospheric fields and of coronal structure and given that a great deal of work has been performed by a number of groups on magnetic field extrapolation, it is now timely to develop a next-generation community tool that can meet the needs of LWS.

1.2.3 Essential Features

- Use vector magnetic field data of the kind expected from Solar-B and SDO/HMI as input;
- Find physically consistent flow fields/electric fields from vector magnetograms for time-dependent (quasi-steady) magnetic field evolution, including flux emergence/cancellation and apparent shearing motions;
- Determine the 3D vector magnetic field and electric currents of a complete active region over as large a scale as possible;
- Include the capability to interface with global coronal-heliospheric field models;
- Provide user-friendly interfaces and graphical interfaces for runs on demand by the general research community, including capability for zooming in on small portions of the simulation domain, and ability to analyze magnetic topology;
- Provide the flexibility for quick-turn-around runs;
- Working version to be delivered to Community-Coordinated Modeling Center (CCMC) within three years, final production version within five years.

1.2.4 Desirable Features

- Includes the ability to incorporate, as input, magnetic field observations from different heights in the solar atmosphere;
- Includes the ability to incorporate, as input, photospheric velocity field data;
- Includes the ability to incorporate, as input, coronal imaging data;
- Allows for a variety of user-selectable field-determination methods.

2. Programmatic Information

2.1 LWS TR&T Strategic Capability

Given the unique nature of the LWS TR&T's strategic capability, 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.

The total funding available for new proposals submitted in response to this solicitation is expected to be about $TBD M. This funding is expected to support approximately TBD awards. Proposals for efforts up to five years' duration are allowed.

The recommendation for funding will be based on the peer evaluation and the scientific and technical merit of each proposal.

The NASA program officers will recommend for selection the proposals that best address the objectives of this solicitation within the resource constraints. NASA reserves the option of funding co-investigator institutions either as a subaward of the principal investigator institution's award or as a separate award directly to the co-investigator institution.

2.2 Proposal Requirements

Proposals to this solicitation are expected to satisfy the following requirements:

- The total award size for any proposal will not exceed $500K per year for a period of performance of up to five years.
- For each institutional partner that proposes a budget of $100K or more within a multiinstitutional collaboration, the proposal should identify a lead co-investigator, provide a statement of work, and provide a separate budget for that institutional partner.
- Proposals should provide a detailed (~1 page) description of how the proposed work will benefit the goals and objectives described in Sections 1.1 and 1.2 and the timetable over which these benefits will accrue.
- The proposal must provide a set of clearly defined milestones and a description of how and when these milestones will be accomplished.
- All models and software modules produced must be submitted to an appropriate modeling center, such as the Community Coordinated Modeling Center (http://ccmc.gsfc.nasa.gov/).
- The Federal Government must be granted a license for full and unrestricted use of the software, including the possible transition to space weather operations centers, consistent with 14 CFR 1260.30 (see Section A of the *NASA Grant and Cooperative Agreement Handbook* at http://ec.msfc.nasa.gov/hq/grcover.htm). In addition,

a) the source code must be fully functioning,
b) the code must be clearly documented according to standard software best practices,
c) the code must be capable of running on actual, real-time, data as input and produce useful output, and,
d) to be part of end-to-end modeling efforts, the code's interoperability should be demonstrated.

- The proposal must include a description of how the resulting model(s) or software module(s) will be validated, documented, and delivered to potential users.
- Awardees may request time on the NASA's high performance computing systems. Information on applying for high-end computer time can be found in this NRA's *Summary of Solicitation*, Section I(d). Please note that the description of the computing resources needed should include an estimate of the aggregated computing time per year (number of runs times, number of processors per run times, number of hours per run), as well as the associated storage capacity needed to support the investigation. Peer-review panels will be asked to consider the realism and reasonableness of the computing request as a requirement for the science investigation and as an appropriate utilization of a highly constrained resource. Successful investigations selected for funding will be considered for an allocation of the requested computing resources, but the fully requested level cannot be guaranteed.

The program will provide links to the abstracts of all selected proposals and their annual progress reports, including developed and tested software and/or refined data products, at http://lws-trt.gsfc.nasa.gov/.

In addition to the required annual progress reports expected for any proposal selected in response to this opportunity, the Program Officers in the NASA LWS TR&T program will conduct a comprehensive review of the milestones accomplished three years after award initiation. At that time, and as directed by NASA HQ, each Principal Investigator (PI) will submit a detailed report to the LWS TR&T Program Officer describing (1) progress to date, (2) problems encountered, and (3) plans for the remaining two years of funding. Each PI will present these results either on site or during a visit to NASA Headquarters. Consistent with their policy of routinely seeking counsel of the scientific community, NASA will invite appropriate members of the research and user community to review and comment upon this three-year report. With the findings from these reviews, NASA will then provide opportunity to the PI teams to revise their plans when requesting continued funding for the fourth year.

2.3 Demonstration of Relevance to NASA's LWS Objectives

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 degree to which the proposed investigation is relevant to the Strategic Goals listed in Section 1.1 and described in Section 1.2; and
- The proposed investigation's feasibility, intrinsic scientific merit, and compliance with requirements to provide public access to any tools and value-added products developed.

2.4 Summary of Key Information

Expected annual program budget for new awards	TBD
Number of new awards pending adequate proposals of merit	TBD
Maximum duration of awards	5 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-LWSSC
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: Madhulika.Guhathakurta@nasa.gov

B.9 VIRTUAL OBSERVATORIES FOR HELIOPHYSICS DATA

1. Scope of Program

1.1 Background

The new challenges in solar and space physics, including linking solar phenomena to human consequences as studied in NASA's Living With a Star (LWS) program, will require unprecedented integration of data and models across many missions, data centers, agencies, and countries. Accomplishing this requires a coordinated effort to link data and service providers to scientific users through software that uses descriptions of resources in a largely universal language to give a uniform face to an underlying heterogeneous and distributed set of sources.

The Virtual Observatories for Heliophysics Data program solicits proposals to develop, demonstrate, and enhance prototypes of software applications generally known as virtual observatories.

> *"A Virtual Observatory (VO) is a suite of software applications on a set of computers that allows users to uniformly find, access, and use resources (data, software, document, and image products and services using these) from a collection of distributed product repositories and service providers. A VO is a service that unites services and/or multiple repositories."* [1]

This program particularly targets the integration of the many data services for solar and space physics data necessary to the conduct of research in the Heliophysics field. A secondary part of this program permits holders of Heliophysics data to propose for grants to upgrade or maintain their data services in order to participate in one of the several VxOs[2] either in existence or proposed.

Background information on the Heliophysics data environment, virtual observatories, and the move to provide VOs to the Heliophysics research community can be found at http://lwsde.gsfc.nasa.gov/. Attention should be given to the presentations and report from the *Space and Solar Physics Virtual Observatories Workshop* held on October 27-29, 2004, and the kickoff meeting of the 2006 VxO awardees, held on May 22, 2006. This information is located at the same site.

---

[1] From A. Roberts, "VO Framework," presented at the Virtual Observatories in Space and Solar Physics Workshop, Greenbelt, Maryland; October 27, 2004. See http://lwsde.gsfc.nasa.gov/vo_workshop_papers.html.

[2] The 'x' in VxO denotes a virtual observatory for the 'x' scientific community in the Heliophysics research field. Examples would include VSO for the Virtual Solar Observatory, VMO for a Virtual Magnetospheric Observatory, etc.

1.2 Virtual Observatories

A proposed VxO should focus on a specific research community and target that community's data repositories and services. The construction of a VxO is to provide for significant enhancement to the abilities to conduct research by members of that community. More specifically, a VxO should:

- Provide coordinated discovery and access to data and service resources for a specific scientific discipline by:
  - Identifying relevant data sources and appropriate repositories,
  - Allowing queries that yield data granules or pointers to them,
  - Providing a user interface to access resources both through an application program interface (API) (or equivalent machine access) and a Web browser application, and
  - Being able to accommodate a wide range of provider types, as needed.
- Understand the data needs of its discipline area by:
  - Recruiting potential new providers,
  - Providing support and "cookbooks" for easy incorporation of providers,
  - Helping to assure high data quality and completeness of the product set, and
  - Resolving issues of multiple versions of datasets.
- Provide documentation for metadata that:
  - Sets standards for metadata and query items,
  - Assists providers and review metadata,
  - Maintains a global knowledge of data availability, and
  - Possibly maintains collection-catalog metadata.
- Provide an API or other means for the VxO to appear to others as a single provider.
- Potentially provide value-added services for data handling and manipulation (can be done by providers or elsewhere) such as:
  - Data Subsetting,
  - Averaging,
  - Filtering,
  - Merging, and
  - Format Conversion.
- Provide access to event lists and ancillary data.
- Collect statistical information and community comments to assess success.

The VxO should access data from NASA's science missions, including those with which NASA has international partnerships. NASA recognizes that the use of collaborative data from space sensors or ground observations sponsored by other sources such as the U.S. Government or international agencies may be important and necessary to support many types of research. Therefore, the incorporation of collaborative data services is appropriate, so long as it is clearly demonstrated that the proposed VxO will primarily be a service portal to data from NASA's Heliophysics missions.

Since there are number of VxOs in existence or under development, proposers are expected not to propose to duplicate these. Proposers are encouraged to consult http://lwsde.gsfc.nasa.gov for background on the scope of existing activities, and to contact these groups for further information. While the emphasis in selections will be on uniform access to data, compelling proposals primarily offering clearly new value-added services, well coordinated with VxO efforts, are encouraged.

The Heliophysics data program strives to foster collaboration and communication amongst the several nascent VxOs. While it is the responsibility of a selected VxO team to serve the science needs of its focused community, the teams should also plan on participating in one technical meeting and/or workshop per year to develop cross-VxO coordination and technical linkage. These meetings and workshops will share the status of VxO investigations and exchange ideas and lessons learned. Furthermore, newly selected VxO teams will be expected to join and participate in ongoing electronic-based discussions among the established VxO teams.

1.3 Data Services Upgrades and Maintenance

Also solicited by this program are proposals designed to upgrade existing Heliophysics data repositories to improve the accessibility of data sets relevant to the Heliophysics research, in general, as well as to become a data provider to a VxO. Relevant tasks could include (but are not limited to) placing data sets on-line, translating data sets into more readily accessible 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 or proposed VxO. Note that the term data set can apply not only to data products derived directly from NASA-funded instruments or other instrumentation, but also to higher-level data sets derived from the results of data analyses, data assimilation, and modeling. We are also soliciting proposals to maintain existing data services featuring data from Heliophysics missions that have terminated or will soon terminate – the so called “resident archives.”

1.4 General Scope

This program seeks improvements to the Heliophysics data environment through specific activities described in sections 1.2 and 1.3 above. Note that there are programs advertised in this NRA that have provided opportunities to improve the Heliophysics data environment, for example, the Living With A Star Targeted Research and Technology program (see Appendix B.7 of this NRA), and the Applied Information Systems Research program (see Appendix E.2 of this NRA).

2. Programmatic Considerations

2.1 Virtual Observatory Proposals

Periods of performance from one to three years may be proposed as appropriate to the nature of the contemplated investigation. It is expected that approximately $800K will be

available in Fiscal Year 2009 to support two or three new investigations. As noted above, proposals should be clearly complementary to ongoing efforts.

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

The proposal should address the following major characteristics of the proposed VxO:

1. Science Rationale
   a. key objectives
   b. relationship to NASA strategic plans
   c. uniqueness or scientific advantages of the proposed approach compared to alternatives
2. Architecture and Implementation Approach
   a. VxO architecture
   b. science instrumentation supported
   c. other scientific data accessed
   d. infrastructure and constraints assumed in place at the time of implementation
   e. compatibility with other VxOs and the SPASE Data Model[3]

Key elements within the scope of this initial effort should include, but are not limited to:

- Assessment of community needs
- Identification of means to get community involvement
- Identification of means to get community acceptance
- Identification of potential and viable VxO data sources
- Formulation of the technical approach for the VxO
- Identification of necessary services, resources, and tools the VxO needs to provide both initially and in the future as add-on capabilities
- Identification of requirements for data providers

The proposers will be expected to demonstrate, among other things:

- Prototype user interface query mechanism(s)
- Extensible communication with other VxOs
- Implementation of a prototype which will provide a small subset of the postulated VxOs functionality

The proposal must provide a detailed statement of the work to be undertaken over the period of performance to develop and demonstrate the VxO concept and include a summary schedule for completing the proposed work.

[3] See http://lwsde.gsfc.nasa.gov/ and references contained therein for more information on the SPASE Data Model.

The titles of proposals submitted to this portion of the NRA must contain the words "VxO for Heliophysics Data." The Scientific/Technical/Management Section (including figures) of proposals submitted to this portion of the NRA should be no more than 20 pages.

2.2 Data Services Upgrades Proposals

In addition to the opportunity described above, funds are also available to support about eight small (~$30–50K), short-term (one year) awards to improve the accessibility of data sets relevant to the Heliophysics research, in general, and specifically could become a data provider for a VxO. Note that priority will be given to those proposals from data providers of NASA-sponsored data sets.

The titles of proposals submitted to this portion of the NRA must contain the words "Data Services Upgrades." The Scientific/Technical/Management section (including figures) of proposals submitted to this portion of the NRA should be no more than five pages.

2.3 Data Services Maintenance Proposals

This is a new feature of the Heliophysics Virtual Observatory program. Funds are available to support about two to four awards (~$50–150K each) for up to three years starting in FY 2009 to maintain existing data services, the so-called "resident archives." A resident archive (RA[4]) was created by the members of a once-active mission and is continuing to serve mission data or a subset of a mission's data (e.g., data products for a single instrument) after the mission 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.

The proposal must demonstrate that the data services provided by the resident archive are vital to ongoing Heliophysics research activities or will be important to future research activities. Those resident archives that are or will be accessed via one or more virtual observatories will be given preferential treatment.

The data services to be maintained include the open, electronic distribution of RA data, the serving of the metadata for the RA data sets, the provision of documentation describing the resident data including calibration and validation procedures and methodologies. The maintenance of RAs includes ensuring adequate security is provided to preclude the irreversible loss of mission data. Limited user support, whether the user is a virtual observatory or a general member of the research community, is expected to be provided at a level commensurate with the budget limitations. The resident archive should include software tools with user documentation needed for accessing and displaying the resident data.

[4] More information on the topic of Heliophysics resident archives may be found at http://lwsde.gsfc.nasa.gov/.

Items that are not to be proposed would be the generation of significant upgrades to the data set, reprocessing data, data processing algorithms, or new data products derived from the resident data. These types of postmission data activities need to be funded from other sources. On the other hand, maintaining an RA 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 RA maintenance award is not renewed or merged under another RA structure, the RA would be responsible for delivering its holdings to the National Space Science Data Center (NSSDC).

The titles of proposals submitted to this portion of the NRA must contain the words "Resident Archive Services." The Scientific/Technical/Management section (including figures) of proposals submitted to this portion of the NRA should be no more than 10 pages.

2.4 Summary of Key Information

Expected annual program budget for new awards	See Sections 2.1, 2.2, and 2.3.
Number of new awards pending adequate proposals of merit	See Sections 2.1, 2.2, and 2.3.
Maximum duration of awards	See Sections 2.1, 2.2, and 2.3.
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Page limit for the central Science-Technical-Management section of proposal	See Sections 2.1, 2.2, and 2.3. See also Chapter 2 of the *NASA Guidebook for Proposers*

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	NNH07ZDA001N-VxO
NASA point of contact concerning this program	Dr. Aaron Roberts Heliophysics Division Science Mission Directorate NASA Headquarters Washington DC 20546-0001 Telephone: (202) 358-0664 E-mail: aaron.roberts@nasa.gov

APPENDIX C. PLANETARY SCIENCE RESEARCH PROGRAM

C.1 OVERVIEW

The Planetary Science Research Program supports investigations of all classes of objects in the Solar System, except 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 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 space flight missions, in any amount, that is not yet publicly available on the PDS will not be considered.

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 Sample Return Laboratory Instrument and Data Analysis Program is to maximize the scientific return from the samples provided by Discovery missions such as Genesis and Stardust through development of laboratory instrumentation and advanced analytical techniques required for the complete analyses of the samples they return. (Appendix C.3)

The Planetary Geology and Geophysics 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 program supports investigations based on ground-based astronomical observations and subsequent data analysis 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 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 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. (Appendix C.7)

The goal of the Lunar Advanced Science and Exploration Research 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 objective of the New Horizons at Jupiter Data Analysis Program is to enhance the scientific return of the Jupiter science data obtained by the New Horizons spacecraft by broadening the scientific participation in the analysis and interpretation of the data returned by the mission. (Appendix C.9)

The objective of the Cassini Data Analysis 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. (Appendix C.10)

The objective of the Discovery Data Analysis Program is to enhance the scientific return of completed Discovery missions by broadening the scientific participation in the analysis of data collected by those missions. (Appendix C.11)

The objective of the Mars Data Analysis Program 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 <u>and</u> to fund high-priority areas of research that support planning for future Mars missions. (Appendix C.12)

The Mars Fundamental Research Program 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 targets instrument development related to characterizing the Martian near-surface, surface, or near-subsurface environments from a lander or rover by conducting detailed *in situ* analytical studies of acquired materials (*i.e.*, collected "samples"), or by mechanically acquiring (grabbing, coring, or chipping of rock and soil samples, or capturing and storing atmospheric samples) samples for analysis and/or caching for later return to Earth. (Appendix C.14)

The Mars Technology Project seeks to ensure that appropriate spacecraft technologies are available in a sufficiently mature state to support the challenges of the Mars Exploration Program and they are ready for incorporation into future mission systems. (Appendix C.15)

The Planetary Instrument Definition and Development program 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 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 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 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 goal of the In-Space Propulsion program is to develop advanced propulsion technologies for use beyond Earth orbit that reduce trip times, mass, and/or cost associated with or enable NASA science missions to the outer planets, satellites, small bodies, and other Solar System destinations. (Appendix C.21)

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);
- Discovery 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 Instrument Development (Appendix C.19); and
- Astrobiology Science and Technology for Exploring Planets (Appendix C.20).

The Planetary Major Equipment 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);
- Planetary Geology and Geophysics (Appendix C.4);
- Planetary Astronomy (Appendix C.5);
- Planetary Atmospheres (Appendix C.6);
- Outer Planets Research (Appendix C.7);
- Mars Fundamental Research (Appendix C.13);
- Astrobiology: Exobiology and Evolutionary Biology (Appendix C.17); and
- Origins of Solar Systems (Appendix E.3);

New instrumentation may also be proposed. Planetary Major Equipment proposals may be submitted <u>only</u> in conjunction with new science research proposals to this solicitation <u>or</u> 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 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). The goal of this program is to support cosmochemical research projects that increase the understanding of the 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 activities for exploring the Solar System or that contribute to the development of techniques for such further exploration. 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 geochemical 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 develop 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, consortia, symposia, or other new initiatives related to the Cosmochemistry Program may also be proposed through this solicitation. 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.

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 Possible Submission of Proposals to Dual Agencies

NASA recognizes that the National Science Foundation (NSF) also considers proposals that address cosmochemistry and related fields. Therefore, a proposer interested in this subject may submit the same proposal to both this NASA program as well as to NSF, if desired. If this is done, (i) such proposals must clearly state they are being submitted to both agencies in the proposal section entitled *Current and Pending Support* (see Section 2 of the *NASA Guidebook for Proposers* as discussed in this NRA's *Summary of Solicitation*); and (ii) the proposal to each agency must be formatted and submitted in accordance with the policies of that agency. Appropriate personnel from both NASA and NSF will coordinate the review and possible selection for funding of such proposals.

2.2 Instrumentation Construction or Upgrade

The Planetary Major Equipment 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. New analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $25,000, should be identified and requested in a special section of each proposal that is to be titled "Major Equipment Request." However, note that a Planetary Major Equipment proposal must be affiliated with a "parent" NASA Planetary Science Division research proposal in order to be considered for selection; see Appendix C.23 for details.

2.3 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.

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 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.

2.5 Summary of Key Information

Expected annual program budget for new awards	~ $5.0M
Number of new awards pending adequate proposals of merit	~ 30-50
Maximum duration of awards	3 years (up to 5 years for programs of exceptional merit and breadth where 3 years is demonstrated to be insufficient)
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-COS
NASA point of contact concerning this program	Dr. David J. Lindstrom Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0311 E-mail: David.Lindstrom@nasa.gov

C.3 SAMPLE RETURN LABORATORY INSTRUMENTS AND DATA ANALYSIS

1. Scope of Program

The goal of the Sample Return Laboratory Instrument and Data Analysis Program is to maximize the scientific return from the samples provided by missions such as Genesis and Stardust (see further below) through development of laboratory instrumentation and advanced analytical techniques required for the complete analyses of the samples they return.

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. Acquisition of "off the shelf" instruments will be supported only if critical for new development efforts or in special cases where existing analytical capabilities at an investigator's institution would combine with a new instrument to create a unique or highly advantageous analytical facility for the analysis of returned samples. In all cases, both the development efforts and the clear relevance to recent, current, or in-development NASA sample-return missions must be clearly documented in the proposals.

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.

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. 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/.

3. Summary of Key Information

Expected annual program budget for new awards	~ $4.0M
Number of new awards pending adequate proposals of merit	~ 8-12
Maximum duration of awards	3 years; shorter term proposals are encouraged.
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-SRLIDAP
NASA point of contact concerning this program	Dr. David J. Lindstrom Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0311 E-mail: David.Lindstrom@nasa.gov

C.4 PLANETARY GEOLOGY AND GEOPHYSICS

1. Scope of Program

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. The goals of the PGG program are to foster the gathering, 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, the origin and evolution of the Solar System, and the nature of the Earth and its history in comparison to other planets.

The PGG program supports research investigations relevant to the scientific interpretation of data from past and existing planetary missions that are now in the public domain and to the science objectives of future missions. Data to be used in proposed investigations must be available in the Planetary Data System (PDS) or other publicly accessible archives at the time of the release of this announcement. Supported investigations involve several types of research efforts such as, but not limited to: analysis and synthesis of existing data, theoretical and numerical modeling of data and processes, generation of new basic data in a laboratory or field environment, and combinations of these kinds of activities. Examples of the kinds of research supported by this program include:

- Direct analysis of data from planetary missions that are in public archives;
- Theoretical modeling of geologic and geophysical processes;
- Photogeologic analysis and geologic interpretation of planetary surfaces;
- Compositional and geologic mapping of planetary surfaces;
- Laboratory and remote sensing studies (note that the PGG program does not support the collection of telescopic data);
- Experimental studies of materials under conditions relevant to objects in the Solar System;
- Theoretical studies of the interiors of planetary bodies;
- The dynamical evolution of the planets, satellites, small Solar System bodies, and ring systems;
- Geologic field studies of terrestrial analogs to planetary phenomena in the context of providing a better understanding of the planetary phenomena; and
- Studies related to the origin and evolution of volatiles in solid planetary bodies.

Proposals for topical conferences, workshops, consortia, symposia, or other new initiatives related to the program and that are generated through the initiative of the proposer may also be proposed through this solicitation. For more information about the type of research supported by this program, abstracts for currently funded investigations are available online at http://nspires.nasaprs.com. In addition, the program supports the development and production of cartographic products from planetary datasets. Proposals to study or develop flight instruments or to study future planetary missions are not solicited by this program.

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 Dr. Kenneth Tanaka of the USGS at E-mail: ktanaka@usgs.gov, or at http://astrogeology.usgs.gov/DataAndInformation/ImagesAndMaps/. Investigators who choose to produce geologic maps as a USGS product will be expected to review maps generated by other planetary mappers.

Investigations that produce 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 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 (E-mail: 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, per the directions in Section 2.3 of the *NASA Guidebook for Proposers*, a letter of support will be required from any facility required 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, Mars, and Venus.

  For more information contact:

  Dr. Ronald Greeley
  Department of Geology
  Box 871404
  Arizona State University
  Tempe, AZ 85287-1404
  Telephone: (480) 965-7045
  E-mail: greeley@asu.edu

- 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 and 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:

  Dr. Carlé M. Pieters
  RELAB Science Manager
  Department of Geological Sciences
  Box 1846
  Brown University
  Providence, RI 02912-1846
  Telephone: (401) 863-2417
  E-mail: Carle_Pieters@brown.edu

- NASA Ames Vertical Gun Range (AVGR). The NASA AVGR is a national facility funded by the NASA Science Mission Directorate to enable investigations of impact phenomena and processes. Exploratory or proof-of-concept programs requiring a limited number of experiments can be accommodated at no cost. More extensive programs are subject to review in order to assess feasibility and cost effectiveness.

  For more information, potential users of the AVGR should contact:

  Dr. Peter Schultz
  Department of Geological Sciences
  Box 1846
  Brown University
  Providence, RI 02912-1846
  Telephone: (401) 863-2417
  E-mail: 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 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:

  Dr. Stephen Mackwell
  Director, The Lunar and Planetary Institute
  3600 Bay Area Boulevard
  Houston, TX 77058-1113
  Telephone: (281) 486-2128
  E-mail: 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.

  Requests from non-U.S. investigators for NSSDC data products and product availability information may be made to:

  World Data Center for Rockets and Satellites
  Code 633
  Goddard Space Flight Center
  National Aeronautics and Space Administration
  Greenbelt, MD 20771-0001
  Telephone: (301) 286-6695

- 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
  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 on-site 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://wwwpds.wustl.edu/. 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 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. New analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $25,000, should be identified and requested in a special section of each proposal, to be titled "Major Equipment Request." However, note that a Planetary Major Equipment proposal must be affiliated with a “parent” Planetary Science research proposal in order to be considered; see Appendix C.23 for details.

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 (*i.e.*, tenure-track, civil servant, or equivalent) position. For more information, please see Appendix C.22, Early Career Fellowships.

4.3 Summary of Key Information

Expected annual program budget for new awards	~ $4.0M
Number of new awards pending adequate proposals of merit	~ 50
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-PGG
NASA point of contact concerning this program	Dr. R. Stephen Saunders Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0294 E-mail: Stephen.Saunders@nasa.gov

C.5 PLANETARY ASTRONOMY

1. Scope of Program

The NASA Planetary Astronomy program supports investigations based on ground-based astronomical observations and subsequent data analysis 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. The investigations proposed to this 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.

In 2007, Uranus will reach equinox, and the planet's equatorial plane will cross into the line of sight from Earth. This event presents a rare opportunity for probing the planet, its rings, and its satellites with astronomical tools not available during the previous equinox in 1965. Along with the Outer Planets Research program, this program is accepting proposals that take advantage of this rare opportunity to investigate equinoctial phenomena such as ring-plane crossings and atmospheric changes driven by varying insolation. Proposals must comply with all guidelines described in this announcement.

2. Programmatic Information

2.1 Supplemental Funding for Additional Instrumentation

The Planetary Major Equipment 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. New, analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $25,000, should be identified and requested in a special section of each proposal, to be titled "Major Equipment Request." However, note that a Planetary Major Equipment proposal must be affiliated with a “parent” SMD research proposal in order to be considered; see Appendix C.23 for details.

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 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, Early Career Fellowships.

2.3 Proposals Utilizing Goldstone Planetary Radar

Proposals intending to use the planetary radar capabilities of the Deep Space Network Goldstone complex must contact the Planetary Astronomy Program Officer listed in the table below for points of contact and direction for inclusion of costs associated with using the Goldstone radar in the proposal.

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 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.

2.5 Summary of Key Information

Expected annual program budget for new awards	~ $2.2M
Number of new awards pending adequate proposals of merit	~ 15-25
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-PAST
NASA point of contact concerning this program	Dr. Philippe Crane Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0716 E-mail: philippe.crane@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 are those that seek to study the 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; and the chemical abundance, physical conditions, and processes that may have prevailed at the time the planets were formed, as they pertain to atmospheres.

Investigations of the atmospheres of extrasolar planets also are included within the scope of this program, provided that they address the same features, properties, and behaviors listed above; however, the astronomical search for 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 in this NRA).

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.

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 New Horizons at Jupiter Data Analysis (Appendix C.9), Cassini Data Analysis (Appendix C.10), or Mars Data Analysis (Appendix C.12), then the proposal should be submitted to that program.

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.

2. Programmatic Information

Investigations which involve the participation of postdoctoral fellows and graduate students are encouraged.

2.1 Demonstration of Relevance

In addition to demonstrating relevance to NASA's Strategic Objectives, proposals must clearly and explicitly identify the rationale for submitting the proposed investigation to this particular section of the ROSES solicitation and not some other closely related section.

2.2 Supplemental Funding for Additional Instrumentation

The Planetary Major Equipment 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. New, analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $25,000, should be identified and requested in a special section of each proposal, to be titled "Major Equipment Request." However, note that a Planetary Major Equipment proposal must be affiliated with a "parent" research proposal in order to be considered; see Appendix C.23 for details.

2.3 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 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, Early Career Fellowships.

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.

2.5 Summary of Key Information

Expected annual program budget for new awards	~ $ 2.5M
Number of new awards pending adequate proposals of merit	~ 10-40
Maximum duration of awards	3 years: shorter term proposals are accepted.
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-PATM
NASA point of contact concerning this program	Dr. Philippe Crane Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0716 E-mail: philippe.crane@nasa.gov

C.7 OUTER PLANETS RESEARCH

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 the Kuiper Belt. 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 Cassini, Galileo, Voyager, Pioneer, and Ulysses 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;
- Defining the dynamical processes operating in the outer Solar System;
- Providing further refinement of mission datasets to improve their usefulness to the general scientific community; and
- Creating data products useful to the broad scientific community.

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 planet satellites funded by the Planetary Astronomy program;
- Correlative analyses that combine data from outer planets missions (Cassini, Galileo, Voyager, Pioneer, and Ulysses), 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. Investigations are expected to result in one or more peer-reviewed publications. Investigations that generate data products useful to the broader scientific community should submit the data products to the Planetary Data System (PDS) by the end of the funding period.

The use of flight mission data in proposed investigations is limited to the Cassini, Galileo, Voyager, Pioneer, and Ulysses missions. However, investigators proposing cometary research may also use data from the Solar and Heliospheric Observatory (SOHO) mission, which has successfully observed dozens of Sun-grazing comets.

Investigators who wish to use data from Discovery missions should submit their proposals to the 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.

In 2007, Uranus will reach equinox, and the planet's equatorial plane will cross into the line of sight from Earth. This event presents a rare opportunity for probing the planet, its rings, and its satellites with astronomical tools not available during the previous equinox in 1965. Along with the Planetary Astronomy program, the OPR program encourages proposals that take advantage of this rare opportunity to investigate equinoctial phenomena such as ring-plane crossings and atmospheric changes driven by varying insolation. Proposals must comply with all guidelines described in this announcement.

Investigators proposing correlative analyses using data from the Cassini, Galileo, Voyager, Pioneer, Ulysses, and SOHO (comets only) missions and other sources should clearly describe the rationale driving the use of the data and the source of the data. Investigations focused solely on analysis of space- or ground-based data that do not utilize data from the missions stated 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, consortia, symposia, or other new initiatives related to the program may also be proposed to the OPR program through this solicitation.

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 that can be accessed via the Internet at http://pds.jpl.nasa.gov/.

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, 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.

In addition to the standard statement of relevance to NASA's objectives, 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 Supplemental Funding for Additional Instrumentation

The Planetary Major Equipment program described in Appendix C.23 of this NRA allows proposals for upgrading the analytical, computational, and other instrumentation required by investigations for certain programs sponsored by the Planetary Science Research Program, including this one. New, analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $25,000, should be identified and requested in a short additional proposal titled "Major Equipment Request." However, note that a Planetary Major Equipment proposal must be affiliated with a "parent" research proposal in order to be considered; see Appendix C.23 for details.

3.3 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.

3.4 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 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.

3.5 Summary of Key Information

Expected annual program budget for new awards	~ $5.0M
Number of new awards pending adequate proposals of merit	~ 35
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-OPR
NASA point of contact concerning this program	Dr. Curt Niebur Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0390 E-mail: Curt.Niebur@nasa.gov

C.8 LUNAR ADVANCED SCIENCE AND EXPLORATION RESEARCH

NOTICE: The following material is a general description of the Lunar Advanced Science and Exploration Research program. The final description of this program will be posted as an amendment to this NRA at least 90 days in advance of its proposal due date and no later than June 30, 2007. The proposal due date is anticipated to be in Fall 2007. Until that time, questions and/or comments may be directed to the LASER Program Officers at the addresses given below.

1. Scope of Program

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 as part of the Vision for Space Exploration's return to the Moon initiatives. The program is funded jointly by NASA's Science Mission Directorate and NASA's Exploration Systems Mission Directorate.

It is the objective of the LASER program to fund a portfolio of lunar science investigations spanning the continuum from pure basic science to pure exploration science. Proposals are not required to fall strictly within one of these two end-member science approaches; therefore, proposals may have significant components of both basic and applied lunar science. Proposals that bridge this gap are highly encouraged.

LASER 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. LASER will provide funding to restore, archive, and prepare these holdings for public access through the Planetary Data System (http://pds.jpl.nasa.gov).

Research regarding the Moon or lunar samples is also solicited in other Planetary Science Research Programs (e.g., Cosmochemistry in Appendix C.2 and Planetary Geology and Geophysics in Appendix C.4). Proposers should read these solicitations carefully in order to determine which research program is most appropriate for submission of a proposal for basic and applied lunar science research. The same proposal should not be submitted to more than one ROSES program element.

2. Summary of Key Information

Expected annual program budget for new awards	TBD
Number of new awards pending adequate proposals of merit	TBD
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	TBD

Due date for proposals	TBD
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-LASER
NASA points of contact concerning this program	Dr. Robert Fogel Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-2289 E-mail: Robert.A.Fogel@nasa.gov Dr. Michael J. Wargo Exploration Systems Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0822 E-mail: michael.wargo@nasa.gov

C.9 NEW HORIZONS AT JUPITER DATA ANALYSIS

NOTICE: NASA intends to solicit research proposals to conduct scientific investigations utilizing data obtained at Jupiter by the New Horizons spacecraft. The final text for Appendix C.9 will be released as an amendment to ROSES 2007 in Fall 2007. Proposals will be due no earlier than 90 days after release of the amendment.

1. Scope of Program

The objective of the New Horizons at Jupiter Data Analysis Program (NH-JDAP) is to enhance the scientific return of the Jupiter science data obtained by the New Horizons spacecraft by broadening the scientific participation in the analysis and interpretation of the data returned by the mission. NASA intends to solicit research proposals to conduct scientific investigations utilizing data obtained at Jupiter by the New Horizons spacecraft via a ROSES-2007 amendment to be released in fall 2007.

The New Horizons spacecraft will fly by Jupiter to obtain a gravity assist on (approximately) February 28, 2007. The New Horizons mission plans to take data with optical remote sensing and particles and fields instruments near Jupiter closest approach (approximately 32 R_J) and for ~ 90 days following when it will fly down the Jupiter magnetotail. Observations of the Jupiter system are planned as well as measurements of particles, fields, aurorae, and solar wind.

A brief overview of the New Horizons instruments can be found at http://pluto.jhuapl.edu/. A special issue of Space Science Reviews to appear in mid-2007 or later will describe the instruments capabilities in detail.

The NH-JDAP program will be limited to the analysis of New Horizons data that are in the Planetary Data System archive at least 90 days prior to the proposal due date announced in the planned ROSES amendment.

2. Programmatic Information

Questions or comments may be directed to the New Horizons Program Scientist, at the address given below.

Dr. Denis J. Bogan
Planetary Science Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
E-mail: dbogan@nasa.gov
Telephone: (202) 358-0359

C.10 CASSINI DATA ANALYSIS

1. Scope of Program

The objective of the Cassini Data Analysis Program (CDAP) 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. This program solicits research proposals to conduct scientific investigations utilizing data obtained by the Cassini spacecraft. This is the second year that the CDAP program has been offered, and proposing PIs are encouraged to read the abstracts of investigations that were selected from the ROSES-2006 competition, which are available online at http://nspires.nasaprs.com/ (select "Selected Proposals," select "Cassini Data Analysis").

In order to be considered, proposing PIs must use data that are in the public domain 90 days before the CDAP proposals due date. Proposals that do not comply with this rule will be declared noncompliant and will be rejected without evaluation. Data from the Cassini Jupiter flyby are eligible; however, several proposals to analyze this data were selected from the ROSES-2006 solicitation. In the interest of program balance, proposals for analysis of Jupiter flyby data should identify and address a need not addressed by any of the ROSES-2006 selections. All proposals to CDAP should identify and address a clear objective with science research that will be a significant, not incremental, advance in our understanding of the Saturn and Jupiter systems.

NASA's organ 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.

Proposals must be focused on the Saturn, or Saturn and Jupiter, system(s) and make significant use of data returned by Cassini instruments. Investigations that propose to produce a higher order data product that enhances the science return from the mission, and investigations that incorporate theory, modeling, laboratory studies, correlative analyses, and/or other research that is relevant to the interpretation of data from the mission, are eligible for CDAP. 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 and/or Jupiter system(s). Proposals that have a significant component of ground-based astronomy should be directed to the Planetary Astronomy program (Appendix C.5). Proposals that contain a significant component of work directed toward Solar System bodies other than

those in the Saturn and/or Jupiter system(s) should be directed to other program elements described in Appendix C of this ROSES NRA, as appropriate.

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.jpl.nasa.gov/documents/pag/pag.pdf. 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 CDAP to specifically identify any needed data and to ascertain that these data are available.

- 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.

3. Programmatic Information

3.1 Annual Progress Report

An *Annual Progress Report* will be due no later than 60 days in advance of the anniversary date of the award and is to be submitted *as an attachment to an E-mail message* to the Program Officer. 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-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 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).

3.2 Summary of Key Information

Expected annual program budget for new awards	~ $4M
Number of new awards pending adequate proposals of merit	~ 35 - 45
Maximum duration of awards	2 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-CDAP
NASA point of contact concerning this program	Dr. Denis J. Bogan Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 E-mail: dbogan@nasa.gov Telephone: (202) 358-0359

C.11 DISCOVERY DATA ANALYSIS

1. Scope of Program

The objective of the Discovery Data Analysis Program (DDAP) is to enhance the scientific return of completed Discovery missions by broadening the scientific participation in the analysis of samples and data collected by those missions. Data from operating missions may also be eligible for funded analysis under DDAP in circumstances where the calibrated data has been delivered in usable format to the Planetary Data System and/or returned samples have undergone preliminary examination and their availability has been announced by December 31 of the previous calendar year.

In particular, candidate missions for proposals submitted under the ROSES-2007 NRA are Stardust, Genesis, Deep Impact, Near Earth Asteroid Rendezvous (NEAR), Lunar Prospector, and Deep Space 1 (DS1).

Proposals for analysis of flight data and/or samples returned from the Stardust mission's encounter with Comet Wild 2 will be accepted. Proposals to analyze flight data and/or material returned by the Genesis spacecraft will be accepted. The allocation of any returned material from Genesis or Stardust must be approved separately by NASA's Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM) as described in Section 2, below. Deep Impact proposals may analyze flight data, impact data, and/or observations of the impact taken by other telescopes, instruments, or spacecraft that can be found in the public domain. For the NEAR mission, proposals may address the analysis and interpretation of data from its 1997 encounter with asteroid 253 Mathilde, its 1998 encounter with asteroid 433 Eros, and its prime mission in orbit around 433 Eros during 2000-2001, through to its final landing on that asteroid. DS1 proposals will focus on the 2001 encounter with Comet Borelly. Any proposal may incorporate data from more than one of these missions.

The Stardust spacecraft collected comet samples during a 6.1 km/sec flyby of comet Wild 2. The dust grains that impacted the silica aerogel collectors 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 to 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 collector is extremely challenging (see http://stardustathome.ssl.berkeley.edu), and work on these materials is not solicited in this solicitation. In addition to investigations involving direct analysis of Stardust materials, proposals to investigate the details of the capture process are solicited.

While scientific investigations proposed to the DDAP program must enhance the science return from one of the six missions identified above, an investigator may additionally

propose tasks that incorporate theory, modeling, laboratory studies, correlative analyses, and/or other research that is relevant to the interpretation of data from the missions listed above, or that place the results of these missions in a larger context of small body and/or lunar processes and evolution. Conversely, the DDAP program is not intended to support the acquisition of new observations nor support ground-based observing facilities except in cases where a compelling case is made that the proposed spacecraft data investigation can significantly benefit from the acquisition and analysis of such data. Each research proposal must constitute a stand-alone scientific investigation, with stated lines of inquiry, and result in one or more peer-reviewed publications. Data products, including maps, improved calibrations, etc., should be submitted to the Planetary Data System (PDS) by the end of the funded research period, unless the investigator explicitly makes a case against this in the proposal.

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 should determine that required data are available. Stardust, Genesis, Deep Impact, NEAR, Lunar Prospector, and DS1 flight data are available from the PDS, which can be accessed via the Internet at http://pds.nasa.gov/.

Information about the Stardust mission and returned data may be found at http://stardust.jpl.nasa.gov/. Results of preliminary examination of the samples were recently published (Science, 2006 December 15), and a catalog of samples (continuously updated) can be found at http://curator.jsc.nasa.gov/stardust. Information on sample requests is contained in the Stardust Sample Investigator's Guidebook, http://curator.jsc.nasa.gov/stardust/StardustInvestigatorsGuidebook.pdf. Many of the "General Proposal Guidelines" given in section 4.1 of the Investigator Guidebook apply to DDAP proposals, as well as to sample requests. In particular, preference will be given to investigators who have demonstrated expertise in working with suitably small samples and aerogel. Proposers are encouraged to form consortia to maximize scientific value by performing coordinated studies of the same samples, especially when samples are to be destroyed by the analyses.

The Stardust samples are extremely precious, and the committee tasked with reviewing sample requests (the Stardust Allocation Subcommittee of the Curation and Analysis Planning Team for Extraterrestrial Materials; see http://www.lpi.usra.edu/captem) will have to be convinced by each investigator's request that the science to be done with the samples is of high value. The Stardust Allocation Subcommittee will meet monthly, and requests submitted by the 15th of the month will be reviewed by the end of the month. The Genesis home page is located at http://genesismission.jpl.nasa.gov/. Deep Impact maintains a page at http://deepimpact.jpl.nasa.gov/home/. Detailed information about the NEAR mission, spacecraft, and instruments can be obtained at http://near.jhuapl.edu/. Lunar Prospector information may be obtained at http://lunar.arc.nasa.gov/. Information about the DS1 mission, spacecraft, and instruments may be found at http://nmp.jpl.nasa.gov/ds1/.

Returned samples from NASA planetary science missions 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. The proposals may be submitted in either sequence, but no selection for funding by the DDAP will be made until CAPTEM and NASA Headquarters have approved the allocation of the samples to be studied. Acceptance of a DDAP research proposal does not guarantee that samples will be provided to the investigators, nor does approval of a sample request imply that research funding will be provided under DDAP. In most cases, funding will not be provided by this program until CAPTEM has approved the allocation of the samples to be studied. However, short-term funding may be provided for work on simulants to show that promising techniques will work on actual samples.

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 *Summary of Solicitation*, Section I(d), "NASA-provided High-End Computing Resources." This section describes the opportunity for successful proposers to the Discovery 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 or at the Ames Research Center's Advanced Supercomputing Division.

3.3 Summary of Key Information

Expected annual program budget for new awards	~ $5.0M
Number of new awards pending adequate proposals of merit	~ 50-60
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Due date for proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-DDAP
NASA point of contact concerning this program	Dr. William Knopf Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0742 E-mail: William.Knopf-1@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 NASA—and other—missions to Mars. These include, but are not limited to, the Mars Pathfinder (MPF), Mars Global Surveyor (MGS), Mars Odyssey (MO), Mars Exploration Rovers (MERs), Mars Express (MEX), and Mars Reconnaissance Orbiter (MRO) missions. 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, or other spacecraft) 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 and MRO. Any proposal may incorporate the investigation of data from more than one of these missions. Additional information about these missions, as well as references containing preliminary science results can be found on the Mars Exploration Program homepage at http://mars.jpl.nasa.gov.

In addition, 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 are also included in this category. 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. Selected investigations may result in by-products such as mineral, topographic, cartographic, and geologic maps, and/or calibration data that are of broad use to the science community; therefore, a plan for archiving and making such by-products readily available must be included in the proposal. NASA reserves the option to require the archiving in the Planetary Data System (PDS; http://pds.jpl.nasa.gov) of data products resulting from MDAP selected proposals.

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 aerobraking and aerocapture.
- Characterization of potential landing sites for future Mars exploration missions (e.g., distribution and size of rocks, pits, sand dunes, regional and local slopes, surface composition and texture variability).
- Improved models for the Mars gravity field, global topography, and global planetary figure.

- Improvement of the geodetic network of Mars for precision landing demonstration.
- Analysis and comparison of Mars orbital and surface data to increase the predictive accuracy of surface characteristics of Mars from orbit.

Proposals for topical conferences, workshops, consortia, symposia, or other new initiatives related to MDAP objectives and the analysis of spacecraft data may also be submitted. Such meetings are considered most relevant if proposed as tasks within a "parent" research proposal based on the objectives given above; however, this is not a requirement. For more information about the type of research supported by this program, abstracts for currently funded investigations 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 are advised that such studies are not appropriate for MDAP but are 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. Spacecraft data that have not been placed in the public domain may not be proposed for use in MDAP investigations. In particular, 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. 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 or will be available. MPF, MGS, MO, MER, MEX and MRO data, as well as data from previous Mars missions, are/will be available from the PDS that can be accessed at the Web site http://pds.jpl.nasa.gov. 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 *Assessment of Mars Science and Mission Priorit*ies [2001], prepared by the Committee on Planetary and Lunar Exploration (COMPLEX) of the Space Studies Board of the National Research Council, and published by the National Academy Press in November 2001. This document includes summaries of Mars scientific priorities from the Mars Exploration Payload Analysis Group, former reports by COMPLEX, and others. These documents are available at http://www.nap.edu/books/0309089174/html.

Mars Exploration Program Analysis Group (MEPAG) reports, including *Mars Scientific Goals, Objectives, Investigations, and Priorities* (2006), are available on the MEPAG homepage at http://mepag.jpl.nasa.gov/. Additional information is available on the NASA HQ Mars web site at: http://www.hq.nasa.gov/mars.

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 *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 or at the Ames Research Center's Advanced Supercomputing Division.

3.3 Summary of Key Information

Expected annual program budget for new awards	~ $3M
Number of new awards pending adequate proposals of merit	~ 30
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-MDAP
NASA point of contact concerning this program	Dr. Robert A. Fogel Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-2289 E-mail: Robert.A.Fogel@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, geochemical, and biogeochemical 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 follow:

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 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, 2006) at http://mepag.jpl.nasa.gov/reports, and the MEP *Mars Exploration Strategy 2009-2020* (2004) JPL 400-1131 and *Robotic Mars Exploration Strategy 2007-2016* (2006) JPL 400-1276. Further guidance is provided in the Space Studies Board reports of the Committee for Planetary Exploration (COMPLEX), *Assessment of Mars Science and Mission Priorities* (2003), at http://www.nap.edu/books/0309089174/html/ and the *Assessment of NASA's Mars Architecture 2007-2016* (2006) at http://newton.nap.edu/catalog/11717.html;
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, biogeochemical, 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 (such as for the 2009 Mars Science Laboratory (MSL) mission for which instrument investigations were selected in 2004, see http://mars.jpl.nasa.gov/missions/future/msl.html);
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 substantially increase 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, etc.), provided that scientific products are proposed as an end product (that is, technology demonstrations alone are not relevant to this NRA); and
9) Topical science conferences, workshops, and symposia related to MFRP may be proposed. Though not required, such meetings are normally considered most relevant if they are directly related to the objectives of a "parent" research investigation submitted to this program.

As part of this research solicitation, NASA encourages innovative research approaches involving the full spectrum of possibilities listed in items (1) – (9) 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 the Mars Data Analysis Program (MDAP), 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 are 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 MER, 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/.

Documents that describe the science priorities and proposed missions for Mars exploration are referenced above and include:

- MEPAG – *Mars Scientific Goals, Objectives, Investigations and Priorities* (2006), available at http://mepag.jpl.nasa.gov/reports/;
- SSB-NRC - *Assessment of Mars Science and Mission Priorities* (2003) and *Assessment of NASA's Mars Architecture 2007-2016* (2006), available at http://www.nap.edu/books/0309089174/html and http://newton.nap.edu/catalog/11717.html; and
- MEP - *Mars Exploration Strategy 2009-2020* (2004) and *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 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 Division, including this one. New, analytical instrumentation requests, as well as requests for upgrades to existing instruments, costing more than $25,000, should be identified and requested in a special section of each proposal, to be titled "Major Equipment Request." However, note that a Planetary Major Equipment proposal must be affiliated with a "parent" research proposal in order to be considered; see Appendix C.23 for details.

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 *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 Summary of Key Information

Expected annual program budget for new awards	~ $2.5M
Number of new awards pending adequate proposals of merit	~ 35-40
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-MFRP
NASA point of contact concerning this program	Dr. Marilyn Lindstrom Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1254 E-mail: Marilyn.Lindstrom-1@nasa.gov

C.14 MARS INSTRUMENT DEVELOPMENT PROJECT

1. Background

1.1 Scientific Goals

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 NASA's 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. Within each goal are listed specific scientific objectives (from *Robotic Mars Exploration Strategy 2007-2016* (2006), JPL 400-1276, available at http://mepag.jpl.nasa.gov/reports).

I. Determine if life ever arose on Mars
- Assess past and present habitability potential of Mars
- Characterize carbon cycling in its geochemical context (including its origin and distribution)
- Test for life (identify and determine the spatial distribution of biosignatures)

II. Understand the processes and history of climate on Mars
- Characterize the atmosphere and present climate and processes
- Characterize Mars' ancient climate and climate processes
- Determine the atmospheric state and processes of critical importance for the safe operation of spacecraft

III. Determine the evolution of the surface and interior of Mars
- Determine the nature and evolution of the geologic processes that have created and modified the Martian crust and surface
- Characterize the structure, composition, dynamics, and evolution of the Martian interior

IV. Prepare for human exploration
- Obtain knowledge of Mars to support the design and implementation of a human mission with acceptable cost, risk, and performance
- Conduct risk and/or cost reduction technology and infrastructure demonstrations in transit to, at, or on the surface of Mars.

1.2 Second Decade Missions

1.2.1 Scout (2011)

NASA released an Announcement of Opportunity (AO) in April 2006 for a competitively-selected PI-led Scout mission to be launched in the 2011 mission launch opportunity.

1.2.2 Mars Science Orbiter (2013)

Continuing the successful program strategy of Mars Global Surveyor, Mars Odyssey, and Mars Reconnaissance Orbiter, the Mars Science Orbiter (MSO) will pursue compelling orbital science while also providing essential telecommunication relay infrastructure for future landed missions. High priority science investigations include atmospheric evolution and atmospheric trace species characterization (including methane). In addition, investigations to quantify the escape of the present atmosphere so that extrapolations can be made to determine the amount and composition of the ancient atmosphere are important to the understanding of the evolution of the Martian system. Final selection of the science objectives and instrumentation will be made after the Scout-2011 selection. Assuming that MSO will be launched in 2013, it is required that the proposed instruments for this mission must reach Technology Readiness Level (TRL) 6 by the Preliminary Design Review (PDR) of this mission (October 2010). An AO for instrument investigations for this mission will most likely be in mid 2008.

1.2.3 Proposed Mission Options for 2016-2018

Three key mission-design options will be investigated by MEP in the coming years for the 2016-2018 opportunity based on mission viability, cost, risk, and compliance with program goals. Mission selection will be based on these factors, as well as on the results of the 2009 Mars Science Laboratory (MSL) science investigations. In addition, another Scout mission opportunity is also possible in this time frame.

Astrobiology Field Lab (AFL). AFL is an MSL-class lander equipped with a major *in situ* laboratory capable of making significant advancements towards the program's life-related scientific goals. This mission would be designed to be responsive to the collective discoveries of the prior Mars missions related to the potential for habitability of various Martian environments. Proposed instruments for this mission must reach TRL 6 by the PDR of this mission (April 2012, for 2016 launch). The instrument AO for this mission will likely be during the 2009-2011 time period.

Dual Mid-size Rovers. The Mid Rovers are two Mars Exploration Rover (MER)-class rovers directed to different sites to explore the geologic and/or geochemical diversity on Mars. Depending on the outcome of MSL, the need to provide a better understanding of the global context may be more compelling than the need for intensive investigation of a single site. Proposed instruments for this mission must reach TRL 6 by the PDR of this

mission (April 2012, for 2016 launch). The instrument AO for this mission will likely be during the 2010-2012 time period.

Network Mission. To further the understanding of the Mars interior and climate systems, multiple landed packages, carrying meteorological, climatic, and geophysical measurement payload, operating simultaneously on the surface over a decade or more will form the basis of the Network mission. Climate objectives would include understanding the mechanisms responsible for surface-atmosphere exchange of heat, momentum, dust, water, and other trace gases. A geophysical package might include seismic sensors, heat flow probes and the capability for making high-precision geodetic measurements to better understand the structure, state and processes of the Martian interior.

1.2.4 Missions beyond 2018

Mars Sample Return (MSR). Sample return from the surface of Mars is essential to understanding the evolution of the planet and its surface and perhaps provide definitive assessment of the habitability of Mars. Science instruments aboard robotic spacecraft are inherently limited in terms of mass, power, volume, and, in general, capability to adapt to unexpected results. In contrast, state-of-the-art analytical instruments operated within Earth laboratories are limited only by technological development. The MSR will return a scientifically important sample from Mars for detailed studies using such powerful instrumentation.

2. Scope of Program

2.1 Science Instrument Development

Such ambitious mission plans require that many new instruments be brought to a flight-ready status within a short time span and at low cost. While NASA's Planetary Instrument Definition and Development Program (PIDDP; see Appendix C.16) funds research to develop breadboard versions of new instruments, there is a critical gap in support between this demonstration phase and actual flight hardware construction. Such a gap increases the mission risk and development time of any proposed new instruments. Therefore, this Mars Instrument Development Project (MIDP) solicits proposals for research and development to take promising instruments that are specifically suited for the second decade missions described above from the breadboard or laboratory-demonstration phase (as may have been developed through the PIDDP) to a point where they can be tested in systems-level simulated rover, static lander, or orbiter operations, or under similarly realistic (terrestrial environment) conditions.

The instruments to be supported under this MIDP solicitation must specifically target issues related to characterizing the Martian atmosphere, near-surface, surface, or near-subsurface environments from a MSL class rover (i.e, AFL mission), or MER class rover (i.e., Mid–size rovers), or via orbital observations supporting the MSO science objectives. Since future Mars Technology Project (see Appendix C.15) solicitations will solicit

sample acquisition as part of the subsurface access technology area, this MIDP solicitation is restricting the proposals to the development of science instruments only. This MIDP solicitation will only support instrument efforts that address the science needs of MSO, AFL, Network Mission, and the Mid-sized rover missions described above.

The instruments proposed for further development through MIDP must be at a moderately advanced ("breadboard") stage of development, consistent with current or past PIDDP funding, current or past Astrobiology Science and Technology Instrument (ASTID; see Appendix C.19) funding, Small Business Innovative Research (SBIR) funding, and/or other documented research and development. Proposed instruments are not required to have past NASA program support but must demonstrate having completed development through a satisfactory breadboard proof-of-concept phase.

It is emphasized that any instrument development proposed in response to this solicitation must be justified by a brief but complete discussion of the type(s) of science investigations that could be carried out should the instrument be eventually selected for flight. Wherever possible, each proposal should contain specific reference to the specific NASA Science Mission Directorate goals, Planetary Science objective, and/or MEP science requirement that is supported by the proposed instrument technology development. Such scientific justification is the responsibility of the proposer and not for inference on the part of NASA or the peer reviewers of the submitted proposals.

2.2 Scientific Focus

Proposals for instrument development that address the science objectives of MSO, AFL, Mid-Size Rover, and surface network missions will be considered for funding through this solicitation (in no particular priority order):

2.2.1 Instruments that can be brought to readiness in time to be considered for a conceptual 2013 orbiter or a Scout opportunity in 2016-2018.

Options of particular interest:

- Instruments that could support MEPAG's scientific goals related to the trace gas composition of the Martian atmosphere, aeronomy and other kinds of upper atmosphere investigations, and geophysical investigations. Power, mass, and volume reduction and long life are important performance metrics.

2.2.2 Instruments that can be brought to readiness in time to be considered for either of the conceptual 2016-2018 landed missions.

Options of particular interest:

- Microscale *in situ* technologies for detection and characterization of organic compounds.

- Innovative sample preparation systems, with demonstrations of their potential scientific value in Mars applications.
- Improved field analysis of "trace" or biomarker gases and biologically important solutes (e.g., nutrients).
- Improved field analyses of physical/chemical factors that might be an indication of life.
- Instruments that would enable a determination of the context of the more detailed observations described above. This could include imaging systems of various scales, mineralogy, chemistry, age dating, etc.
- Instruments for network mission such as seismic sensors, heat flow probes and the capability for making high-precision geodetic measurements.

3. Programmatic Information

3.1 Field Testing of Instruments

The instruments to be developed under this program may be tested using the NASA Jet Propulsion Laboratory rover platforms such as the FIDO and Rocky 8 (http://www-robotics.jpl.nasa.gov/systems/), or the Ames Research Center K-9 rover (http://ti.arc.nasa.gov/tech/groups/index.php?gid=6&ta=2). When utilizing NASA-provided testbeds, accommodation of instruments with the field tests and the funding of these tests will be arranged by the MIDP Project Manager as each one reaches the appropriate level of readiness.

3.2 Availability of Funding

It is planned that this iteration of the MIDP solicitation will be funded at a level of $5.0M per year for three years. Instrument technologies selected for development will be expected to achieve a TRL 6 level of maturity by the end of the MIDP funding. Based on this funding level and the submission of proposals of appropriate merit, it is anticipated that 10-15 selections will be made.

3.3 Evaluation of Proposals

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 merit of the type(s) of science investigations that could be carried out should the instrument be eventually selected for flight;
- The degree to which proposals specifically address the science objectives of the specified future Mars mission;
- The likelihood that the proposed instrument will reach TRL 6 by the date appropriate for the targeted mission; and

- The degree to which the proposal demonstrates that the proposed instrument has completed development through a satisfactory breadboard proof-of-concept phase.

It is understood that the relevance of a proposal shall include the following factors:

- The extent to which the proposed instrument technology development investigation supports specific NASA Science Mission Directorate goals, Planetary Science objectives, and/or MEP science requirements.

3.4 Future Solicitations

This solicitation is the fourth of an ongoing sequence of MIDP solicitations. It is expected that these solicitations will be issued biannually, with their focus dependent upon current NASA MEP mission requirements and goals. In all cases, however, continued funding of multiyear projects will be contingent upon the availability of funds and annual assessment of performance and relevance of the research effort to mission and program requirements.

3.5 Selection of Proposals

NASA Headquarters will be responsible for the evaluation and selection process associated with this solicitation. Selections for this MIDP solicitation will be made by the Director of the Mars Exploration Program in the Planetary Science Division, Science Mission Directorate, NASA Headquarters.

Questions or comments may be directed to the MIDP Program Officer, at the address given below.

3.6 Awards

The Mars Exploration Program is managed by the Mars Directorate at the Jet Propulsion Laboratory (JPL).

JPL will award subcontracts to non-Government participants selected for funding. These subcontracts may require submission of additional proposal data to JPL after selection is made. Instructions will be provided at that time. This proposal information will be reviewed by the JPL subcontracting official as the basis for negotiating and awarding a subcontract. Government organizations, including NASA centers, selected for funding under this NRA will be funded directly by NASA and will collaborate with JPL in performance of the work.

To facilitate and expedite contract implementation, proposers are required to deliver the following documentation in an Appendix to the proposal:

Point of Contact
Identify the contract manager/program coordinator responsible for direct interaction with the JPL Subcontract Manager.

Data Submittal
Complete the acknowledgement form found at http://acquisition.jpl.nasa.gov/pdf/2384-a1.pdf or at http://acquisition.jpl.nasa.gov/pdf/2384-3-a5.pdf (if the proposer is a university) and have it executed by the proposer's cognizant authority.

Complete and submit the Government Property form found at http://acquisition.jpl.nasa.gov/pdf/0544-a3.pdf and the Past Performance form found at http://acquisition.jpl.nasa.gov/pdf/0358-a14.pdf.

Authorization Letter
Provide a letter authorizing the release of rate and other relevant information to the Jet Propulsion Laboratory.

Cost Information
Submit the cost information requested below covering a one-year period of performance, summarized by cost element and time phased by month. Labor should be proposed by work hour, not work month. Provide a breakdown of all labor categories and associated hours to perform the effort defined in the Specimen Contract. This information should be submitted using the form found at http://acquisition.jpl.nasa.gov/pdf/0549-a15.pdf or your computer generated equivalent.

This data provides a detailed cost proposal for performing contract activities. To effectively evaluate cost proposals, JPL requires costs and supporting evidence stating the basis for the estimated costs. The categories of cost should include the following:

Direct Labor. List by labor category, with labor hours and rates for each. Provide actual salaries of all personnel, including civil service labor, and the percentage of time each individual will devote to the effort. NASA civil service labor and supporting NASA Center infrastructure must be costed on a full cost accounting basis.

Overhead. Include indirect costs that, because of their inclusion for common or joint objectives, are not readily subject to treatment as a direct cost (usually this is in the form of a percentage of the direct labor costs). **Materials**. Provide the total cost of the bill of materials, including estimated cost of each major item.

Subcontracts. List subcontracts over $5,000, specifying the vendor and the basis for estimated costs and including any baseline or supporting studies.

Special Equipment. List special equipment with lead and/or development time, including number of units and types.

Travel. List estimated number of trips, destinations, duration, purpose, number of travelers, and anticipated dates.
E/PO. E/PO costs should be summarized.
Other Costs. Provide all costs not covered elsewhere.
General and Administrative Expense. Include the expenses of the institution's general and executive offices and other miscellaneous expenses related to the overall business.
Fee. List any applicable fee for the submitting organization.

Exceptions to Terms and Conditions
JPL contracts include certain General Provisions. These can be found at http://acquisition.jpl.nasa.gov/pdf/gp/Cost-ReimbursementwithoutFeewithEducationalInstitution12-04.pdf (for universities), or http://acquisition.jpl.nasa.gov/pdf/gp/Cost-TypeContract12-04.pdf (for other cost-type contracts). A large number of exceptions, or one or more significant exceptions to these General Provisions, may substantially delay getting on contract. You must provide a detailed explanation, including the rationale, for any exceptions your organization may take.

Contractual Statements of Work.
All Statements of Work must include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities

4. Summary of Key Information

Expected annual program budget for new awards	~ $5M
Number of new awards pending adequate proposals of merit	~ 10-15
Maximum duration of awards	3 years
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.
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. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-MIDP
NASA point of contact concerning this program	Mr. Dave Lavery Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-4684 E-mail: dave.lavery@nasa.gov

C.15 MARS TECHNOLOGY PROJECT

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 support the challenges of the Mars Exploration Program, and they are ready for incorporation into future mission systems.

> **NOTICE: The announcement of the Mars Technology Project (MTP) is on hold pending programmatic decisions to be made in the first quarter of calendar year 2007. If proposals are solicited in Calendar Year 2007, this NASA Research Announcement will be amended no later than April 30, 2007. Proposals would be due no later than 90 days after release of the amendment.**

Questions or comments may be directed to the MTP Program Officer, at the address given below.

Mr. Dave Lavery
Planetary Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC, 20546-0001
Phone: 202-358-4684
E-mail: dave.lavery@nasa.gov

C.16 PLANETARY INSTRUMENT DEFINITION AND DEVELOPMENT

1. Scope of Program

The Planetary Instrument Definition and Development (PIDD) program supports the advancement of spacecraft-based instrument technology that shows promise for use in scientific investigations on future planetary missions. The goal of the program is not to develop flight-qualified hardware, but rather to define and develop scientific instruments or components of such instruments to the point where the instruments may be proposed in response to future announcements of flight opportunity without additional extensive technology development. Results of the PIDD program have contributed to the eventual development of flight hardware flown on, or selected for, many of NASA's planetary missions. The proposed instrument technology must address specific scientific objectives of candidate future technology validation and science missions.

Instrument definition and development studies can take place at several stages, including feasibility studies, conceptual design, and laboratory breadboarding of critical components and complete instruments. The technology readiness level (TRL) that the PIDD program supports is TRL 1-4. For immature or particularly complex new instruments, proposers initially may choose to only define or develop the most risky components. If the proposal is for a component only, one or more likely scenarios for possible follow-on instrument development should be described. Scientific objectives of the instruments, proposed follow-on instruments, and future candidate missions must be discussed in the proposal. In particular, it is the responsibility of the proposer to demonstrate how their proposed instruments address significant scientific questions relevant to stated NASA goals and not for NASA to attempt to infer this. The emphasis in this program is also on the development of miniaturized, low-power, low-cost instruments for missions in the Discovery, New Frontiers, Mars Exploration, and other planetary programs. New measurement concepts, methods to significantly improve the performance of existing instruments, and development of technologies that enable integrated instrument packaging (architectures) may also be proposed.

In years when the Astrobiology Science and Technology Instrument Development program is not solicited, NASA will consider funding a number of astrobiology proposals under the PIDD program deemed strategically important. Additionally, in years when the Mars Instrument Development Program is not solicited, the PIDD program will consider funding one to two proposals that strategically advance instrument technology beyond the TRL 4 level but not beyond TRL 6.

Proposals not appropriate for the PIDD program are those that seek to develop laboratory instruments, ground-based or orbiting telescopes, auxiliary instrumentation such as spectrometers for telescopes, onboard data processing or data compression studies, or any spacecraft technology that does not directly address science instrumentation.

While this program element will be advertised annually, the nature of specific efforts selected for funding will vary, with emphasis in any given year placed on preparation for

the nearest term missions for which instruments have not yet been selected. However, support may also be provided for long lead-time definition studies, for innovative approaches that may provide entirely new classes of instruments, for the development of new enabling technology for missions farther in the future, and/or for detector development studies that may advance the technology for a wide range of planetary instrumentation applications. Therefore, proposers are encouraged to relate their proposed efforts as closely as possible to specific future planetary missions and demonstrate how their technology addresses the scientific goals of these missions and the strategic interests of NASA.

2. PIDD Program-Focused Future Missions

Proposals for instrument definition and breadboard development for the following future types of missions will be considered for funding through the PIDD program. It should be noted that the contemplated sequence of missions described in this solicitation is a best current estimate and is subject to change. NASA reserves the right to make a determination of relevance based on the contemplated sequence of missions as it is understood at the time of proposal evaluation and selection.

- *Discovery Program Missions*

The Discovery Program is envisaged as a series of focused, quick turnaround missions. Development time will be approximately 36 months, and solicitations will occur approximately every 18–24 months as the budget allows. The Discovery missions may include flybys, orbiters, landers, the deployment of airplanes or balloons in planetary atmospheres, Earth-orbiting telescopes, and sample return missions to various Solar System bodies. Scientific studies range widely within the basic fields of planetary astronomy, geology, geochemistry, geophysics, astrobiology, and atmospheric science. Instrumentation and techniques addressing critical scientific questions in this broad range are appropriate development efforts under the PIDD program. Technology applicable to multiple missions and investigations will have higher priority for funding. Conversely, proposals for the development of instruments for missions already selected for flight or selected for Discovery Phase A study and/or development will not be accepted under this NRA.

- *Mars Exploration Program (MEP) Missions*

The PIDD program seeks new concepts for Mars scientific instrumentation and experiments, including, but not limited to: instruments for radiometric age-dating (for absolute age determination), soil/rock mineralogy and chemistry (including key isotopic ratios, elemental analyses, and organic molecules), water/ice detection and characterization, drilling/coring, and aeronomy and atmospheric physics (including trace gas species detection, including as an example CH_4, ozone, SO_2, etc.). Some, but not all, of these are truly new and complex instrument concepts for planetary exploration. As such, proposers may choose to initially pursue only development of the most challenging components, as long as discussion of their connection to possible future instruments and

scientific objectives is clearly discussed. Future MEP missions, including mobile analytical laboratories, reconnaissance orbiters, airborne experiments, bore-hole measurement systems, and sample returns, will have payloads of small, lightweight, low power-consumption instruments and will launch approximately every 26 months. Instrument development proposals for both U.S. and international follow-on missions to Mars (*i.e.*, beyond the 2009 Mars Science Laboratory) are appropriate under this NRA. Instrument technologies for the *in situ* exploration of Mars are of particular interest for future missions. However, next-generation orbital experiments that considerably advance the state of the art (as demonstrated on the 2005 Mars Reconnaissance Orbiter), are also encouraged, with particular attention to orbital detection of evidence of organics, liquid water, climate records, and geophysics.

- *New Frontiers Missions*

This PIDD program solicits instrument concepts relevant to possible future New Frontiers missions that will be solicited for specified targets in the Solar System. The NRC Decadal Survey for exploration of the Solar System, entitled *New Frontiers in the Solar System* (2003), lists three candidate missions: Venus *In Situ* Explorer, Lunar South Pole-Aitken Basin Sample Return, and Comet Surface Sample Return. Prospective proposers are encouraged to review this Decadal Survey report to learn more about these missions. Emphasis in this PIDD program instrument selection will be placed on preparation for the nearest term missions that have <u>not</u> been selected for development.

3. <u>Programmatic Considerations</u>

3.1 <u>Special Requirements for Proposals</u>

Proposals are solicited under this program element for instrument definition and development only for the missions or classes of missions described in Section 2 above. Therefore, all proposals submitted to this program element must specify:

- <u>The mission or class of missions for which the proposed instrument is applicable</u>. Instruments that might fly on more than one mission will be given priority over those applicable to only a single mission.
- <u>The science objectives of the proposed instrument</u>. 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.
- <u>Technological advances to be pursued as an inherent element of achieving the science objectives.</u> 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.

It is anticipated that the scientific payloads on most future solar system exploration missions will be limited to small, low-mass, low power-consumption, and low-cost instruments. For this reason, only proposals for instrument definition and development satisfying these general specifications will be considered for support.

3.2 Additional Evaluation Factors

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 *NASA Guidebook for Proposers*, the intrinsic merit of a proposal shall include the following additional factors:

- The extent to which the proposed instrument is applicable to multiple missions in the Planetary Science objectives;
- 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;
- Either the near-term nature of the mission or missions in question, or 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, even though it is not in the near-term queue; and
- Whether the instrument is deemed to fall within the scope of the PIDD program, including whether it is too developmentally mature for the PIDD program.

3.3 Summary of Key Information

Expected annual program budget for new awards	~ $2.5M
Number of new awards pending adequate proposals of merit	~ 10-15
Maximum duration of awards	3 years; shorter term proposals are encouraged.
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-PIDD
NASA point of contact concerning this program	Dr. Jonathan A. R. Rall Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1938 E-mail: jonathan.rall@nasa.gov

C.17 ASTROBIOLOGY: EXOBIOLOGY AND EVOLUTIONARY BIOLOGY

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 or 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.

- *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.

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 in 2005 or 2006 or are expiring in the first half of 2007. Periods of performance from one to three years may be proposed as appropriate to the nature of the contemplated research. Programmatic balance may limit the opportunities for funding in some areas.

2.2 Supplemental Funding for Additional Instrumentation

The Planetary Major Equipment 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. New, analytical instrumentation

requests, as well as requests for upgrades to existing instruments, costing more than $25,000, should be identified and requested in a special section of each proposal, to be titled "Major Equipment Request." However, note that a Planetary Major Equipment proposal must be affiliated with a “parent” Planetary Science research proposal in order to be considered; see Appendix C.23 for details.

Note: Development of advanced instrument concepts and technologies as precursors to astrobiology flight instruments should be submitted to the Astrobiology Science and Technology Instrument Development (ASTID) Program (Appendix C.19 in this 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).

2.3 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.

2.4 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 will 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:

Dr. Peter Schultz
Department of Geological Sciences
Box 1846
Brown University
Providence, RI 02912-1846
Telephone: (401) 863-2417
E-mail: 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.

3. Summary of Key Information

Expected annual program budget for new awards	~ $2.5M
Number of new awards pending adequate proposals of merit	~ 15-20
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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 application package from Grants.gov	NNH07ZDA001N-EXOB
NASA point of contact concerning this program	Dr. Michael H. New Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-1766 E-mail: Michael.H.New@nasa.gov

C.18 PLANETARY PROTECTION RESEARCH

1. Scope of Program

There are numerous areas of research in astrobiology/exobiology that have implications for the survival of Earth microbes in extraterrestrial environments and the prevention of contamination of other bodies by organisms carried by spacecraft. 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. Many of these research requirements derive directly from recent National Research Council (NRC) reports on planetary protection requirements for solar system exploration missions (see the NRC's Space Studies Board website at http://www.nas.edu/ssb/ 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:

- Characterizations of the limits of life in laboratory simulations of planetary environments or in appropriate Earth analogs, and particularly studies of the potential and dynamics of organism survival and reproduction in conditions present on the surface or subsurface of Mars (e.g., gullies and ice-rich environments, potentially in the presence of a heat source brought from Earth), or on Europa and other icy 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 capable of surviving spacecraft flight or planetary environmental conditions (e.g., anaerobes); and
- New methods, procedures, and conditions for spacecraft sterilization that are compatible with spacecraft materials and assemblies.

It should be noted that the evolving planetary protection requirements of NASA's planetary exploration programs may affect the priorities for funding among these areas.

2. Programmatic Information

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, as well as for successor proposals that seek to extend to their next logical phase those tasks doing research in Planetary Protection that are currently funded but whose periods of performance will expire in 2006 through mid-

2007. Periods of performance from one to three 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 proposed in response to this solicitation.

2.2 Summary of Key Information

Expected annual program budget for new awards	~ $300-500K
Number of new awards pending adequate proposals of merit	~ 2-4
Maximum duration of awards	3 years; shorter term proposals are encouraged.
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
General information and overview of this solicitation	See the *Summary of Solicitation* of this NRA.
Detailed instructions for the preparation and submission of proposals	*Guidebook for Proposers Responding to NASA Research Announcement – 2007* 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. 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	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	URL: http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading of application package from Grants.gov	NNH07ZDA001N-PPR
NASA point of contact concerning this program	Dr. Catharine A. Conley Planetary Protection Officer Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-3912 E-mail: Cassie.Conley@nasa.gov

C.19 ASTROBIOLOGY SCIENCE AND TECHNOLOGY INSTRUMENT DEVELOPMENT AND MISSION CONCEPT STUDIES

NOTICE: The announcement of the Astrobiology Science and Technology Instrument Development (ASTID) Program is on hold pending programmatic decisions to be made in the first quarter of Calendar Year 2007. If proposals are solicited in Calendar Year 2007, this NASA Research Announcement will be amended at least 90 days prior to the proposal due date. Proposals would be due no earlier than July 31, 2007.

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. Selected activities are expected to advance the development of scientific instruments or instrument components to the point where the instruments could be credibly proposed in response to future flight opportunity announcements, although proposals to build flight-qualified hardware are not currently a part of this program element. In addition, this program solicits the development of laboratory instruments designed to open a new area of study for Astrobiology, as well as the development of field instruments for use in future field campaigns under the Astrobiology Science and Technology for Exploring Planets Program (see Appendix C.20).

In addition, this program element also solicits proposals for Astrobiology mission concepts that may help increase the pool of ideas that may be considered for mission planning or take advantage of mission opportunities such as offered by NASA's Discovery, Explorer, Mars Scout, and New Frontiers Programs, as well as with payloads placed on future Earth-orbital free-flyer or Lunar missions.

Questions or comments may be directed to the ASTID Program Officer, at the address given below:

Dr. Michael New
Planetary Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-1766
E-mail: Michael.H.New@nasa.gov

C.20 ASTROBIOLOGY SCIENCE AND TECHNOLOGY FOR EXPLORING PLANETS

NOTICE: The announcement of the Astrobiology Science and Technology for Exploring Planets (ASTEP) Program is on hold pending programmatic decisions to be made in the first or second quarter of calendar year 2007. If proposals are solicited in calendar year 2007, this NASA Research Announcement will be amended no later than December 15, 2007. Proposals would be due no later than March 15, 2008.

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 C.19, above.)
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 addition, ASTEP solicits proposals to develop technologies (see examples above) that are focused on enabling future field campaigns. Any field testing included in such proposals would be expected to be a minor part of the overall proposed effort.

In summary, ASTEP is expected to lower the risks of planetary exploration through instrument/technology development aimed at or 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 *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.

Questions or comments may be directed to the ASTEP Program Officer, at the address given below:

Dr. John D. Rummel
Planetary Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-0702
E-mail: John.D.Rummel@nasa.gov

C.21 IN-SPACE PROPULSION

The goal of the In-Space Propulsion (ISP) program of the NASA Science Mission Directorate is to develop advanced propulsion technologies for use beyond Earth orbit that enable or reduce trip times, mass, and/or cost associated with NASA science missions to the outer planets, satellites, small bodies, and other solar system destinations. While the ISP program does not intend to provide flight hardware to be utilized for a specific mission, it does intend to develop technologies that may enable missions to be planned that might otherwise be considered untenable.

> **NOTICE: The announcement of the In-Space Propulsion Program is on hold pending programmatic decisions to be made early in the first quarter of calendar year 2007. If proposals are solicited in 2007, this NRA will be amended no later than April 30, 2007. Proposals would be due no earlier than 90 days after release of the amendment.**

Questions or comments may be directed to the ISP Program Officer, at the address given below.

Mr. Dave Lavery
Planetary Science Division
Science Mission Directorate
NASA Headquarters
Washington, DC, 20546-0001
Phone: 202-358-4684
E-mail: dave.lavery@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-2007. 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 2000 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 2000 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);
- Discovery 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 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-2007 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 this NRA's *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 the 2005 or 2006 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: May 31 or October 31, 2007.

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 annual program budget for 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	5 years, plus an additional year of start-up funds, if selected
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA for the appropriate science research program element.
Due date for proposals	For consideration as a Fellow, submit a standard research proposal to the participating program by the deadline specified for the participating program. See Tables 2 and 3 in the *Summary of Solicitation* of this NRA for the appropriate science research program element. Proposals for start-up funds from Fellows selected in prior years are due twice annually: May 31, 2007, and October 31, 2007.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Please refer to the specific science research program element and Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
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*
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	For consideration as a Fellow, see the appropriate science research program element. Proposals from Fellows selected under the 2005 or 2006 ROSES who are submitting proposals for start-up funds should use NNH07ZDA001N-FECR1 (May 31 due date) NNH07ZDA001N-FECR2 (October 31 due date)

NASA point of contact concerning this program	Dr. Curt Niebur Planetary Science Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0390 E-mail: Curt.Niebur@nasa.gov

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);
- Planetary Geology and Geophysics (Appendix C.4);
- Planetary Astronomy (Appendix C.5);
- Planetary Atmospheres (Appendix C.6);
- Outer Planets Research (Appendix C.7);
- Mars Fundamental Research (Appendix C.13);
- Astrobiology: Exobiology and Evolutionary Biology (Appendix C.17); and
- Origins of Solar Systems (Appendix E.3);

Planetary Major Equipment (PME) proposals may be submitted only in conjunction with new science research proposals to this NRA or as an augmentation to Planetary Science Research Program multiple year awards. A PME proposal that is not affiliated with such a new or existing NASA science research proposal is nonresponsive to this program element and will be rejected without review.

Instrumentation purchases or upgrades that may be requested through this program are to be of a substantial nature; that is, over $25K. Types and/or classes of instruments that are considered appropriate to be proposed for this program element include: solid source, light element, and noble gas mass spectrometers; scanning electron microscopes; transmission electron microscopes; secondary ion mass spectrometers; activation analysis equipment; X-ray fluorescence analyzers; molecular characterization tools; liquid or gas chromatographs; static high pressure instrumentation; telescopic instrumentation; high resolution infrared spectrometers; instrumentation for planetary atmospheres laboratory studies; and instrumentation for measurements of gas phase reaction rates, photochemical reaction rates, branching rates, and/or collision, disassociation, ionization, and/or recombination cross-sections.

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

Requests for fabrication or purchase of an instrument should specify how the instrument is to be used, i.e., in terms of the three categories defined below:

- Investigator Instrument. An investigator instrument is defined as an instrument acquired or developed by the proposer to support his/her research where he/she has full authority for its exclusive use and where there are no commitments to make the instrument available to other investigators.

- Investigator Facility Instrument. An investigator facility instrument is defined as an instrument acquired or developed by an investigator to support his/her 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.

- Regional Facility Instrument. A regional facility instrument is defined as an instrument of considerable cost or one that is limited to one location by virtue of its use on a specific facility but has been acquired by a PI to support his/her research. A significant, specified 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. Such proposals must include a description of the management plan for this 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://ec.msfc.nasa.gov/hq/grcover.htm. However, in the cases where the equipment upgrade is for a facility owned by the 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 this 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 this program element. Each relevant cost should be fully explained and substantiated, and a quote 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.

Cost-sharing and substantial institutional contributions are encouraged. 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.

All requests 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 at the end of this section.

4. Programmatic Information

4.1 Submission of PME proposals

To submit a request for PME funds in conjunction with a new proposal, include up to five additional pages of description of the instrument request, including how this purchase will contribute to the research described in the science research proposal. Include also a page of instrument specifications and at least one quote for the instrument or major components. In addition, 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 4.3 below).

To submit a request for PME funds in conjunction with an existing science research award in one of the Planetary Science Research Programs noted above, prepare a complete proposal in full compliance with all applicable instructions and deadlines associated with the science research program to which you are proposing. The only exception is that the *Scientific/Technical/Management* section of the proposal is limited to seven pages instead of fifteen. Such PME proposals should contain sufficient

background information on the affiliated research so that each can be reviewed without also rereviewing the existing science research award. The proposer should select the PME checkbox on the *Cover Page* of this submission.

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.

4.2 Evaluation Criteria and Review of PME Proposals

PME proposals will be reviewed as part of the science research program peer reviews, in the context of their respective science research proposals. Evaluation factors will be those listed in each science research program element, with the following additions:

- In evaluating the intrinsic merit of the request, additional factors that will be considered of equal weight are the scientific merit of the science research proposal and the value that the new or enhanced capability would add to science and/or education beyond that offered specifically to planetary science.
- In considering the relevance of the request to NASA's planetary science objectives, attention will be focused on the added value that would be gained by the addition of the instrument capability to ongoing and anticipated research of the proposer, in particular, and to NASA's objectives in general.

Those proposals that most clearly meet the evaluation criteria will be considered by the Planetary Science Research Program Officers when developing their recommendations for selection.

4.3 Summary of Key Information

Expected annual program budget for new awards	~ $1 M
Number of new awards pending adequate proposals of merit	~ 5-10
Maximum duration of awards	Usually 1 year
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA. Please refer to the specific science research program element.
Due date for proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA. Please refer to the specific science research program element

NASA strategic objective(s) which proposals must state and demonstrate relevance to	Please refer to the specific science research program element and Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Page limit for the central Science-Technical-Management section of proposal	7 pp for stand-alone proposals affiliated with an existing research award; 5 pp for addenda to new proposals in other science research programs; see also Chapter 2 of *Guidebook for Proposers Responding to NASA Research Announcement – 2005*
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	Please refer to the specific science research program element.
NASA point of contact concerning this program	Dr. David J. Lindstrom Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0311 E-mail: David.Lindstrom@nasa.gov

APPENDIX D. ASTROPHYSICS RESEARCH PROGRAM

D.1 OVERVIEW

1. Introduction

The objectives of research solicited in program elements described in Appendices D.2 through D.10 of this NRA are focused on achieving the goals of the Science Mission Directorate¹s Astrophysics Research Program as defined in the *NASA Science Pla*n (http://science.hq.nasa.gov/strategy). Proposers to the elements described in Appendices D.2 through D.10 are encouraged to read this *NASA Science Plan* to gauge the relevance of their research to NASA.

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 (Appendix D.2) supports the broad range of data analysis efforts relating to past or current NASA astrophysics space missions regardless of the physical phenomena studied. Since there are changes to the type of research solicited under this program element of the NRA, interested proposers are urged to read Appendix D.2 carefully to ensure that the research that they are proposing is appropriate.

3. Astronomy and Physics Research and Analysis

The Astronomy and Physics Research and Analysis program (Appendix D.3) supports investigations in the areas of suborbital flights, detector development, supporting technology development, laboratory astrophysics, and limited ground based observing. Basic research proposals are solicited for investigations that are relevant to NASA's programs in astronomy and astrophysics and include research over the entire range of photons and particles of astronomical origin.

4. Astrophysics Theory and Fundamental Physics

The Astrophysics Theory and Fundamental Physics program (Appendix D.4) integrates the Beyond Einstein Foundation Science Program into the previous Astrophysics Theory Program. It supports theoretical investigations or modeling of the astrophysical phenomena targeted by past, current, or future NASA astrophysics space missions, including those of the Beyond Einstein program. It also supports limited laboratory work related to NASA strategic goals in gravitation and fundamental physics. Theoretical work pertaining to atomic and molecular astrophysics and other topics directly related to Laboratory Astrophysics should be proposed to the Astronomy and Physics Research and Analysis program element (Appendix D.3).

5. Astrophysics Guest Investigators

Six program elements support science investigations that require and/or support new data obtained with currently operating NASA astrophysics space missions, or such missions that are to be launched within the next two years. Guest investigator programs are included for the Galaxy Evolution Explorer (*GALEX*) (Appendix D.5), the Far Ultraviolet Spectroscopic Explorer (*FUSE*) (Appendix D.6), the *Swift* gamma-ray burst explorer (Appendix D.7), the *Suzaku* mission (Appendix D.8), and the Gamma-ray Large Area Space Telescope (*GLAST*) (Appendix D.9). The *Kepler* mission Participating Scientist Program element is described in Appendix D.10.

6. Origins of Solar Systems

The portion of this program that relates to the detection and characterization of planetary systems that is directly tied to the NASA strategic goal to search for Earth-like planets is solicited (as it has been in previous years through the Astronomical Search for Origins program) in the program element described in the Origins of Solar Systems program (Appendix E.3).

D.2 ASTROPHYSICS DATA ANALYSIS

1. Scope of Program

1.1 Research Objectives

The Astrophysics Data Analysis Program (ADP) solicits research involving NASA space astrophysics data that are currently 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 following space astrophysics missions are a representative, but not complete, alphabetical list of missions that have such mature data archives (note: for the purpose of this program, the 2MASS data archive is considered NASA space astrophysics data):

- Advanced Satellite for Cosmology and Astrophysics (ASCA)
- Astro Shuttle Experiments: the Hopkins Ultraviolet Telescope (HUT), the Wisconsin Ultraviolet Photopolarimetry Experiment (WUPPE), the Ultraviolet Imaging Telescope (UIT), and the Broad-Band X-Ray Telescope (BBXRT)
- Beppo Satellite di Astronomia X (BeppoSAX)
- Compton Gamma-Ray Observatory (CGRO)
- Cosmic Background Explorer (COBE)
- European X-Ray Astronomy Satellite (EXOSAT)
- Extreme Ultraviolet Explorer (EUVE)
- Far Ultraviolet Spectroscopic Explorer (FUSE)
- Galaxy Evolution Explorer (GALEX)
- Ginga
- High Energy Astronomy Observatories (HEAO-1, 2, and 3)
- High Energy Transient Explorer 2 (HETE-2)
- Infrared Astronomical Satellite (IRAS)
- Infrared Space Observatory (ISO)
- International Gamma-ray Astrophysics Laboratory (INTEGRAL)
- International Ultraviolet Explorer (IUE)
- Keck Interferometer Archive (KI)
- Keck Observatory Archive (KOA) at the Michelson Science Center
- Midcourse Space Experiment (MSX)
- ORFEUS-SPAS I and II
- Palomar Testbed Interferometer (PTI).
- Roentgen Satellite (ROSAT)
- Rossi X-ray Timing Explorer (RXTE)

- Ramaty High Energy Solar Spectroscopic Imager (RHESSI) [limited to analysis of X-ray and γ-ray emission from cosmic sources other than from the Sun or Solar System objects]
- Two Micron All Sky Survey (2MASS)
- Submillimeter Wave Astronomical Satellite (SWAS)
- Swift
- Ulysses [galactic cosmic ray and gamma ray data only]
- Voyager Ultraviolet Spectrometer (UVS)
- X-ray Multi-Mirror-Newton (XMM-Newton)
- Wilkinson Microwave Anisotropy Probe (WMAP).

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/);
- Legacy Archive for Microwave Background Data Analysis (LAMBDA) (http://cmbdata.gsfc.nasa.gov/);
- Michelson Science Center (MSC) (http://msc.caltech.edu/);
- Multimission Archive at Space Telescope (MAST) (http://archive.stsci.edu/); and
- NASA/IPAC Extragalactic Database (NED) (http://nedwww.ipac.caltech.edu/).

Note that proposals for archival research exclusively using data from the operating Great Observatories (the Hubble Space Telescope (HST), the Chandra X-Ray Observatory (CXO), or the Spitzer Space Telescope (SST)) are solicited through separate announcements issued by the NASA-chartered science operations centers for those missions and should not be submitted in response to this ADP solicitation. However, proposals for the analysis of a combination of data from more than one of these Great Observatory missions or using data from other missions in combination with Great Observatory data, as listed above, are eligible for funding under this program. Such data must be in the public domain at the time the proposal is submitted, and the proposal must clearly demonstrate that approximately no more than a third of all the data being analyzed in the proposal is from any one of the Great Observatories.

In support of any ADP proposal, but as a secondary emphasis and only as needed to interpret NASA's archival data, the proposed research may include theoretical research or numerical modeling, may use existing data from ground-based data, or may use suborbital observations and/or laboratory astrophysics measurements. ADP proposals may also request support for science-driven investigations that require a modest level of development of new algorithms and/or enhancements of computational techniques. In addition, NASA will consider requests for support for new ground-based observations provided that the requests are clearly described, that the observations are important to the

success of the proposed ADP effort, and that their expense (including salary, travel, etc.) constitutes no more than ten percent (10%) of the proposal's total budget.

Proposers to this NRA should note that the ADP is not intended to support:

- Investigations whose primary emphasis is theoretical research, numerical modeling, laboratory astrophysics measurements, or detector development (other NASA programs support these research activities);
- 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);
- Proposals primarily for the general education and/or training of students (note: this does not exclude graduate students doing 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.

Prospective 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 ADP (see, for example, abstracts of currently and previously funded ADP projects at http://nspires.nasaprs.com/). Therefore, ADP 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 objects of some class or type. 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. Identification of Proposal Data Set(s) and Research Areas

The *Cover Page* (see the *NASA Guidebook for Proposers*) for ADP 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 facilitates the assignment of each proposal to an appropriate review panel. Note that each proposal must identify a primary Research Area (a secondary Research Area may be designated, if necessary). NASA reserves the right to reassign a proposal to a different primary or secondary Research Area. The eight defined Research Areas are:

1. *Star Formation and Pre-Main Sequence Stars* (including star-forming clouds, protoplanetary and debris disks, protostars, and T Tauri stars);
2. *Main Sequence Stars*;
3. *Post-Main Sequence Stars and Collapsed Objects* (including giants, isolated white dwarfs, isolated neutron stars, central stars of planetary nebulae, and gamma-ray bursts);
4. *Binary Systems* (including cataclysmic variables, x-ray binaries, and black hole binaries);

5. *Interstellar Medium and Galactic Structure* (including supernova remnants, dark clouds, interstellar dust, H II regions, diffuse galactic emission, and planetary nebulae);
6. *Normal Galaxies*;
7. *Active Galaxies and Quasars* (including interacting galaxies, starburst galaxies, Seyfert galaxies, radio galaxies, AGNs, and quasars); and
8. *Large Scale Cosmic Structures* (including clusters of galaxies, galaxy environment and evolution, intracluster medium, diffuse x-ray background, and cosmology).

2. Summary of Key Information

Expected annual program budget for new awards	~ $2.5M
Number of new awards pending adequate proposals of merit	~ 28
Maximum duration of awards	3 years; shorter term proposals are encouraged.
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-ADP

NASA point of contact concerning this program	Dr. Jeffrey J. E. Hayes Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202)358-0353 E-mail: Jeffrey.J.Hayes@nasa.gov

D.3 ASTRONOMY AND PHYSICS RESEARCH AND ANALYSIS

1. Scope of Program

1.1 Overview

The Astronomy and Physics Research and Analysis (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 and particles of cosmic origin. Note that proposals related to gravitational physics and the fundamental laws of physics that were previously supported under APRA are now being solicited under the Astrophysics Theory and Fundamental Physics program (see Appendix D.4 of this NRA).

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:

- Detector Development
- Suborbital Investigations
- Supporting Technology
- Laboratory Astrophysics
- Ground-Based Observations.

Specific Considerations and Exclusions.

- Investigators proposing stand-alone detector development should propose to the Detector Development category, whereas proposals for which detector development is integrated into a suborbital program should be submitted to the Suborbital Investigations category.
- 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 Astrophysical Theory and Fundamental Physics program described in Appendix D.4 of this NRA.
- 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.

- Except for investigations in support of rapid searches for counterparts to Gamma-Ray Bursts, which may be submitted by any investigator, proposers to the Ground-Based Observations component of APRA must be ineligible by virtue of their institutional affiliation to receive direct support from the National Science Foundation for ground-based astronomy. Ground-based particle observations are not supported by this program element.
- 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 in those cases where a Co-Investigator is affiliated with a U.S. Government Laboratory (see Section 2.3.11(b)(iii) of the *NASA Guidebook for Proposers*), 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). (For Suborbital Investigations, see also Section 1.2.2 below.)

1.2.1 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.

1.2.2 Suborbital Investigations

This APRA category supports science investigations and/or technology development utilizing payloads flown on sounding rockets or balloons or similar-class payloads flown 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 should be given. Although most awards are for three years' duration, in rare cases 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 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.

Investigators proposing payloads to be flown on sounding rockets should answer the program-specific questions on the APRA 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.

Investigators proposing sounding rocket payloads are strongly urged to discuss prospective investigations with operations personnel at the NASA Wallops Flight Facility to ensure that probable operational costs are properly anticipated. Questions concerning potential sounding rocket investigations may be addressed to:

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

Note: Owing to 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.*

Special Instructions for Multiple-Institution Proposals for Suborbital Investigations

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:
  - The PI's work statement and budget, plus appended *Task Statements* and budgets from all other collaborating Co-I institutions (see further below) as part of its *Budget Details*.
  - The *Cover Page/Proposal Summary/Budget Summary* of the lead proposal, showing only the budget requested by the lead organization.
  - A table, included in the *Budget Details* of this lead proposal, 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.
  - A clear statement in the first sentence of the *Proposal Summary* that identifies the proposal as the lead proposal.

- Each collaborating Co-I institution proposal must:
  - 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's proposed activities.
  - Provide a copy of the *Budget Summary*.
  - Have a *Proposal Title* that is identical to the title of the lead proposal, and have a *Proposal Summary* that clearly cross-references the PI of the lead proposal in the first sentence.
  - Be submitted electronically through the institution's Authorized Organizational Representative, with the Co-I (Institutional PI) from that

institution listed as the PI. The submittal must be prefaced with the *Cover Page/Proposal Summary/Budget Summary* and include all materials indicated in the *NASA Guidebook for Proposers*.

1.2.3 Supporting Technology

This APRA category supports technology investigations 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.

1.2.4 Laboratory Astrophysics

This APRA category supports basic science investigations that do not require the space environment for completion, but which have the potential to enable or contribute significantly to space astronomy and astrophysics goals. Examples of such investigations include the measurement of fundamental atomic, molecular, and nuclear parameters important for the analysis of NASA's space data, and laboratory examination of processes that are relevant to astrophysical phenomena observed by NASA missions.

1.2.5 Ground-Based Observations

This APRA category will consider proposals for ground-based observations only if they are in direct support of NASA space astronomy and astrophysics missions and/or goals. Note that proposers eligible for support by the National Science Foundation may not apply to this NASA program unless their investigation is specifically for rapid identification of the counterparts to Gamma-Ray Bursts.

2. Programmatic Information

2.1 General Information

The following table provides the approximate amount of FY 2009 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
Detector Development	4.0	10
Suborbital Investigations	5.0	8
Supporting Technology	2.0	12
Laboratory Astrophysics	1.5	12
Ground-Based Observations	0.2	2

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.

2.4 Summary of Key Information

Expected annual program budget for new awards	See Section 2.1
Number of new awards pending adequate proposals of merit	See Section 2.1
Maximum duration of awards	3 years (5 years for major suborbital investigations); shorter term proposals are permitted.
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation of this NRA.*
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
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*

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	NNH07ZDA001N-APRA

Questions about the APRA Program may be directed to the relevant Program Officers listed below with their areas of expertise, all of whom share the same mailing address (if uncertain, contact the APRA Lead Program Officer):

Astrophysics Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001

NAME	PROGRAM RESPONSIBILITY	TELEPHONE	E-MAIL
Dr. Wilton T. Sanders	APRA Lead Program Officer	(202) 358-1319	Wilton.T.Sanders@nasa.gov
Dr. F. Rick Harnden	Gamma-ray Astrophysics	(202) 358-3809	Frank.R.Harnden@nasa.gov
Dr. Louis J. Kaluzienski	X-ray Astrophysics	(202) 359-0365	Louis.J.Kaluzienski@nasa.gov
Dr. Pamela M. Marcum	Ultraviolet and Visible Astrophysics	(202) 358-0377	Pamela.M.Marcum@nasa.gov
Dr. Eric P. Smith	Infrared, Submillimeter, and Radio Astrophysics	(202) 358-2439	Eric.P.Smith@nasa.gov
Dr. W. Vernon Jones	Particle Astrophysics	(202) 358-0885	W.Vernon.Jones@nasa.gov

D.4 ASTROPHYSICS THEORY AND FUNDAMENTAL PHYSICS

1. Scope of Program

The new Astrophysics Theory and Fundamental Physics (ATFP) program represents a merger between the previous Astrophysics Theory Program (ATP) and the Beyond Einstein Foundation Science (BEFS) program. It supports efforts to develop the basic theory for NASA's space astrophysics programs, including its Beyond Einstein program (see http://universe.nasa.gov/). It also supports limited laboratory work related to NASA strategic goals in gravitation and fundamental physics. Abstracts of previously selected ATP and BEFS projects may be found online at http://nspires.nasaprs.com. Theoretical work pertaining to atomic and molecular astrophysics and other topics directly related to Laboratory Astrophysics should be proposed to the Astronomy and Physics Research and Analysis (APRA) program element (Appendix D.3).

The periods of performance of investigations for this research element range from one to three years, although most selected proposals have a duration of three years.

Theoretical proposals submitted for this program must both:

- be directly relevant to space astrophysics or Beyond Einstein program goals by facilitating the interpretation of data from space astrophysics missions or by leading to predictions that can be tested with space astrophysics observations or spaceborne fundamental physics missions; and
- consist predominantly of theoretical studies and the development of theoretical models.

Theoretical proposals satisfying both of the above requirements may:

- involve development of data analysis methods for astrophysics and fundamental physics missions and may *incidentally* include actual data analysis as a test of the theory or the method.

Theoretical proposals to the ATFP 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 (Appendix D.2) program as offered in this solicitation);
- 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);
- 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).

Experimental proposals to the ATFP program may only:

- consist of analysis of data from NASA missions to test theories of gravitation and fundamental physics;
- consist of small technology development efforts for the Laser Interferometer Space Antenna (LISA); or
- develop experimental concepts for future NASA fundamental physics missions.

Experimental proposals to the program may <u>not:</u>

- consist of laboratory research whose primary goal is the fundamental physics result rather than the development of techniques for a space mission (such proposals should be submitted to other appropriate Federal agencies); or
- propose technology development for missions other than LISA (such proposals should be submitted to the APRA program element, D.3).

2. <u>Proposal Category and Research Areas</u>

ATFP proposals will only be accepted from individual Principal Investigators (PIs) whose proposed work has a clear, single focus. <u>Group proposals</u>, *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 ATFP program and will be considered unresponsive to this solicitation. However, individual theory PIs may still include as many Co-Investigators and Collaborators as they wish on their proposals.

Investigators may submit more than one proposal to the ATFP if the research program of each proposal is significantly distinct and if the implied work does not overcommit the personnel involved. If a proposal is submitted as a successor to work supported by an earlier proposal, the new proposal must identify that work and clearly summarize all significant results from it.

For the purposes of conducting the peer review, every proposal for this ATFP 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. *Normal Stars and Star Formation* (e.g., star forming clouds, protoplanetary and debris disks, protostars, brown dwarfs, dust, astrochemistry);
2. *Post-Main Sequence Stars and Collapsed Objects* (e.g., giants, isolated white dwarfs, isolated neutron stars, central stars of planetary nebulae, cataclysmic variables, x-ray binaries, black-hole binaries);
3. *Supernovae and Gamma Ray Bursts;*
4. *Interstellar Medium and Galactic Structure* (e.g., SN remnants, dark clouds, interstellar dust, H II regions, diffuse galactic emission, planetary nebulae);
5. *Normal Galaxies* (e.g., normal galaxies, interacting galaxies, starburst galaxies);
6. *Large Scale Cosmic Structures* (e.g., clusters of galaxies, galaxy environment and evolution, intracluster medium, diffuse photon backgrounds);

7. *Cosmic rays*;
8. *Active Galaxies and AGNs* (e.g., population studies, accretion discs, jets);
9. *X-ray Astrophysics* (e.g., sources for Con-X or Black Hole Finder Probe, x-rays from binaries and neutron stars, studies of AGNs that emphasize the x-ray observations);
10. *Dark Energy and the Cosmic Microwave Background* (e.g., theoretical studies of cosmological observation techniques, theoretical cosmology, dark energy models);
11. *Gravitational Astronomy* (e.g., gravitational wave sources, computation of gravitational radiation waveforms, data analysis methods for LISA signals);
12. *Experimental Gravitation, and Fundamental Physics* (e.g., Solar System tests of gravitation, studies of future missions in experimental gravitation and fundamental physics);
13. *Other Astrophysics Theory and Fundamental Physics* (NASA HQ will assign the proposal to what it deems is the most appropriate review panel).

3. Additional Programmatic Information

3.1 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 and Fundamental Physics 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.

3.2 Summary of Key Information

Expected annual program budget for new awards	~ $3M
Number of new awards pending adequate proposals of merit	~ 20 to 25
Maximum duration of awards	3 years; shorter term proposals are encouraged.
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.

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 – 2007* 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. 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	NNH07ZDA001N-ATFP
NASA point of contact concerning this program	Dr. Ronald W. Hellings Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0995 E-mail: hellings@hq.nasa.gov

D.5 GALEX GUEST INVESTIGATOR – CYCLE 4

1. Scope of Program

1.1 Overview

This program element solicits proposals for the acquisition and analysis of new scientific data from the Galaxy Evolution Explorer (GALEX). The GALEX mission is designed to map the global history and probe the causes of star formation over the redshift range $0<z<2$, a time span that traces 80% of the life of the universe, when galaxies have evolved dramatically, and when most stars, elements, and galaxy disks formed. This solicitation is for Cycle 4 of the GALEX Guest Investigator (GI) Program, to be carried out beginning on or around January 1, 2008, and lasting approximately 12 months (http://galexgi.gsfc.nasa.gov/). GI programs may address any area of astrophysics; they are not restricted to galaxy evolution studies.

Proposals submitted in response to this program may be for new observations with GALEX or for analysis of GALEX archival data. New observations may be for standard observing proposals or for Legacy proposals. *Standard Proposals* are for small focused investigations and will generally be less than 100 orbits, while *Legacy Proposals* are for large, coherent projects of general and lasting importance to a wide astrophysical audience and are expected to require more than 100 orbits. During GI Cycle 4, approximately two-thirds of the GALEX observing time will be used by the GALEX science team to carry out the mission's primary science investigations (http://galexgi.gsfc.nasa.gov/piscience). The remaining observing time during Cycle 4 will be available to the scientific community through this solicitation for investigations that do not duplicate the GALEX science team investigations. Proposals may also be submitted to use archival GALEX data for investigations. During Cycle 4, archival investigations may make use of any publicly available GALEX data.

1.2 The GALEX Mission

GALEX provides ultraviolet imaging in two broad bands, Far-UV (FUV, 1350-1800 Å) and Near-UV (NUV, 1800-2800 Å), and low-resolution (R = 150-300) grism spectroscopy. The images cover a circular field of view of 1.25^{o}, at a spatial resolution of ~4 arc sec FWHM, with sufficient sensitivity to study a wide variety of objects within and outside of our Galaxy. GALEX is a Principal Investigator (PI)-class mission, developed in collaboration between the California Institute of Technology (CIT), Pasadena, California, the Laboratoire d'Astrophysique Spatiale, Marseilles, France, the University of California at Berkeley, The Johns Hopkins University, Baltimore, Maryland, and the Yonsei University, South Korea. The GALEX PI, Dr. Christopher Martin of CIT, is responsible to NASA for the mission design, development, and operations. GALEX is controlled from the GALEX Scientific Operations Center located on the CIT campus.

The GALEX prime mission will achieve its scientific objectives by performing a series of six complementary imaging and spectroscopic surveys. The four imaging surveys (http://galexgi.gsfc.nasa.gov/surveys) include one intended to cover ~90% of the sky at

moderate sensitivity (the All-observable-Sky Imaging Survey), two other imaging surveys covering smaller areas to increasing sensitivities, and a survey of 200 nearby galaxies. Two spectroscopic surveys (http://galexgi.gsfc.nasa.gov/surveys) are matched to subsets of the imaging surveys. Further information on the design and contents of these surveys may be found at the GALEX GI website (http://galexgi.gsfc.nasa.gov/). Although the PI team surveys are designed to study galaxy evolution, the satellite and accompanying rich data sets should prove invaluable for exploring many astrophysical problems. Proposers to this Cycle 4 GI program are encouraged to take full advantage of the capabilities of GALEX (within operational constraints) to address important problems in astrophysics, for example, large scale structure, Active Galactic Nuclei populations, massive star evolution, supernova remnants, interstellar and intergalactic material, young stellar objects and their environments, planets and their satellites, or comets.

2. Programmatic Information

2.1 Proposal Submission and Evaluation

Proposers are asked to submit proposal materials electronically, as detailed below

2.1.1 Submission of Proposals to the GALEX Cycle 4 GI Program

NASA will review proposals for this program in a two-phase process. In Phase 1, proposals will be evaluated with respect to their intrinsic merit and relevance to NASA's objectives. Observing proposals selected in the Phase 1 review will be awarded observing time on GALEX and become candidates for funding subject to the Phase 2 review process. Archival proposals selected will become candidates for funding subject to the availability of proposed targets in GALEX publicly available data. For both observing and archival proposals, the cost of the investigation will be evaluated in the second phase: ***no budgets are required for Phase 1 proposals.***

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 deadline to the Web address given in this NRA's *Summary of Solicitation*. Note that an NOI submission is not required but is of considerable value in helping NASA plan for an expeditious peer review of proposals.

Prospective proposers to Cycle 4 of the GALEX GI Program must adhere to the following 2-part procedure for the submission of Phase 1 proposals. Both submissions are due by the due date for this program element (see Tables 2 and 3 in the *Summary of Solicitation* for this NRA):

- **Prepare and submit the Phase 1 scientific and technical proposal *as a PDF file* to galexprop@galexgi.gsfc.nasa.gov**. Proposers who are familiar with LaTeX or Word may retrieve and prepare proposals using template Cycle 4 proposal forms available on the GALEX GI Website

(http://galexgi.gsfc.nasa.gov/). Proposers need not use the LaTeX or Word templates, but must adhere to the page limits, font sizes, etc., as given on the Web site. An acknowledgement of receipt will be sent to the proposal submitter by E-mail.

- **Prepare and submit the required minimum set of GALEX target data to the GALEX GI website** (http://galexgi.gsfc.nasa.gov/). The easiest way to do this is to generate the XML observing form using the tool at http://galexgi.gsfc.nasa.gov/targets, and then submit it from the Web site. However, proposers may also create the XML file themselves following the format given at http://galexgi.gsfc.nasa.gov, and E-mail it to galexprop@galexgi.gsfc.nasa.gov. An acknowledgment of receipt will be sent to the target list submitter by E-mail.

All electronic proposal materials must be submitted by 4:30 p.m. Eastern time on the due date for this program given in Tables 2 and 3 of the *Summary of Solicitation* for this NRA in order to be included in the proposal review for this cycle of the GALEX GI program. **Note: The deadline of 4:30 p.m. on the due date replaces the deadline stated in the *Guidebook for Proposers* and in the *Summary of Solicitation* for this NRA.**

Phase 1 proposals submitted to the GALEX GI program (Cycle 4) may not be submitted via NSPIRES or Grants.gov.

2.1.2 Evaluation and Selection of Proposals submitted to the GALEX GI Program

Phase 1 proposals will be evaluated with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers* (excluding cost), where it is understood that the intrinsic merit of a proposal shall include the following factors:

- The overall scientific merit of the proposed investigation;
- The suitability of using the GALEX observatory and/or data products for the proposed investigation;
- The degree to which the investigation uses GALEX's unique capabilities;
- The feasibility of accomplishing the objectives of the investigation; and
- The feasibility and suitability of the proposed analysis techniques.

Legacy proposals will also be judged on the factor:

- Provisions to provide legacy data and enhanced data products to the community in a timely fashion.

Based upon the results of the above reviews, the GALEX Program Officer identified below will recommend a set of proposals to the Selecting Official for selection.

2.2 Available Funding

Selected investigators at U.S. institutions, including U.S. Co-Investigators on selected non-U.S. proposals, will be eligible for funding. For Phase 2, the selected investigators

will receive a funding guideline from NASA based on the scope of the approved observing program and the available budget for the GALEX Cycle 4 GI Program. Eligible investigators may submit Phase 2 proposals for funding. Instructions on submitting electronic Phase 2 proposals through NSPIRES or Grants.gov and the due date for submission will be provided to eligible investigators with the funding guideline.

It is estimated that the FY 2008 funding available for this program will be approximately $3M and that this level of funding will support about 40 research investigations. The maximum period of performance that may be proposed is for one year. A budget summary and narrative description of how the award will be used must be submitted with the Phase 2 proposal. Phase 2 proposals must be submitted by an Authorized Organizational Representative (AOR) of the proposing institution.

2.3 Supplemental Information

Further details of the proposal submission requirements and process may be found at the GALEX GI Program Web site (http://galexgi.gsfc.nasa.gov/), which includes a detailed mission description; technical information about GALEX and instrument; instrument and observer handbooks; tools for determining the feasibility of potential observations; information on the GALEX PI team science investigations; listings of observed and planned targets and of data sets available for archival proposals; sample data sets; detailed information regarding proposal submission, evaluation, selection and implementation; and instructions for completing the required proposal forms.

2.4 Schedule

The schedule for submission of *Notice of Intent* (NOI, encouraged but not required), and for submission of electronic Phase 1 proposals and target information is given in Tables 2 and 3 of the *Summary of Solicitation* of this NRA. All electronic proposal materials must arrive by 4:30 p.m. Eastern time on the due date for this program.

2.5 Contact Information:

Scientific and technical questions concerning this program element should be directed to:

Dr. Susan G. Neff
GALEX Mission Scientist
Laboratory for Observational Cosmology
Code 665
Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, MD 20771-0001
Telephone (301) 286-5137
E-mail: Susan.G.Neff@nasa.gov

Programmatic information may be obtained from the GALEX Program Officer:

Dr. Zlatan Tsvetanov
Astrophysics Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone (202) 358-0810
E-mail: Zlatan.Tsvetanov@nasa.gov

Technical information may be obtained from the GALEX GI website and/or help desk:

GALEX GI Help Desk
Laboratory for Observational Cosmology
Code 665
Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, MD 20771-0001
Telephone (301) 286-5689
E-mail: GALEX.helpdesk@galexgi.gsfc.nasa.gov

2.6 Summary of Key Information

Expected annual program budget for new awards	~ $3M
Number of new awards pending adequate proposals of merit	~ 40
Maximum duration of awards	1 year
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. Note: Proposals are due by 4:30 p.m. Eastern time on the due date.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/ And http://galexgi.gsfc.nasa.gov/
Page limit for the central Science-Technical-Management section	See http://galexgi.gsfc.nasa.gov/

of Phase 1 proposal	
Submission medium	Electronic proposal submission of Phase 1 proposal is required; no hard copy is required. See also Section 2.1.1
Address for submission of electronic Phase 1 proposal	See Section 2.1.1
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
NASA point of contact concerning this program	Dr. Zlatan Tsvetanov Astrophysics Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0810 E-mail: Zlatan.Tsvetanov @nasa.gov

D.6 FUSE GUEST INVESTIGATOR – CYCLE 9

1. Scope of Program

1.1 Overview

This program element solicits proposals for the acquisition and analysis of new scientific data from the Far Ultraviolet Spectroscopic Explorer (FUSE). The FUSE mission is designed to investigate the nature and physics of interstellar and intergalactic gas, stars, galaxies, and planets through the use of high-resolution spectroscopy of far ultraviolet radiation. This solicitation is for Cycle 9 of the FUSE Guest Investigator (GI) Program, to be carried out beginning on or around January 1, 2008, and lasting until approximately September 30, 2008.

All proposals submitted in response to this program must be for new observations with FUSE. Therefore, investigations that do not require new FUSE observations are not within the scope of the FUSE GI Program, including proposals for analysis of archival FUSE data and proposals for complementary observations or theoretical work that do not require new FUSE observations.

1.2 The FUSE Mission and Scope of Science Capabilities

FUSE provides high-resolution (R ~20,000) spectroscopy at far ultraviolet wavelengths (905-1187 Å) with sufficient sensitivity to study a wide variety of objects, including many extragalactic lines of sight, and was launched on June 24, 1999. FUSE is a PI-class mission developed in collaboration with the space agencies of Canada and France. The FUSE Principal Investigator, Dr. Warren Moos of The Johns Hopkins University (JHU), is responsible to NASA for the mission design, development, and operations. FUSE is controlled from the FUSE Satellite Control Center located on the JHU campus in Baltimore, Maryland.

The spectral window covered by FUSE permits the study of many astrophysically important atoms, ions, and molecules that cannot otherwise be investigated, including the Lyman series of atomic hydrogen and deuterium, the electronic transitions of H_2, and the O VI doublet, which is a key diagnostic of ~300,000 K gas. Proposers to this Cycle 9 GI Program are encouraged to take full advantage of the capabilities of FUSE to address important problems in astrophysics, for example, the study of Active Galactic Nuclei and quasars, massive stars, supernova remnants, nebulae, the outer atmospheres of cool stars, protoplanetary disks, as well as interstellar and intergalactic material.

2. Programmatic Information

2.1 Proposal Submission and Evaluation

Owing to the need to provide electronic databases both to NASA Headquarters for overall cognizance of its research programs, as well as to the FUSE Satellite Control Center for planning of the new observations requested by the investigations to be selected through this

program element, proposers are required to electronically submit proposal materials to two separate Web sites as detailed below.

2.1.1 Submission of Proposals to the FUSE Cycle 9 GI Program

NASA will review proposals for this program in a two-phase process. In the first phase, proposals will be evaluated with respect to their intrinsic merit and relevance to NASA's objectives. Proposals selected in the Phase 1 review will be awarded observing time on FUSE and become candidates for funding subject to the Phase 2 review process. The proposed cost of the investigation will be evaluated in the second phase.

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 deadline to the Web address given in this NRA's *Summary of Solicitation*. Note that an NOI submission is not required but is of considerable value in helping NASA plan for an expeditious peer review of proposals.

Prospective proposers to Cycle 9 of the FUSE GI Program must adhere to the following procedures for the submission of Phase 1 and Phase 2 proposals:

2.1.2 Submission of Phase 1 Proposals

Phase 1 proposal submission is completely electronic for Cycle 9.

- Obtain and complete the Cycle 9 proposal form on the FUSE GI Web site at http://fusegi.pha.jhu.edu. Create a PDF version of the completed proposal.

- Register with NSPIRES, the NASA proposal database system, at http://nspires.nasaprs.com. This is required for all proposers, including proposers at non-U.S. institutions.
    - Proposers from U.S. institutions must affiliate with an institution that is registered in NSPIRES (see Section IV(b)(i) of this NRA's *Summary of Solicitation*).
    - Proposers from non-U.S. institutions must affiliate either with their institution (if it is registered in NSPIRES) or with the FUSE GI Support Center. Note: Only proposers from non-U.S. institutions may affiliate with the FUSE GI Support Center. More detailed instructions for non-U.S. based proposers will be posted at the FUSE website at (http://fusegi.pha.jhu.edu).

- Using NSPIRES, complete the required *Cover Page/Proposal Summary* form for FUSE Cycle 9. The budget should be zero for Phase 1. The PDF version of the completed FUSE Cycle 9 proposal must be uploaded as an attachment within NSPIRES.

- Release the proposal to the affiliated proposing organization. For some proposers from non-U.S. organizations, this will be the FUSE GI Support Center. For everyone else, it will be the proposing organization. The proposal must be submitted to NASA by an Authorized Organizational Representative (AOR) of the proposing organization.

- All proposers must E-mail the Cycle 9 proposal form (in LaTeX format, not in PDF format) to fuseprop@pha.jhu.edu. An acknowledgment of receipt will be sent to the proposer by return E-mail.

Note: All electronic proposal materials must be submitted by 4:30 p.m. Eastern time on the due date for this program given in Tables 2 and 3 of the *Summary of Solicitation* to this NRA in order to be included in the proposal review for this cycle of the FUSE GI Program. All proposers (at U.S. institutions and non-U.S. institutions) **must** release the proposal to the AOR; the AOR must submit the proposal in NSPIRES to NASA before 4:30 p.m. on the due date. For some proposers from non-U.S. organizations, proposals must be released to the FUSE GI Support Center for that organization to submit the proposal to NASA.

All other submission requirements are the same for proposers from both U.S. institutions and from non-U.S. institutions.

Note: The deadline of 4:30 p.m. on the due date replaces the deadline stated in the *Guidebook for Proposers* and in the *Summary of Solicitation* for this NRA.

Phase 1 proposals submitted to the FUSE Cycle 9 Guest Investigator Program may not be submitted via Grants.gov.

2.1.3 Evaluation and Selection of Phase 1 Proposals

Proposals will be evaluated with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers* (excluding cost), where it is understood that the intrinsic merit of a proposal shall include the following factors:

- The suitability of using the FUSE observatory and data products for the proposed investigation;
- The degree to which the investigation uses FUSE's unique capabilities;
- The feasibility of accomplishing the objectives of the investigation; and
- The feasibility and suitability of the proposed analysis techniques.

Based upon the results of the above reviews, the FUSE Program Officer identified below will recommend a set of proposals to the Selecting Official for selection.

2.1.4 Submission of Phase 2 Proposals

Selected investigators at U.S. institutions, including U.S. Co-Investigators on selected non-U.S. proposals, will be eligible for funding. For Phase 2, the selected investigators

will receive a funding guideline from NASA based on the scope of the approved observing program and the available budget for the FUSE Cycle 9 GI Program. Eligible investigators may submit Phase 2 proposals for funding. Instructions on submitting Phase 2 proposals through NSPIRES or Grants.gov and the due date for submission will be provided to eligible investigators with the funding guideline.

A total of about $400 K is planned for the support of up to about 20 Cycle 9 Guest Investigations of one year duration each. A budget summary and narrative description of how the award will be used must be submitted with the Phase 2 proposal. Phase 2 proposals must be submitted via NSPIRES or Grants.gov by an AOR of the proposing institution.

2.2 Supplemental Information

Further details of the proposal submission requirements and process may be found at the FUSE GI Program website http://fusegi.pha.jhu.edu/ that includes a detailed mission description; technical information about the FUSE mission, instrument, and feasibility; detailed information regarding proposal submission, evaluation, selection and implementation; and instructions for completing the required proposal forms.

Scientific and technical questions concerning this program element should be directed to:

Dr. George Sonneborn
FUSE Project Scientist
Laboratory for Observational Cosmology
Code 665
Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, MD 20771-0001
Telephone (301) 286-3665
E-mail: George.Sonneborn-1@nasa.gov

Programmatic information may be obtained from the FUSE Program Scientist:

Dr. Hashima Hasan
Astrophysics Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone (202) 358-0692
E-mail: hhasan@nasa.gov

2.3 Summary of Key Information

Expected total program budget for new awards	~ $400 K
Number of new awards pending adequate proposals of merit	~ 20
Maximum duration of awards	1 year
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. Note: Proposals are due by 4:30 p.m. Eastern time on the due date.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Page limit for the central Science-Technical-Management section of Phase 1 proposal	See http://fusegi.pha.jhu.edu/
Submission medium	Electronic proposal submission to two web sites is required for Phase 1; no hard copy is required. See also Section 2.1.1.
Address for E-mail submission of Cycle 9 proposal form	fuseprop@pha.jhu.edu (see Section 2.1.2)
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 Phase 1 proposal via Grants.gov	Option not available
NASA point of contact concerning this program	Dr. Hashima Hasan Astrophysics Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0692 E-mail: hhasan @nasa.gov

D.7 SWIFT GUEST INVESTIGATOR – CYCLE 4

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 non-transient sources.

Compared to Swift GI Cycle 3, a new aspect of Cycle 4 is that observing time will be made available to scientists at U.S and non-U.S. institutions to study non-GRB, nontransient astrophysical sources. Cycle 4 will also continue the opportunity initiated in Cycle 3 for GIs to propose TOOs on non-GRB transients. Funding through the NASA Swift GI Program is available only to scientists at U.S. institutions. 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.

The Swift GI program is intended to provide the following benefits to participating scientists:

- Funding to carry out investigations using Swift data, to conduct correlative observations at other wavelengths and to conduct theoretical investigations in support of Swift observations;
- Involvement with the Swift science team in the analysis and interpretation of GRB data obtained with the observatory;
- Rapid, time-critical multiwavelength follow-up observations on unique astrophysical targets of opportunity; and
- Multiwavelength non-TOO observations on compelling, variable astrophysical sources.

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 providing the Italian ground station at Malindi. The mission operations center is at Pennsylvania State, and the Science Center is at Goddard. 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. Recently, the mission has been

extended at least another four years beyond this initial period based upon the continued scientific productivity of the mission. 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 UV Optical Telescope (UVOT). The spacecraft can be autonomously repositioned to direct the XRT and UVOT toward events detected by the BAT. The BAT is a wide-field gamma-ray imager that detects GRBs and rapidly sends positions of arcminute accuracy to the spacecraft and to the ground. The BAT operates in the 15-350 keV range and has a 1.4 steradian (half-coded) field-of-view. It has a GRB detection sensitivity that is ~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 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 24 arcminutes with an angular resolution of 18 arcseconds and positional determination accuracy of 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, with an angular resolution of 1.8 arcseconds and positional determination accuracy of 0.3 arcseconds. UVOT provides a sensitivity to afterglows of 22nd magnitude for a 1000 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 ($E/\Delta E$ ~ 300) of sources brighter than 17th magnitude. The narrow-field instruments produce accurate positions 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 Coordinate 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 Astronomer's Telegrams (ATELs, http://www.astronomerstelegram.org/) and IAU Circulars (http://cfa-www.harvard.edu/iau/services/IAUC.html). Data from serendipitous sources in the fields-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

The Swift GI Program has been expanded to include areas of research in non-GRB science and to allow GI-specified pointings. The Swift science team core science program includes ongoing programs to produce a comprehensive Swift GRB catalog, as well as serendipitous source catalogs for the three separate instruments. Thus, no GI funding is available for producing similar catalogs through this opportunity. These catalog efforts, together with a small number of additional Key Projects, are listed at http://swift.gsfc.nasa.gov/docs/swift/proposals/swift_keyprojects.html.

This Swift GI Program solicits proposals in the following areas:

- New Swift GRB projects not duplicative of team Key Projects and not requiring GI-specified observatory pointings;
- New Swift pointed observations on non-GRB astrophysical objects which benefit from Swift's unique capability of simultaneous multiwavelength coverage;
- New Swift non-GRB target of opportunity (TOO) observations which promise large scientific return and capitalize on Swift's unique capabilities of rapid repointing and multiwavelength observations;
- Correlative GRB observations with non-Swift instruments and observatories; and
- Theoretical GRB investigations that will advance the mission science return of Swift.

1.3.1 New Swift GRB projects

GIs may propose to initiate their own new GRB projects, avoiding duplication of existing efforts while supplementing the Swift science return with their unique facilities and capabilities. Proposers should address how their activities will complement the Swift science team core science program. 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 (see Section 2.2 below).

1.3.2 Swift Guest Observer program

The Swift GI program now includes a Guest Observer (GO) component that permits GOs to request non-GRB pointed observations. A total of 2 million seconds of observing time will be made available to the GO program during Cycle 4. Swift GO observations will be performed only as the result of an uploaded ground command through the normal planning process and will not be slewed to autonomously. GO 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. Because of this restriction, successful GO PIs 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 GO observation is defined as one requested pointing to a target, but proposers should be aware that, due to Swift's low Earth orbit (95 minute orbit

period) and scheduling priorities for other objects, any GO observation longer than 1 ks is likely to be broken up into several different pointings on different orbits. GO proposals are subject to the following limitations:

- Requested time per observation will be limited to between 1 ks (minimum) and 20 ks (maximum).
- In order to ensure that GO targets are distributed pseudo-uniformly on the sky, no more than 500 ks of observing time will be allocated to GO targets in each 6-hour range of right ascension (RA).
- No more than 10 monitoring programs (GO and TOO) will be permitted in Cycle 4.
- No more than 20% of the GO time may be used for time-constrained proposals. 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 monitoring programs. Since non-GRB targets must be scheduled around existing GRB observations, regular periodic monitoring cannot be accommodated. Proposals requiring periodic monitoring will be rejected.

GO proposers must clearly describe how their proposal capitalizes on the unique capabilities of Swift.

There will be no time carried over from Cycle 4 to Cycle 5 for accepted GO programs. Therefore, GOs whose observing programs are not completed in Cycle 4 will be required to repropose in Cycle 5 if they wish to acquire more observing time on their targets of interest.

1.3.3 Swift Target of Opportunity program

The Swift GI program now includes a Target of Opportunity (TOO) component that permits GIs to request non-GRB Targets of Opportunity in response to transient phenomena. A total of 800 ks 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 telecommand by the Flight Operations Team 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 PIs 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. A single observation is defined as one requested pointing to a target. PIs submitting TOO proposals must:

- Limit the requested time per observation to between 1 ks (minimum) and 20 ks (maximum);
- Clearly describe how their proposal capitalizes on the unique capabilities of Swift; and
- Give exact, detailed trigger criteria.

Swift TOOs must be assigned a priority by the PI. The priority specifies the time criticality of the observation. From the time of the trigger, the priorities are defined as

- Top Priority: Observation should be performed within 4 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.

Scheduling of Swift observing time is unique and affects the type of non-GRB program that can be achieved. Because new GRBs are constantly being discovered, the Swift observing schedule is replanned on a daily basis. Because of these constraints, it is expected that no more than six Top Priority, and no more than fifty High Priority TOOs can be performed for Cycle 4. Note that Top and High 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 (i.e., transient events important enough to be covered in newspapers). In addition, up to 10 monitoring campaigns (TOO and GO proposals that involve multiple pointings to the same object) will be scheduled for Swift Cycle 4. Since non-GRB targets must be scheduled around existing GRB observations, regular periodic monitoring requiring precise time constraints cannot be accommodated. Proposals requiring periodic monitoring will be rejected.

For Swift TOO proposals, it is the responsibility of the PI to alert the Swift Observatory Duty Scientist when trigger conditions 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.) Swift TOO proposals must have an astrophysical trigger. Once the trigger criteria of an approved target have occurred, the PI should make sure that the target location is more than 5 hours in RA from the Sun, and more than 20 degrees from the Moon, before requesting Swift observations. TOO observations closer to the Sun than 5 hours RA will not be approved unless they are of exceptionally high scientific priority. 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.

GOs whose TOO programs do not trigger in Cycle 4 will be required to repropose in Cycle 5 should they wish to acquire observing time on their targets of interest.

Note that TOO requests for exceptional transients will continue to be possible through the Swift TOO Web site even for TOO's 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 designate.

1.3.4 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 (relative to the UVOT 22nd magnitude limit in 1000 seconds in V) of the afterglow and possible host galaxy, deep X-ray imaging and spectroscopy, and rapid optical observations with time scales shorter than the 1-minute Swift response time.

1.3.5 Theoretical Studies

Finally, theoretical studies related to the GRB observations conducted with Swift 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 Swift science objectives.

2. Programmatic Information

2.1 General Information

It is anticipated that approximately $1.8 M will be available through this solicitation for the support of approximately 30 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 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 already receiving support from the Project are also eligible for support, although such individuals 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

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 deadline to the Web address given in this NRA's *Summary of Solicitation*. Note that an NOI submission

is not required but is of considerable value in helping NASA plan for an expeditious peer review of proposals.

Prospective proposers to the Swift GI Program must adhere to the following procedures for the submission of proposals:

- U.S. institution proposers will submit their proposals (including budgets) through the NASA NSPIRES electronic proposal website (http://nspires.nasaprs.com) or through Grants.gov (http://www.grants.gov) following the instructions in the *Summary of Solicitation* of this NRA.

- Non-U.S. institution proposers will submit their proposals as outlined by the instructions on the Swift Science Center website (http://swiftsc.gsfc.nasa.gov).

- All proposers who are submitting non-GRB pointed observing proposals must complete and submit target forms as described by the instructions on the Swift Science Center website (http://swiftsc.gsfc.nasa.gov).

- Due to the nature of prospective investigations within the Swift GI Program, the Scientific/Technical/Management section of proposals is limited to 4 pages, instead of the default 15 pages specified in the *NASA Guidebook for Proposers*, and any budget justification is limited to 2 pages. A 1-page biographical sketch for the PI is required. A list of current and pending funding must be included in proposals requesting funding. The requirement of a table of contents in the body of the proposal is waived.

All electronic proposal materials must be submitted by the due date for this program given in Tables 2 and 3 of the *Summary of Solicitation* to this NRA in order to be included in the proposal review for this cycle of the Swift GI Program.

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.3 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 approved Key Projects and enhances the anticipated science return from the Swift mission;
- The degree to which the proposed investigation places demands upon mission resources;
- For GO and TOO investigations, 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.

2.3 Supplemental Information

Further details of the proposal submission requirements and process may be found at the Swift Science Center Web site http://swiftsc.gsfc.nasa.gov/, which includes a detailed mission description; technical information about the Swift mission, instruments, and feasibility; information regarding proposal submission; and instructions for completing the required proposal forms.

Technical questions concerning this program element may be directed to the Swift Science Center:

Dr. Patricia T. Boyd
Swift Guest Investigator Program
Code 661
Building 2, Room S208
Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, MD 20771-0001
Telephone: (301) 286-2550
E-mail: swifthelp@athena.gsfc.nasa.gov

Programmatic information may be obtained from the Swift Program Scientist:

Dr. F. Rick Harnden
Astrophysics Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone: (202) 358-3809
E-mail: Frank.R.Harnden@nasa.gov

3. Summary of Key Information

Expected annual program budget for new awards	~ $1.8 M
Number of new awards pending adequate proposals of merit	~ 30
Maximum duration of awards	1 year
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
General information and	See the *Summary of Solicitation* of this NRA.

overview of this solicitation	
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers Responding to a NASA Research Announcement – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Page limit for the central Science-Technical-Management section of proposal	4 pp; note this difference from Chapter 2 of the *NASA Guidebook for Proposers*
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://www.grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH07ZDA001N-SWIFT4
NASA point of contact concerning this program	Dr. F. Rick Harnden F. Rick Harnden Astrophysics Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-3809 E-mail: frank.r.harnden@nasa.gov

D.8 SUZAKU GUEST OBSERVER – CYCLE 3

1. Scope of Program

1.1 Overview

This program element solicits proposals for participation in the NASA program for the conduct of space science observations and subsequent analysis of the resultant scientific data from the joint Japanese-U.S. Suzaku X-ray observatory, formerly known as Astro-E2. The primary goal of the Suzaku mission is to investigate the nature and physics of astrophysical objects as revealed through detailed observations of their high-energy emission. A broad range of astrophysical objects will be studied, including stars, X-ray binaries, diffuse galactic emission, active galactic nuclei, and clusters of galaxies.

Cycle 3 observations will commence on or around April 1, 2008, and last approximately 12 months. NASA is responsible for allocating the U.S. share of Suzaku observing time during the mission via this and subsequent solicitations. All of the U.S.-allocated observing time will be awarded competitively. Allocation of the Japanese observing time will be the responsibility of the Institute of Space and Astronautical Science of the Japanese Aerospace Exploration Agency (ISAS/JAXA). This program element solicits proposals for observations using the X-ray Imaging Spectrometer and/or Hard X-ray Detector instrument on Suzaku. Proposals may be submitted for observing time only; proposals for complementary observations or theoretical investigations are not solicited.

1.2 The Suzaku Mission

1.2.1 Mission Overview

Suzaku is Japan's fifth x-ray astronomy mission and the third for which the U.S. has provided a significant part of the scientific payload. Its five large-area telescopes focus x-rays from a wide energy range onto four x-ray sensitive charge-coupled devices (CCDs) and a microcalorimeter (now no longer operational). In addition, Suzaku carries a nonimaging Hard X-ray Detector. Suzaku will observe a variety of x-ray sources over a very broad spectral band with moderate spatial resolution and moderate spectral resolution. It is anticipated that Suzaku will typically perform one pointing every day or two. These combined capabilities enable a diverse and exciting program of astrophysical research.

The four, nearly identical x-ray CCD cameras are known as the X-ray Imaging Spectrometers (XISs) and are provided by a hardware team from Kyoto University, Osaka University, Ehime University, Rikkyo University, Kogakuin University, the Massachusetts Institute of Technology (MIT), and ISAS. Each CCD camera head is based upon a single 1024 x 1024 pixel CCD chip, manufactured at MIT Lincoln Laboratory. The field-of-view of each camera is 18 x18 arcminutes. The CCD spatial resolution is defined by the X-Ray Telescope (~2 arc minute half-power diameter). Three units have a front-side illuminated chip, each with a bandpass of 0.4 to 12 keV; the fourth unit has a back-side illuminated chip covering 0.2 to 12 keV. The XIS spectral resolution is ~130 eV at 6 keV and scales as the square-root of the photon energy.

The high-throughput X-Ray Telescopes (XRTs) utilize multiply-nested, thin foil, conical mirrors. The XRTs are supplied by the NASA Goddard Space Flight Center (GSFC), Nagoya University, Tokyo Metropolitan University, and ISAS and provide a spatial resolution of ~2 arcminutes (half-power diameter) and a broad bandpass of 0.1-12 keV.

The Hard X-ray Detector (HXD) is a low background, collimated detector, covering the 10-600 keV band. It is provided by the University of Tokyo, Japan's Institute of Chemistry and Physics (RIKEN), Japan's National Laboratory for High Energy Physics (KEK), Hiroshima University, Saitama University, Kanazawa University, Osaka University, Aoyama Gakuen University, the Stanford Linear Accelerator Center (SLAC), and ISAS. Its spectral resolution ranges from ~9 percent at 662 keV to ~30 percent at 10 keV. The detector array consists of silicon PIN diodes (sensitive below 70 keV) and GSO well-type phoswich counters (sensitive above 40 keV). Below 100 keV, fine collimators limit the field of view to 34 arcminutes x 34 arcminutes full width at half maximum (FWHM).

For more information about the instruments, please see the Suzaku Technical Description, which can be obtained from the Suzaku Guest Observer Facility at http://suzaku.gsfc.nasa.gov/.

1.2.2 Operations

The Suzaku spacecraft was launched July 10, 2005, 1:30 UT, from Uchinoura Space Center (USC) in Japan. An ISAS M-V rocket placed Suzaku into an approximately circular orbit of inclination about 31 degrees at an altitude of about 550 km. Direct contact between the satellite and the ground station at USC is possible for five orbits per day. The XIS and HXD science instruments are expected to last about five years. Based upon an anticipated data rate of ~1.2 Gigabytes/day, the final mission archive will contain of order 2 Terabytes of raw data.

Suzaku operations are managed by Japanese astronomers and engineers at ISAS. They schedule observations, direct the satellite, collect the data, and monitor the health of the spacecraft and its payload. All data are copied and sent to the U.S. Suzaku Guest Observer Facility (GOF) at GSFC. There they are processed, distributed to U.S. Guest Observers, and archived.

1.2.3 Observing Time Allocation

The observing time allocation for Cycle 3 is as follows:

30 percent for U.S. investigations;
60 percent for Japanese investigations; and
10 percent for joint U.S./Japanese investigations.

1.2.4 General Observing Constraints

Cycle 3 of the Suzaku Guest Observer Program is anticipated to commence in April 2008. Proposals may be submitted only for projects that may be completed within a

period of one year; proposals for multiyear projects will not be considered under this solicitation. Investigators whose observing proposals are chosen will receive the data that result from their proposal in a form suitable for analysis. One year following the receipt of data by the PI, the data will be placed in a public archive for other interested investigators.

It is anticipated that Suzaku will typically perform one pointing every day or two. The number of pointings is limited by the long (up to one orbit) settling time required by the attitude control system after a maneuver to a new pointing position. In order to maintain a satellite observing efficiency around 50 percent, this means that the minimum allowable observing time on a particular target is 10,000 seconds. Proposals must take this into account and justify the need for an exposure of this (or longer) duration. In some well-justified circumstances, shorter observations (5,000-10,000 seconds) might be considered. Also, for targets having limited spatial extent (< 1 degree), it will be possible to specify a "raster" observation: multiple brief pointings at slightly offset locations. The total time on a specific region of sky must still exceed the minimum.

There are no restrictions regarding the amount of observing time or the number of targets requested in Guest Observer proposals. A proposal may be submitted for a single target with a relatively short observation time or for a larger program involving multiple targets or a greater amount of observing time. All proposals will be reviewed together in the same peer review, and it is expected that a mix of large, medium, and small programs will be selected. It is anticipated that about 70 investigations containing approximately 100 new observations will be selected from proposals received in response to this solicitation.

Time-critical observations, i.e., observations with scheduling constraints, impose a particular burden on Suzaku mission planning. (For further discussion of such observations, see the Suzaku Technical Description, Section 3, which is available from the Suzaku GOF at http://suzaku.gsfc.nasa.gov/). In particular, for "short-lived" phenomena, i.e., phenomena where timing within a spacecraft orbit matters, the ability to observe an event may only be assessed a few weeks prior to scheduling. Too many such time-critical observations would compromise the ability of the mission planning and operations team to effectively schedule the full set of requested observations. As all time-critical observations drive the scheduling process and, therefore, must receive highest scheduling and scientific priority, their total share must be kept relatively small. For Suzaku, time-critical observations must be accepted as priority A targets, which comprise 50% of the total available observing time. This includes both truly time-critical observations (observations requiring a specific day, such as coordinated observations) and less constrained time-critical observations (such as monitoring observations or those that require a specific orbital phase or roll angle).

We recognize the category of Target of Opportunity Observations (TOOs) of rapidly evolving phenomena whose occurrence is not predictable. Proposals for TOOs of specific targets are allowed for Suzaku, but not those of generic TOOs (e.g., "the next Galactic supernova"). Details regarding the circumstances in which a TOO is "triggered" must be included in the scientific justification and on the target form. TOO proposals must also include an estimated duration of the event, as well as an estimated probability

for triggering the observation; the latter will be used in the accounting of total allocated time. TOOs remain reserved only for the observing cycle in effect; TOOs not carried out during the current cycle may be reproposed for subsequent cycles. Data from preapproved TOOs will be proprietary to the Principal Investigator (PI) for one year. Note that a proposal may not include both TOOs and regular observations, even of the same object.

Additionally, a mechanism exists for requesting TOOs for cosmic objects or events unanticipated by any proposal. A small percentage of observing time (~5 percent) has been set aside for this. Data for such serendipitous TOOs will be placed immediately into the public archive. Further details about proposing for TOOs, both in response to this solicitation and for unanticipated events, can be found in the Suzaku Technical Description.

It is anticipated that investigations will be selected covering a variety of topics, including solar system objects, stars, x-ray binaries, supernova remnants, galaxies, clusters of galaxies, active galactic nuclei, and the x-ray background. Details about sources observed prior to Cycle 3, as well as tools for searching the observation database, are available from the Suzaku GOF homepage at http://suzaku.gsfc.nasa.gov/. Proposers should check whether their targets of interest have either been observed or are planned to be observed. If this is the case, the need for additional observations of those sources must be justified.

1.2.5 The U.S. Suzaku Guest Observer Facility

Telemetry converted to Flexible Image Transport System (FITS) format, together with satellite attitude and position information, will be sent from Japan to the Suzaku GOF at GSFC. The GOF will distribute the data electronically and support U.S. Guest Observers with their analysis of these data. The Suzaku GOF is a part of the Office of General Investigator Programs at the Astrophysics Science Division, NASA Goddard Space Flight Center, in Greenbelt, Maryland. The Suzaku GOF can also provide additional technical information if needed for the preparation of proposals. In addition, it receives, validates, and distributes data and calibrations; provides data analysis software; provides expert help and documentation; and creates the U.S. Suzaku archive.

2. Programmatic Information

2.1 Proposal Submission and Evaluation

NASA will review proposals for this program in a two-phase process. In Phase 1, proposals will be evaluated with respect to their intrinsic merit and relevance to NASA's objectives. Proposals recommended by the Phase 1 peer review panel will subsequently be considered by a joint Japanese/U.S. merging committee to eliminate duplication of targets submitted to both programs (see Section 2.1.3). Proposals selected in the Phase 1 review will be recommended for Suzaku observing time and become candidates for funding subject to the Phase 2 review process and the availability of program funds. The reasonableness and realism of the proposed cost of the investigation will be evaluated in the second phase.

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 deadline to the Web address given in this NRA's Summary of Solicitation. Note that a NOI submission is not required but is of considerable value in helping NASA plan for an expeditious peer review of proposals.

2.1.1 Who May Propose

The intent of this program is to enhance U.S.-Japanese scientific cooperation, in keeping with the bilateral agreement between the U.S. and Japan. Thus, only PIs affiliated with U.S. institutions and located in the U.S. are eligible to propose for Suzaku guest investigations through NASA. The requirement of affiliation with a U.S. institution does not extend to Co-Investigators. It is possible that some targets will be shared by U.S. and Japanese teams, but either a U.S. or a Japanese "Prime" PI will always be named.

A small amount of time will be reserved for joint U.S.-Japanese collaborative projects. This observing time will be used primarily to resolve conflicts between the U.S. and Japanese programs or assigned to proposals that exhibit a strong spirit of collaboration between U.S. and Japanese scientists. Individuals wishing to propose a joint U.S.-Japanese collaborative project may request time from either the U.S. or Japanese program. In all cases, proposals involving a U.S.-Japanese collaborative project to observe a common target (or set of targets) must be submitted to either the U.S. or Japanese program, depending upon the national affiliation of the identified PI. A consortium of investigators from the U.S. and Japan may choose to split a large observing program into two separate programs for submission to their respective agencies. In doing so they should also, in the spirit of the above rules, split their source lists; each individual proposal submitted to each agency must be capable of being evaluated on its own merit. The joint U.S.-Japanese observing time will be allocated during the merging of the Japanese and U.S. programs and will utilize proposals that have been highly ranked in the U.S. or Japanese peer reviews.

Following selection, the Suzaku mission timeline team will deal only with the person identified as the PI or lead Co-Investigator. It will be his/her duty to respond to any questions about detector usage or observational modes. In the event that the data are to be shared by U.S. and Japanese teams, it is expected that the respective PIs will consult regarding observing configuration issues, although a single primary PI will be designated as responsible for communicating with the mission planning team.

2.1.2 Submission of Phase 1 Proposals to the Suzaku Cycle 3 GO Program

Prospective proposers to the Suzaku GO Program must adhere to the following procedures for the submission of Phase 1 proposals:

- Complete and electronically submit all required forms at the Suzaku Web site at http://suzaku.gsfc.nasa.gov/. No hard copy submission is required. Note that the scientific justification must not exceed four pages, of which no more than three

may be devoted to proposal text, and no more than two to tables and figures. Proposals should include a description of the scientific objectives and a demonstration of the feasibility of the proposed observations and utilization of the unique capabilities of Suzaku for carrying out the investigation.

All electronic proposal materials must arrive at the above address by 4:30 p.m. Eastern time on the due date for this program given in Tables 2 and 3 of the *Summary of Solicitation* for this NRA in order to be included in the proposal review for this cycle of the Suzaku GI program. Note: The deadline of 4:30 p.m. on the due date replaces the deadline stated in the *Guidebook for Proposers* and in the *Summary of Solicitation* for this NRA.

Phase 1 proposals submitted to the Suzaku Cycle 3 Guest Observer Program may not be submitted via NSPIRES or via Grants.gov.

2.1.3 Evaluation and Selection of Phase 1 Proposals

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* (excluding cost), where it is understood that the intrinsic merit of a proposal shall include the following factors:

- The suitability of using the Suzaku observatory and data products for the proposed investigation;
- The degree to which the investigation uses Suzaku'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 Suzaku's observational constraints; and
- The feasibility and suitability of the proposed analysis techniques.

There are two steps in the evaluation of Suzaku observation (Phase 1) proposals submitted in response to this Announcement. First, a NASA peer panel will review them according to the specified evaluation criteria. Second, a Japanese/U.S. merging committee, comprised of members of the U.S. and Japanese Suzaku Project team and representatives of the U.S. Guest Observer community (selected from the NASA peer panel), will eliminate the duplication between targets submitted to the U.S. and Japanese programs.

The task of the Suzaku merging committee is to integrate the two national observing proposal sets into the observing program. This observing program should be devoid of unnecessary duplications among the nationally defined observing programs. Selections made between overlapping proposals will use the priorities assigned by the NASA and Japanese review committees.

A substantial oversubscription of Suzaku observing time is expected. With the above process, most of the reduction in the oversubscription will occur at the national level of proposal review. The most important criterion for the assessment by the national proposal

evaluation committees is the scientific merit of the proposed research. However, the factors cited above including the feasibility of the proposed observations, as well as observational constraints that may overburden Suzaku mission planning, will also be taken into account in the final selections.

2.1.4 Submission and Evaluation of Phase 2 Proposals

Subject to the availability of funding, successful Phase 1 proposers will be contacted by the Suzaku Program Officer and invited to submit a Phase 2 proposal, including a cost proposal for evaluation during 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, including budget (not to exceed one year in duration), received in the selection notification from the Phase 1 review. Phase 2 proposals must be submitted through NSPIRES or Grants.gov by an Authorized Organizational Representative (AOR) of the proposing organization.
- As part of the Phase 2 proposal, investigators may request support for correlative observations at other wavelengths, providing that they were proposed and accepted as part of the Phase 1 proposal. Funding for such correlative studies will be considered only insofar as they directly support a specific investigation using Suzaku.

A review team comprised of a subset of the Phase 1 peer evaluation panel will be convened by NASA to review the Phase 2 cost proposals against the third evaluation criterion, cost realism and cost reasonableness. Comparison of the proposed cost to available funds will be performed by NASA program personnel, as specified in Section C.2 of the *NASA Guidebook for Proposers.*

2.2 Supplemental Information

2.2.1 Available Funding

A total of about $1M is tentatively planned for the support of approximately 30 Suzaku Cycle 3 investigations of one-year duration each. The actual amount of funding available for the support of Cycle 3 Guest Observers will be announced at the time of solicitation of Phase 2 proposals.

2.2.2 Sources of Further Information

Further details of the proposal submission requirements and process may be found at the Suzaku GOF homepage at http://suzaku.gsfc.nasa.gov/. The Suzaku GOF homepage includes a detailed mission description; technical information about the Suzaku mission, instruments, and feasibility; detailed information regarding proposal submission, evaluation, selection, and implementation; and instructions for completing the required proposal forms.

Technical questions concerning this program element may be directed to Dr. Koji Mukai of the Suzaku Guest Observer Facility. Programmatic information may be obtained from the Suzaku Program Officer, Dr. Wilton T. Sanders of NASA Headquarters. Contact information for may be found in Section 2.3.

2.3 Summary of Key Information

Expected annual program budget for new awards	$1M
Number of investigations selected for observations	About 70 investigations containing approximately 100 new observations
Number of funded awards pending adequate proposals of merit	Approximately 30
Maximum duration of awards	1 year
Due Date for Notice of Intent to Propose	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA.
Due Date for electronic submission of proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA. Note: Proposals are due by 4:30 p.m. Eastern time on the due date.
NASA Strategic Objectives to which proposals must state and demonstrate relevance	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
General information and overview of this solicitation	See *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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/ and the Suzaku GOF homepage at http://suzaku.gsfc.nasa.gov/
Page limit for the central Science-Technical-Management section of Phase 1 proposal	4 pp (this supersedes the 15-page length limit given in the *NASA Guidebook for Proposers*)
Submission medium and number of copies	Electronic proposals only; see Section 2.1.2
Web site for submission of Phase 1 proposal and required forms	http://suzaku.gsfc.nasa.gov/ (help desk available at http://heasarc.gsfc.nasa.gov/cgi-bin/Feedback)
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 Suzaku Program Officer	Dr. Wilton T. Sanders Astrophysics Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-1319 Email: Wilton.T.Sanders@nasa.gov
Technical questions concerning this program element may be directed to the Suzaku Guest Observer Facility	Dr. Koji Mukai Suzaku Guest Observer Facility Code 662 Building 2, Room W020M Goddard Space Flight Center National Aeronautics and Space Administration Greenbelt, MD 20771-0001 Telephone: (301) 286-9447 E-mail: mukai@milkyway.gsfc.nasa.gov

D.9 GLAST GUEST INVESTIGATOR – CYCLE 1

1. Scope of Program

1.1 Overview

The Gamma-Ray Large Area Space Telescope (GLAST) Guest Investigator (GI) program solicits proposals for basic research relevant to the GLAST 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 obtained by earlier space missions. A secondary goal includes the study of transient gamma-ray sources with energies extending from 10 keV up to 300 GeV.

The GLAST GI program is intended to encourage scientific participation by providing funding to carry out investigations using GLAST data to conduct correlative observations at other wavelengths, to develop data analysis techniques applicable to the GLAST data, and to carry out theoretical investigations in support of GLAST observations.

The GLAST GI program is open to all investigators, but NASA funding is available only to investigators at U.S. institutions.

During this first Cycle of the GI program, event data from the primary instrument, the Large Area Telescope (LAT), will be proprietary to the LAT instrument team. However, summary LAT data, such as energy-binned light curves from ~20 strong gamma-ray sources and information about new transients, will be made public during Cycle 1. During subsequent Cycles of the GI program, all processed LAT data, including those from Cycle 1, will be public. Gamma-ray burst observations by the GLAST Burst Monitor (GBM) will be public throughout the mission, including Cycle 1.

A GLAST Fellows program will be solicited separately in a forthcoming announcement.

1.2 The GLAST Mission

GLAST is an international and multiagency observatory-class mission that will study the cosmos in the 10 keV to >300 GeV energy range. The primary instrument, the Large Area Telescope (LAT), will have a peak effective area (>8000 cm^2), angular resolution (<3.5º at 100 MeV, <0.15º above 10GeV), field of view (>2 sr), and deadtime (<100μs per event) that will provide a factor of 30 or more advance in sensitivity compared to previous missions. The GLAST Burst Monitor (GBM) will also provide 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 10 keV. Although pointed observations will be possible, the observatory will primarily scan the sky continuously because of the LAT's large field-of-view; this survey mode is planned for GLAST's first year. A more complete description of GLAST can be found at http://glast.gsfc.nasa.gov/ssc/proposals/manual/.

The product of a NASA/U.S. Department of Energy/international collaboration, the LAT builds on the success of the Energetic Gamma-Ray Experiment Telescope (EGRET) on

the Compton Gamma-Ray Observatory (CGRO). The LAT is a pair-conversion telescope: gamma rays pair-produce in tungsten foils, silicon strip detectors track the resulting pairs, the resulting particle shower deposits energy in a CsI calorimeter, and 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 EGRET.

Astrophysical photons will be only a small fraction of all the events detected by the LAT on orbit; most events will be primary cosmic rays and their associated secondary charged and neutral particles produced in the surrounding spacecraft and the Earth atmosphere. Therefore, event filtering on board will reduce the ~4 kHz detected event rate to ~300 Hz that will be telemetered to the ground. Further ground processing is expected to yield a "true" celestial photon average rate of about 1 to 2 Hz.

Much like the CGRO Burst and Transient Source Experiment (BATSE), the GBM will detect gamma-ray bursts. Consisting of 12 NaI(*Tl*) (10-1000 keV) and 2 BGO (0.15-25 MeV) detectors, the GBM will extend GLAST's burst spectral sensitivity to the ~10 keV to ~25 MeV band and will monitor more than 8 sr of the sky, including the LAT's field-of-view. Bursts above a fluence of ~10 photons cm^{-2} will be localized to ~3°, by comparing the rates in different detectors, and will be rapidly disseminated. The GBM will trigger if the rates in two or more detectors increase by 4.5σ. The onboard trigger will be a flux of about 0.7 photons cm^{-2} s^{-1} (50 to 300 keV band), for a 1-second burst, and will use a variety of energy band and time windows.

The current expectation is that GLAST will be launched in November 2007, into an initial orbit of ~565 km altitude at an anticipated inclination in the range 25° to 28.5° and an eccentricity <0.01. The mission design lifetime is 5 years, with a goal of 10 years. Science operations and Cycle 1 will begin after a ~60 day checkout period.

The GI community is supported by the GLAST Science Support Center (GSSC), 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 GSSC (see http://glast.gsfc.nasa.gov/ssc/).

1.3 Types of Proposals

The Cycle 1 GLAST GI program solicits proposals in the following areas:

- Analysis using any of the data released during Cycle 1, including correlative multiwavelength observations with other instruments and observatories that are directly relevant to GLAST science objectives; a GLAST Users Committee statement about the importance of such observations is posted at http://glast.gsfc.nasa.gov/ssc/resources/multi/;
- The analysis of burst data from the GBM;
- Development of data analysis techniques applicable to the data provided by the GLAST instruments (for a list of tools and techniques provided or under

development by the GSSC, see http://glast.gsfc.nasa.gov/ssc/data/analysis/SAE_overview.html); and

- Theoretical investigations that will advance the mission science return of GLAST. (Up to 10% of GLAST GI funding may be devoted to such theoretical efforts.)

GIs may propose GLAST investigations that avoid duplication of the two main goals of the LAT science team: (1) development of event-reconstruction and background-rejection techniques and (2) production of a catalog of gamma-ray sources. The extent to which the proposed research will enhance the science return from GLAST will be considered in the proposal evaluation process (see Section 2.2 below).

Because correlative observations will substantially augment the science return from GLAST, such proposals are encouraged. Examples of correlative observations that will add significantly to the GLAST science include monitoring of blazars, follow-up observations of gamma-ray burst afterglows, and determination of pulsar ephemeredes. During Cycle 1 the LAT instrument team will post the light curves (including spectral information) of ~20 pre-selected sources (see http://glast.gsfc.nasa.gov/ssc/data/policy/LAT_Monitored_Sources.html), will announce the discovery of bright transients, and will provide light curves and locations for these sources.

The GBM will provide event lists accumulated during the burst, permitting both temporal and spectral studies. In addition, background count rates with differing temporal and spectral resolution will also be available, enabling background studies and source detection through occultation steps.

New data analysis techniques that will maximize the mission's scientific yield are also encouraged. While the GLAST mission will provide a basic set of analysis tools applicable to the GLAST data, specialized techniques might address such specific scientific issues as blind pulsar period searches, the discovery of faint transients, and the detection of sources through occultation steps in the GBM background light curves. GI proposals for new data analysis techniques are solicited and should specifically address how the proposed techniques will advance GLAST science objectives. Because LAT event data will not be public until the start of Cycle 2, techniques that cannot be developed without access to such data are not solicited during Cycle 1. The policy and procedures governing the release of GLAST data are available at http://glast.gsfc.nasa.gov/ssc/data/policy/.

Finally, theoretical studies related to the observations conducted with GLAST 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 GLAST science objectives.

In Cycle 1 there will be two proposal classes: (1) Regular proposals with research plans that can be completed in one year and (2) Large proposals whose research plans are more expansive and may take up to three years to complete. The number of Large projects funded, and corresponding budgets awarded in any given year, will be limited. Large

projects will be reviewed each year to determine if appropriate progress is being made toward the proposed objectives. Because of the significant resources that are allocated to Large projects, those that do not make progress consistent with the proposed investigation may be reduced or terminated. In order to permit annual evaluation, PIs of approved Large projects must submit a progress report annually on the Phase 1 proposal due date rather than on the anniversary of the award date.

2. Programmatic Information

2.1 General Information

It is anticipated that approximately $4 M will be available through this solicitation for the support of approximately 40-50 Guest Investigations of one-year duration each and up to ~4 Large projects. GLAST GI funding is open to all individuals employed at U.S. institutions, including GLAST science team members. GLAST science team members include the members of the two instrument teams, the staff of the GLAST Science Support Center, and the Interdisciplinary Scientists. GLAST science team members already receiving support from the Project are eligible for support, although such individuals must provide a compelling justification for the award of additional funds under the GI Program and cannot base their proposed research on access to proprietary GLAST data. Finally, pending the receipt of sufficient proposals of merit, it is the intent of this program that a majority of available GI funding be awarded to proposers not already formally associated with GLAST.

2.2 Proposal Submission and Evaluation

2.2.1 Submission of Phase 1 Proposals to the GLAST GI Program

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 deadline to the Web address given in this NRA's *Summary of Solicitation*. Note that an NOI submission is not required but is of considerable value in helping NASA plan for an expeditious peer review of proposals.

The GLAST GI program will use a two-phase proposal process. The first phase will be the submission and evaluation of the science/technical justification, together with a brief management section that includes a budget cap (as described below) and a corresponding basis for this estimate. In the second phase only proposers whose science/technical justifications are accepted will submit budget proposals. All proposal materials will be submitted electronically.

Each proposer who anticipates requesting funding must provide a “budget cap”, i.e., an approximate estimate of the total cost to NASA (including overhead) of his/her proposed investigation. This budget cap will be used in gauging the potential total cost to NASA of the selected proposals. A more detailed cost evaluation will be deferred until Phase 2. The amount requested in the Phase 2 cost proposal may not exceed this cap. A box for entering the budget cap is provided on the Remote Proposal System (RPS) Cover Form.

Prospective proposers to the GLAST GI Program must adhere to the following procedures for the submission of proposals:

- Proposers will submit their Phase 1 proposals (excluding budgets) electronically through the RPS website at: http://heasarc.gsfc.nasa.gov/akbar/rps/. Instructions for doing so are provided at the GSSC web site at: http://glast.gsfc.nasa.gov/ssc/proposals/.
- Target lists are submitted through the RPS form. All sources that will be analyzed, whether using GLAST data or correlated multiwavelength observations, must be included in the target list.
- Due to the nature of prospective investigations within the GLAST GI program, the Scientific/Technical/Management section of proposals is limited to 4 pages, instead of the default 15 pages specified in the *NASA Guidebook for Proposers*. The requirement of 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 *Summary of Solicitation* to this NRA in order to be included in the proposal review for this cycle of the GLAST Guest Investigator program. Note: The deadline of 4:30 p.m. on the due date replaces the deadline stated in the *Guidebook for Proposers* and in the *Summary of Solicitation* for this NRA.

NASA uses a single, uniform set of instructions for the submission of proposals submitted in response to a NASA Research Announcement such as ROSES. This material is contained in the *NASA Guidebook for Proposers* (http://www.hq.nasa.gov/office/procurement/nraguidebook/). Proposers should follow these instructions, except as otherwise stated in this program element or in the *Summary of Solicitation*.

2.2.2 Evaluation of Phase 1 Proposals submitted to the GLAST 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 GLAST observatory and data products for the proposed investigation;
- The extent to which the investigation enhances the anticipated science return from the GLAST mission; and
- The degree to which the proposed investigation places demands upon mission resources.

It is understood that the relevance of a proposal shall include the following factors:

- The extent to which the investigation supports NASA's Strategic Goals and Outcomes (see Table 1 of the *Summary of Solicitation*); and
- For data analysis development and theoretical investigations, the degree to which the investigation directly advances GLAST 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 GLAST Program Officer and invited to submit a Phase 2 proposal, including a cost proposal for evaluation during 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, including budget, received in the selection notification from the Phase 1 review. Proposers whose Scientific/Technical/Management Phase 1 proposals are tentatively accepted will submit their Phase 2 proposals including budgets through the NASA NSPIRES electronic proposal website (http://nspires.nasaprs.com/) or through Grants.gov (http://grants.gov) following the instructions in the *Summary of Solicitation* of this NRA. Budget Details are limited to 2 pages plus a 1-page Narrative section. Phase 2 proposals must be submitted through NSPIRES or Grants.gov by an Authorized Organizational Representative (AOR) of the proposing organization.

A review team comprised of a subset of the Phase 1 peer evaluation panel will be convened by NASA to review the Phase 2 cost proposals against the third evaluation criterion, cost realism and cost reasonableness. Comparison of the proposed cost to available funds will be performed by NASA program personnel, as specified in Section C.2 of the *NASA Guidebook for Proposers.*

2.3 Supplemental Information

Further details of the proposal submission requirements and process may be found at the GLAST Science Center Web site http://glast.gsfc.nasa.gov/ssc/, which includes a detailed mission description; technical information about the GLAST mission, instruments, and feasibility; information regarding proposal submission; and instructions for completing the required proposal forms.

Technical questions concerning this program element may be directed to the GLAST Science Support Center:

Dr. David L. Band
GLAST Guest Investigator Program
Code 661
Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, MD 20771-0001
Telephone: (301) 286-5439
Help Desk: http://glast.gsfc.nasa.gov/ssc/help/

Programmatic information may be obtained from the GLAST Program Scientist:

Dr. F. Rick Harnden
Astrophysics Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone: (202) 358-3809
E-mail: Frank.R.Harnden@nasa.gov

3. Summary of Key Information

Expected annual program budget for new awards.	$4 M (This might permit, for example, the selection of 40 Regular proposals with average awards of $80K, together with 4 Large proposals with average awards of $200K.)
Number of new awards pending adequate proposals of merit	~40 Regular proposals; ~4 Large proposals
Maximum duration of awards	1 year
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. Note: Proposals are due by 4:30 p.m. Eastern time on the due date.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or research objective(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Page limit for the central Science-Technical-Management section of Phase 1 proposal	4 pp; note this difference from Chapter 2 of the *NASA Guidebook for Proposers*
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 Phase 1 proposal and required forms:	http://glast.gsfc.nasa.gov/ssc/proposals/ (Help Desk available at: http://heasarc.gsfc.nasa.gov/akbar/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
GLAST Science Support Center helpdesk	http://glast.gsfc.nasa.gov/ssc/help/
Programmatic information may be obtained from the GLAST Program Officer	Dr. F. Rick Harnden Astrophysics Division Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-3809 E-mail: Frank.R.Harnden@nasa.gov
Technical questions concerning this program element may be directed to the GLAST Science Support Center	Dr. David L. Band GLAST Guest Investigator Program Code 661 Goddard Space Flight Center National Aeronautics and Space Administration Greenbelt, MD 20771-0001 Telephone: (301) 286-5439 Help Desk: http://glast.gsfc.nasa.gov/ssc/help/
Questions concerning GLAST capabilities may be directed to the GLAST Project Scientist.	Dr. Steven Ritz Mail Code 661 NASA Goddard Space Flight Center Greenbelt, MD 20771 Telephone: 301-286-0941 Email: steven.m.ritz@nasa.gov

D.10 KEPLER MISSION PARTICIPATING SCIENTISTS

1. Description of the Opportunity

1.1 Proposal Opportunity

This program element solicits proposals for Kepler Participating Scientists (PSs). Kepler PSs will serve as members of the Kepler Science Team and will participate in Kepler Science Team activities such as data analysis, archiving, and publication.

A separate opportunity to select targets of general astrophysical interest in the Kepler field-of-view (FOV), or to acquire data for stars which are not part of the Kepler monitoring program, will be openly solicited as a Guest Observer (GO) program in 2008, before launch.

1.2 The Kepler Mission

The Kepler mission will be the tenth mission to be launched under NASA's Discovery Program. The Discovery Program provides planetary and planet-searching communities frequent access to space for modest but scientifically meritorious and focused missions lead by a Principal Investigator (PI). The Kepler PI is William Borucki of NASA's Ames Research Center.

In its four-year prime mission beginning upon launch in November 2008, Kepler will continuously monitor over 100,000 stars in a ~100 square degree FOV in the Cygnus region (RA $19^h\ 22^m\ 40^s$, Dec. 44° 30' 00"). The majority of these stars will be of spectral type F5 and later, while the remaining targets will consist of earlier dwarfs and giants. The mission will achieve a photometric precision of 20 parts-per-million (ppm) on a m_v=12 magnitude G2V star, for a 6.5-hour integration and using differential ensemble processing. All observations will have at least a 30-minute temporal resolution. A smaller number of observations will be monitored at a one-minute cadence to better resolve transits and to allow stellar acoustic (p-mode) measurements.

The nominal magnitude range of Kepler is between 9th and 15th apparent visual magnitude. Photometry will be taken through a broad bandpass ranging from 430 to 890 nm. There are neither changeable filters nor dispersing elements. Because of a very stable focal plane, a precision better than 1 milliarcsecond over periods up to three months is expected for relative star centroid positions.

The primary scientific objectives of the Kepler mission are to:

- Provide a statistically significant value for the frequency of Earth-size and larger planets in and near the habitable zone;
- Characterize the size and orbital distributions of such planets; and
- Identify correlations between the presence and characteristics of planetary systems with stellar properties of the host star.

A detailed discussion of the Kepler mission and its scientific objectives can be found at http://kepler.nasa.gov/. Background information on NASA's Discovery Program is available at http://discovery.nasa.gov/.

1.3 Kepler Science Team Activities

The mission-related activities of the existing 30-member Kepler science team are organized into five discipline groups: (1) Asteroseismology, (2) Transit follow-up observations, (3) Planetary system characterization, (4) Astrometry, and (5) Analysis algorithm development.

Research activities currently tasked by Science Team members are listed below:

- Asteroseismology

For the several thousand stars to be monitored that are 12th magnitude and brighter, observations at a one-minute cadence will be used to detect acoustic oscillations, which will be used to:

- Accurately determine the size and mass of the star; and
- Determine the size of the planet and its semi-major axis.

- Transit Follow-up Program

False positive elimination is needed to provide a valid estimate of the frequency of planets and their characteristics. To eliminate statistical false positives in the pipeline processing, the Science Team plans to:

- Verify that the transit parameters such as the duration, shape, and repeatability are consistent with a planet orbiting a star having the measured characteristics of the target star; and
- Check that the movement of the star centroid is consistent with a transit of the target star rather than the effects of a background eclipsing binary.

Additionally, radial velocity (RV) measurements are planned which will:

- Identify small stellar companions ; and
- Verify the association of the transit with the target star through observation of the Rossiter-McLaughlin effect.

- Characterization of Discovered Planets

The Kepler team will use mission results to determine the size, orbital period, semi-major axis, position relative to the habitable zone (HZ), mass, presence of moons and/or atmospheres, frequency, and association with stellar properties. The utilization of the following specific techniques to accomplish these goals is planned as part of the Science Team activities:

- Kepler photometry will be used to search for planet transits;
- High-precision, ground- and space-based RV observations will determine masses;
- Reflected light observations of short-period giant planets will be used for albedo;
- Measurements and the determination of the presence of an atmosphere; and
- Multiband photometry, astrometry, spectroscopy, and RV techniques will be utilized to deduce the properties of both the stars and planets.

- Astrometry
  - Centroid motion will be used to determine if the transit is associated with a background star; and
  - Long-term motion of the centroids will be used to measure parallax and thus the distance to each target.

- Development of an Automated Pipeline

An automated pipeline has been constructed, tested, and validated to:

- Search for planets by detecting patterns of transits in the Kepler photometry data;
- Search for planets by reflected light; and
- Archive the data at the Space Telescope Science Institute (STScI).

2. Role of Participating Scientists

In addition to conducting science investigations addressing the broad science goals of the mission, based on the nature of their proposals, Kepler PSs will also join one or more of the Kepler discipline groups as new Kepler Science Team members. The selected PSs will coordinate their activities and analyses with the Mission PI and Co-Investigators (Co-Is) and NASA Program Scientist, and they will be bound by team agreements.

The proposed investigations can be analytical, observational, or theoretical in nature. Investigations may involve preparation for launch, participation in the observing program, and/or follow-up investigations. Proposals should include investigations that:

- Are directly related to the detection, characterization, or understanding of extrasolar planets;
- Provide added value to the science investigations currently planned by the Kepler Science Team; and
- Complement but are not redundant with investigations planned or currently in progress by current Science Team members as listed in Section 1.3 above.

Examples of appropriate analytic programs include:

- Detection of nontransiting planets by timing of the variations of the transit epochs;
- Improvement of stellar atmosphere models through the use of Kepler observations of eclipsing binary stars; and
- Estimates of the sizes of stars, and, therefore, the sizes of transiting planets, through the application of stellar atmosphere models.

Examples of possible ground-based observational programs include:

- Determination of the multiplicity of stars with planets, especially those with stellar orbital periods exceeding one year and with mass ratios of five or more; and

- Elimination of false positive planet detections caused by very close background eclipsing binaries using ground-based color photometry of the transits.

3. Programmatic Information

3.1 Period of Performance and Availability of Funds

Proposers should provide budgets and justification for participation in the Kepler mission as PSs with a period of performance beginning on October 1, 2007. This start date is contingent on funding being available. It is expected that most investigators will propose for the maximum three years. A second Kepler PS Program (PSP) open competition for three-year funding is planned for 2010. If selected in both competitions, a PS could participate through the prime mission phase plus an additional year (potentially through October 1, 2013).

It is anticipated that approximately $1.0M will be available through this solicitation for the support of approximately 7-10 PS investigations per year. Because PS 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 renewal 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 mission; and
- Reasonableness and realism of identified key projected milestones, accomplishments, and deliverables during each year of the proposed investigation.

Based upon the results of the proposal review, the Kepler Program Scientist identified in Section 4 will recommend a set of proposals to the Selecting Official for selection.

3.4 Eligibility

Application to the Kepler PSs program is open to all investigators. Kepler Science Team members who wish to submit a proposal in response to this solicitation must provide a compelling justification for the request of additional funds under the PSP and must clearly state how the proposed research is distinct from their funded Science Team activities.

3.5 Guidelines for Non-U.S. Proposals

NASA welcomes proposals from outside the U.S. but generally on a no-exchange-of-funds basis. All proposals from non-U.S. participants must be compliant with the policies stated in the *NASA Guidebook for Proposers* (see Section 1.6), including the requirement that they must be endorsed by the respective government agency or funding/sponsoring institution for the entire period of performance of the proposed investigation.

3.6 Awards

Kepler PS proposal selections will be funded as three-year awards, with an additional three years possible if a successor proposal is selected in the second Kepler PS competition.

Selection of Kepler Participating Scientists investigations is the responsibility of the Astrophysics Division, Science Mission Directorate, NASA Headquarters. NASA Headquarters will be responsible for the evaluation and selection process associated with this solicitation.

The Kepler Science team is managed by the PI at NASA's Ames Research Center (ARC). It is the ARC Kepler Project's responsibility to provide the science interface to the investigation teams.

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)	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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-KPS
NASA point of contact concerning this program	Dr. Pamela M. Marcum Kepler Program Scientist Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0377 E-mail: Pamela.M.Marcum@nasa.gov

APPENDIX E: CROSS-DIVISION RESEARCH PROGRAM

E.1 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 *Summary of Solicitation* of this NRA. 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 only two such programs:

The Applied Information Systems Research (AISR) program (Appendix E.2) seeks innovative ideas for applying advances in information science and technology to increase productivity of SMD research endeavors in Earth Science, Heliophysics, Planetary Science, and/or Astrophysics.

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.

Any other multidisciplinary programs that are defined during calendar year 2007 will be issued as amendments to this NRA, 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 APPLIED INFORMATION SYSTEMS RESEARCH

NOTE: The following text is a DRAFT description of the Applied Information Systems Research Program based on the 2006 solicitation. The revised description is expected to be posted in final form by the fall of 2007 upon completion of a steering group assessment. The final version of this program will be posted as an amendment to this NRA at least 90 days in advance of its proposal due date. Until August 30, 2007, comments or suggestions on this draft version are welcome and may be directed to the Program Officer at the address given below.

1. Scope of Program

The purpose of the Applied Information Systems Research (AISR) Program is to employ advances in information science and technology to enhance science productivity of the Science Mission Directorate (SMD). AISR seeks innovative ideas for applying advances in information science and technology to increase life-cycle effectiveness and efficiency of research endeavors conducted by SMD research programs in Planetary Science, Heliophysics, Astrophysics, and Earth Science.

AISR provides practical application of emerging information technologies, concepts, methodologies, etc. to demonstrate their feasibility and potential to increase science return, as well as to inform missions and research disciplines of promising techniques and capabilities worthy of broader application and/or further development through full maturity.

The specific goals of the AISR Program are to:

- Investigate novel information technologies and computational methods that have the potential to increase productivity of the SMD research endeavors and that would extend the state-of-the-practice in those endeavors;
- Demonstrate the degree of relevance, applicability, and potential impact of emerging information technologies to SMD missions and programs; and
- Foster interdisciplinary collaborations that span the space science, Earth science, and computer science disciplines.

The AISR Program seeks innovative adaptations of advances in information science and technology to enrich the NASA science environment. It is not intended for basic computer science research or for low-level technology developments, but rather for experimental application of such advances as an entrée for early exposure in the NASA science environment.

The AISR Program is intended to allow SMD to be an early, innovative, and a less risk-averse adopter of advanced information technologies and capabilities, especially in areas with potential for high payoff if successful. Typically, NASA science disciplines and/or

missions are unwilling to take chances and invest in unproven technologies, and AISR serves as an incubator to mitigate risks and inform potential beneficiaries for subsequent infusion within NASA.

Notional areas of interest for proposals to this program include, but are not limited to:

- Reduce mission development time, risk, and cost through, for example, advanced simulation and design capabilities;
- Increase mission duration and reliability through, for example, autonomous operations and control, improved dynamic scheduling, fault tolerant and/or adaptable computing, etc.;
- Increase data return through, for example, onboard science autonomy and intelligent compression;
- Increase science return from the data and enable qualitatively new science through, for example, advanced knowledge discovery, data synthesis, and data presentation methodologies; distributed and heterogeneous, interdisciplinary collaborative frameworks; intelligent knowledge-building systems to assist scientific research and applications; etc.; and/or
- Deploy enhancements to persistent software tools and environments that assist the productivity of the scientific users of high-end computing resources.

The first four areas of interest roughly frame the possibilities in terms of the science life cycle. The fifth area of interest targets a specific application domain for consideration, and affords an opportunity to align with and complement the NASA High-End Computing Program support for scientific modeling and analysis.

Background information and abstracts for current investigations in the AISR Program can be found online at http://aisrp.nasa.gov.

2. Programmatic Information

2.1 Period of Performance and Available Funding

Periods of performance from one to three years may be proposed. It is expected that approximately $TBD per year will be available to support on the order of TBD new investigations selected through this solicitation.

2.2 Access to High Performance Computing

Those investigators whose research requires access to 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 apply for computing resources on either of two NASA computing facilities and instructions for including a description of the need and rationale for such resources in the originating proposal.

2.3 Evaluation of Proposals

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:

- Clear objectives for the investigation and clear description of the capabilities expected to result, how it will extend the state-of-technology, what is novel about the investigation, what is the technical likelihood for success;
- Compelling justification demonstrating the relevance and importance to NASA science research and the generality of the benefits likely to accrue across a broad set of NASA science requirements;
- Quality and suitability of the work plan and schedule, including task break-down, staffing, and other resources; and
- Success criteria for the investigation and plans and for infusing the results into NASA missions and research programs.

2.4 Programmatic Requirements

Proposals should compare and contrast methods and techniques with existing techniques, including those being developed in ongoing AISR investigations. If a proposal is itself based on a previously funded AISR effort, the proposal should identify that work, clearly summarize significant results from it, and demonstrate how the proposed effort is unique and/or extends the capability.

The tools and capabilities resulting from AISR investigations are expected to be available for open use as Web-based or downloadable applications and/or as available source code. Plans for migration into a persistent software framework or infrastructure for ongoing maintenance and user support should be identified. Proposals should discuss plans for this, even if the project is not expected to reach that level of maturity in the term of the award.

The AISR Program strives to foster collaboration and communication amongst its investigators, as well as with other related and/or potentially benefiting SMD programs. An annual investigator workshop is held to share results and exchange ideas, and to inform science disciplines of the status of the investigations. Investigators are expected to participate in these workshops. Investigators are also expected to participate in electronic-based discussions on an ongoing basis, including topical and/or “birds of a feather” sessions and technical exchanges.

The program will attempt to identify overlapping proposals within AISR and with other programs and will encourage direct collaborations between such efforts. Proposers are encouraged to identify such possibilities.

2.5 Reporting Requirements

Reporting requirements over the course of the award period include:

- An Entry Quad chart, which gives general information about the research effort,
- Annual Reports, due prior to the award anniversary date, and
- A Final Report upon completion of the period of performance.

Report formats and instructions will be made available at a designated Web site.

3. Summary of Key Information

Expected annual program budget for new awards.	TBD
Number of new awards pending adequate proposals of merit	TBD
Maximum duration of awards	3 years
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.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-AISR
NASA points of contact concerning this program	Mr. Joseph H. Bredekamp Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-2348 E-mail: joe.bredekamp@nasa.gov Dr. Tsengdar J. Lee Science Mission Directorate National Aeronautics and Space Administration Washington, DC 20546-0001 Telephone: (202) 358-0860 E-mail: tsengdar.j.lee@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 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:

- Investigations to detect and characterize extra-solar planets;
- Observations related to the formation and evolution of planetary systems;
- Theoretical investigations related to the formation and evolution of planetary systems; and
- Studies of chemical and atomic processes related to the formation of planetary systems.

This Origins of Solar Systems program realizes the existing potential for complementary interdisciplinary efforts to solve key scientific questions. To achieve this goal, proposals are encouraged that involve joint research efforts by investigators from different scientific communities, for example, 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.

Proposals for topical conferences, workshops, symposia, or other new initiatives related to the Origins of Solar Systems program are also solicited through this program element. 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.

2. Programmatic Information

2.1 Coordination with Astrophysics Research Programs

Approximately one fourth of the Origins of Solar Systems program supports searches for extrasolar planets. For administrative purposes, the search for extrasolar planet investigations will be managed by the Astrophysics Research Program. The remainder of

the Origins of Solar Systems program will be managed by the Planetary Science Research Program.

2.2 Additional Funding for Relevant Instrumentation

The Planetary Major Equipment 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. New analytical instrumentation requests, as well as requests for upgrades to existing instruments costing more than $25,000, should be identified and requested in a special section of each proposal, to be titled "Major Equipment Request." However, note that a Planetary Major Equipment proposal must be affiliated with a “parent” research proposal in order to be considered; see Appendix C.23 for details.

2.3 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 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.

2.4 Selecting Official

The Selecting Official for investigations that are managed by the Planetary Science Division is the Director of the Planetary Science Division. The Selecting Official for investigations that are managed by the Astrophysics Division is the Director of the Astrophysics Division.

2.5 Summary of Key Information

Expected annual program budget for new awards	~ $2.0M
Number of new awards pending adequate proposals of merit	~ 20-30
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	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.

NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the *Summary of Solicitation* of this NRA.
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 – 2007* 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. 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	NNH07ZDA001N-SSO
NASA point of contact concerning this program	Dr. David J. Lindstrom Planetary Science Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0311 E-mail: David.Lindstrom@nasa.gov