A.41 ADVANCED INFORMATION SYSTEMS TECHNOLOGY

1. Scope of Program

1.1 Introduction

The Earth Science Technology Office (ESTO) manages the development of advanced technologies and applications that are needed for cost-effective missions. The ESTO plays a major role in shaping Earth science research and application programs of the future, aggressively pursuing promising scientific and engineering concepts, and ensuring that the program maintains an effective balance of investments in order to advance technology development.

Information technology advances play a critical role in collecting, handling, and managing very large amounts of data and information in space and on the ground. The objectives of the Advanced Information Systems Technology (AIST) program are to identify, develop, and (where appropriate) demonstrate advanced information system technologies that:

- Reduce the risk, cost, size, and development time for Earth science space-based and ground-based information systems,
- Increase the accessibility and utility of science data; and
- Enable new observations and information products.

The AIST program is designed to bring information system technologies to a Technology Readiness Level (TRL) that allows integration into existing or future technology/science research and development programs, or infusion into existing or planned subsystems/systems to enable timely and affordable delivery of information to users. The TRL scale is used to assess the maturity of a particular technology. The AIST program accepts technology developments at various stages of maturity and advances the TRL through appropriate risk reduction activities, such as requirements analysis, conceptual design, prototypes, and proof-of-concept demonstrations. The AIST program also tracks information system technology needed to achieve the goals for future NASA data systems, both in orbit and on the ground. The AIST Capabilities and Needs Matrix is documented at the ESTO web site (http://esto.nasa.gov/AIST-ROSES), along with the TRL definitions and information about former AIST solicitations for technology.

For ROSES-2011, the AIST solicitation features a new collaboration initiative with the NASA Applied Sciences Program (ASP) to promote the integration of technical capabilities enabled by AIST development for use by selected decision support or end user applications. Section 1.4 describes the technology infusion option for Earth science applications. The AIST program is also collaborating with the High End Computing (HEC) Program to solicit technologies and tools to help meet the computing challenges of the Earth science modeling community.

1.2 Background and Solicitation Justification

NASA's Earth Science Division (ESD) faces a significant challenge ahead in responding to the Decadal Survey recommendations of the National Research Council (NRC) and the current

Administration's overarching emphasis on climate research and monitoring. New technology will play a key role in enabling many recommended missions and supporting data systems, as well as reducing the cost of future systems. NASA must have an effective long-term data acquisition system to support the needed Earth System science and environmental monitoring and prediction capabilities. This AIST solicitation will facilitate the implementation of the recommendations and architectures by carefully choosing where to invest in information technologies to get the most benefit from NASA's technology development funds. The following documents identify the relevant missions and programs and supporting technologies for this solicitation:

1. *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* may be accessed on the web at http://www.nap.edu/catalog/11820.html. This report is hereafter referred to as the "*Decadal Survey*."
2. *Responding to the Challenge of Climate and Environmental Change: NASA's Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space* may be accessed on the web at http://science.nasa.gov/media/medialibrary/2010/07/01/Climate_Architecture_Final.pdf. This report is hereafter referred to as the "*Climate-Centric Architecture*."
3. NASA missions listed in the table found at http://science.nasa.gov/earth-science/missions/
4. *Earth Observing Mission Applications Workshop* may be accessed on the web at http://appliedsciences.nasa.gov/2010EOMA-Workshop.php.
5. *NASA Science Mission Directorate Computational Modeling Capabilities Workshop Final Report (2008)* may be accessed on the web at http://www.hec.nasa.gov/workshop08/workshop08.html. This report is hereafter referred to as the "*Computational Modeling Capabilities Report.*"

1.3 Proposal Research Topics

The AIST program will invest in technology developments to reduce the risk and cost of evolving NASA information systems to support future Earth observations and to transform those observations into Earth information, as envisioned by the documents referenced in Section 1.2. This solicitation focuses on the information technologies required to enable and facilitate the Earth observation missions and supporting information systems that are described by those reference documents.

Table ES.2 of the *Decadal Survey* summarizes the missions recommended to NASA, and Chapter 3 highlights the *Decadal Survey* vision for transforming satellite observations to Earth information. Information technology will support scientific breakthroughs resulting from new observations and new ways of using those observations, whether from space, airborne, or in situ sensors. Methods for deriving data and information from multiple observations and sensors, for supporting scientists working in modeling and data assimilation, and for managing data and information to enable low cost distribution of data to users are some of the information system capabilities recommended in the *Decadal Survey*.

In support of the current Administration's focus on climate change and monitoring, NASA will advance climate research by increasing applications using the full set of available NASA and non-NASA satellite measurements and developing/maturing technologies that are essential for transforming those measurements into accurate predictions, efficient information products for the broad range of end-users, and consistent bases for long-term monitoring. Section 2.1.6 of the *Climate-Centric Architecture* describes two key investment areas to enable more rapid delivery of critical data products to provide societal benefit: standard instrument to spacecraft interfaces and ground systems for mission operations and data management. Section 2.2 identifies specific targets for increased investment that will have a significant impact on the areas of data utilization, synthesis, calibration, and product production. The AIST program seeks to develop information technology related to these investment areas, such as on-board computing and data system infrastructures.

The AIST program addresses information system technology needs for NASA Earth science missions, including those currently operating, under development, and in study. The table provided in the NASA Earth science missions web site referenced in item 3 in Section 1.2 lists relevant missions and provides links to more details about those missions. The Climate Continuity missions and the Tier 3 Decadal Survey missions not yet in study phase are also relevant to AIST.

The *2010 Earth Observing Missions Applications Workshop* documents the results of the NASA Applied Sciences Program community workshop to engage the applications community early in the *Decadal Survey* mission design process. The goal of the workshop was to improve preparation for data management and product generation responsive to evolving societal needs.

The *Computational Modeling Capabilities Report* documents the results of the NASA Earth Science July 2008 community workshop to identify science and engineering computing needs and to evaluate them against current capabilities. This workshop was an integral part of NASA's Science Mission Directorate process to determine the computational modeling capabilities and infrastructure investments required to enable the goals defined in the *Science Plan for NASA's Science Mission Directorate 2007–2016*.

This NRA solicits both hardware and/or software information systems technology proposals in either space or ground based systems. For the purposes of this solicitation, all proposed technologies must have an entry TRL between 2 and 5 (see Table 1). The entry TRL must be substantiated in the proposal.

Testbeds needed for testing, verification, or validation of components, subsystems, and/or systems (both hardware and software) can be included and costed as an integral part of a proposed technology effort, but will not be funded as a stand-alone proposal. If any special purpose equipment, facilities, etc., is required, it is the responsibility of the proposer to negotiate its use.

The solicited topic categories are as follows. No prioritization is implied in the presentation order. Proposers must indicate in the proposal to which category they are proposing:

1.3.1 Advanced Data Processing

These are information systems technologies that operate directly on the data produced by the real or simulated sensor (or instrument) in order to improve or enhance 1) the information extracted from the data stream or model outputs, or 2) the measurements to be acquired by a new mission or science campaign. Technologies in this category are intended to improve the science value of the data at minimal cost. As a consequence, they have the potential for improving the overall cost effectiveness of a mission and reduce the end product latency. The modeling community exploits advanced data processing techniques to enhance productivity in high end computing environments. Example technology areas include (but are not limited to):

- Processing techniques to enable multi-source data fusion across models, satellites, and *in situ* sensors.
- Data mining and visualization to enable analysis (e.g., data immersion approaches to enable real-time interaction with the models, and visualization of highly complex systems).
- Techniques to exploit specialized processing units (e.g., graphic processing unit or GPU) and cloud computing technologies for large-scale on-demand data processing, mining, distribution, and provenance.
- Tools to manage the validation and assessment of model data inter-comparisons (e.g., to more easily evaluate new algorithms, and/or quantify data and product uncertainty).
- Tools to broaden the applicability and reduce the cost of simulations (e.g., Observing System Simulation Experiment, OSSE) for evaluating instrument, mission, sensor networks, and field campaigns.

1.3.2 Data Services Management

These are information systems technologies that broadly support the management of Earth science data from NASA missions by enabling the science and applications communities to more effectively exchange and share data and information. These technologies can also support and incorporate an increasing number of shared software tools built to handle Earth observation data. These technologies provide opportunities for high end computing and modeling systems to more efficiently interoperate with the observation data systems. Data service management technologies are envisioned to enable software applications to execute functions and then autonomously share results with one another, without compromising system security or violating associated data and governance policies. These technologies will have a direct impact on integrated Earth science missions by enabling discovery and access to Service Oriented Architecture components and services. Example technology areas include (but are not limited to):

- Management of sensor and/or science data operation workflows (e.g., tools to generate new and/or enhanced scientific workflows to support the management of large simulation experiments involving data, algorithms and computing resources).

- Techniques to discover and consolidate/integrate shared services for more effective management and use of data and metadata in the science and applications communities (e.g., data provenance mechanisms, uncertainty quantification methods, data quality metrics).
- Software architectures and frameworks that support the incorporation of models, data, sensor webs, data mining algorithms, and visualization by leveraging and/or enhancing interoperability standards.
- Management and processing techniques for large data volumes (e.g., data distribution services and service migration) and for reducing end product latency approaching real time delivery.
- New and/or enhanced customized tools for managing the development, reuse, and evolution of large scientific codes (e.g., enhancements to open source tools).

1.3.3 Sensor Web Systems

Technologies in this category are intended to increase the effectiveness of Earth observing by providing situational awareness gathered from unattended environs and improve science data and product generation (e.g., products on-demand) and sharing over the Internet. Sensor webs are information systems that broadly support scalable, self-organizing, autonomous, task-able, dynamically adaptive, and reconfigurable observing systems providing raw and processed data, along with associated metadata to provide timely, on-demand data and analysis. Example technology areas include (but are not limited to):

- Sensor Web technologies for science applications, spacecraft operations, and decision support (e.g., to build connections between sensors and models contributing to global change assessments and the decision makers applying the results).
- Sensor system technologies for instrument signal processing, product generation, and communication.
- Tools for sensor system design, observation planning, and operations (e.g., to manage sensor calibration across satellites).

1.3.4 Operations Management

These are information systems technologies that broadly support on-board sensors (both flight and *in situ*), incorporate autonomy or intelligence within the sensing process, and allow rapid response to needed measurements to improve the quality and science value of the data collected. Technologies in this category are intended to increase the operational effectiveness of Earth observing instruments or missions. Example technology areas include (but are not limited to):

- Technologies and tools for reducing operational costs and/or enhancing capabilities (e.g., multi-spatial and temporal sensor calibration/validation, near real-time operations, direct downlink, and operations autonomy).
- Flight operational concepts and precision operations strategies.
- Technologies for efficient operation and control of small satellites, UAVs, and science campaigns.

- Technologies to support Earth science operations for the continuous observations from geosynchronous sensors (e.g., optimize the science return from routine vs. episodic events).
- On-board processing systems and end-to-end system strategies for special product generation and dissemination (e.g., cost effect approaches to data latency thresholds).

Please note that AIST is not soliciting new sensors that make science measurements; these proposals are funded by the Instrument Incubator Program in ESTO (see ROSES-2010, Appendix A.35 at http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId=%7bD8EF89F6-4B95-8377-CE43-270E7289A9BC%7d&path=open). Furthermore, with the exception of the Technology Infusion Option specified in Section 1.4, AIST proposals should not focus on enhancing and improving existing components of the NASA data and information systems infrastructure achieved through deployment of mature technology (TRL 7-9); that work is funded by NASA's Advancing Collaborative Connections for Earth System Science (ACCESS) Program (see ROSES-2010, Appendix A.34 at http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId=%7bC29FAEDD-CD2B-5ADF-EB76-3D7824D3525F%7d&path=open). AIST does not fund science algorithm development, which is covered by Earth Science Division Research and Analysis or by the missions themselves. Finally, AIST is not funding space communications and navigation technology; that work is funded by NASA's Space Communications and Navigation (SCaN) program within the Space Operations Mission Directorate.

1.4 Technology Infusion Option for Earth Science Applications

This NRA is a technology development activity. Proposers also have an opportunity to add a technology infusion option of up to two years in duration in their proposals to enhance a decision-making activity in support of the Earth science ASP at NASA HQ. Proposers should identify and describe the decision-making activity to be supported, and fully explain how they plan to integrate the new technical capabilities enabled by the technology development into the proposed decision support or end user application.

The technology infusion option must identify a path to implementation within an end user organization for these specific Earth science applications: water, health and air quality, ecological forecasting, or disasters. A letter of endorsement supporting infusion of the technology from the end user's organization is required. At least one member of the proposal team (PI, Co-I, or collaborator) must be from the end user's organization. Budget and schedule information for the technology infusion option shall be provided in the same formats as those used for the technology development activity and must be clearly distinguishable from the technology development budget and schedule.

Proposals including the technology infusion option shall be evaluated as a whole; proposers should note, however, that it is possible that the technology development portion of the proposal could be selected without the technology infusion option. Under no circumstances will the technology infusion option be selected if the technology development is not selected. In addition, implementation of the technology infusion option shall be predicated on the successful completion and demonstration of the technology development.

2.0 Programmatic Information

Proposers should periodically check the solicitation website (http://nspires.nasaprs.com/) for any amendments to the ROSES-2011 NASA Research Announcement (NRA).

This solicitation provides additional details governing the proposed activities that supersede the general guidelines announced in the *Summary of Solicitation* of ROSES-2011.

2.1 Proposal Content and Submission

2.1.1 Proposal Content

2.1.1.1 Proposal Summary

Each proposal shall include a proposal summary, or abstract, that describes the proposal in no more than 4000 characters. The proposal summary shall include: (a) objectives and benefits; (b) an outline of the proposed work and methodology; (c) the period of performance; (d) entry and planned exit TRL; (e) infusion option, if applicable; and (f) infused application planned exit TRL, if applicable.

2.1.1.2 Project Description for Technology Development

The Project Description for the technology development must include the following content information in subsections that use the same titles. Failure to provide any of this material may be a cause for the proposal being judged as noncompliant and returned without further review. The Project Description shall be limited to 15 non-reduced, single-spaced typewritten pages. Standard proposal style formats shall be in accordance with Section 2.2 of the *Guidebook for Proposers*. Proposals that exceed the 15-page limit will be truncated at 15 pages, and only that portion provided to reviewers for evaluation. However, proposals including the technology infusion option will follow the additional guidance provided under 2.1.1.3.

1. Applicability to Earth Science missions in the reference documents – Describe the benefits to future Earth science investigations or Earth science missions that could utilize the proposed technology. Proposers shall include a one-page relevancy scenario (i.e., use case) showing how the proposed technology contributes to one or more of the referenced Earth science missions or measurements. Proposers including a technology infusion option shall focus their relevancy scenario on the proposed decision support or end user application (see 2.1.1.3). Involvement of Earth science researchers in advancing these concepts is highly encouraged. Proposals that fail to include a relevancy scenario may be considered noncompliant and returned without review. The format for the one-page relevancy scenario is as follows and must be strictly adhered to:
   a. Identify applicable NASA mission(s) or measurement(s).
   b. Indicate whether the technology is on-board the spacecraft, an airborne system, a ground based system(s), or some combination thereof.

c. Describe how the proposed technology will enable missions/measurements and associated Earth science information system challenges.
d. Indicate how the entry TRL and proposed exit TRL will position the proposed technology to meet mission/measurement schedules.

2. Description of Proposed Technology – Provide a description of the proposed element, system, or subsystem technology. Describe the technical approach and include an operational concept of the proposed technology that addresses Earth science needs. Discuss any possible cross-cutting or commercial benefits. Note: the description of the proposed technology infusion will be in a separate section as indicated in 2.1.1.3.

3. Comparative Technology Assessment – Describe the anticipated advantages of this element, system, or subsystem technology compared to those currently in use, e.g., reduction of size, mass, power, volume or cost, improved performance, or enabling of a new capability not previously possible. Review the current state of the art and relate it to the proposed work. Proposers including a technology infusion option shall include the targeted technology application in the discussion of the current state of the art.

4. TRL Assessment – Provide the current TRL assessment of the technology and the anticipated progression of TRL levels throughout the proposed effort. The TRL shall advance by at least one during the first two years of performance of the activity. If the proposed activity duration is for multiple years, advancement of one TRL per year is desirable. Note: the TRL assessment for the proposed technology infusion will be in a separate section as indicated in 2.1.1.3.

   For this solicitation, the entry TRL shall be between 2 and 5. This solicitation is intended to support technology development for Earth science missions listed in the documents referenced in Section 1.2. Table 1 provides high-level definitions for information system technology TRLs. More detailed TRL definitions can be found at http://esto.nasa.gov/AIST-ROSES. The proposer shall identify the entry TRL, the planned exit TRL, and success criteria in their proposal. Past and ongoing work on the research activity should determine the entry TRL; the proposer shall substantiate the entry TRL in the proposal. Proposals that fail to include and substantiate the entry TRL may be considered noncompliant and returned without review.

Table 1. High-Level TRL Definitions

TRL	Definition
1	Basic principles observed and reported
2	Technology concept and/or application formulated
3	Analytical and experimental critical function and/or characteristic proof-of-concept
4	Component/subsystem validation in laboratory environment
5	System/subsystem/component validation in relevant environment
6	System/subsystem model or prototyping demonstration in a relevant end-to-end environment (ground or space)
7	System prototyping demonstration in an operational environment (ground or space)
8	Actual system completed and "mission qualified" through test and demonstration in an operational environment (ground or space)
9	Actual system "mission proven" through successful mission operations (ground or space)

5. Research Management Plan – Provide a statement of work that concisely describes each task or milestone to be accomplished in the course of the research and development. Define the success criteria associated with each task or milestone. Also include a milestone schedule chart that identifies critical milestones. At least two milestones per 12-month period must be defined. Note: the description of the technology infusion management plan will be in a separate section as indicated in 2.1.1.3.

   Subcontracting portions of the research project is acceptable and is the responsibility of the proposing organization to manage and include in reporting.

6. Personnel – Include a list of key personnel and identify experience related to the proposed activity. Proposers should demonstrate technology development and relevant science skills on the team. Proposals including a technology infusion option must identify at least one end user in the Key personnel list. The Key personnel list is included in the overall page count and must include, as a minimum, the Principal Investigator (PI). Optionally, one-page resumes for Key Personnel may be supplied; these resumes are not included in the overall page count.

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

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

9. Quad Chart – Provide a quad chart that contains the following information:

   a. Upper Left Quadrant: “Description and Objectives”
   b. Upper Right Quadrant: A visual, graphic, or other pertinent information
   c. Lower Left Quadrant: “Approach” and “Co-Is /Partners”

d. Lower Right Quadrant: “Milestone Schedule” and “Entry TRL”

A template and example of the quad chart can be downloaded from http://esto.nasa.gov/files/EntryQuad_instructions_template.ppt. This quad chart is not included in the overall page count.

2.1.1.3 Project Description for Technology Infusion Option for Earth Science Application

The description for the technology infusion option, if provided, shall be limited to an additional 5 non-reduced, single-spaced typewritten pages. Technology infusion descriptions that exceed the 5 page limit will be truncated at 5 pages, and only that portion provided to reviewers for evaluation.

1. Description of Proposed Infusion– Provide a description of the proposed technology infusion. This section must identify and describe the decision-making activity to be enhanced in this option. Describe the management, business, or policy topic or issue that it serves, including any quantitative information regarding its use. Identify and describe the end-user organization(s) and their responsibility and/or mandate to address the topic/issue.

   Describe the technical approach to integrate the proposed technology into the decision-making activity that addresses Earth science application need. Describe the approach to develop and test the integrated system and describe the operational concept. Discuss any possible cross-cutting or commercial benefits.

2. TRL Assessment – Provide the TRL assessment of the final, infused technology application.

3. Infusion Management Plan – Provide a statement of work that concisely describes each task or milestone to be accomplished in the course of the technology infusion. Define the success criteria associated with each task or milestone.

4. Personnel – If different from the technology development, describe any changes. The infusion end user must be a member of the team from project inception.

5. Facilities and Equipment – If different from the technology development, describe any changes.

6. Special Matters – If different from the technology development, describe any changes.

2.1.2 Proposal Submission

Proposals shall be submitted electronically via NASA’s master proposal database system, NSPIRES or via Grants.gov, as described in the *Guidebook for Proposers* (see Chapter 3 for details). Proposals submitted after the due date will not be evaluated.

2.2 Award Information

2.2.1 Funding

Funds are not currently available for awards under this solicitation. The Government's obligation to make award(s) is contingent upon 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 solicitation. No additional funds beyond the negotiated award value will be available. NASA does not allow for payment of profit or fee to commercial firms under grant awards (see section 2.2.3).

The funding available for each solicitation under this solicitation will limit the number and magnitude of the proposals awarded. The ESTO expects that a total of 20 to 25 proposals will be selected and awards issued, with values in the approximate range of $150K to $500K per year per award. The funding proposal for the technology infusion option must be clearly distinguished from the technology development proposed budget. That is, specify what portion of each year's budget is allocated to the technology infusion option. No total yearly award shall exceed $500K per year.

2.2.2 Period of Performance

The minimum period of performance for technology development is 12 months, the maximum period of performance for technology development is 36 months. The period of performance for technology infusion is limited to a maximum of 24 months. The total proposed period of performance for technology development and infusion must not exceed 48 months. Multi-year grants may be awarded for a period of up to four (4) years. Annual reviews will be held according to the criteria specified in the *NASA Grants and Cooperative Agreement Handbook* (14 CFR 1260). Proposals must define clear, measurable milestones to be achieved for each year of performance in order to warrant continuation of the second and subsequent years.

2.2.3 Type of Award

All selected proposals will result in the award of grants or intra- or inter-Government transfers, as appropriate. Contracts are specifically excluded as an award vehicle for this solicitation. Grants will be subject to the provisions of the *NASA Grants and Cooperative Agreement Handbook*. If a commercial organization wants to receive a grant, cost sharing is required unless the commercial organization can demonstrate that it does not expect to receive substantial compensating benefits for performance of the work. If this demonstration is made, cost sharing is not required but may be offered voluntarily (see also Section D, Provision 1274.204, of the *Grants Handbook*).

2.3 Evaluation Criteria

Evaluation criteria are given in the *Guidebook for Proposers*. These criteria are relevance, intrinsic merit, and cost realism/reasonableness. In addition to the factors for each criterion given in the *Guidebook*, evaluation of proposals specifically includes the following factors:

The first criterion, relevance to NASA's objectives, includes the applicability of the proposed investigation to Earth science missions and technology needs (one third of total evaluation weight) and specifically includes the following factors:

1. The proposal's relevance and potential contribution to NASA's scientific and technical areas of emphasis, including the potential to enable new information products and/or measurements which are part of the NASA mission/measurement concepts.

2. The potential for the element or subelement technology development to reduce the risk, cost, size, and development time of Earth science systems. Potential cost reductions should be clearly stated and substantiated to the extent possible, with supporting analysis that indicates scalability.

3. The potential of the element or subelement technology to be integrated, once matured, into an Earth science mission. If proposed, the benefit of the technology infusion to the proposed Earth science application.

4. The potential for the element or subelement to have commercial benefits.

The second criterion, intrinsic merit, includes the technical merit of the proposed investigation (one third of total evaluation weight) and specifically includes the following factors:

1. Feasibility and merit of the proposed technical approach to achieve the technology development and, if proposed, technology infusion objectives.

2. Degree of innovation of the proposed study or technology development concepts and approach.

3. Substantiated justification and appropriateness of the entry and exit TRL. For this solicitation, the entry TRL must be between 2 and 5 inclusive, with the exit TRL no higher than 7 for a technology development project. If proposed, the exit TRL for a project with a technology infusion option may exceed TRL 7 and should advance at least one TRL during the proposed infusion.

4. Feasibility of obtaining the potential reduction in risk, cost, size, and development time with the proposed element or subelement, and the feasibility of making a demonstrable TRL increase. The TRL must advance by at least one (1) level during the base performance period of the life of the project.

The third criterion, cost realism and reasonableness (one third of total evaluation weight) specifically includes the following factors:

1. Adequacy and realism of proposed milestones and associated success criteria.

2. Realism and reasonableness of the proposed cost, and comparison of costs to available funds.

3. Adherence to sound and consistent management practices appropriate to the TRL level of the proposed task.

4. Past performance and related experience in the proposed area of technology development and, if proposed, technology infusion as it contributes to cost realism.

5. Qualifications of key personnel, and adequacy of facilities, staff, and equipment to support the proposed activity as it contributed to cost realism.

6. Commitment of the organization's management to the proposed technology development and, if proposed, technology infusion (evidenced by cost and resource sharing, prior teaming arrangements, etc.). Proposers should identify any previous investment by the organization/program and provide supporting documentation.

2.4 Technical Reporting Requirements

All status information, presentation material, and report deliverables applicable to this AIST solicitation shall be submitted to the web-based ESTO AIST-11 Award Administration e-Book. A user account on the ESTO e-Book will be provided to the PI upon award. Due to NASA IT security requirements, all PIs must register with NASA's Identity Management and Account Exchange (IdMAX) system before a user account on the e-Book will be established. All submissions shall be made in PDF, Microsoft Word, Microsoft Excel, or Microsoft PowerPoint.

The following deliverables shall be required of awarded proposals. In cases where subcontract arrangements exist, consolidated project reports are the responsibility of the PI. The proposed budget should provide for these reporting requirements. In this context, "Annual" refers to a 12-month task effort that commences at award.

Soon after selection is announced, the PI will necessarily need to work with the ESTO AIST program to develop a Statement of Work, revised milestone schedule around the negotiated start date, and revised cost plan based on allowable costs.

2.4.1 Quarterly Technical Reports

The quarterly technical report shall focus on the preceding three month's efforts. Quarterly reports are only required on those quarters that an Interim or Annual/Final Review is ***not*** due, e.g., 3rd, 9th, etc. Each report shall address:

1. Technical status: The PI shall summarize accomplishments for the preceding three months, including technical accomplishments (trade study results, requirements analysis, design, etc.), technology development results, and results of tests and/or demonstrations.

2. Schedule status: The PI shall address the status of major tasks and the variance from planned versus actual schedule, including tasks completed, tasks in process, tasks expected to complete later than planned, and tasks that are delayed in starting, with rationale for each, and recovery plans as appropriate.

Quarterly Technical Reports shall be uploaded to the appropriate location in the ESTO e-Book starting on the three-month anniversary date of the official start date of the award, and every six months thereafter. Reports shall be submitted in PDF, Microsoft Word or PowerPoint compatible

formats by the required due date or by close of business of the first workday following the due date if the due date falls on a weekend or a holiday. A teleconference or brief meeting may be conducted between the ESTO and the PI to review and discuss each report.

2.4.2 Interim Reviews

The PI shall provide an Interim Review at the end of the first 6-month calendar period, commencing from the start date of award, and at 12-month intervals thereafter. Interim Reviews are required annually and are anticipated to last about 1.5 hours, including question and answer time. The PI must provide a PowerPoint presentation that uses the ESTO template as a "slide master" and summarizes the work accomplished and results leading up to this Interim Review. The presentation must:

1. Include a cover page, quad chart, technical information and achievements, a list of technical publications, programmatic (including a milestone schedule and actual vs. planned costs since project inception), student pictures and involvement (including the degree they are pursuing), if applicable, and an acronym list. Acronyms should be spelled out the first time they are used. Each slide should stand on its own and contain sufficient explanation to enable future reviewers of the presentation to understand the information presented without the benefit of having participated in the review itself.

2. Describe the primary findings, technology development results, and technical status, e.g., status of elements, construction of breadboards or prototype implementations, results of tests and/or proof-of-concept demonstrations, etc.

3. Describe the work planned for the remainder of the project and critical issues that need to be resolved to successfully complete the remaining planned work.

4. Summarize the cost and schedule status of the project, including any schedule slippage/acceleration. A schedule milestone chart of all major task activities shall be created and maintained and shown at all reviews. A cost data sheet shall be created and maintained, showing total project costs obligated and costed, along with a graphical representation of the project cost run outs.

5. Report any educational and outreach components of the project, e.g., graduate degrees, educational activities; technology infusion or patents applied for or granted; journal or conference publications; presentations at professional conference, seminars and symposia; demonstrations; media exposure; and, other activities that contributed to the overall success of the research project.

6. At the second and subsequent Interim Reviews, address the comments and recommendations prepared by the Independent Reviewer participating in the most recent Annual Review.

The ESTO will conduct the Interim Review via teleconference. The presentation shall be uploaded to the appropriate location in the ESTO e-Book at least two (2) working days prior to the review. Upload any technical publications to e-Books under "Other Documents." Following the review, the presentation, updated in accordance with comments and discussion resulting from

the review, will constitute the Interim Report and shall be uploaded to the appropriate location in the ESTO e-Book within 10 days after the review.

2.4.3 Annual Review

The PI shall provide an Annual Review at the end of each 12-month calendar period, commencing from the date of award. With the following exceptions, the Annual Reviews include all of the requirements identified for the Interim Review.

1. The review is held at the PI's facility or a mutually agreed upon location.
2. The review is attended by ESTO management staff and an independent technical reviewer from an organization separately funded by ESTO.
3. Use the Quad chart shown on the ESTO home page "Blue Button" (bottom of page at URL www.esto.nasa.gov) as the basis for the updated quad chart; show changes in the milestone schedule in parentheses.
4. The PI may provide a laboratory demonstration, if appropriate, to show technical results and status.
5. The PI shall report any educational and outreach components of the project, e.g., graduate degrees, educational activities; technology infusion or patents applied for or granted; journal or conference publications; presentations at professional conference, seminars and symposia; demonstrations; media exposure; and, other activities that contributed to the overall success of the research project.

The Annual Review is anticipated to last about 2 hours, including question and answer time; length of the Annual Review presentation may be tailored, as appropriate, depending on the amount of work to be discussed. The Annual Review should be comprehensive and should include a discussion of the planned content of the written report. The review package shall be uploaded to the appropriate location in the ESTO e-Book at least two (2) working days prior to the review. Upload any technical publications to e-Books under "Other Documents." The presentation, updated in accordance with comments and discussion resulting from the review, together with the separate Annual Report, shall constitute the Annual Report deliverable and shall be uploaded to the appropriate location in the ESTO e-Book within 10 days after the review.

2.4.4 Annual Report

The Annual Report shall include the following:

1. Results of all analyses, element, subsystem, or system designs, breadboards, and/or prototyping implementations and designs.
2. Performance analysis results of tests and/or demonstrations; estimation of reduction(s) in size, mass, power, volume and/or cost; improved performance;

description of newly enabled capability; and documentation of technology dependencies.

3. Tables, graphs, diagrams, curves, sketches, photographs, and drawings in sufficient detail to comprehensively explain the results achieved.

4. An updated TRL assessment.

5. Updated Quad Chart.

The Annual Report, updated Quad Chart, and updated TRL assessment shall be uploaded with the updated Annual Review presentation to the appropriate locations in the ESTO e-Book within 10 days of the review. NOTE: For grant recipients, the annual report must include the required cover sheet. The period of performance on the cover sheet is the grant anniversary date, not the review date. This cover sheet is required in order to continue the grant should NASA elect to do so.

2.4.5 Final Review

The PI shall provide a Final Review at the completion of the activity. The Final Review is similar to the Annual Review and includes all of the products required at the Annual Review, with the following exceptions:

1. The Final Review must provide conclusions of the work performed and make recommendations for follow-on activities that should be pursued, and, if appropriate, with estimates of the cost and schedule required to achieve TRL 7.

2. Provide a final Accomplishments Chart which contains the following information (a template is available in the e-Book):

   - Upper Left: “Description and Objectives”
   - Upper Right: A visual, graphic, or other pertinent information
   - Middle: “Accomplishments”
   - Bottom: “Co-Is” (name and affiliation), “Entry TRL,” and “Exit TRL.”

3. Provide a final Accomplishments Chart which contains the following information (a template is available in the e-Book):

Future work plans need not be presented.

The length of the Final Review presentation will be tailored, as appropriate, depending on the amount of work to be discussed. The Final Review should be comprehensive and should include a discussion of the planned content of the written report. The review package shall be uploaded to the appropriate location in the ESTO e-Book at least two (2) working days prior to the review. The presentation, updated in accordance with comments and discussion resulting from the review, together with the separate Final Report, shall constitute the Annual Report deliverable and shall be uploaded to the appropriate location in the ESTO e-Book within 10 days after the review.

2.4.6 Final Report

The written Final Report shall include all of the elements of the Annual Reports with the following exceptions:

1. In addition to the updated TRL assessment, provide a rough order of magnitude cost and a description and estimate of the duration of the follow-on activities necessary to achieve TRL 7, if appropriate.

2. A final Accomplishments Chart.

The Final Report, Accomplishments Chart, and updated TRL assessment shall be uploaded with the updated Final Review presentation to the appropriate locations in the e-Book within 10 days of the review.

2.4.7 Earth Science Technology Forum and Workshops

The awardee is encouraged to participate in the annual Earth Science Technology Forum (ESTF). The ESTF is an opportunity for NASA planners, managers, technologists, and scientists to review the research funded by the ESTO. It is also an opportunity for researchers from NASA, academia, and industry to meet with their peers and to better understand NASA Earth science requirements.

During the course of the technology development, PIs or their representatives are expected to participate in ESTO Earth science information systems technology workshops to advance information sharing on components and concepts. Follow-on efforts are envisioned to identify candidate Earth science scenarios that will benefit from information systems technology concepts and approaches and that can be prototyped to demonstrate those benefits through collaboration and science participation.

Travel expenses will be provided for non-Government awardees selected to participate in the ESTF and information systems technology workshop(s). A travel charge number will be provided to NASA awardees selected to participate; an invitational travel order will be issued to other (non-NASA) Government awardees selected to participate. Therefore, no travel costs for participation in the ESTF or information systems technology workshop(s) should be included in the proposal. If selected for participation in the ESTF, the awardee should be prepared to make a presentation, provide a paper, or create a poster providing a description of the project, the objectives, approach, technical status, and schedule information.

3. Summary of Key Information

Expected program budget for first year of new awards	~ $8.3 M
Number of new awards pending adequate proposals of merit	~ 20-25
Maximum duration of awards	Technology development: Minimum 1-year / Maximum 3-year awards. Technology development with infusion option award limits: Minimum 2-year / Maximum 4-year.
Supplemental EPO Eligibility	Yes, for awards >1 year; see Appendices E.5 and E.6
Due date for Notice of Intent to propose (NOI)	June 17, 2011
Due date for proposals	August 12, 2011
Planning date for start of investigation	6 months after proposal due date.
Page limit for the central Science-Technical-Management section of proposal	Technology development: 15 non-reduced single-spaced typewritten pages; see also Chapter 2 of the *NASA Guidebook for Proposers*. Technology development with infusion option: an additional 5 non-reduced single-spaced typewritten pages; see reference above.
Relevance	This program is relevant to the Earth science strategic goals and subgoals in NASA's *Strategic Plan*; see Table 1 and the references therein. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.

Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH11ZDA001N-AIST
NASA point of contact concerning this program	Michael Seablom Earth Science Technology Office Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0442 Email: Michael.S.Seablom@nasa.gov **[Changed April 22, 2011]**