Earth Science Subcommittee Report
January 17-18, 2008 Meeting
NASA Headquarters

From: The NASA Earth Science Subcommittee – Daniel J. Jacob (chair, djacob@fas.harvard.edu), Roni Avissar, John R. Christy, Lisa Curran, Jonathan Foley, James Hansen, Gregory Jenkins, John Jensen, Patricia Matrai, Julian McCreary, Jean-Bernard Minster, Michael Ramsey, Kamal Sarabandi, Mark Simons, Konrad Steffen, Edward Zipser
To: Edward David, Jr. (Chair, NAC Science Committee)
Cc: Greg Williams (NAC Science Committee Executive Secretary), Michael Freilich (ESD Director), Bryant Cramer (ESD Deputy Director), Jack Kaye (ESD Associate Director for Research), Stephen Volz (ESD Associate Director for Flight Program), Teresa Fryberger (Associate Director for Applied Sciences). Lucia Tsaoussi (Earth Science Subcommittee Executive Secretary)
Date: February 6, 2008

Dear Dr. David:

The Earth Science Subcommittee (ESS) met on January 17-18, 2008 at NASA Headquarters. We received updates on ESD and NPOESS (Michael Freilich), SMD (Alan Stern), CCSP (Jack Kaye), and the NRC Decadal Survey missions (community workshop chairs, costing information from Stephen Volz). We received briefings on Data and Information Systems (Martha Maiden), geodetic networks (John LaBrecque), and the Ocean Biology and Biogeochemistry research program (Paula Bontempi).

Our summary recommendations are presented in bold. Two of the recommendations, "**Cost Analysis for Earth Science Missions"** and "**Support and Communication of ESD's role in CCSP"** are specifically for you to transmit to the NAC and we elaborate on those in Appendices following the standard format.

Central in our discussion at the meeting was the ESD implementation plan for the Decadal Survey (DS) missions. We stressed in our past two reports the importance of the DS as a well-thought ensemble of 14 strategic missions for advancing Earth Science and addressing societal concerns over the next decade. We pointed out that the current ESD funding levels do not allow for implementation of the DS at a reasonable pace. We recommended that resources for an Earth Science Initiative be found, either within or outside NASA, to enable implementation of the DS. This Initiative would involve a 30% increase in ESD budgets, i.e., a restoration to 2000 levels. Our recommendation was transmitted in August 2007 by the NAC to the Administrator with the title, "Action on NASA Earth Science Initiative Needed by FY09". The short description of that NAC recommendation read, "NASA should present to the Science Committee at the February 2008 Meeting (once the FY09 budget comes out) the revised Earth Science plan, including independent cost comparisons, and a comparison of the FY 09 budget elements with the 2007 NRC decadal survey recommendations, along with accompanying rationale."

Unfortunately, the January timing of our meeting preceded the release of the FY09 budget. We have since been apprised of that budget but FACA rules prevent us from

commenting on it here. We will discuss the implications of the FY09 budget for implementation of the DS at our next meeting in May/June 2008.

We had been hopeful at our last meeting in June 2007 that the FY08 budget would begin to move NASA toward implementation of the DS. We were sorely disappointed. Although Congress stated the importance of implementing the DS in its setting of the FY08 budget, the new wedge of $33M allocated to start "seven DS missions" is not a practical level of funding for this purpose. There is also an alarming lack of support within SMD. Congress allocated a $24M R&A increase to SMD but only $3.4M of that increase (14%) was distributed to ESD, a much smaller share than ESD's overall share of the SMD budget (27%), and even though R&A is a larger relative fraction of the budget in ESD than in other science divisions. Further adding to the injury, the ESD budget was cut by $47.7M due to $81M rescission to SMD. The bottom line for FY08 is a continued erosion of ESD resources, at a time of unprecedented societal concern over Earth Science issues. We endorse and applaud the requirement by Dr. Stern that R&A be shielded from these budget cuts. But the FY08 cuts to ESD have to be applied somewhere, and they translate into further inability for ESD to implement the DS. **We are dismayed by the continued cuts in the ESD budget for FY08, at a time of unprecedented urgency for Earth Science research and in a situation where NASA's satellite observation capabilities represent an invaluable asset. We are counting on the NAC to follow up on its "Action on NASA Earth Science Initiative Needed by FY09" recommendation.**

An Earth Science Initiative will require parallel effort by ESD to increase its budget efficiency. Two specific issues discussed at our meeting were: (1) the perceived high cost of Earth Science missions relative to Space Science missions (this issue was raised by Dr. Stern); (2) inefficiencies in moving money from ESD to grantees and contractors (with the resulting damage from budget rescission). It is not clear to us that Earth Science missions are actually more expensive than Space Science missions, but the concern expressed by Dr. Stern needs to be addressed urgently through a broad cost analysis. We believe that part of the higher cost of Earth Science compared to Space Science missions may be due to the much higher degree of precision and resolution demanded for Earth Science missions in order to provide effective information. Also to be considered is that Earth Science missions tend to last longer than Space Science missions and to generate a larger amount of data and publications. But there may be additional important factors contributing to the high cost of Earth Science missions including choice of launch vehicles, mission risk tolerance, balance between industry and NASA centers in mission implementation, inefficient combinations of instruments on platforms, etc. These factors need to be aggressively investigated. Using smaller launchers (with acceptance of increased mission risk) seems to be specifically in need of consideration. **We recommend the formation of a blue-ribbon panel to analyze the cost of Earth Science missions and identify opportunities to reduce mission costs. A good place to start would be the cost estimates produced by NASA for the NRC Decadal Survey missions.**

Another serious problem is the slow flow of money from ESD to grantees, combined with slow spending rate at the grantees' institutions, resulting in substantial unobligated funds subject to rescission. An important difference here between ESD and the other SMD divisions is that it has many more grantees, making it more challenging to track individual grants and allocation/spending rates. The large number of grantees reflects the large body of users of Earth Science products, involving a wide range of applications. Dr. Stern suggested

that consolidation of grants to individual institutions might help. This would have to be done in a way that does not impose undue burdens on the institutions and does not compromise the independence of individual investigators. Lengthening the duration of grants might also help but has the negative impact that it decreases opportunities for competition. Funding commitments earlier in the FY for proposals having fared well in peer review and thus well within the expected budgetary envelope would help, and we commend ESD for beginning to implement this practice. Most institutions will allow pre-spending on grants with a funding approval letter from NASA but only if it includes a funding amount. One possibility would be to provide a minimum funding amount in the letter, to be augmented once the FY budget is finalized. We note also that ESD accounting support staff at HQ has shrunk greatly over the past two decades, making it more difficult to distribute money in a timely way. Grant processing through the NASA Centers adds yet another bottleneck. Overall, this is a complicated problem with many possible solutions. **We recommend the appointment of a panel to review accounting practices for ESD grants and to make specific recommendations for improving spending rates.**

ESD presented us with funding statistics for the latest R&A ROSES competitions. We were thoroughly impressed that ESD has been able to maintain a satisfactory funding yield (~30% of submitted proposals) despite its budgetary difficulties. This success reflects excellent management of the ROSES AO process. We also appreciate the focused effort being made by Drs. Freilich and Kaye to shorten the time for funding decisions.

We commend ESD for moving aggressively to implement the DS mission agenda through community workshops and detailed costing of the first cohort of DS missions (SMAP, DESDynI, ICESat-II, CLARREO), as well as initial costing activities for the second and third cohorts. Among the first cohort, it appears to us that SMAP, DESDynI, and ICESat-II have a high level of technological readiness and mission definition as well as broad community support. The CLARREO mission seems to require further definition of what it aims to achieve and of its mission requirements. For example, does it entail a long-term commitment to high spectral resolution monitoring of the outgoing IR? That mission also needs more buy-in from the climate modeling community that it is intended to serve. The ESD cost estimate for CLARREO ($437M) has come out much higher than the DS estimate ($206M), so that it isn't a low-cost mission anymore. **We recommend that ESD continue to move aggressively in the implementation of the SMAP, DESDynI, and ICESat-II missions. The CLARREO mission needs further definition.**

In our June 2007 letter we stressed the need for considering different possible configurations of the DESDynI and ICESat-II missions to improve cost efficiency with least compromise for science. We were disappointed that this idea was not sufficiently explored in the community workshops and again recommend attention to this issue. The main issue is the vegetation lidar on DESDynI. The presence of this lidar on a shared platform with the InSAR requires compromise on mission orbit and also drives up the cost and risk of DESDynI. Would the vegetation lidar be better located on ICESat-II? To what extent does the vegetation lidar actually add to the vegetation mapping capability of the ICESat-II lidar? We understand that it is better, but how much better? Should the vegetation lidar be a free flier? **We believe that consideration of different possible configurations for the DESDynI and ICESat-II missions requires further attention and urge the ESD Mission Program Office to explore this issue to improve both scientific and cost return.**

A pressing issue for ESD is to develop an acquisition strategy for these first three missions. Dr. Freilich presented to us two possible options for an acquisition strategy, one involving independent analysis and decision by the ESD Mission Program Office, and the other involving competing mission proposals by the NASA centers. The first option seems clearly preferable to us because of (1) the need at this stage to explore the individual mission configurations further and to seek general options to decrease mission costs (see recommendation above), and (2) the need to set up a pipeline as quickly as possible and release the first mission AO by FY 09 if possible. **We recommend that the ESD Mission Program Office proceed without delay to optimize the configurations of the SMAP, DESDynI, and ICESat-II missions, seek opportunities to reduce costs, and set an order and pipeline for these missions.**

We commented in previous letters on the delay in the implementation of the DS and how this irretrievably compromised consideration of the ensemble of 14 DS missions as a realistic package to be implemented over the next decade. The DS insisted on the importance of viewing the 14 missions as a synergistic ensemble that addresses in a minimum yet effective manner the top priorities for Earth Science, and specifically warned against cherry-picking of missions in the list. We commend ESD for moving aggressively toward implementing the first cohort of DS missions. At the same time, it must be recognized that this cohort serves only a subset of Earth Science research areas and that support of other areas cannot be provided on the basis of an expected schedule for launching the second and third cohorts of DS missions within the DS time horizon (2020). The presentation by Dr. Bontempi on the needs of the ocean biology research community was a clear call to action in that regard. The atmospheric composition community is in a similar position. Specific actions should involve active international partnerships with other space agencies, consideration of Venture-class missions, sustained R&A support for research using existing and past sensors, and rethinking of long-term mission priorities. **We recommend that ESD establish Working Groups in its focus areas not served by the first cohort of DS missions in order to rethink short-term and long-term opportunities for satellite missions, including collaborations with international partners, in the context of evolving science goals.**

We were glad to hear from Drs. Freilich and Stern of ESD's commitment to a Venture-class mission line. Dr. Freilich raised the issue of whether the AOs for these missions should restrict opportunities to measurements not included in the ensemble of DS missions - for example, should a mission proposal be considered responsive if it offers to carry out half a DS mission for half the price? This is indeed a concern for the first cohort of DS missions; however, the second and third cohorts will most likely be delayed beyond the DS 2020 horizon and thus having a new opportunity to deliver critical science from those cohorts in a timely manner could be of considerable interest. **We recommend that AOs for Venture-Class missions not exclude measurements to be provided in the second and third cohorts of DS missions.**

We received a briefing from John LaBreque on geodetic networks. A general problem affecting all Earth Science missions is the current decay of geodetic networks that monitor accuracy of satellite orbits and the maintenance and improvement of reference frames. **We recommend that ESD constitute a panel to examine the future outlook for geodetic networks and advise on actions to be taken to protect this network.**

We received an update from Dr. Freilich on the status of climate sensors on NPOESS. We were glad to see that the current NPOESS plan restores the continuity of critical climate sensors. We look forward to another update at our next meeting. Preserving the long-term records from critical climate sensors requires continued vigilance.

We received a briefing from Ms. Maiden on NASA's Information and Data Systems program. We were impressed by the success and clear sense of direction of that program. It has been able to manage efficiently the growing inflow of satellite and model data to serve the Earth Science research community in a free-access environment. The number of users has increased much beyond the original projections, and the system has been able to adapt superbly to this changing load. We find it particularly impressive that the program has been able to maintain and improve its service with decreasing financial requirements. We are a long way from the EOSDIS problems of less than a decade ago!

The DAAC system managed by the Information and Data Systems program is arguably the largest distributed data curation and dissemination system ever implemented worldwide. NASA has created a unique resource to support Earth System research. Given the exponential growth in bandwidth technology worldwide -- with a doubling time half that of IC density -- there is an opportunity for NASA to lead in the applications of this technology to the management of distributed data systems. **NASA's Information and Data Systems program should continue exploring active partnerships with the very high-bandwidth engineering community in order to facilitate the emergence of very large worldwide data systems.**

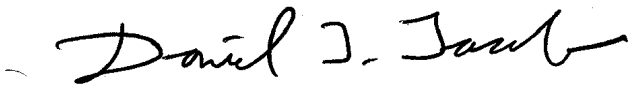
One of the underpinnings of NASA's data policy is the principle of "full and open" access to scientific data. We strongly support Ms. Maiden's vision of the NASA data system as a scientific data system. This is very consistent with the data policy of the ICSU WDC system (International Council of Science World Data Centers). It has been suggested time and again in the past that the DAACs be incorporated as a new US contribution to the WDC. With the advent of GEO and GEOSS, this proposition gains fresh currency, inasmuch as the NASA data sets constitute the largest and most relevant initial component of future GEOSS data sets. **The NASA Data Systems program may choose to explore with ICSU mechanisms to jump-start the implementation of the GEOSS data systems, by identifying NASA data sets as part of the World Data Centers holdings. We feel that such a step would be highly beneficial to the worldwide Earth science community.**

Dr. Kaye briefed us on NASA's contribution to the interagency Climate Change Science Program (CCSP), which is the umbrella for the nation's investment in climate research. ESD contributes about half of the total CCSP budget in fundamental climate research. This support may not be widely appreciated and this is relevant to Dr. Stern's comment about ESD being the 'best-kept secret' of NASA. A recent NRC review of CCSP concluded that the fundamental science component of CCSP is in good shape and that more investment be directed towards decision-making and risk/opportunity management related to climate change. In this regard, it is important to emphasize that ESD's suite of satellites, in addition to supporting basic climate research, is also essential for advancing CCSP-recommended activities in applied science. **We recommend that ESD's leading role in CCSP, as the U.S. program delivering the fundamental science for understanding and managing 21st-century climate change, be better communicated and supported through the higher levels at NASA.**

Our next meeting will be in May/June 2008. We will discuss at that meeting the implications of the FY09 budget for implementing the DS. Other topics of discussion will include (1) discussion of the role and sequencing of Venture-class missions as part of ESD's portfolio, and (2) consideration of a basic science program to promote high risk, novel ideas and approaches that can lead to new sensor modality or new ways of data analysis.

Sincerely,

The Earth Science Subcommittee



Daniel J. Jacob, chair

APPENDIX 1: Proposed Recommendation for the NAC Science Committee

Subcommittee Name: Earth Science

Chair: Daniel J. Jacob

Date of Public Deliberation: January 17-18, 2008

Date of Transmission: February 6, 2008

Short Title of Proposed Recommendation: **Cost Analysis for Earth Science Missions**

Short Description of Proposed Recommendation:

We recommend the formation of a blue-ribbon panel to analyze the cost of Earth Science missions and identify opportunities to reduce mission costs. A good place to start would be the cost estimates produced by NASA for the NRC Decadal Survey missions.

Outline of the Major Reasons for Proposing the Recommendation:

The apparent high cost of Earth Science missions compared to Space Science missions has been raised by Dr. Stern as a major issue in the ability of NASA to carry out the program of missions recommended by the NRC Decadal Survey (DS). This needs to be aggressively investigated. We believe that the higher cost of Earth Science missions may be due in part to the much higher degree of precision and resolution demanded from these missions in order to effectively augment suborbital information. Also to be considered is that Earth Science missions tend to last longer than Space Science missions and to generate a larger amount of data and publications. But there may be other important factors contributing to the high cost of Earth Science missions including choice of launch vehicles, mission risk tolerance, balance between industry and NASA centers in mission implementation, inefficient combinations of instruments on platforms, etc. Using smaller launchers (with acceptance of increased mission risk) seems to be specifically in need of consideration. Considering the current perception by NASA upper management that ESD missions are too expensive, conducting a broad analysis of ESD mission costs is urgent.

Outline of the Consequences of No Action on the Proposed Recommendation:

Opportunities for reducing the costs of Earth Science missions could be missed.

APPENDIX 2: Proposed Recommendation for the NAC Science Committee

Subcommittee Name: Earth Science

Chair: Daniel J. Jacob

Date of Public Deliberation: January 17-18, 2008

Date of Transmission: February 6, 2008

Short Title of Proposed Recommendation: **Support and Communication of ESD's role in CCSP**

Short Description of Proposed Recommendation:

We recommend that NASA ESD's leading role in the U.S. Climate Change Science Program be better communicated and supported through the higher levels at NASA.

Outline of the Major Reasons for Proposing the Recommendation:

The Climate Change Science Program (CCSP) is the interagency program which combines the Congressionally mandated US Global Change research program (USGCRP) and the Administration's Initiative on Climate Change (CCRI 2001). NASA's Earth Science constitutes more than 60% of the total CCSP budget as reported in the annual report to Congress: "Our Changing Planet". NASA's contribution in global observations and basic climate research is crucial to the CCSP but may not be widely and sufficiently appreciated. This is relevant to Dr. Stern's comment about ESD being the 'best-kept secret' of NASA. A recent NRC review of CCSP concluded that the fundamental science component of CCSP is in good shape and that more investment be directed towards decision-making and risk/opportunity management related to climate change. In this regard, it is important to emphasize and communicate to the Administration and Congress that ESD's suite of satellites, in addition to supporting basic climate research, is also essential for advancing CCSP-recommended activities in applied science.

Outline of the Consequences of No Action on the Proposed Recommendation:

The critical role of ESD in advancing fundamental climate science research and enabling decision-making related to climate change may not be properly recognized.