

**NASA EARTH SCIENCE
2007 SENIOR REVIEW**

Evaluation of Education and Public Outreach

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INTRODUCTION

The Education and Public Outreach (E/PO) panel met on April 17 through April 18, 2007 to review the E/PO component of proposals for extended missions for ACRIMSAT, Aqua, CloudSat, EO-1, GRACE, ICESat, Jason, QuikSCAT, SORCE, Terra, and TRMM. The request for E/PO plans was in response to the following language in the senior review proposal call:

All of the Earth Science flight missions have implemented E/PO activities to various degrees, and these efforts are critical to the successful integration of the science results to the broader scientific community, educators and the public. The Science Mission Directorate is committed to continuing support for education and public outreach as an inseparable component of our overall scientific mission.

In preparing the E/PO Section, you should familiarize yourselves with the Earth Science education and outreach plans (<http://science.hq.nasa.gov/research/epo.htm>). Two elements should be included in the E/PO section. First, summarize what has been accomplished in previous years, and in particular since the 2005 Senior Review. Second, describe your plans for the period covered by this proposal. Characterize your planned activities against the evaluation criteria described in the following paragraph for E/PO programs within the Science Mission Directorate. Include a detailed budget breakout as shown below. Tie your E/PO budget to those plans and provide a detailed budget narrative including details on the level of effort, travel, and equipment requested. Summarize the capabilities of key team members and partners. An expenditure of approximately 0.5% - 1% of the total budget request (or \$15,000 per year, whichever is higher) is considered reasonable; however, variation from this guideline is allowed if it is justified.

The E/PO evaluation criteria include Intrinsic Merit (Quality and Feasibility, Customer Focus, Partnerships/Leverage/ Sustainability, and Evaluation), Relevance to NASA's Education Objectives (Content, Pipeline, and Diversity), and Cost (Resource Utilization). They are of approximately equal weight. As in the science part of the proposal, collaborations and coordinated activities across mission and instruments are encouraged where they forward the Earth Science objectives of developing a better integrated picture of the Earth as a system. A more detailed description of indicators of alignment may be found at <http://science.hq.nasa.gov/research/guidelines.html#evaluation> or http://research.hq.nasa.gov/code_y/nra/current/NNH04ZYO006N/main.html#V.

REVIEW PROCESS

The panel, chaired by Larry Cooper at NASA HQ, was composed of science, education, and outreach specialists from universities and research organizations. Proposals were reviewed by three panelists, who submitted written reviews prior to the meeting. Each proposal was presented by the primary panelist, followed by comments from the secondary panelists and further discussion by the full panels. A consensus rating was determined by the panel and consensus review written up by the primary panels, read and approved by the secondary panelists before being finalized. Proposals were scored on a scale of 1 (poor) to 5 (Excellent). Final scores for proposals considered by the panel ranged from 1.67 to 4.0, with no proposal rating “excellent” overall. Proposals were not ranked overall, as there was no expectation that funding decisions for extended missions would be influenced by the quality of the E/PO component. Rather, the primary intent of the scores was to convey an adjectival rating for the proposal areas, as well as of the overall E/PO plan.

Mission	E/PO Budget (FY07 \$K)	% of Mission Costs	Score*	Recommendation
CloudSat	764.7	3.40%	4	Acceptable
SORCE	129.1	0.77%	4	Acceptable
Terra	566	0.77%	3.8	Acceptable
Terra “Plus”	2,556	3.25%		
Jason	631.6	3.81%	3.2	Acceptable with revisions
QuikSCAT	263.9	2.0%	3.2	Acceptable with revisions
ICESat	530.4	1.80%	3.0	Acceptable with revisions
TRMM	1,200	0.57%	2.8	Acceptable with revisions
Aqua	905.0	0.74%	2.6	Acceptable with revisions
GRACE	160	1.96%	2.4	Acceptable with revisions
ACRIMSAT	92.2	1.49%	2.2	Acceptable with revisions
EO-1	0	0%	1.8	Unacceptable

* Scores were based on: 5 – Excellent, 4 – Very Good, 3 – Good, 2 – Fair, and 1 – Poor.

COMMON ISSUES

The quality of the proposals was not correlated with the size of the mission or the E/PO budget. Small missions show the ability to do excellent programs when they are focused. With a few notable exceptions there still appears to be little synergy amongst the efforts. The 2005 Earth Sciences Senior Review Report noted:

The education and outreach components of each of the proposals often reflected a sub-critical set of activities. Further, contact with schools tended to be tied to the location of the PI or supporting scientists. Web pages were associated with specific instruments or maintained by centers. This seems problematic. The Review Team is not suggesting that

each investigator invest more time in educational activities. Rather, the Earth Sciences education and outreach effort might benefit from a more coordinated, central approach to web pages and the development of materials for dissemination, as well as efforts to connect with a broader community of teachers, as well as the general public. The Review Team also recognizes that these efforts have been recently reviewed by a separate panel and are only an ancillary part of the Senior Review process.

In a period with fewer resources available for E/PO [1-2% in 2005 to .5-1% in 2007], it would appear more important than ever that missions work together to optimize use of resources through collaborative efforts. It is suggested that the Earth Science Division convene a facilitated discussion of the mission E/PO personnel to lay out a set of Earth Science E/PO priorities that the missions could collectively contribute towards rather than each pursuing individual plans. The space science missions have successfully implemented this approach. Later this year, SMD plans to select an organization to help support the Earth Science division E/PO efforts. This would be an excellent opportunity to bring the Earth Science E/PO efforts into greater coherence for the next several years.

Lower rated proposals were commonly lacking in details about the planned efforts. [Some proposers utilized the bulk of the available pages to described the past accomplishments and didn't satisfactorily address future plans. More specific guidance in page usage should be considered for future calls.]

- ✘ Customer Needs Assessment and Evaluation plans were generally weak. Earth Science E/PO personnel could benefit from “professional development” (e.g., where to find well-vetted external/independent evaluators at reasonable cost, how to make it into a class project or thesis research as a low-cost alternative, etc.)
- ✘ Proposals that contained E/PO activities at the elementary level were weak across the board. Teachers and students in elementary grades are much more capable than “coloring books!” It is another case of the need for professional development (e.g., familiarity with the AAAS Atlas of Science Literacy).
- ✘ Although most missions submit their products to SMD E/PO Products Review before final production of large quantities, most products lack field-tests. We need to help connect the E/PO teams to capable and interested no cost test users (e.g., American Geological Institute, Council of State Science Supervisors, etc.).

The individual mission-by-mission E/PO assessments follow.

Individual Mission Assessments

ACRIMSAT

AcrimSat/ACRIM3 is a small satellite/instrument project measuring total solar irradiance.

Proposed E/PO activities are:

- ✘ Participating in Sun-Earth Connection Forum efforts through teacher workshops and professional development opportunities.
- ✘ Supporting the Solar System Ambassadors by providing a ready-to-give mission based presentation.
- ✘ Working with the Earth-Sun Museum Alliance to deliver a PD teleconference to support informal educators.
- ✘ Enhancing the website to include web stories which provide new content and add links.
- ✘ Reaching out to the media.

Comments:

The proposed activities are a modest effort that will leverage successful existing programs and resources. The requested funding is commensurate with the level of effort. Science team members will participate in E/PO (Solar System Ambassadors presentation, professional development informal science educators through Earth-Sun Museum Alliance, “Roger’s Corner” on the AcrimSat). ACRIMSAT leverages existing partnerships (SECEF, SOHO, Earth-Sun Museum Alliance, etc.) effectively.

The target audience needs were poorly explained. The project evaluation was ignored. The commitment and roles of partners were not well defined.

It is suggested that the project staff work to get ACRIM data into programs that provide Earth science data for use in K-12 classrooms (e.g., My NASA Data or S.ON/Sun-Earth Viewer) and/or provide stories to Earth Observatory.

The budget appears insufficient to properly support the variety of suggested works successfully in an effective and efficient way. It may be prudent to determine which strategy will best deliver the most exciting and important mission science messages.

Aqua

The Aqua mission is collecting information about Earth's water cycle. It consists of a spacecraft with six Earth-observing instruments (AIRS, AMSU, AMSR-E, CERES, HSB, and MODIS). Two of the instruments (CESE and MODIS) are also flown on Terra.

Aqua E/PO has consisted of instrument-specific E/PO and "Aqua-wide" E/PO activities. These activities have included Aqua Webcasts, the Student Cloud Observations On-Line (S'COOL) project, MODIS Rapid Response System, development of resources (e.g., Aqua Cool Science Website), The Magic Globe digital video globe, contributing Aqua data to ViewSpace (auto-updating, multimedia exhibits that are Internet fed and based on astronomy and Earth science), and visits to schools by Aqua instrument scientists.

The following enhanced mission activities are proposed:

- ✘ Science on a Sphere (SOS) – Develop specific Aqua content for SOS, as well as a formal education lesson.
- ✘ Climate@home – a "distributed climate modeling infrastructure" that allows thousands of volunteers to donate idle CPU time from their home computers to help NASA scientists conduct more climate experiments. This activity also features the use of three climate models that users can run, pre-canned experiments using the NASA GISS Education Global Climate Model (EdGCM), and instructional links.

Comments

Scientists, including the Aqua PI, have been actively involved in E/PO and past Aqua E/PO accomplishments have included some very successful efforts – e.g., S'COOL and MODIS RRS. However, the proposal was very difficult to review because insufficient detail was provided about which past activities are proposed to continue in the future, nor is sufficient detail provided to truly understand the appropriateness of the effort. The proposal does not provide personnel breakdown, roles, and responsibilities. No milestones, timeline, or plan of work are provided for the proposed activities.

The proposed budget is not broken down in sufficient detail to evaluate the appropriateness of the costs. A large proportion of the budget is identified for subcontracts but no details are provided about these subcontracts.

Evaluation is also not addressed and is an essential element of all NASA SMD E/PO projects. The panel noted that while it is important to evaluate individual activities, for an effort of this size it is also be important to evaluate the overall program and approach. One suggestion is consider contacting local Space Grant Consortium about helping with evaluation.

CloudSat

CloudSat collects cloud data. Their current E/PO efforts consist of the CloudSat Education Network and CloudSat web site. Schools collect cloud data (subset of GLOBE), both domestically and internationally, and feed this back to the project. The project also provides mentorships to schools. For the next phase of the project, they intend to expand on their existing efforts by adding more schools (with mentorships) and provide online standards-based research projects for elementary, middle and high school students. They will also continue to develop the CSU CloudSat web site and the NASA CloudSat Portal pages, as well as provide additional data analysis tools for students and CloudSat scientists.

Comments:

The CloudSat E/PO plan is based upon past successes and will be expanded through adding schools and developing online research projects for K-12 students. An external evaluation would help bolster their decision to expand the existing program to more schools. Teachers and students would benefit from the project's linking activities from their two web sites. There is concern that making the new online projects only available to GLOBE schools will limit the impact of the program.

EO-1

EO-1 was launched as part of the “New Millennium Program technology path-finding activities to enable more effective (and less costly) hardware and strategies for meeting Earth science needs in the 21st century.” Mission goals are to improve scientists’ ability to characterize terrestrial surface state and processes.

E/PO section describes accomplishments and past activities including:

- ✘ Project with 6 undergraduates and 12 graduate students who tested small wireless sensors for autonomous operations (e.g., sending signal to EO-1 instructing to image the location).
- ✘ An article published in ITEA magazine.
- ✘ Working with GSFC to develop junior college-level curriculum for STEM to train students for support roles in using remote sensing technologies.
- ✘ Participating in Open Geospatial Consortium (organization developing standards for geospatial and location-based services).
- ✘ Publications in technical journals and presentations at technical conferences.

Comments:

The previous E/PO work of the mission is commended, especially when there is no indication that this mission was conceived under a climate where E/PO was a required or an encouraged part of the operating plan.

However, there appears to be no funding in the extended budget for E/PO and the proposal does not provide adequate details as to how E/PO will be conducted in the future.

GRACE

The Gravity Recovery and Climate Experiment (GRACE) is a joint NASA and DLR mission whose purpose is to improve our understanding of the Earth's dynamical system by making pioneering measurements of the gravity signals associated with exchange of mass between its components.

E/PO is conducted across four organizations – University of Texas, GSFC, JPL, and GFZ. Plans are to

- ✗ Recruit 10 additional GRACE master teachers per year, with the goal of having a master teacher in every state by 2011.
- ✗ Implement detailed evaluation plan developed by outside source.
- ✗ Incorporate changes and enhancement to current curriculum, research and activities.
- ✗ Introduce 1,000 educators to GRACE models, maps and curriculum.
- ✗ Implement project-based training for leaders of youth-serving organizations.
- ✗ Distribute student packets to teachers by request (through website) and through workshops.
- ✗ Sponsor distance learning activities.

Comments:

GRACE education resources need to address comments from the SMD education products review (several have been reviewed, but needed revisions have not been submitted). This is important because the NASA portal will NOT link to any of their resources until they have passed the review.

Current GRACE education products should be revised with a focus on best practices before being used in further training of additional Master Teachers or other future E/PO efforts.

Design of web site delivery of project data and innovative use of the science of this mission should be the primary focus for change.

The panel recommends that the project staff further consider the recommendations of the 2005 Senior Review.

ICESat

The primary science objective of ICESat is to determine the current mass balance of the Greenland and Antarctic ice sheets and their contributions to sea level change. ICESat E/PO objectives are to:

- ✗ Promote past, present, and future of the ICESat mission through development of formal and informal education, and public outreach products.
- ✗ Develop formal and informal ICESat education products and materials to parallel IPY efforts.
- ✗ Get ICESat datasets and imagery into the hands of K-12 and university programs, students and educators.

Proposed E/PO efforts are:

- ✗ ICESat Cryospheric Mosaic Poster
- ✗ ICESat Lithograph
- ✗ ICESat/IPY museum display
- ✗ ICESat DVD – similar to Tour of the Cryosphere, focusing on how ICESat visualizations and measurement are used to focus on topics such as global warming, sea-level rise and other environmental parameters.
- ✗ ICESat Visualizations/Animations (stand alone and can be used on DVD)
- ✗ Current Partnerships – continue current partnerships, which will lead to creation of ICESat material. (NSTA, Signals of Spring, NASA Earth Observatory, NEO, Science on a Sphere, and Texas Space Grant Consortium)
- ✗ Future Partnerships: Journey North, Go North, GLOBE, and History of Winter.
- ✗ ICESat Web Suite – redesign and update website, including a more comprehensive E/PO section (add activities and lessons developed via partnerships).

Comments:

The scope of the proposed effort is aligned with the mission science and appears consistent with the overall budget.

The poster and lithograph products seem targeted for too broad an audience to be educationally effective. It is strongly recommended to target a narrower audience and design the products to meet that audience's unique needs.

Jason

Jason is a follow-on mission to TOPEX/Poseidon (T/P) with a primary goal of extending the T/P measurements for studying global ocean variability on decadal scales. Jason's E/PO efforts consist of workshops, lectures, web site and the Argonautica project. They appear to rely on the efforts of senior staff on the project to interface with the schools audience and with higher education. In their new program, they plan to develop ocean literacy activities, continue work on the Argonautica project, conduct educator workshops, and generate educational material for the informal audience. They will also continue to participate in Science Bowls, the JPL Open House, web sites, and speaking engagements.

Comments:

Jason's E/PO plan involves many relatively small projects and many partners, which makes it difficult to have any significant impact on a specific target audience. The effort would benefit by external evaluation of all the projects, working with the entire COSEE network, a greater effort in improving their programs, and more than just a half-time E/PO staff person.

QuikSCAT

QuikSCAT provides global ocean surface wind vectors and wind stress observations for science applications such as ocean and climate model forcing, air-sea interaction studies, and hurricane studies. Data are also used in weather prediction models, sea –ice monitoring, estimates of snow accumulation over ice sheets, and tracking icebergs.

QuikSCAT’s E/PO proposes to work with pre-college programs, teacher workshops, student career nights, digital learning network, and the Explorer schools program. They are also addressing the needs of the informal education audience through the Earth Science Museum Alliance, JPL’s Open House, and through a media campaign.

Comments:

Overall, the prior work appears to have been of good quality, appropriate content, and conducted with solid partners.

The proposed scope for future E/PO is very ambitious, but the budget seems inadequate to accomplish the goals. The mission should consider narrowing the scope of their programs and focus on a tighter audience with fewer projects. Partnerships with other missions should be further explored. Inadequate details are provided to completely ascertain the structure, customer needs, and eventual impact of the future work.

SORCE

Solar Radiation and Climate Experiment (SORCE) simultaneously measures total solar irradiance (TSI) and solar spectral irradiance (SSI). SORCE successfully completed 4 years of its 5-year core mission (January 2003 to January 2008), contributing unique new observations and understanding of solar radiative forcing of Earth's climate and atmosphere during the descending phase of solar activity cycle 23.

The E/PO proposal is for an Undergraduate Data Analysis Program (UDAP), which will support 3 undergraduate students each summer (for 8 weeks) who will work with SORCE scientists on research projects. UDAP students will join 12-15 other undergraduates who will be participating in the NSF REU (Research Experiences for Undergraduates) program at LASP.

Comments

The plan is well constructed and addresses recruitment, evaluation, diversity, and other important factors. The project staff should ensure participant awareness of NASA support for the students in the REU program.

Note: NASA E/PO funds may only be used to support underrepresented and/or underserved participants at the college level.

TERRA

The Terra mission consists of the Terra satellite and five instruments, each with its own team, taking complementary measurements of atmosphere, land, cryosphere, and ocean.

The Terra E/PO objective is to “share the new knowledge and Terra’s data products through customer-oriented activities designed to inspire engage, educate, and employ our target audiences.”

Proposed future Terra E/PO builds on previous accomplishments and includes:

1. Basis Mission E/PO Continuation

- ✘ Formal – S’COOL and My NASA Data – will incorporate data from all five Terra instruments; use to create “multi-disciplinary, inquiry-based ESS exercises for K-12 teachers and students.”
- ✘ Informal – Continue support for science centers and museums through Earth-Sun Museum Alliance and IGLO. Includes access to NASA Terra data and fostering partnerships and the use of Terra data products and resources (e.g., NEO).
- ✘ Outreach – communicate science data and results to public and stakeholder communities (including education). Includes publishing new data and science results through feature articles in NASA’s Earth Observatory and Visible Earth, and making Terra data available through MODIS Rapid Response System.

They also include a number of E/PO elements for “optimal” overguideline E/PO funding

- ✘ Data Browser Independence – build “back-end bridges” so that users Terra data, imagery, and information can use the interface of their choice (e.g., ESRI tools, Google Earth, World Wind, etc).
- ✘ Tools Data, and Lessons for Higher Education – work with existing partnership (Integrated Geospatial Education and Technology Training) to augment access to and tools for using MODIS, MODIS RRS, and ASTER data by 2-year colleges (community colleges and tribal colleges).
- ✘ AEON and the On-Line Guide to Amateur Earth Observation – convene a NASA-wide workshop at NASA ARC; participants would include informal science educators from outside NASA, as well as NASA scientists and E/PO personnel.
- ✘ Terra Science Story Theater – Augment developing infrastructure for science storytelling and video jukebox by developing stories with visualizations that can be used in a variety of public institutions with which NASA partners
- ✘ Joint Terra E/PO Coordinators – Split Terra E/PO management among three people – Lin Chambers (LARC), David Herring (NASA GSFC), and Karen Yuen (JPL).
- ✘ Earth& Sky Podcasts – Earth & Sky will produce 12, 15-minute podcasts of Earth Observatory feature stories, which would be broadcast on Earth & Sky and Earth Observatory Websites.

Comments

The proposal identifies a budget breakdown by activity with two activities in the Basic Mission E/PO Continuation budget and additional activities for an Optimal E/PO budget.

Overall this is a strong proposal. The Terra E/PO team has a proven track record for implementing very successful NASA E/PO programs and resources that promote wide access and use of NASA Terra science, data, and imagery by all levels of E/PO audiences.

The panel encourages the Terra E/PO team to work collaboratively with other missions. The activities that they propose under the Project-Led Enhanced Science Mission would enable multi-instrument and multi-platform data fusion, and would be valuable tools for other missions. These tools could serve as models across many SMD missions.

The panel also strongly recommends that the project conduct an overall Terra E/PO program evaluation. Evaluations are planned for individual elements (mostly consisting of user surveys), but not to evaluate the overall program and approach.

TRMM

TRMM collects data on tropical rainfall. They intend expanding this effort in future years to measure global rainfall. Their existing education and public outreach programs consist of a web site with maps, visualizations, educational materials, links to datasets and a database of research papers. They also have science vignettes, which are downloadable from their website. In their new plan, which is designed to cover the Outreach portion of E/PO, they intend continuing and expanding their existing programs.

TRMM proposed to address the Education aspect of E/PO through a separate proposal into NASA ROSES.

Comments:

There are very few details about the Outreach plan, which is essentially a continuation of past efforts. What is proposed appears manageable.

The formal and informal education efforts were dependent upon funding by a NASA ROSES proposal and there was no discussion of the plan impact if the proposal was not funded? If the ROSES proposal is funded, the panel recommends that the project contract with professional curriculum developers, rather than use teachers to develop the middle school materials.