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 – 2005 (ROSES-2005)

NASA RESEARCH ANNOUNCEMENT (NRA)
SOLICITING BASIC AND APPLIED RESEARCH PROPOSALS

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CATALOG OF FEDERAL DOMESTIC ASSISTANCE (CFDA) NUMBER: 00.000

ISSUED: JANUARY 28, 2005

PROPOSALS DUE
STARTING APRIL 8, 2005
THROUGH MARCH 17, 2006

SYNOPSIS

This NASA Research Announcement (NRA), entitled *Research Opportunities in Space and Earth Sciences (ROSES) – 2005*, solicits basic and applied research in support of the Science Mission Directorate (SMD), National Aeronautics and Space Administration (NASA). (Note: In August 2004, the SMD was formed by merging the previously separate Office of Earth Science and Office of Space Science). 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 lab analysis of both extraterrestrial samples returned by spacecraft as well as terrestrial samples that support or otherwise help verify observations from SMD Earth science space 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; and the 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 over 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-Government 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 nonprofit, 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 programs involving non-U.S. participants will be conducted on the basis of no exchange of funds. Any changes or modifications to any of these guidelines will be discussions of the relevant programs in Appendices A, B, C, or D of this solicitation

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

Details of the solicited programs are given in Appendices A, B, C, and D of this NRA. Proposal due dates are given in its *Summary of Solicitation*. Interested proposers should monitor the Web address http://nspires.nasaprs.com for this solicitation for additional new programs or amendments through January 2006, at which time a subsequent ROSES NRA is planned for release.

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RESEARCH OPPORTUNITIES IN SPACE AND EARTH SCIENCES (ROSES) – 2005

SUMMARY OF SOLICITATION

I. FUNDING OPPORTUNITY DESCRIPTION

(a) Introduction and Background

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

To improve life here, to extend life to there, and to find life beyond,

and its Mission,

To understand and protect our home planet,
To explore the Universe and search for life, and
To inspire the next generation of explorers
…as only NASA can,

allow the science objectives of the NASA Science Mission Directorate[1] to be clearly defined as the orderly pursuit of the agency's strategic goals and strategic objectives.

Responsibility for achieving several of NASA's strategic objectives (see Table 1) belongs, in whole or in part, to the Science Mission Directorate (SMD), including:

- Undertake robotic and human lunar exploration to further science, and to develop and test new approaches, technologies, and systems to enable and support sustained human and robotic exploration of Mars and more distant destinations;
- Conduct robotic exploration of Mars to search for evidence of life, to understand the history of the Solar System, and to prepare for future human exploration;
- Conduct robotic exploration across the Solar System for scientific purposes and to support human exploration -- in particular, explore Jupiter's moons, asteroids and other bodies to search for evidence of life, to understand the history of the Solar System, and to search for resources;
- Conduct advanced telescope searches for Earth-like planets and habitable environments around other stars;
- Explore the universe to understand its origin, structure, evolution, and destiny;
- Conduct a program of research and technology development to advance Earth observation from space, improve scientific understanding, and demonstrate new technologies with the potential to improve future operational systems;

[1] Note: In August 2004, the Science Mission Directorate was formed by merging the previously separate Office of Earth Science and Office of Space Science.

- Explore the Sun-Earth system to understand the Sun and its effects on Earth, the Solar System, and the space environmental conditions that will be experienced by human explorers, and demonstrate technologies that can improve future operational Earth observation systems; and
- Use NASA missions and other activities to inspire and motivate the nation's students and teachers, to engage and educate the public, and to advance the scientific and technological capabilities of the nation.

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

- *The New Age of Exploration - NASA's Direction for 2005 and Beyond*, available in early February 2005 at http://www.nasa.gov,
- *Space Science Enterprise 2003 Strategy*, accessed at http://science.hq.nasa.gov/strategy, and
- *Earth Science Enterprise 2003 Strategy*, accessed at http://science.hq.nasa.gov/strategy.

The national objectives for NASA, and the NASA strategic objectives that support the national objectives, are given in Table 1. These NASA strategic objectives are also used to assess NASA's research progress for compliance with the *Government Performance Review Act* (GPRA) of 1993. Therefore, proposers to this NASA Research Announcement are expected to provide a short statement in their proposals that shows how their proposed research activities support one or more of these NASA strategic objectives (further instructions concerning this issue are provided in the last sections of every program element given in Appendices A, B, C, and D of this solicitation).

Amended March 31, 2005
Begin insertion
Proposers may refer to NASA's national and agency strategic objectives as given in Table 1 in the *Summary of Solicitation*. Alternatively, proposers may refer to NASA's Guiding National Objectives (page 4) and the NASA Strategic Objectives for 2005 and Beyond (page 8) in the NASA planning document, *The New Age of Exploration: NASA's Direction for 2005 and Beyond* (available at http://www.nasa.gov/about/budget/).
End insertion

SMD pursues NASA's strategic objectives using a wide variety of both space flight programs that enable the execution of 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-2005 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 objectives 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 programs given in Appendices A, B, C, and D (see also the *Table of Contents* that prefaces this NRA). Table 2 below lists these programs 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 this solicitation. Questions about each specific program should be directed to the Program Officer(s) identified in the *Programmatic Information* section that concludes each one.

In order to pursue NASA's goals and objectives, NASA's Science Mission Directorate (SMD) is organized into three science divisions:

- The *Earth-Sun System Division* that manages programs to expand our understanding of the Earth and the Sun and the Sun's effect on the Solar System environments;
- The *Solar System Division* that manages programs to explore the Solar System with robots to study its origins and evolution including the origins of life within it, bringing the lessons of our study of Earth to the exploration of the Solar System, and vice versa; and
- The *Universe Division* that manages programs to explore the Universe beyond, from the search for planets and life in other solar systems to the origin, evolution, and destiny of the Universe itself.

The programs in Appendices A, B, and C are managed by these three science divisions, respectively, while Appendix D contains multidisciplinary programs relevant to two or more of these science Divisions. Each of these four Appendices is prefaced with an *Overview* section that provides an introduction to its program content that all interested applicants to this NRA are encouraged to read. The programs described in these appendices also provide any clarifications or amendments to the general guidelines contained in this *Summary of Solicitation*.

(b) Opportunities for Education/Public Outreach

(i) Overview

As noted in Section I(a) above, part of the NASA vision is "…*to inspire the next generation of Explorers as only NASA can*." The SMD has an essential role in NASA's mission to inspire the next generation of explorers by motivating the Nation's teachers and students, engaging and educating the public, advancing the scientific and technical capabilities of the nation, as well as helping to ensure the participation by underrepresented and underserved groups.

As part of its response to this mandate, SMD is committed to fostering the broad involvement of the space and Earth science research communities in Education and Public Outreach (E/PO) with the goal of enhancing the nation's formal education system and contributing to the broad public understanding of science, mathematics, and

technology. Progress towards achieving this goal has become an important part of the broad justification for the public support of Earth and space science. In addition, an enhanced, coordinated Agency-level education program is now being undertaken through the NASA Office of Education. The SMD sponsors a broad spectrum of educational activities ranging from kindergarten to postgraduate levels via several vehicles of solicitation.

Information and more detailed descriptions about NASA Education and Public Outreach programs may be found in the following references.

- The strategic plan for NASA's Office of Education is found in the *NASA Education Strategy* (October 2003) at http://education.nasa.gov/about/strategy/.
- Background information from Space Science Education is found at http://science.hq.nasa.gov/research/epo.htm and at http://science.hq.nasa.gov/education. These sites include E/PO *Newsletters*, *Annual Reports*, and other publications (e.g., *Partners in Education* (March 1995), *Implementing the Office of Space Science Education/Public Outreach Strategy* (October 1996), and *History of the Office of Space Science E/PO Program* (February 2003)).
- Background information from Earth Science Education is found at http://science.hq.nasa.gov/research/epo.htm and at http://science.hq.nasa.gov/education. These sites include the *Earth Science Education Plan* (June 2004), the *Earth Science Outreach Plan* (April 2004), the *2004 Education Catalog*, and monthly electronic newsletters.

(ii) E/PO Opportunities for New Investigators

Three opportunities to participate in NASA's Education/ Public Outreach programs are included in this NRA. The first is the opportunity to receive supplemental E/PO awards by the Principal Investigators of selected investigations (see below). The second is the opportunity for early-career scientists and engineers to participate in the *New Investigator Program in Earth-Sun System Science* (see Appendix A.25). The third is the opportunity for early-career scientists and engineers to participate in the *Carl Sagan Fellowships Program in Solar System Science* (see Appendix B.21). Graduate fellowships, E/PO opportunities embedded in SMD missions and programs, and other opportunities to develop systemic and sustainable educational effort are not included in this NRA but are posted separately at http://nspires.nasaprs.com.

(iii) Supplemental Education/Public Outreach Awards for ROSES Investigators

Supplemental E/PO awards are used to encourage authentic participation by research scientists themselves in education and scientific communication by adding an E/PO component to their "parent" SR&T research investigations.

In order to propose an E/PO activity as a supplement to a SR&T research proposal submitted in response to this NRA, the following instructions must be followed.

- 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 award"), as well as those who hold a parent award selected through any previous Office of Space Science (OSS) or Office of Earth Science (OES) SR&T 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.
- An "Institutional E/PO Proposal" option is available that allows several SMD-funded researchers located at the same institution 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.
- 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 award (for an institutional award, this limit applies to the last expiring award involved in the consortium of proposing investigators).
- 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 new 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 SR&T 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 either of the following individuals:

Dr. Larry Cooper	Tel.: (202) 358-1531	E-mail: Larry.P.Cooper@nasa.gov
Dr. Paula Coble	Tel.: (202) 358-1457	E-mail: Paula.Coble-1@nasa.gov

(c) NASA-Provided High-end Computing Resources

Amended October 3, 2005
Insertions are underlined; deletions are struck through

NASA's Science Mission Directorate provides some specialized computational infrastructure to support its research community. High performance computing resources are available from two major computing facilities, namely, the Computational & Information Sciences and Technology Office (CISTO) ~~Earth and Space Data Computing Division (ESDCD)~~ (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 platform at GSFC is an HP/Compaq Alpha SC45 system consisting of 1392 processors, and a SGI Altix system with 1152 processors. This system 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 allocating computing time on this system.

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, 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 per run) should also be included.

The box provided on the proposal 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. The Science Mission Directorate will make every attempt to satisfy the needs in the context of the overall set of requirements, constraints, and science priorities.

~~Successful investigations selected for funding will be instructed to apply for an allocation of the NASA high-end computing resources needed for their investigation through a separate process. The Science Mission Directorate intends to accept applications and allocate the computing resources twice yearly with January and July starts for durations of 12 months.~~

End October 3, 2005 amended text

For further information contact either of the following two individuals:

Dr. Tsengdar J. Lee
Mission and Systems Management Division
Science Mission Directorate
NASA Headquarters

Mr. Joseph H. Bredekamp
Mission and Systems Management Division
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Telephone: 202-358-2348.

(d) NASA Safety Policy

All prospective proposers to this NRA are advised that the highest priority in all of NASA's programs is safety. 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.

(e) 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 programs at the time of its release. The Government's obligation to make awards is contingent upon the availability of appropriated funds from which payment can be made and the receipt of proposals that NASA determines are acceptable for award under this NRA.

II. AWARD INFORMATION

(a) Funding Policies

- The amount of funds expected to be available for new awards for proposals submitted in response to this NRA is given in the subsection entitled *Programmatic Information* that concludes each program element description in Appendices A, B, C, and D. 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 programs 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. However, this number may be longer based on the workload experienced by NASA, the availability of funds, and any necessary post selection 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) to help expedite the processing of the award should their proposal be selected.
- Generally, Principal Investigators holding previous awards selected through any of the programs offered through earlier OES or OSS SR&T NRAs are welcome to submit "successor" proposals that seek to continue a previously funded line of research. 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.
- Proposals that were submitted but not selected for any previous OES or OSS SR&T NASA solicitation(s) may be submitted either in a revised or their 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.
- Awards made through this NRA will be in the form of grants, cooperative agreements, contracts, and intra- or inter-Government transfers depending on the nature of the submitting organization and/or the specific requirements for awards given in the *Programmatic Information* subsection of each program in the Appendices A, B, C, and D. 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 *NASA Grants and Cooperative Agreement Handbook* (hereafter referred to as the *Grants Handbook,* found at http://ec.msfc.nasa.gov/hq/grcover.htm). 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).