

A.24 ENHANCING THE CAPABILITY OF COMPUTATIONAL EARTH SYSTEM MODELS AND NASA DATA FOR OPERATION AND ASSESSMENT

**Amended June 23, 2010. Because the NSPIRES web interface through which proposals and NOIs are submitted will not be available from Thursday July 15 through Sunday July 18, the NOI due date for this program element has been changed to July 22, 2010. The proposal due date remains unchanged at September 17, 2010.**

**Amendment 4 on May 7, 2010. This version of the text replaces the prior draft version in its entirety.**

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 properties. For these measurements, NASA's Earth Science Research Program sponsors algorithm development, calibration/validation activities, and modeling studies to produce high-quality data products for scientific research and operational use.

This solicitation recognizes the advances already made by investigations which were solicited by prior NASA Research Announcements and/or National Oceanic and Atmospheric Administration (NOAA) Announcements of Opportunity and which focused in the areas of sensor calibration, algorithm development and refinement, product validation, and scientific data analysis. This solicitation offers investigators an opportunity to analyze, assess, and increase the impact of NASA data in research and operational environments, particularly in the areas of weather prediction, climate projection assessment, and global carbon cycle modeling in anticipation of carbon management regulations.

This solicitation also recognizes that there may be more efficient ways to deliver model predictions or datasets using the latest innovations in computing and computational technologies. NASA will support research proposals to experiment with the latest computing technologies with specific models and assimilation systems.

2. Areas of Proposals Solicited

This solicitation seeks three areas of proposals: (a) Acceleration of Operational Use of Research Data, including Joint Center for Satellite Data Assimilation (JCSDA), (b) data for IPCC climate projection assessment, and (c) computational support of Earth system modeling.

## 2.1 Acceleration of Operational Use of Research Data

### 2.1.1 *Operational Short-term Weather Predictions*

NASA encourages more rapid use of NASA's observations in operational weather predictions. Research and development proposals are sought to accelerate the operational use of NASA data. Proposals may be in areas of transitioning existing research data into the operational environments or of developing algorithms in the operational environment to accept future NASA NPOESS Preparatory Project (NPP) Joint Polar Satellite System

([http://eosps0.gsfc.nasa.gov/eos\\_homepage/mission\\_profiles/show\\_mission.php?id=71&mission\\_cat\\_id=17](http://eosps0.gsfc.nasa.gov/eos_homepage/mission_profiles/show_mission.php?id=71&mission_cat_id=17)), or decadal survey measurements.

In order to facilitate a rapid transition of research data into an operational environment, NASA has set up the Short-term Prediction Research and Transition Center (SPoRT; <http://www.ghcc.msfc.nasa.gov/sport/>) at NASA Marshall Space Flight Center. The SPoRT center is NASA's primary research and operation transition interface with the National Weather Service for short-term weather predictions. NASA is seeking external research proposals to collaborate with the SPoRT center to transition research data into at least one operational environment. Since the main motivation is to broaden the utilization of NASA's research satellite observations, proposals using models, data assimilation systems, or weather information systems, other than those currently employed by an operational entity, will *not* be considered.

Potential proposers are encouraged to contact the SPoRT center. The point of contact at SPoRT is Dr. Gary Jedlovec, [gary.jedlovec@nasa.gov](mailto:gary.jedlovec@nasa.gov), 256-961-7966. Total funding for this area is approximately \$500K per year. Two to three projects may be selected.

### 2.1.2 *Joint Center for Satellite Data Assimilation*

The Joint Center for Satellite Data Assimilation (JCSDA; <http://www.jcsda.noaa.gov/>) 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. Seven partner organizations (<http://www.jcsda.noaa.gov/partners.php>) benefit from the partnership in which the resources and talents of several agencies are combined to solve problems of mutual interest. The JCSDA research and development also benefited from the efforts made by investigators external to the JCSDA partners.

Research and development proposals are sought, from external investigators, in the following four specific areas in global models or data assimilation systems used by the JCSDA partner organizations.

1. Snow/soil moisture assimilation work for the Land Information System (LIS) that is/will be common to NOAA National Center for Environmental Prediction (NCEP), NASA, and Air Force Weather Agency (AFWA), to be coordinated with related efforts within Environmental Modeling Center (EMC) and Global Modeling and Assimilation Office (GMAO);

2. Work toward establishing a JCSDA capability of maintaining a high-quality spectroscopy database over all remote sensing parts of the electromagnetic spectrum from ultraviolet to microwave wavelengths. Community Radiative Transfer Model (CRTM) fast models need to be periodically updated using the new line by line data base;
3. Some experiments seem to indicate that a greater impact on Numerical Weather Prediction (NWP) skill is obtained by the use of Atmospheric Infrared Sounder (AIRS) temperature retrievals than by use of AIRS radiances from both temperature and moisture channels. Efforts are sought that elucidate this issue in the JCSDA operational systems, identifying the elements of retrieval algorithms that enhance the impact of AIRS in analyses and NWP skill, a careful comparison with the procedures used in radiance assimilation, and modification of the radiance assimilation procedures if warranted; and
4. Development of a common JCSDA Infrared (IR) and Microwave (MW) emissivity database for use by all partners, along with test cases to be used for impact experiments.

Total funding for the above area is approximately \$500K per year. Three to four projects may be awarded. Awards will be in the form of a Cooperative Agreement or contract. Baseline models and data assimilation systems will be provided by the JCSDA. Proposals using models or data assimilation systems other than that provided by the JCSDA will not be considered. To avoid the appearance of conflict of interest, NASA will not accept proposals including investigators (PI or Co-I) from the following organizations, which helped to define the research topics for this call: NOAA/National Environmental Satellite Data and Information Service/Center for Satellite Applications and Research, NOAA/NWS/NCEP, Navy/Naval Research Laboratory/Marine Meteorology Division, AFWA, NASA/Goddard Space Flight Center/Science and Exploration Directorate/Earth Science Division, and NOAA/Office of Oceanic and Atmospheric Research/Atlantic Oceanographic Meteorological Laboratory. Proposals with funded investigators from all other organizations are permitted.

Parallel to this solicitation, NOAA is offering the Federal Funding Opportunity (FFO). Research organizations are also encouraged to check out the NOAA FFOs referred to at the JCSDA web site (<http://www.jcsda.noaa.gov/>).

## 2.2 Data for IPCC Climate Projection Assessment

NASA encourages more widespread use of NASA satellite observations, particularly, but not limited to, ocean biological and biogeochemical (ocean color) data, in existing global and regional models to be employed by the IPCC or similar climate or global carbon cycle assessments. There is a need to better parameterize the ocean's biology and chemistry within global climate and carbon cycle models and to constrain the energy and carbon fluxes across the air-sea interface. This is in the interest of supporting the Fifth IPCC Assessment Report (AR5) and future IPCC assessments for Working Group 1 Climate Model intercomparisons, to inform any future carbon management strategies, or to support development of tools for climate adaptation and mitigation. For example, a carbon management system will require global carbon cycle models to verify permanent carbon sequestration, which is dependent on quantification of carbon sources, sinks, fluxes, stocks, etc. and processes affecting them in the ocean. Research and development proposals are sought to accelerate the use of NASA ocean color satellite data for these purposes. NASA will select up to two projects that directly support the IPCC AR5

Working Group 1 Climate Model intercomparison projects (in the interest of climate or carbon cycle assessments). Proposals may seek to transition existing research data into the global climate and/or carbon cycle assessment environments or develop algorithms to accept future NASA ocean color satellite observations.

NASA is also interested in the improved access and documentation of satellite observational data sets for the Climate Model Intercomparison Project Phase 5 (CMIP5), which will support the IPCC AR5 report. Research and development proposals are sought to organize satellite observations to support the construction, validation, or verification of cloud or radiation components of models and to support the construction of interface between the ocean and atmosphere in the coupled models. The proposals must demonstrate the use of the data in CMIP5 studies. Since the data will be used for the CMIP5 and IPCC AR5, the resulting data must be accessible through the Earth System Grid (ESG) nodes.

Proposals *must* use models, data assimilation systems, or global climate or carbon cycle information systems that are currently employed by the IPCC or similar climate or global carbon assessment activities and the plan for transition of the research data or results must be clearly identified and committed to the proposed effort.

Total funding for this area is approximately \$1M per year. Four to six projects may be selected.

### 2.3 Computational Climate Modeling

NASA's weather and climate models are used in long-term climate projections, inter- and intra-seasonal climate, and global weather predictions. As the spatial resolution of the models is increased, they require more computational resources. It is highly desirable that the efficiency of the computational models be increased so that maximum efficiency can be gained from advances in computational technology, including hardware, software, networks, and tools. NASA has identified several areas for which improvements in the efficiency of its models as implemented with currently available and planned computing technology are highly desired.

In addition, the long-term integration of the models often generates a large number of output files. NASA is seeking to develop innovative approaches to improve our ability to create time series of specific parameter(s) from model output.

The total funding for this area is approximately \$1M per year. Four to six projects are sought in the following areas:

1. Acceleration of NASA Global Modeling and Assimilation Office (GMAO) GEOS-5 atmospheric model or NOAA/NASA Grid point Statistical Interpolation (GSI) using the Graphic Processing Unit (GPU) technology,
2. Acceleration of radiative transfer codes, both CRTM and Rapid Radiative Transfer Model (RRTM)/G, using GPU technology,
3. Utilization of parallelism to improve the input/output (I/O) performance of the GEOS-5 model and its associated adjoint model,

4. OpenAD automatic numerical model adjoint generation software development applicable to GEOS-5 and GSI Fortran-Message Passing Interface (MPI)-based components, including issues involving communication and Earth System Modeling Framework (ESMF) constructs, and
5. Develop innovative approaches to I/O for post-processing large GEOS-5 or Model-E data volumes across many files on high performance computers, especially using virtual file systems.

### 3. Programmatic Information

#### 3.1 Identify the Research Area

Proposers must identify and respond to only one of the three areas defined in Section 2.

#### 3.2 Prior Research Results

Proposers responding to sections 2.1 and 2.2 must identify prior research results that demonstrate the potential value of the NASA research data on operational or assessment activities. The citation of one or more peer-reviewed papers in which positive results have been reported is considered to be the minimum requirement.

#### 3.3 Schedule

Proposals responding to area 2.1: Acceleration of Operational Use of Research Data should propose a schedule with the aim to fully transition the operational use of NASA research data to an operational entity within two years of the inception of the project.

#### 3.4 Peer Review

Proposals will be evaluate by peer-review panels. Mail reviews will not be used. For the proposals responding to the JCSDA requirements the panel members will be selected by the JCSDA partner agencies. The final selection authority will be NASA.

#### 3.5 Education and Public Outreach Opportunities

NASA policy strongly encourages participation in Education and Public Outreach (E/PO) activities by members of the science community. You may be eligible to propose a supplemental Education or Outreach effort if your research proposal is selected for award. The research award must have more than 12 months remaining at the time of submission of the supplement proposal. For additional details concerning the submission of Outreach or Education supplement proposals, please see Supplemental Outreach Awards for ROSES Investigators (Appendix E.5) and Supplemental Education Awards for ROSES Investigators (Appendix E.6).

#### 4. Summary of Key Information

Expected program budget for first year of new awards	Up to \$3M
Number of new awards pending adequate proposals of merit	~ 12 - 18
Maximum duration of awards	2 years
Due date for Notice of Intent to propose (NOI)	<b>July 22, 2010 [Amended June 23, 2010]</b>
Due date for proposals	See Tables 2 and 3 in the <i>Summary of Solicitation of this NRA</i> .
Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	15 pages; see also Chapter 2 of the <i>NASA Guidebook for Proposers</i>
Relevance to NASA	This program is relevant to the Earth science strategic goals and subgoals in NASA's <i>Strategic Plan</i> ; see Table 1 and the references therein. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the <i>ROSES Summary of Solicitation</i> .
Detailed instructions for the preparation and submission of proposals	See the <i>NASA Guidebook for Proposers</i> at <a href="http://www.hq.nasa.gov/office/procurement/nraguidebook/">http://www.hq.nasa.gov/office/procurement/nraguidebook/</a> .
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the <i>ROSES Summary of Solicitation</i> and Chapter 3 of the <i>NASA Guidebook for Proposers</i> .
Web site for submission of proposal via NSPIRES	<a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)
Web site for submission of proposal via Grants.gov	<a href="http://grants.gov/">http://grants.gov/</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH10ZDA001N-COUND

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