Earth Science Subcommittee Report
November 27 and 28, 2012
NASA Headquarters

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To: Dave McComas (Chair, NAC Science Committee)

Cc: Jens Feeley (NAC Science Committee Executive Secretary), Michael Freilich (ESD Director), Peg Luce (ESD Deputy Director), Jack Kaye (ESD Associate Director for Research), Stephen Volz (ESD Associate Director for Flight Programs), Lawrence Friedl (Associate Director for Applied Sciences), Lucia Tsaoussi (Earth Science Subcommittee Executive Secretary)

Dear Dave:

The Earth Science Subcommittee (ESS) met on November 28 and 29, 2012 at NASA Headquarters. The presentations include the status of the Earth Science Division in the context of: 1) the proposed FY13 budget, and the possible impact of budget perturbations from the impending sequestration discussions, 2) the division plans related to the mission launch requirements, including issues with the availability and cost of the launch vehicles, 3) developments in the NPOESS and JPSS programs, 4) a discussion of the Data Center Study introduced by the IT Committee for updating the NASA Science Directorate Data Management and Distribution capabilities and 5) a review of the findings and recommendations from the NRC Midterm Review of the Earth Science Division response to the 2007 Decadal Survey. The ESS also received the annual ethics briefing during the meeting.

Michael Freilich, ESD Director, gave a comprehensive briefing on the status of the ESD program including a discussion of the budget status, the orbiting satellite constellation, a selection of science highlights from the observations provided by this constellation, the status of the Venture Class program, the current mission development plans and the ESD Science activities planned for the ISS. The details of FY 2013 budget were not available. However, the budget is projected to be stable for the next several years and, although there are some important deficiencies, there is funding for a healthy program. NASA continues to fly the pre-eminent constellation of Earth Observation Satellites, but there is concern that most of the satellites in the current constellation are well past their nominal mission lifetime. Appropriate aircraft operations compliment the ESD satellite program and ground based measurements and the measurement programs are augmented by an extensive R&A Program with both Earth System Processes and Climate Change elements focused on Earth System Dynamics. The overall science analysis program is augmented by a developing applications program. The discussion of the presentation led to the following finding.

Finding: The ESD program, as formulated, is well balanced, robust and is providing significant science return from the orbiting assets. With, the current budget level, most of the program goals are achievable.

There were concerns with some elements of the program, including the implementation of missions in the Earth surface topography area and the general availability of access to space. As noted in past reports, the availability of acceptable launch vehicles is one of the more significant problems facing ESD. Launch vehicle reliability, capability and cost pose significant challenges. In past assessments, a major concern was focused on the availability of mid-class launch vehicles, but current assessments include the lack of availability of the small launch vehicles required for the Venture Class missions.

Finding: Given the limited availability of vehicles for LEO missions, the impact that the launch vehicle availability continues to have on the overall science program and the concern for increasing activity in the Venture Class program, ESD should continue an effort to identify options for launching small satellite and small payloads to LEO orbits.

The potential impact on the ESD budget from the current national budget debate was discussed. Approaches for coping with any budget reductions were discussed in the context of the overall principles that ESD should use. The discussion noted that the maximum impact to the vitality of the current science program would occur if a reduction was implemented by uniformly reducing all elements, with the consequence that all program elements would be delayed. To minimize the impact of a budget reduction, the committee agreed that ESD should adopt a strategy of focusing on specific program elements to accommodate any budget reduction. The ESS assessment of the proposed reduction should be available prior to the budget reduction implementation.

Finding: In the context of a directed budget reduction, the ESD should pursue a strategy of reducing the funding for specific program elements rather than accommodating the budget reduction by distribution across all budget elements. The ESS should review the program element eliminations prior to implementation of the budget cuts.

In the continuing concern about the JPSS program, the committee notes that the Suomi National Polar-orbiting Partnership mission is operating successfully. It is important to ESD objectives in that the satellite collects and distributes remotely-sensed land, ocean, and atmospheric data for both meteorological and global climate change studies and is planned to provide continuation of the measurements provided by the EOS Earth-observing missions The continuation of both the instruments and the processing standards for the measurements provided by the instruments under the JPSS program are of concern.

One of the primary objectives of the EOS measurements was to initiate what are now called Climate Data Records (CDRs). The CDRs are long term measures of the Earth System designed to detect critical changes. After data records up to 14 years generated by the EOS instrument measurements, long-term continuity of theses measurements has been assigned to JPSS. The original suite of EOS data products has expanded with new experimental products, but the value of the some of the new data products for long-term climate science is variable. In the international planning by CEOS and GEOSS, general lists of CDRs have been generated. However there has not been a sensor specific, product-by-product evaluation of the suite of products to determine which of the current EOS data products should be prioritized for JPSS continuity as climate data records. The committee re-iterates its concerns regarding the continuation of the essential EOS climate measurements by the JPSS. Specific questions concern which of EOS data products will be continued in the transition of the current data products to the JPSS and the processing standards to which the sensor data will be processed.

Recommendation: NASA should convene a review committee to evaluate current regularly produced data products from the Terra, Aqua and Aura platforms, and identify and prioritize which data products to explicitly continue in the JPSS era. This activity should not preempt experimental algorithm development, but should focus on identifying and prioritizing the set of existing EOS data products that must have continuity and identifying the processing standards

to be used in the creating the products.

The ESD Airborne Science Program (ASP) overview was presented by Michael Freilich, Jack Kaye and Bruce Tagg. The ASP plays an important role in the overall observation program. The program provides cal/val data for satellite observations and allows the collection of regional data with higher spatial and temporal sampling than is possible with satellite data. The airborne science data supports Earth System process studies and model validation, plays a fundamental role in space sensor and remote sensing technology development and demonstration and supports application efforts related to hazard response.

The program contains a mix of manned and unmanned aircraft assets. The unmanned or UAV assets have demonstrated long flight times that can be utilized to increase range or to increase observation time over a given region. A current concern focuses on the cost/benefit of the UAVs as compared with manned piloted aircraft. The large number of personnel needed to maintain and operate UAVs impacts the UAV operating costs. This is driven by a lack of fully autonomous control and command systems as well as the use of Department of Defense (DoD) operating procedures. The manned aircraft costs are directly related to the cost of the labor required to operate and maintain the aircraft as well as the cost of fuel. The unmanned aircraft are not considered as a replacement for all scientific and operational applications. Instead, they are targeted for specific scientific applications, such as the sounding of the large East Antarctic ice sheet and fast-flowing glaciers and operational applications, such as hurricane landfall, monitoring of floods and fires where continuous coverage is required. The discussion indicated the need for a detailed cost benefit assessment of the UAVs versus the manned aircraft utilization

Recommendation: It is recommended that an external review of the Airborne Science Program be conducted to clarify the science objectives and to establish a cost/benefit basic for future program decisions. The review should recommend criteria to establish when the science return justifies the added cost of using the UAV.

The status of the Land Surface Geodetic Imaging Missions was discussed in the context of the delay in the DESDnyl mission. The level of the technology required to conduct the mission—primarily an all weather L-band radar— will provide effective support of many of the science goals. The scientific requirements for such a mission have been formulated and refined over the past 20 years within the context of numerous studies and several proposals that were invariably very highly rated. Most recently, the proposed mission (DESDynI) was highly rated as a Tier 1 mission in the Decadal Survey, and was proposed as an element of the NASA ESD Climate Initiative. However, due to overall cost and directed budget reductions, the mission has been delayed. The community of potential users is large and vibrant, as evidenced by over 100 institutional members of the WInSAR data consortium (winsar.unavco.org). One unfortunate consequence of the delay is that the large base of US researchers have tended to focus their interests elsewhere, and are hesitant to encourage students to work in this field. The ESS Subcommittee appreciates the efforts made by ESD to maintain a "budget wedge" in order to sustain a pre-mission formulation level of effort for a 2021 "L-band SAR" mission, but remains concerned that the leadership for research and development in this arena has *de facto* shifted abroad to Japan and Europe.

Finding: ESS should receive a briefing by ESD, focused on plans to address this need. In particular:

What are the lessons learned, concerning the various reasons for the delay?
What should be expected from the scientific community that has not been done?
What are missed opportunities, and what is the scientific cost thereof?
What are practical plans to remedy the situation, and on what time scale?

In a briefing by Kass Green, the Chair of the Applied Sciences Advisory Committee (ASAC), the recent activity of the ASAC was summarized. The objectives of the ASAC are to: 1) Enhance applications research so as to advance the use of NASA Earth science in policy making, resource management and planning, and disaster response, 2) Increase collaboration by establishing a flexible program structure to meet diverse partner needs and applications objectives and 3) Accelerate applications by ensuring that NASA's flight missions plan for and support applications goals in conjunction with their science goals.

To address this concerns related to including application requirements in the program formulations, the ESD created a Program Applications lead for missions; added language to the L1Requirements Document (L1RD), added content to the mission SDT, and initiated a study of data latency. The Program Applications (PA) lead is responsible for bringing an applications perspective into early mission planning. An ESD study on data latency identified capabilities, requirements, and user needs, and examined possible methods and mechanisms to deliver data for meeting data latency targets. It was noted that rapid response is not an ESD mandate, but NASA does have the responsibility to bring assets to bear if possible.

Finding: The ESS finds that the steps taken by ESD are important steps in ensuring that the maximum utility of the satellite data occurs. The ESS endorses the role of the program application lead and believes that, where possible, providing the sensor data availability with short latency is an important step in ensuring its full utility.

The next ESS meeting/telecon is planned for June 2012.

Sincerely,

The Earth Science Subcommittee
Byron Tapley, Chair