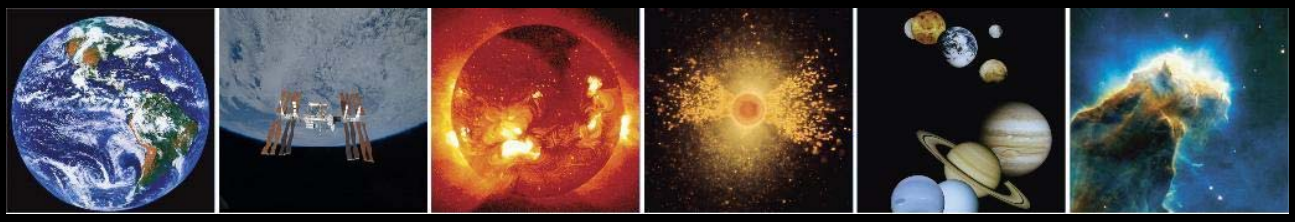
SPACE STUDIES BOARD NEWS



APRIL—JUNE 2009

INSIDE THIS ISSUE

From the Chair: Charting a New Course for NASA

NASA is at a turning point in its history, and not just because it and the country have new leadership.

—Charles F. Kennel, chair, SSB

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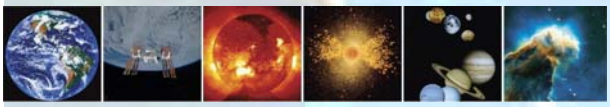

FROM THE CHAIR:
CHARTING A NEW COURSE FOR NASA

As I write, accomplished astronaut Charlie Bolden is being confirmed by a unanimous vote of the Senate as the twelfth NASA administrator. The able Lori Garver, who headed the NASA transition team, is also being confirmed as deputy administrator. Interim administrator Chris Scolese may now return to his regular duties with the thanks of the entire U.S. space community for a difficult job extremely well done.

NASA is at a turning point in its history, and not just because it and the country have new leadership. NASA is in the midst of the crisis associated with the retirement of the space shuttle, which many predicted. With shuttle retirement comes the need to chart a new course for human spaceflight. What NASA chooses to do in the next 2 years will determine what is possible in the next 40 years.

A new philosophical course was set by President Bush's announcement of the Vision for Space Exploration in 2004. It was time to begin exploring space beyond low Earth orbit (LEO) and to aim toward an eventual human landing on Mars. This was to be done on a "go as you can pay" basis.

The first instantiation of the "Vision" is the Constellation program. A new human-rated launch vehicle, ARES-1, is to be developed and flown by 2015. A heavy-lift cargo vehicle, ARES-5, is in development in tandem with ARES-1, as are a crew capsule, Orion, and a landing vehicle, Altair. The next beyond-LEO target is the Moon, with an initial U.S. landing in 2018, now pushed back to 2020.

In order to pay for Constellation, other NASA programs have had to give. Constellation's budget assumes that the shuttle program will come to a hard stop in 2010 and that the International Space Station (ISS) will be sent into the atmosphere in 2016, after only 5 years of full operation. The 2015 and 2018/20 deadlines also have meant that other development costs have been pushed back before 2010, with predictable consequences for NASA science and aeronautics.

NASA is in the midst of the crisis associated with the retirement of the space shuttle, which many predicted. With shuttle retirement comes the need to chart a new course for human spaceflight. What NASA chooses to do in the next 2 years will determine what is possible in the next 40 years.

Five years in, it now appears that we cannot go to the Moon because we can not pay. The combination of budget pressures, technical difficulties, and policy considerations have made it unlikely that the Vision's schedule can be met, even with strong assumptions made about the shuttle and the space station. Moreover, shuttle launches may extend into 2011 for safety reasons, and it is not at all clear that people will be comfortable with an early retirement of the station. All this pushes any reasonable prospect of a human lunar landing into the 2020s or beyond. Perhaps the Chinese will get there first.

What to do about all this is the question before the Augustine Commission, which is to report to the president's science advisor and the NASA administrator by the end of August. The Commission will evaluate the current program as well as alternate approaches. All options should assume that the shuttle is eventually retired, and most should conform to the go as you can pay principle. A huge decision for space remains even with these constraints. What are our mid-term goals? Long-duration ISS operations? The Moon? Direct to Mars? An asteroid? Which launch vehicle should we use for humans? Cargo? Do we need two? Should we extend ISS beyond 2016? Can ISS support beyond-LEO exploration? How should NASA and the aerospace industry deploy their human resources? What might we expect from increased international cooperation? How will the nascent commercial involvement in the exploration program evolve?

The National Academies can be proud of the contributions it has already made to the Augustine Commission. The National Research Council (NRC) report on the civil space program, *America's Future in Space: Aligning the Civil Space Program with National Needs*, chaired by General Lester Lyles, and our SSB workshop on international cooperation, *Approaches to Future Space Cooperation and Competition in a Globalizing World: Summary of a Workshop*, were completed and distributed during the Commission's deliberations. They have had a measurable effect.

There are vital issues beyond exploration. The Commission is planning to hear from the chairs of our decadal surveys, and not just about what science might be done in the exploration program. It is even more important for the Commission to keep in mind what is at stake for the entire space science enterprise as it considers options for human spaceflight.

A year from now, NASA will be on a different course. The charts on which this course is plotted are being drawn now.

—Charles F. Kennel, Chair, Space Studies Board

DIRECTOR'S CORNER

This quarter's column was written by Brian Dewhurst, the co-study director of the ad hoc Committee on the Rationale and Goals of the U.S. Civil Space Program (a joint committee of the SSB and the ASEB).

As Charlie Kennel discusses in his column, 2009 has been a very active year for those involved in civil space policy. Two activities are particularly notable—the NRC's Committee on the Rationale and Goals of the U.S. Civil Space Program (the Lyles Committee) and NASA's Review of Human Space Flight Plans (the Augustine Committee).

The NRC committee, chaired by Gen. Lester L. Lyles, USAF (ret.), was sponsored by the presidents of the NAS, NAE, and IOM and was funded through internal NRC funds. A joint activity between the SSB and the Aeronautics and Space Engineering Board (ASEB), the committee was tasked by the presidents to take a broad, strategic view of the entire U.S. civil space program and identify overarching goals that are in the national interest. The committee was also tasked to identify issues critically important to achieving the goals and to make recommendations for how to address those issues.

The NRC committee's report, *America's Future in Space: Aligning the Civil Space Program with National Needs*, was released on July 7. The committee's overall conclusion is that "a preeminent U.S. civil space program with strengths and capabilities aligned for tackling widely acknowledged national challenges—environmental, economic, and strategic—is a national imperative today and will continue to grow in importance in the future." The committee also noted that a "preeminent" program need not be one that dominates in every arena, but is a program that "can influence, by example, nations' use of space," and that furthers the ability of the United States to be a strategic leader in a globalized world.

To that end, the committee identified six goals that, achieved as a set, would provide the United States with the preeminent space program the committee discussed. These goals are to:

- Re-establish leadership for the protection of Earth and its inhabitants through the use of space research and technology;
- Sustain U.S. leadership in science by seeking knowledge of the universe and searching for life beyond Earth;
- Expand the frontiers of human activities in space;
- Provide technological, economic, and societal benefits that contribute solutions to the nation's most pressing problems;
- Inspire current and future generations; and
- Enhance U.S. global strategic leadership through leadership in civil space activities.

As the Lyles Committee was completing its report, the Administration announced the formation of a blue-ribbon panel to assess NASA's plans for its human spaceflight activities— the Review of Human Space Flight Plans Committee (the Augustine Committee). Chaired by NAE member Norman Augustine, this committee includes, among others, SSB chair Charlie Kennel and two members of the Lyles Committee—Gen. Lyles himself and NAE member Wanda Austin.

The Augustine Committee held its first public meeting Wednesday, June 17, in Washington, DC. During the morning session the committee heard briefings from policymakers, including the acting NASA administrator Chris Scolese, Senator Bill Nelson, and the heads of the European and Russian space agencies. The committee was also briefed on the Constellation program's current architecture, the requirements that drove its design—global lunar access, anytime return, four people to the surface, ISS servicing, and so on. The afternoon session was largely given over to a series of briefings on alternative architectures such as the Evolved Expendable Launch Vehicle (EELV) capability and whether it could be adapted to carry human passengers more efficiently than the Ares I program. The president of United Launch Alliance advocated this approach, but was followed by an Aerospace Corporation briefing on their analysis of the EELV and options. According to Aerospace, human-rating the Delta-IV Heavy would be less expensive than creating the Ares I rocket for the ISS-servicing mission, but that the cost of Delta-IV Heavy + Ares V would be more expensive than the Ares I + Ares V architecture for the return to the Moon. In short, the most efficient use of resources depended strongly on the requirements of the overall system.

The committee also heard from SpaceX about its plans to service the ISS through NASA's COTS program, and from two alternative architectures for human access to space—DIRECT and the shuttle-derived heavy lift vehicle. However, listening to the various presentations, one got the feeling that the different groups were talking past each other; emphasizing those areas where their idea was strongest and glossing over their shortcomings. While such a presentation strategy is understandable, it highlighted the fact that an essential common understanding was missing from the discussions.

In general, the implementation of policy involves three steps: (1) the setting of the policy in question, (2) the translation of that policy into a set of requirements for a program, and (3) the technical means by which those requirements are achieved. For much of the Augustine Committee meeting, it seemed as if the presenters were conflating steps two and three—often implicitly assuming a set of requirements that matched the capabilities of their system. When the Constellation program presented their work, they made it clear that the current architecture was a response to a set of requirements set by Administrator Griffin at the beginning of NASA's Exploration Systems Architecture Study. As the Augustine Committee's first meeting showed, that set of requirements does not have the same level of buy-in the in space community that the broader exploration policy does.

In the series of briefings that accompanied the release of the Lyles Committee report, committee representatives were often asked about the relationship between their report and the work of the Augustine Committee. The NRC report was designed from the outset to address the first step of policy implementation—laying out the rationale and goals for a U.S. civil space program. The Augustine Committee, by contrast, is focused on the next two steps. The Augustine Committee could strongly benefit the U.S. civil space program if it is able to recommend a broadly supported set of requirements (step 2) that can achieve the goals of the space exploration policy.

SSB ACTIVITIES

THE BOARD AND ITS STANDING COMMITTEES

The **Space Studies Board** (SSB) held its 158th meeting on May 13-15, 2009, in Washington DC. The first day of the meeting was a joint session with the Aeronautics and Space Engineering Board (ASEB) devoted to the FY 2010 budgets of the agencies. Guest speakers included Chris Scolese, NASA associate administrator (and acting administrator at the time of the meeting); Gale Allen, NASA Exploration Systems Mission Directorate; Lynn Cline, NASA Space Operations Mission Directorate; Robie Samanta Roy, Office of Science and Technology Policy; Paul Shawcross, Office of Management and Budget; and congressional staff, including Jeff Bingham, Ed Feddeman, Chan Lieu, and Dick Obermann. On the second day, the SSB continued the discussion about FY 2010 budgets with Charles Gay, NASA Science Mission Directorate; Mary Kicza, NOAA-NESDIS; and Richard Behnke, National Science Foundation. The third day included a presentation and discussion about optical communications with John Rush, director of systems planning, NASA Space Communications Office.

The board will meet next at the National Academies' Arnold and Mabel Beckman Center in Irvine, CA, November 2-4, 2009.

The **Committee on Astronomy and Astrophysics (CAA)** is on hiatus until the completion of the astronomy and astrophysics decadal survey.

The **Committee on Earth Studies (CES)** met on April 16-17, 2009, in Washington, DC at the National Academies' Keck Center. Highlights of the meeting included updates on activities at NASA's Earth Science Division and at NOAA NESDIS, which were provided by NASA Earth Science Division director Michael Freilich and NOAA assistant administrator for satellite and information services, Mary Kicza, respectively; a videoconference with Dan Baker and Peter Pilewskie from the University of Colorado on the potential role of small satellites in Earth observations; a discussion with Ed Crawley from MIT, who has developed a modeling tool that can be used to optimize investments in the 2007 Earth science and applications from space decadal survey; an update on GEOSS and CEOS activities, which was presented by committee member Jay Pearlman; a discussion with University of Wisconsin researcher Hank Revercomb on prospects for restoring sounding capabilities in next-generation GOES satellites; and updates on several prospective and ongoing NRC studies. The committee is currently engaged in follow-up discussions with NASA and NOAA on potential ad hoc studies or workshops that would be of mutual interest.

Several members of the committee participated in the June 15-16, 2009, workshop "Geoengineering Options to Respond to Climate Change: Steps to Establish a Research Agenda," which was organized by CES staff officer Art Charo. The workshop brought some 120 scientists, engineers, philosophers, political scientists, economists, and policy experts together to examine proposed "geoengineering" approaches, or interventions in the climate system, with an emphasis on the research needed to better understand the potential efficacy and consequences of the various approaches. Information from the workshop is being used to inform the work of the NRC's "America's Climate Choices" (http://americasclimatechoices.org) panels and steering committee.

The **Committee on the Origins and Evolution of Life (COEL)** did not meet this quarter. The committee is currently engaged in defining a potential task related to planetary protection measures for spacecraft missions to the icy bodies of the outer solar system. The committee is also encouraging members of the astrobiology community to draft white papers to support the goals of the Planetary Science Decadal Survey. The committee's remaining two meetings of 2009 will take place in Bozeman, MT, and Irvine, CA, on September 1-3, and December 1-3, respectively.

SSB MEMBERSHIP
JULY 1, 2009—JUNE 30, 2010

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ROBERT T. PAPPALARDO
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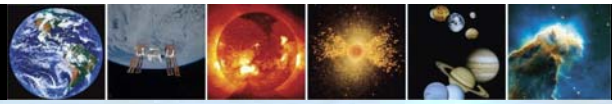
U.S. REPRESENTATIVE TO COSPAR

EDWARD C. STONE
California Institute of Technology

For more information on the membership of the SSB please visit our website at <www.nationalacademies.org/ssb>.



The **Committee on Planetary and Lunar Exploration (COMPLEX)** is on hiatus until the completion of the Planetary Science Decadal Survey.

The **Committee on Solar and Space Physics (CSSP)** did not meet this quarter, but is planning to meet in August to receive briefings on the FY 2010 budget request, the SSB report *A Performance Assessment of NASA's Heliophysics Program*, and NASA's 2009 Heliophysics Roadmap

STUDY COMMITTEES

The ad hoc **Committee on the Assessment of Impediments to Interagency Cooperation on Space and Earth Science Missions** was formed to assess impediments, including cost growth, to the successful conduct of interagency cooperation on Earth science and space science missions; identify lessons learned and best practices from past interagency Earth science and space science missions; and recommend steps to help facilitate successful interagency collaborations on Earth science and space science missions. The first meeting of the committee is scheduled for July 30-31, 2009, in Washington, DC. An approved prepublication version of the committee's report is targeted for March 1, 2010.

Congress directed NASA to arrange for an independent **Assessment of NASA Laboratory Capabilities**; as a result, the NRC's Laboratory Assessments Board, in collaboration with the SSB, is in the process of forming an ad hoc committee to carry out a review of NASA's laboratories, including laboratory equipment, facilities, and support services, to determine whether they are equipped and maintained at a level adequate to support NASA's fundamental science and engineering research activities. The study will also include an assessment of the relative quality of NASA's in-house laboratory equipment and facilities compared to comparable laboratories elsewhere. Formation of a committee of approximately 20 persons, drawn from academia, government, and industry, is presently underway. The committee will meet 3 times in 2009 and four site visits will be organized to NASA laboratories.

The Program Prioritization Panels (PPPs) of the ad hoc **Astronomy and Astrophysics Decadal Survey Committee (Astro2010)** held their first meetings on May 11-13 in Irvine, CA. The plenary meeting on the 11th included the chairs of the five Science Frontier Panels (SFPs) and the members of the four PPPs. The SFP chairs delivered their key science questions to the PPPs. The PPPs then held their first meetings May 12-13 in Irvine. The PPPs held their second meetings June 8-11, coincident with the annual meeting of the American Astronomical Society, where they received proposals from the community. The SFPs and PPPs are scheduled to complete their third meetings in the next quarter, in preparation for the third meeting of the Survey Committee in October. For further details, including community input to the study, please see: http://www.nationalacademies.org/bpa/Astro2010.html.

The **Steering Committee for the Decadal Survey on Biological and Physical Sciences in Space** held its first meeting on May 6-8 at the National Academy of Sciences Building in Washington, DC. The first day and a half was devoted to discussions of the study goals with NASA and congressional staffers and obtaining necessary background briefings on topics such as NASA exploration capability needs and the current research program structure and content. During the closed portion of the meeting, the committee concentrated its efforts on determining how it would structure its seven focus panels and began the process of identifying appropriate expertise and membership for each panel. Work on panel development continued following the meeting, through both frequent internal discussions and consultations with members of the community.

The steering committee held its second meeting on June 29-July 1 at the National Academies' Keck Center in Washington, DC. Additional briefings related to the various past research solicitation and management approaches used by NASA were obtained, however most of the meeting was devoted to detailed planning for the work of the committee and its panels. A tentative date of August 19-21 was selected for a joint, first meeting of all the panels in Washington, DC, where panel members would receive a full set of background briefings, form cross-panel working relationships, and begin planning their activities. The third meeting of the steering committee is tentatively set for October 16 in Irvine, CA.

The ad hoc **Committee on Cost Growth in NASA Earth and Space Science Missions** is being formed. This committee will identify the primary causes of cost growth in NASA Earth and space science missions involving large, medium, and small spacecraft. The committee will recommend what changes, if any, should be made to contain costs and ensure frequent mission opportunities in NASA's Earth and space science programs. The first meeting of the committee will likely take place in late August or early September 2009.

The ad hoc **Committee on NASA's Suborbital Research Capabilities** held their first meeting at the National Academies' Keck Center in Washington, DC, on May 20-21 and was briefed on the NASA suborbital program and the Stratospheric Observatory for Infrared Astronomy (SOFIA) by NASA staff; on NASA workforce issues by David Black, co-chair of the committee that wrote the 2007 report *Building a Better NASA Workforce: Meeting the Workforce Needs for the National Vision for Space Exploration*; and on NASA mission-enabling issues by Lennard Fisk, chair of the Committee on the Role and Scope of Mission-Enabling Activities in NASA's Space and Earth Science Missions, and staff officer Joseph Alexander. At the its second meeting in Boulder, CO, August 19-20, the committee will hear from researchers and continue work on its draft report. Its third, final meeting will be at the National Academies' Beckman Center in Irvine, CA, on September 23-25.

The **Planetary Science Decadal Survey** continues its 2-year study to define a new science and mission strategy for solar system exploration activities at NASA and NSF. Major developments this quarter included the preparation of slates for the survey's steering group and five subsidiary panels. The steering group's membership was approved by the NRC's Executive Office in early May and their first meeting was held in Washington, DC, on July 6-8. The steering group's subsequent meetings will be held on November 16-18 (Irvine, CA), February 22-24 (CA or AZ), and May 25-27 (Washington, DC). Community outreach activities in support of the decadal survey are scheduled to be held at a variety of venues including the meetings of the Outer Planets Assessment Group (Colombia, MD, July 14), NASA Lunar Science Institute (Moffett Field, CA, July 21-23), Mars Exploration Program Analysis Group (Providence, RI, July 29-30), European Planetary Science Congress (Potsdam, Germany, September 13-18), Division for Planetary Sciences of the American Astronomical Society (Fajardo, PR, October 4-9), the American Geophysical Union (San Francisco, CA, December 14-18), and Lunar and Planetary Sciences Conference (The Woodlands,

TX, March 1-5, 2010). The second update from the steering committee chair Steve Squyres to the planetary community can be found at http://www7.nationalacademies.org/ssb/SSEdecadal2011_Squyres2.pdf. The decadal survey is scheduled to be delivered to NASA and NSF by the end of March 2011.

The ad hoc **Committee for the Review of Near-Earth Object (NEO) Surveys and Hazard Mitigation Strategies** and its panels have undertaken a two-phase study to provide recommendations addressing two major tasks: determining the best approach to completing the NEO census required by Congress to identify potentially hazardous NEO's larger than 140 meters in diameter by the year 2020 and determining the optimal approach to developing a deflection strategy and ensuring that it includes a significant international effort. Both tasks will include an assessment of the costs of various alternatives, using independent cost estimating. The steering group held its second meeting on May 18-20 at the Arecibo Observatory in Puerto Rico, and will hold its third meeting on August 10-11 Woods Hole, MA, and its fourth meeting in early September, location TBD. The Survey/Detection Panel held its second meeting on April 20-22 at the Lunar and Planetary Laboratory in Tucson, AZ, and visited the Catalina Sky Survey Telescope; its third meeting on April 29-30, where the chair and a member of the Mitigation Panel visited the Pan-STARRS-1 telescope facility on Maui; and devoted its fourth meeting on July 13-15 in Santa Fe, NM, to writing its final report. The Mitigation Panel held its second meeting on June 23-25 at Woods Hole, MA, and will hold its third meeting, devoted primarily to writing its final report, on July 29-31 in Boulder, CO. The committee's interim report is due for release in late July or early August.

The **Committee on the Role and Scope of Mission-Enabling Activities in NASA's Space and Earth Science Missions** met at the National Academies Keck Center in Washington, DC, on May 20-23 to discuss initial findings and recommendations and begin work on the study report. The final report should be completed and released in the fourth quarter of 2009.

OTHER ACTIVITIES

The **Committee on Space Research (COSPAR)** is currently seeking nominations (see separate item) for COSPAR awards to be distributed at the scientific assembly to take place in Bremen, Germany, on July18-25, 2010.

OTHER NEWS

CHARLES L. BENNETT, professor of physics and astronomy at Johns Hopkins University and member of the SSB, is the recipient of the National Academy of Sciences Comstock Prize in Physics. Dr. Bennett is being honored for his mapping of the cosmic microwave background and determining the universe's age, mass-energy content, geometry, expansion rate, and reionization epoch with unprecedented precision. This prize is awarded for a recent innovative discovery or investigation in electricity, magnetism, or radiant energy.

SSB STANDING COMMITTEE CHAIRS

COMMITTEE ON ASTRONOMY AND ASTROPHYSICS (CAA)*

COMMITTEE ON EARTH STUDIES (CES)
Chair: Berrien Moore III
Vice Chair: Ruth Defries

COMMITTEE ON THE ORIGINS AND EVOLUTION OF LIFE (COEL)**
Co-Chairs: Robert T. Pappalardo and J. Gregory Ferry

COMMITTEE ON PLANETARY AND LUNAR EXPLORATION (COMPLEX)***
Chair: Joseph F. Veverka

COMMITTEE ON SOLAR AND SPACE PHYSICS (CSSP)
Chair: Daniel N. Baker
Vice Chair: Thomas H. Zurbuchen

*Joint with the Board on Physics and Astronomy. CAA is on hiatus during the Astro 2010 decadal survey.
**Joint with the Board on Life Sciences.
***COMPLEX is on hiatus during the planetary sciences decadal survey.

NEW RELEASES FROM THE SSB

Summaries are reproduced here without references, notes, figures, tables, boxes, or attachments. Copies of reports are available from the SSB office at 202-334-3477 or online at <www.nap.edu/>.

America's Future in Space:
Aligning the Civil Space Program with National Needs

This report by the ad hoc Committee on the Rationale and Goals of the U.S. Civil Space Program (a joint committee of the SSB and the ASEB) is available at http://www.nap.edu/catalog.php?record_id=12701. The study was led by Chair Lester L. Lyles, and Co-Vice Chairs Raymond S. Colladay and Lennard A. Fisk and staffed by Joseph K. Alexander and Brian D. Dewhurst, Co-Study Directors, Carmela Chamberlain, Administrative Coordinator, Lewis Groswald, Research Associate, Victoria Swisher, Research Associate, and Catherine A. Gruber, Editor.

As civil space policies and programs have evolved, the geopolitical environment has changed dramatically. Although the U.S. space program was originally driven in large part by competition with the Soviet Union, the nation now finds itself in a post-Cold War world in which many nations have established, or are aspiring to develop, independent space capabilities. Furthermore, discoveries from developments in the first 50 years of the space age have led to an explosion of scientific and engineering knowledge and practical applications of space technology. The private sector has also been developing, fielding, and expanding the commercial use of space-based technology and systems.

Recognizing the new national and international context for space activities, *America's Future in Space* is meant to advise the nation on key goals and critical issues 21st-century U.S. civil space policy.

Approaches to Future Space Cooperation and Competition in a Globalizing World: Summary of a Workshop

This report by Rapporteur James V. Zimmerman (a joint workshop of the SSB and the ASEB) is available at http://www.nap.edu/catalog.php?record_id=12694. The workshop planning was led by Chair Charles F. Kennel and staffed by Ian Pryke, Study Director, Joseph K. Alexander, Program Officer, Carmela Chamberlain, Administrative Coordinator, and Catherine A. Gruber, Editor.

Numerous countries and regions now have very active space programs, and the number is increasing. These maturing capabilities around the world create a plethora of potential partners for cooperative space endeavors, while at the same time heightening competitiveness in the international space arena.

This book summarizes a public workshop held in November 2008 for the purpose of reviewing past and present cooperation, coordination, and competition mechanisms for space and Earth science research and space exploration; identifying significant lessons learned; and discussing how those lessons could best be applied in the future, particularly in the areas of cooperation and collaboration.

Presentations and initial discussion focused on past and present experiences in international cooperation and competition to identify "lessons learned." Those lessons learned were then used as the starting point for subsequent discussions on the most effective ways for structuring future cooperation or coordination in space and Earth science research and space exploration. The goal of the workshop was not to develop a specific model for future cooperation or coordination, but rather to explore the advantages and disadvantages of various approaches and stimulate further deliberation on this important topic.

Assessment of Planetary Protection Requirements for Mars Sample Return Missions

This report by the ad hoc Committee on the Review of Planetary Protection Requirements for Mars Sample Return Missions is available at http://www.nap.edu/catalog.php?record_id=12576. The study was led by Chair Jack D. Farmer and staffed by David H. Smith, Study Director, Rodney N. Howard, Senior Project Assistant, Kayleigh Bohemier, Lloyd V. Berkner Space Policy Intern, and Catherine A. Gruber, Editor.

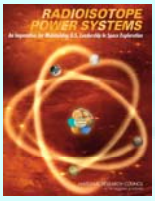
NASA maintains a planetary protection policy to avoid the forward biological contamination of other worlds by terrestrial organisms, and back biological contamination of Earth from the return of extraterrestrial materials by spaceflight missions. Forward-contamination issues related to Mars missions were addressed in a 2006 NRC report *Preventing the Forward Contamination of Mars*. However, it has been more than 10 years since back-contamination issues were last examined.

Driven by a renewed interest in Mars sample return missions, this book reviews, updates, and replaces the planetary protection conclusions and recommendations contained in the NRC's 1997 report *Mars Sample Return: Issues and Recommendations.* The specific issues addressed in this book include the following:

- The potential for living entities to be included in samples returned from Mars;
- Scientific investigations that should be conducted to reduce uncertainty in the above assessment;
- The potential for large-scale effects on Earth's environment by any returned entity released to the environment;
- Criteria for intentional sample release, taking note of current and anticipated regulatory frameworks; and
- The status of technological measures that could be taken on a mission to prevent the inadvertent release of a returned sample into Earth's biosphere.

Radioisotope Power Systems: An Imperative for Maintaining U.S. Leadership in Space Exploration

This report by the ad hoc Radioisotope Power Systems Committee (a joint committee of the SSB and the ASEB) is available at http://www.nap.edu/catalog.php?record_id=12653. The study was led by Co-Chairs William W. Hoover and Ralph L. McNutt, Jr., and staffed by Alan C. Angleman, Study Director, Dwayne A. Day, Program Officer, Andrea M. Rebholz, Program Associate (from February 2009), Sarah M. Capote, Program Associate (through November 2008), Celeste A. Naylor, Senior Program Assistant (from November 2008 to February 2009), and Catherine A. Gruber, Editor.



Spacecraft require electrical energy. This energy must be available in the outer reaches of the solar system where sunlight is very faint. It must be available through lunar nights that last for 14 days, through long periods of dark and cold at the higher latitudes on Mars, and in high-radiation fields such as those around Jupiter. Radioisotope power systems (RPSs) are the only available power source that can operate unconstrained in these environments for the long periods of time needed to accomplish many missions, and plutonium-238 (238Pu) is the only practical isotope for fueling them.

Plutonium-238 does not occur in nature. The committee does not believe that there is any additional 238Pu (or any operational 238Pu production facilities) available anywhere in the world. The total amount of 238Pu available for NASA is fixed, and essentially all of it is already dedicated to support several pending missions--the Mars Science Laboratory, Discovery 12, the Outer Planets Flagship 1 (OPF 1), and (perhaps) a small number of additional missions with a very small demand for 238Pu. If the status quo persists, the United States will not be able to provide RPSs for any subsequent missions.

CONGRESSIONAL TESTIMONIES

External Perspectives on the FY 2010 NASA Budget Request and Related Issues
Before the House Committee on Science and Technology
Subcommittee on Space and Aeronautics
June 18, 2009

At the June 18 hearing before the House Committee on Science and Technology's Subcommittee on Space and Aeronautics, SSB Member and Chair of the SSB Committee on Earth Studies, Berrien Moore III, and ASEB Chair Raymond Colladay testified on their perspectives on the FY 2010 NASA Budget Request. Their prepared statements are reprinted here (without references, notes, appendices, tables, or figures). Dr. Kenneth Ford, Chair, NASA Advisory Council, Mr. Robert M. Hanisee, Chair, Audit and Finance Committee, NASA Advisory Council, Mr. John C. Marshall, Member, Aerospace Safety Advisory Panel, and Mr. J.P. Stevens, Vice President for Space Systems, Aerospace Industries Association also testified. Their prepared statements are available at http://science.house.gov/publications/hearings_markups_details.aspx?NewsID=2493.

(from L to R): Mr. John Marshall, Mr. Kenneth Ford, Mr. Robert Hanisee, Dr. Raymond Colladay, Dr. Berrien Moore, and Mr. J.P. Stevens

Photo courtesy of the House Committee on Science and Technology

Dr. Berrien Moore III, Executive Director
Climate Central, Princeton, New Jersey

Madam Chairman and members of the Subcommittee, thank you for the opportunity to appear today on behalf of Space Studies Board (SSB) of the National Research Council (NRC), chaired by Dr. Charles Kennel. Dr. Kennel is also a member of the blue-ribbon Review of U.S. Human Space Flight Plans Committee. Dr. Kennel regrets that he could not be here to provide testimony today. I will try to cover most of the same key priorities, issues, challenges and opportunities for NASA's science programs that Dr. Kennel would have presented for you. Although I also serve on the SSB with Dr. Kennel, my views are my own and do not represent an official position of the NRC.

With your permission, I will submit my written testimony for the record and recap briefly my views for you here this morning.

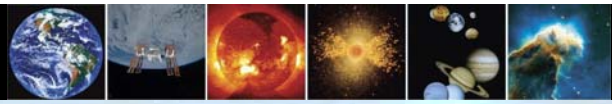
NASA's science programs have been called the agency's "crown jewel" and with good reason. They represent less than a quarter of NASA's annual budget and only three percent of the annual federal Research and Development (R&D) investment. For this relatively small investment, in recent years, NASA's science programs have provided: critical insights into global climate change and the management of Earth's resources; helped us understand and anticipate the impact of solar storms on our technological infrastructure; changed our views about the potential habitability of other worlds in our solar system and beyond; and revolutionized our understanding of the major constituents of energy and matter in our universe and its eventual fate. In a word, NASA's science programs have enriched our lives, strengthened our societies, and expanded our horizons.

As you consider NASA authorization legislation for the coming years, it is important to keep in mind the potential opportunities that lie in front of the agency's science programs. On the increasing strength of Earth science, we now can state that global warming is "unequivocal," but this simply sets the challenge. We need now to develop the capability to monitor and thereby manage greenhouse gas emissions through this century and beyond, and concurrently, we need the capability to project with a quantitative understanding of the uncertainties the impact of climate change to at least the regional level, and thereby, provide essential information to help decision makers mitigate the varying impacts of climate change on local environments and populations.

In solar and space physics, joint observations from multiple spacecraft orbiting in the wake of the Earth may allow predictive models of space plasma and particle interactions to begin to unravel the physics of "magnetic reconnection" and thereby advance our understanding across a range of spatial scales and topics from fusion reactors to black holes. In planetary science, we will have an opportunity to follow-up on the discovery of liquid water environments on Mars and the moons of the outer planets and search for organic compounds and other past or present evidence of potentially life-bearing environments beyond Earth. In astrophysics, we will have an opportunity to follow up on the discovery over the past decade of more than 300 planets outside our solar system and hence expand the search for planets 'more like' our own Earth. There is also an opportunity in astronomy for NASA to cooperate with the physics community to build upon discoveries about the accelerating expansion of our universe and associated energy "creation" and thereby establish the necessary extended observational platforms to understand the nature of the now-termed "dark energy", which apparently dominates the energy budget of the universe and drives its expansion. And in life and microgravity sciences, the International Space Station (ISS) could provide U.S. researchers with their first permanent microgravity research platform.

These are each unique opportunities during our lifetimes for the United States to demonstrate technical leadership, advance the state of scientific knowledge for humanity's benefit, and leave important legacies for future generations. In stating this, I clearly recognize the significantly challenging economic environment, and I am well aware of the out-year budget constraints and recent "Guidelines." The times call for careful setting of priorities; I present this testimony in the knowledge of this necessity.

When considering authorization legislation for the agency, it is also important to keep in mind how NASA's science programs can be employed as a tool to address national priorities outside the scientific enterprise. For example, in foreign affairs, NASA's science programs have a long history of international cooperation with partners in Europe, Japan, Russia, and Canada. With a number of new space powers emerging around the globe, NASA's science activities provide an opportunity to engage countries like China and India in peaceful, scientific pursuits that could encourage transparency in their space programs. Because they are a demanding consumer of new technologies, NASA's science programs also help address economic competitiveness by driving new developments in critical technologies like instrumentation, autonomy, communications, and data management. And the exciting discoveries made in NASA's science programs are particularly inspirational to youth and easily



shared with the internet and smart phone generation, a potentially important source of new engineers and scientists for our economy. In past legislation, Congress has recognized the value of sharing the adventure of space research via new virtual methods and should continue to do so.

To realize these opportunities, a number of critical issues must be addressed and challenges met. Arguably the largest issue is restoring or at least maintaining the balance of funding between NASA's science and human space flight activities. Several years ago, over $3 billion was eliminated from the Science Mission Directorate budget to help pay for return to flight, Space Shuttle retirement, and the Constellation Program.

This eliminated the projected growth in NASA's Science Mission Directorate and exacerbated what had already been dangerous downward trends in portions of the science portfolio. For example, after accounting for structural changes in how NASA categorized its budget, the 2007 National Research Council Earth science and applications from space "decadal survey" documented that support for the overall effort for Earth observations and the associated science in NASA was reduced by more than 30-percent between 2000 and 2006 (see discussion below).

Across the Agency, reductions in science support led to the deferment of multiple missions, painful program restructurings, dramatic reductions in research grants, and the elimination of many technology investments. A recent report by the Congressional Budget Office warns that estimates of the cost of NASA's Constellation Program through the first manned lunar landing have risen from $57 billion to $92 billion, and may reach $110 billion. Although the Review of U.S. Human Space Flight Plans Committee is tasked with developing an affordable and sustainable human space flight program that fits within the current budget profile for NASA's human exploration activities, it is a very difficult task and does not guarantee that NASA's human space flight programs will not encounter unanticipated problems and future cost growth. To ensure the productivity of NASA's science programs, it is important that any future growth in human space flight costs not impact the already flat science budget. In the past, budgetary "firewalls" have been erected to protect other parts of the NASA budget from cost growth in human space flight programs, and Congress may want to consider such measures in the future. In doing so, Congress may need to ensure that such firewalls are actually honored.

A related issue is the question of ISS utilization and NASA funding for microgravity research. While a number of the long-promised ISS research facilities are available or will become available in the next year, the number of US investigators currently in a position to exploit the potential of these facilities is very limited. The NASA programs that supported the development of investigations to use these facilities were either cancelled or severely cut in the middle of this decade. From 2004 to 2008, the number of life and microgravity science investigators supported by NASA fell from 769 to 230, a 70-percent drop overall with physical sciences research dropping by 90-percent. Many of the small number of US-sponsored ISS investigations that remain were preserved by congressional intervention. Although Congress has designated the ISS as a national research laboratory to encourage its utilization by other federal R&D agencies, Congress should keep in mind that NASA's role, which has declined significantly, in supporting the life and microgravity sciences community to make effective use of ISS remains central and limited. As a consequence, the former research community has largely dissipated, and there are many questions about how high quality research can, or will be, solicited and supported during the window of opportunity we are now entering for ISS utilization.

Turning to the other science-related studies, per Congressional request, the NRC is currently undertaking three decadal surveys—in astronomy and astrophysics, planetary science, and biological and physical science in space. Upon completion, these surveys will have reached community consensus on research priorities that can inform NASA's planning processes and congressional and White House decision makers. Each of these surveys incorporated inputs from hundreds of researchers. I strongly encourage members of Congress to closely review these decadal survey reports when they are released, invite their leadership to brief you and your staffs, and reflect their priorities in your legislation wherever possible.

Within NASA's Science Mission Directorate, Earth science is arguably one of its most critical functions and a source of some of NASA's greatest contribution to the nation. It is also an area where a decadal survey had profound impact. As one of the co-leaders of the Earth Science decadal survey, I applaud Congress's subsequent increased support for NASA's Earth science program. This support was and is needed.

As noted earlier, despite the wealth of information that NASA's Earth observation research has supplied on understanding climate change, much more is needed. The challenge is growing and will not go away; climate change is not a *problem de jour*. Recognizing the need for increased information, the 2009 Recovery Act was targeted to accelerate implementation of the Earth science decadal missions. I believe that NASA used this money primarily to pay for cost overruns and delays in the existing program, (e.g., LDCM, GPM, and Glory), which could be argued indirectly accelerates (or rather does not further delay) the decadal missions. It could also argue that it rewards poor management.

The Earth science budget in the President's FY 2010 request is a marked improvement over the early budgets. However, it remains inadequate, particularly in the out-years and well below the recommended profile from the Decadal Survey. The following Figure highlights the difficulty (see full testimony at http://science.house.gov/publications/Testimony.aspx?TID=15132).

On the current path only four (SMAP, ICESat-II, DESDynl and CLARREO) of 15 missions recommended by the NRC's Earth Science decadal survey will be launched before 2020. This mission backlog, which I believe the nation can ill afford, has been exacerbated by the recent loss of the Orbiting Carbon Observatory mission and continuing delays in NPP. Where funding can be added to the NASA science budget, Congress should consider accelerating the remaining missions from the Earth science decadal survey. Congress may also want to consider encouraging NASA to explore more rapid means of obtaining key measurements from space by utilizing smaller spacecraft wherever possible.

Finally, I note that Congressional add-ons can add further stress to the budget:

- An additional $9 million was marked to refurbish the DSCOVR spacecraft's earth science instruments, even though DSCOVR did not rise to the very high bar set by the decadal survey. (The survey did note that the space environment sensors on DSCOVR would fulfill the pressing need for an operational replacement of the instruments on the aging ACE spacecraft.

- Last year Congress directed NASA to spend $10 million to initiate development of the TIRS instrument. The FY10 budget indicates the LDCM project is now carrying "between $150-175M" to accommodate TIRS. Although very desirable, the cost for TIRS comes at the expense of the recommended program.
- In a separate area, I question the logic in this cost environment of spending what may eventually amount to $50 million to undertake the feasibility of the Constellation architecture facilitating service missions to future observatory-class science spacecraft.

In closing my extended discussion on Earth science, let me note that there are major strategic issues in Earth science and the associated observations which remain open as we consider how best to provide the needed information to respond wisely to climate change. In the decadal survey, we recommended that:

- The Office of Science and Technology Policy, in collaboration with the relevant agencies, and in consultation with the scientific community, should develop and implement a plan for achieving and sustaining global Earth observations. This plan should recognize the complexity of differing agency roles, responsibilities, and capabilities as well as the lessons from implementation of the Landsat, EOS, and NPOESS programs.

The need for this *overall* Earth observing plan remains.

Returning to the many cross-cutting issues that affect NASA science programs broadly, one of the most critical is mission cost growth. I touched upon the issue of cost growth in my Earth science discussion above, but it is hardly an issue for Earth science alone; it is an issue that has plagued many of NASA's programs for a long time. It is important to note the obvious: the problems induced by cost growth can become acute within a flat budget environment. To pay for cost growth on one mission, the funding for other missions is often deferred, leading to schedule slippage and potential gaps in the overall research enterprise. For example, a recent NRC mid-decade review of NASA's solar and space physics programs found that very little of the recommended priorities from the prior decadal survey will be realized during the decade in question – threatening the status of the survey's integrated research strategy – partly because cost growth on some missions has delayed their launch as well as the development of other missions. The effect can be and usually is cascading.

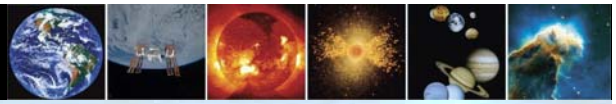
There are numerous different explanations for why cost growth occurs, and the pathologies are different for each mission. Some causes, such overly ambitious science measurements and technology assumptions, are self-inflicted. NASA's Science Mission Directorate is taking some steps to correct these issues. One of the long-standing axioms of program management is that it is necessary to spend a significant amount of money on a program in the early concept stages in order to better understand the technology and engineering requirements and tradeoffs. NASA is now doing this for some of its missions. NASA and the NRC are also requiring independent cost estimates—as opposed to estimates produced by a mission's advocates—in the current round of decadal surveys to improve the overall planning process and help to keep mission proposals honest. The NRC is also starting a congressionally-mandated study of the causes of mission cost growth and possible ways to remediate it that may inform future cost management strategies.

However, it is important to also point out that some causes of cost growth originate outside NASA. The engineering development of each mission has a most efficient path to follow, and stable, adequate funding is critical to keeping that efficient path in place. If Congress and the White House do not provide stable, adequate funding levels, the schedule for mission developments are often stretched out, leading to increased mission costs. As discussed above, this has occurred in the Earth science program; the NRC mid-decade review of NASA's solar and space physics programs also found that instability in the funding for NASA's Solar-Terrestrial Probes Program was a key cause of mission cost growth. The budget resources that the White House and Congress provide to NASA must match not only mission objectives, but also how, where, and by whom a mission will be developed and carried out.

An issue related to cost growth is the balance between different sizes of missions. The NRC's decadal surveys universally recommend a mix of small, medium, and large missions in each research area. This allows a field to pursue difficult, long-term, but highly rewarding research goals that usually require missions costing a billion dollars or more, while still infusing the field with new data from regular missions costing hundreds or even tens of millions of dollars. Unfortunately, cost growth on large missions can reduce or eliminate opportunities for frequent, innovative, and risk-taking research by eliminating small mission opportunities, such as NASA's Discovery, Mars Scout, Explorer, and suborbital programs. This problem is especially acute where a single large mission development, like the James Webb Space Telescope in astrophysics or the Mars Science Laboratory in the Mars Exploration Program, dominates spending for a particular field or program.

Congress should be vigilant about mission balance in NASA's science programs, encourage NASA to take proactive steps to avert cost growth on large missions as early as possible, protect funding for smaller mission opportunities where possible, and restore funding for smaller mission opportunities when they are temporarily reduced. The NRC is currently undertaking two studies, on suborbital and mission-enabling activities, that will provide additional advice on those NASA programs that provide smaller, more frequent research opportunities.

Another cross-cutting issue that has emerged in several recent NRC reports is the importance of investments in technology development independent of science flight missions. NASA had such programs in the past, but they were largely eliminated due to other budget demands. My colleague, Ray Colladay, has covered this issue in detail in his testimony, but its importance to NASA's science programs should be noted. There are numerous technologies that are essential to accomplishing the goals established by the decadal surveys that are currently at relatively low technology readiness levels. Attempts to develop these technologies within flight mission development projects increase the chances that the missions will go dramatically over budget. In addition, it limits the ability of these technologies to be adapted to a broader set of missions. NASA managers are often reluctant to create separate technology development programs because of concern that they become unfocused and also because they are easy targets for budget cuts when flight programs overrun. However, there is no reason that a well-run and tightly focused technology development program will not work. Congress should encourage NASA to make necessary technology investments in advance of mission development starts and protect those investments when they are well-managed and productive.



An issue that has repeatedly appeared in NRC reports on NASA's science programs is the shrinking availability and affordability of launch vehicles. This problem is most acute for medium-sized science payloads that have relied in the past on the workhorse Delta II launch vehicle. As the Air Force moves the Global Positioning System (GPS) to Evolved Expendable Launch Vehicles (EELVs), there may not be enough business to maintain the Delta II line in an operational or affordable state. NASA is encouraging the development of potentially affordable alternatives to the Delta II through its Commercial Orbital Transportation Systems (COTS) program, and these efforts should receive Congress's support. If these efforts do not come to fruition, NASA will either have to make potentially unacceptable technical compromises to fit medium-sized missions on smaller launch vehicles, or pay unnecessary and much higher costs to launch medium-sized missions on larger launch vehicles.

Finally, NASA is both a research and advanced technology development agency. As such, it must continue to have multi-year budget authority (subject to the availability of funds). This is essential.

Like any cutting-edge, highly technical endeavor, NASA's science programs face a number of issues, from both within and without, that must be addressed in a forthright manner to maintain the high productivity of the U.S. civil space program's "crown jewel". I hope my testimony provides you with useful advice on some of the important steps that can be taken to meet these challenges. Given the remarkable advances in NASA's science programs over the past decade, the relatively small investment required, and the opportunities we anticipate in the coming decade, such steps are well worth the effort.

This completes my prepared remarks and I am happy to answer any questions the subcommittee may have. Thank you.

Dr. Raymond S. Colladay

Madame Chairwoman and members of the Subcommittee, I appreciate the opportunity to appear before you today. My name is Ray Colladay and the personal views I express are shaped by my 40 years of experience in aerospace, through positions I have held in government, industry, and academia. I chair the Aeronautics and Space Engineering Board (ASEB) of the National Research Council (NRC) and although I have insights into NASA acquired through that position, my views are my own and do not represent an official position of the NRC.

With your permission, I would like to submit my prepared testimony for the record and summarize my views for you here this morning, leaving sufficient time to answer any questions you may have.

Civil, commercial, and national security space and aviation affects every part of our lives. It inspires, it facilitates a one-world community, it encourages training and education in science and engineering, it protects our future, and addresses the profound questions of our place in the universe—how did we get here and are we alone? NASA has demonstrated its ability to accomplish great things. It has a vision for the future for which there is general consensus in broad terms even as the finer details are debated. There are two fundamental questions that are pertinent to the subject of this hearing in dealing with NASA and its primary role of providing U.S. leadership in space and aeronautics: are the programs and the goals of the agency the right ones for the nation to be pursuing?—which is to say is the path and the destination right? And are there sufficient resources to effectively implement the program and the vision being pursued? I would like to address both of these questions in my remarks this morning.

There are a number of issues in the human space flight program that need to be untangled like what to do with the ISS beyond 2016; is the Constellation program headed in the right direction and does it have the commitment and support of this administration; is the timing for Shuttle retirement right; and are the replacement vehicles—Ares and Orion—the best approach to move beyond low-Earth orbit? The recently appointed Augustine Human Space Flight Review Committee will address these issues and present options charting a clear way forward.

Until the disposition of the ISS is decided, there is a big hole in mission planning with uncertain out-year budget implications. The issue is not just are we going to keep the station beyond 2016, which seems likely given how much we have spent finally getting it assembled and ready for full occupancy, but more importantly, what are we going to use it for? This is a remarkable facility and a significant accomplishment in engineering design and on-orbit assembly. It is a modern-day example of cooperative program management on an international scale; not a simple feat. As we transition from the assembly phase to utilization, we should take full advantage of its utility for research to expand our knowledge of how to live and work in space. Having said that, however, the vision and destination for human space flight should be outward, beyond low Earth orbit. The ISS is a way-point in that journey outward and I believe it will prove to be indispensable in learning to take the next steps.

The NASA science program continues to amaze the world with its spectacular achievements. The science community has led the way in providing consensus views on planning and roadmaps for the future through its Decadal Surveys. We borrowed the technique on the Aeronautics and Space Engineering Board for the Decadal Survey of Civil Aeronautics in 2006. Others will address the state of space science and I will limit my remarks to a shared concern about cost growth in ongoing programs and projects that put other projects at risk and crowd out new-start opportunities.

There are a number of reasons for cost growth on projects—from poor initial cost estimates to over-confidence in what can be done with constrained budgets to years of inadequate attention paid to advance space technology development. I would like to specifically address the last point. Because of budget pressures, NASA has turned away from putting a priority on advanced technology development, even though the Space Act of 1958 and every subsequent amendment calls for NASA to be a leader in R&D. Today the advanced technology base is so deficient it is costing us in lost opportunities to do bold things with more capable systems and is costing us valuable resources in overruns some of which could be avoided with a more robust technology base.

Aeronautics is underfunded, but a broad-based, innovative advanced space technology development program that is organizationally independent of ongoing hardware development programs is nonexistent. The downward trend started soon after aeronautics and space technology, once logically managed together, were split apart. A decision soon followed to focus technology specifically on major development program needs by moving the resources to mission areas it intended to serve. Predictably, once all technology development was placed with the major development efforts it became near-term oriented as a risk reduction effort backstopping hardware development. The Aeronautics and Space Engineering Board spon-

sored study on the Exploration Technology Development Program for Constellation done last year expressed concern on just that point of the need for more emphasis on longer-term research. With budget and schedule pressures as demanding as ever, the situation has not improved. Clearly, there is a need for focused, risk-reduction technology that is defined by explicit mission requirements and funded by the mission office, but it does not fill the need for the agency on a broader level to pursue long-term technology "push" well out in front of requirements and broad in scope supporting civil (not just NASA) and commercial space. An agency that has inspired us with bold missions and spectacular accomplishments needs to be investing in technology that continually seeks to transform state-of-the-art capabilities and enable future missions that some day we may want to do, if we only knew how.

In DARPA, when I was Director, we sought to be disruptive with technology that challenges or disrupts conventional thinking and it is still doing that today. By setting up a healthy tension in an organization between technology push focused on long-term research and technology pull from programs, someone is always asking not only "what for?", but also "what if?" and "why not?" An advanced research and technology development mission of NASA would be exploring advanced launch systems in pursuit of low cost access to space; compact nuclear power systems; plasma- and other electric-propulsion concepts; energy storage technology; highly energetic propellants; affordable space-based solar power systems; multi-spectral sensors; advanced space-based communications; closed-loop life-support systems; radiation shielding concepts; highly intelligent and mobile robotics—the list could go on with a host of other areas of research not being addressed in today's constrained environment. And you will not see requirements for such systems, because we do not write a requirement for something no one knows how to do.

NASA should revitalize advanced space technology development as a priority mission area of the agency. It should engage the best science and engineering talent in the country wherever it resides in universities, industry, NASA centers or other government labs focused on world-class research and innovation and not driven by the need to maintain ten healthy centers. It should support not only future NASA missions, but other government agencies and commercial space. The "customers" for its technology products would be industry, NASA itself, other government agencies like NOAA, and military space where dual-use technology is applicable. Having this broad mandate would make it similar in the breadth of customers served to the NASA role in aeronautics with its heritage in NACA going back almost a century.

That brings me to the aeronautics program where there is good news and bad. Aviation has a major impact on U.S. economic competitiveness and our leadership position in the world. No one questions that it is vitally important particularly in the U.S. in moving people and goods throughout the country and the world. The good news regarding the NASA aeronautics program is the restructured program in fundamental research is stable and providing excellent results. I am particularly pleased with the new emphasis in systems research in this year's request. The Environmental Responsible Aviation (ERA) program builds on the progress in the base research program and begins to address the complex system interactions accompanying the integration of technology to achieve lower fuel consumption, lower emissions, lower noise, improved safety, and greater air-traffic system capacity. These attributes, all desirable in isolation, tend to work against each other when integrated into a system. The newly formed category of Integrated Systems Research, of which the ERA program is the first in the category, enables NASA, in cooperation with industry and universities, to explore the system advances that will make aviation more energy independent and environmentally friendly. More resources in the out-years would be helpful. The Recovery Act funding that the Congress was able to add to the NASA aeronautics budget this year was very helpful in jump starting this important area of research and it is also being put to good use in facilitating the transition of NextGen focused technologies to the FAA.

This year's budget request is very encouraging and a positive step. However, NASA's investment in aeronautics is a fraction of what it was just a short time ago, and that is the bad news. Ten years ago the aeronautics budget was over 3 times what it is today in equivalent full-cost accounting terms and today's dollars. Then, it was 10 percent of the total NASA budget. The Congress has consistently recognized inadequate funding for aeronautics by augmenting past administration requests, but unless that level is reflected in the runout budget request by the administration, the research efforts at the higher level cannot be sustained, year-to-year. More resources would be helpful in areas of system-level testbeds and taking technology to higher readiness levels for the advances in the Airspace Systems and Aviation Safety programs in support of NextGen. Also, it would enable NASA to shift the balance of R&D to be a better blend of in-house and out-of-house research with universities and industry—something the NRC Decadal Survey on Civil Aeronautics also recommended.

Taking aeronautics and space technology together, an investment of at least ten percent of the total agency's budget for advanced aerospace technology development focused on forward-looking innovation is not unreasonable, in my view, for a government agency that has a mandate to help maintain U.S. leadership in aerospace science, engineering, research, and advanced technology development. One does not need to go too far back to a time when it exceeded that level.

Coming full circle to my opening comment about having the right program content and the right amount of resources to implement it, I have touched on where I think some of the holes are in program content and underfunded technology and of course the Augustine Committee will untangle the big issues in human space flight. I must be perfectly clear that the areas I mentioned needing more funding cannot and should not be solved by transferring money from other parts of NASA. Every time I look at the current scope of the NASA program and consider what budget level it takes to do it right, I come up with a level of around $22-23 Billion for the agency. This figure is not based on a rigorous, detailed assessment, but a well-informed opinion. It would seem that at this level, NASA's space and aeronautics mission should compete favorably for discretionary resources against other priority national needs, particularly given how it supports many of those needs of broad national interest. Much less than that level of funding means something has to give—some combination of mission scope, program content, schedule, or institutional infrastructure. This subcommittee has taken aggressive steps in the past to recognize the need for increased funding for NASA. I hope the testimony given at this hearing is helpful in your deliberations on the FY 2010 budget.

That completes the remarks I wanted to make and I would be pleased to take questions if you have them. Thank you.

Continuing Independent Assessment of the National Polar-Orbiting Operational Environmental Satellite Program

Before the House Committee on Science And Technology Subcommittee on Investigations And Oversight June 17, 2009

At the June 17 hearing before the House Committee on Science and Technology's Subcommittee on Investigations and Oversight, SSB Vice Chair A. Thomas Young testified in his capacity as the Chair of the NPOESS Independent Review Team. His prepared statement is reprinted here (without references, notes, appendices, tables, or figures). Ms Mary Glackin, Deputy Undersecretary for Oceans and Atmosphere and Deputy Administrator, NOAA and Mr. David Powner, Director, Information Technology Management Issues, Government Accountability Office also testified. Their prepared statements are available at http://science.house.gov/publications/hearings_markups_details.aspx?NewsID=2492.

(From L toR): Mr. David Powner, Mr. Tom Young, and Ms. Mary Glackin

Photo courtesy of the House Committee on Science and Technology

Mr. A. Thomas Young

Chairman Miller, Ranking Member Broun, and Members of the Subcommittee, I am Tom Young and I chair the NPOESS Independent Review Team (IRT) that was established by the NPOESS Executive Committee (EXCOM) to review the NPOESS program baseline and the management approach.

After numerous meetings, interviews with Air Force (AF), Department of Defense (DoD), National Aeronautics and Space Administration (NASA), and National Oceanic and Atmospheric Administration (NOAA) principals, visits to the primary contractors Northrop Grumman and Raytheon, and discussions with contractor Chief Executive Officers (CEOs), the IRT identified ten findings and recommended corrective actions.

1. The current NPOESS program has an extraordinary low probability of success. Implementation of the following recommendations is necessary to address this finding.
2. Continuity of data, which each user organization identifies as number one priority, is at significant risk. The program is hardware poor with little protection against a launch failure or early spacecraft failure. Data outages in a particular orbit can be measured in years with a failure. Corrective action is limited to moving C3 and C4 closer to C1 and C2, launching on need rather than schedule and exploiting NPOESS preparatory Project (NPP) data.
3. NPOESS is being managed with cost as the most important parameter and not mission success. This Program cost focused culture needs to change to a mission success focused culture and the NPOESS contract award fee criteria needs a similar change in focus.
4. NPOESS EXCOM is ineffective. Members must have decision authority. Focus of EXCOM should be top level issues and timely decisions.
5. NPOESS Program is not part of a space acquisition organization which makes program implementation extremely difficult. NPOESS must be assigned to a space acquisition organization such as Space and Missiles Systems Center (SMC) or NASA.
6. Fiscal year funding shortfalls are causing decisions to be made that are adding risk and increasing cost. Funding shortfalls must be corrected.
7. The highest probability of success is to maintain the current contractor team, Northrop Grumman and Raytheon and the IRT recommends this action.
8. Due to potential for coverage gaps, NPP has become a critical asset and it is recommended that this be recognized and incorporated in program planning.
9. Priorities of NOAA and DoD/AF are not aligned. DoD/AF stated that legacy performance is acceptable and that they are unwilling to provide additional funding to achieve above legacy capability. NOAA stated that current weather forecasting utilizes legacy and NASA Research and Development (R&D) satellite data. Accepting legacy capabilities would be a significant step back. This difference in priorities must be resolved.
10. The current budget is inadequate with a shortfall in excess of $1 billion. Funding the program by fiscal year and through completion to 80% cost confidence including a management reserve of approximately 25% is required to have an executable program budgeted at the most likely cost.

The IRT recognizes that NPOESS is a national program with quality of life, economic, disaster planning, and national security implications.

While the IRT believes the cited recommendations must be implemented, additional actions are necessary to have a successful NPOESS program.

The critical issue is the lack of alignment of DoD/AF and NOAA priorities. The IRT believes that the EXCOM will be unable to resolve this difference and the White House will be required to define the NPOESS program that is in the national interest.

Following the NPOESS program decision the responsibility for program implementation must be assigned to one organization, AF with SMC having implementation responsibility or NOAA with NASA having implementation responsibility. Either can do the job.

The IRT believes that the managing organization must have total acquisition responsibility, be allocated all currently planned and programmed budget and be responsible for funding the defined program at an 80% confidence level.

The IRT recommends that responsibility for NPOESS be assigned to NOAA with NASA acting as NOAA's acquisition organization. This recommendation is based upon recognition that

NOAA has a broader responsibility for weather and climate requirements than any other organization and is a natural national advocate for this program.

Under this construct NOAA/NASA will provide NPOESS data to DoD/AF and establish a process to meet future DoD/AF needs.

The EXCOM concept should continue to assure effective program implementation.

Implementation of the IRT recommendations and additional actions is urgently required. Risk and unnecessary cost are being realized at an unacceptable rate.

SUMMARIES OF CONGRESSIONAL HEARINGS OF INTEREST

House Committee on Science and Technology Subcommittee on Investigations and Oversight
Continuing Independent Assessment of the National Polar-Orbiting Operational Environmental Satellite System
June 17, 2009

Attended and summarized by Lewis Groswald, Research Associate

Witnesses: David Powner, Director of Information Technology Management Issues at the Government Accountability Office (GAO); Thomas A. Young, Chairman of the NPOESS Independent Review Team and Vice Chair of the SSB; and Mary Glackin, Deputy Under Secretary for Oceans and Atmosphere and Deputy Administrator of NOAA.

Opening remarks were made by Chairman Brad Miller (D-NC) and ranking member Paul Broun (R-GA), both of whom expressed disappointment in the progress of NPOESS. Chairman Miller noted, "Despite our relentless pressure, relentless oversight, we still need to know what's gone wrong."

Unanticipated technical difficulties, compounded by project mismanagement, have led to an increase of about $1 billion to the $14 billion estimate for total development costs of NPOESS. Mr. Powner noted that EXCOM has failed to provide adequate project oversight or make quick decisions, and that the competing interests and priorities of the three agencies involved in managing NPOESS are the root cause of the management problems.

Mr. Young began his testimony by summarizing the 10 findings resulting from the NPOESS IRT report and noting the areas in which NPOESS has failed, including making cost the most important factor; EXCOM is ineffective; the priorities of NOAA/NASA/DOD are not aligned; and there is a current budget shortfall of $1 billion. He recommended that NPOESS be placed under the control of NOAA, and that they provide weather data to DOD. Mr. Young later noted that one of the main sources of contention between the Air Force and NOAA is that the Air Force will not pay for anything other than legacy systems, which Mr. Young contends would be a step back for weather-data quality.

Ms. Glackin was concerned about future slips and delays and noted that NOAA has recently advocated for a high-level review of NPOESS. She also presented four possible management options for NPOESS: retaining the existing tri-agency structure with an adjusted budget; establishing NOAA as the national lead for delivering weather data and NASA as the acquisition agency and moving operations to Goddard Space Flight Center; establishing DOD as the national lead and moving operations to Los Angeles AFB (Space Missile Command); or allowing each agency to handle its own acquisitions.

Ms. Glackin told the Subcommittee that NOAA is prepared to take leadership of the program. She did not object to allowing DOD to take the lead; however, she noted that since NOAA already operates its own ground stations for satellite operations, it is more cost-effective for NOAA to lead the program. Mr. Young and Mr. Powner agreed that NOAA should take the lead on NPOESS.

House Committee on Science and Technology Subcommittee on Space and Aeronautics
Hearing on the Proposed Fiscal 2010 Budget for NASA
June 18, 2009

Attended and summarized by Angie Wolfgang, SSB Intern

Witnesses: John C. Marshall, member, Aerospace Safety Advisory Panel; Kenneth Ford, chair, NASA Advisory Council; Robert M. Hanisee, chair, Audit and Finance Committee, NASA Advisory Council; Raymond S. Colladay, chair, National Academies' Aeronautics and Space Engineering Board; Berrien Moore III, member, National Academies' Space Studies Board; J.P. Stevens, vice president, Space Systems, Aerospace Industries Association

Subcommittee Members in Attendance: Gabrielle Giffords (D-AZ), Chair; Dana Rohrabacher (R-CA); Pete Olson (R-TX), Ranking Member; Parker Griffith (D-AL); David Wu (D-OR)

Stating that the United States' current space policy is the best the nation has had in a long time, Kenneth Ford of the NASA Advisory council (NAC) asserted that "stability in purpose, strategy, requirements, and funding" is essential for NASA's future success.

John Marshall listed priorities which included a stable budget, a definite decision about the shuttle program, balancing NASA's performance with its cost schedule, and finding a way to go forward with human spaceflight. Ford added that a space transportation system is also important and needs a space exploration program: "If commercial crew transport materializes, NASA will take advantage of it," he said.

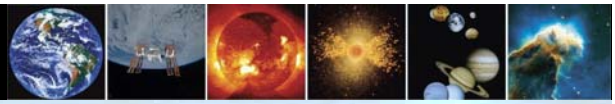
Robert Hanisee stated that although NASA has improved its management in the last few years, problems with financial systems and property accounting continue to plague the agency. After describing how NASA has failed to sufficiently support broad, long-term space-technology development and research, Raymond Colladay stressed that NASA needs $22 to $23 billion dollars to accomplish the job before them, $4 to $5 billion more than is currently allotted in the 2010 budget.

Berrien Moore reiterated that oversubscription was a problem: the competing pressures of the ISS, the shuttle program retirement, support of the aeronautics program, meeting expectations for scientific studies of climate change, and starting the lunar program overdraw NASA's available funds. Dr. Moore noted that this pressure could be alleviated by using simpler instruments and alternative platforms such as autonomous vehicles, but he warned that the Recovery Act funds were used by over-budget pre-decadal items and additional money can only hope to minimize delays. "We must have the courage to terminate over-budget programs," Dr. Moore stated.

J.P. Stevens prioritized keeping current programs such as Constellation on schedule, continuing the ISS until 2020, providing sufficient funds for the development of the lunar lander, and supplying research and development monies for next generation technology.

In response to questioning from Rep. Griffiths, Mr. Ford affirmed that NASA has done everything it can to minimize the gap, but he was not certain if the agency had taken inventory of the scientists whose expertise it regularly utilizes. Mr. Marshall agreed that the agency needs to do more to catalog and manage its workforce. Mr. Ford also stressed that a failure to restore the $500 million that was withheld from the FY 2010 House NASA Appropriations Bill would result in layoffs, and Mr. Marshall added that it would also damage NASA's ability to stabilize its spending and operations.

After receiving a general consensus from the panel members that NASA needed to stay on a 2-year accounting cycle for appropriations, Chair Giffords concluded the hearing.



Senate Appropriations Committee Subcommittee on Commerce, Justice, Science and Related Agencies
Subcommittee Markup of the FY 2010 Commerce, Justice, Science and Related Agencies Appropriations Bill
June 24, 2009

Attended and written by Angie Wolfgang, Abigail Fraeman, Jordan Bock, SSB Interns, and Abigail Sheffer, Research Associate

Subcommittee Members in Attendance: Barbara Mikulski (D-MD), Chair; Richard Shelby (R-AL), Patrick Leahy (D-VT); Byron Dorgan (D-ND); Ben Nelson (D-NE)

Sen. Barbara Mikulski, chair of the Commerce, Justice, Science, and Related Agencies subcommittee, opened the markup by emphasized the Subcommittee's top funding priorities: keeping America safe from terrorism and violent crime, investing in America's scientific infrastructure to create new technologies and new jobs, and ensuring a timely and accurate 2010 Census.

After detailing the justice appropriations, Sen. Mikulski announced, "I'm proud to report that the CJS bill follows the framework of the America COMPETES Act for investments to improve America's competitiveness" by providing $880 million for the NIST, $6.9 billion for the NSF, $4.7 billion for NOAA, and $18.7 billion for NASA. Sen. Mikulski expressed the Subcommittee's strong disagreement with the decision in the House to cut $500 million from NASA's proposed budget, stressing that the participating senators fully support human space exploration and the president's budget requests.

Next Sen. Mikulski called attention to the funding which the CJS bill has allocated for earth science and climate change research. Noting that the subcommittee has provided $1.4 billion for NASA Earth science, $650 million for NASA research on how the Sun affects Earth, $1.2 billion for NOAA weather satellites, and $430 million for NOAA research, Sen. Mikulski stated, "Funding for earth science includes $135 million for new NASA Earth science missions recommended by the National Academy of Sciences to measure our ice sheets, climate, and atmosphere so we can better predict changes to our planet." Deviating from her prepared statement, she declared that this Subcommittee wanted to be known for promoting science and innovation, listening to the studies produced by the National Academies, and acknowledging the "gathering storm" identified by the 2007 NRC report *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future.*

At the conclusion of her remarks, Sen. Mikulski solicited comments from the Subcommittee members in attendance. The statements from the present senators were brief, and the CJS bill was unanimously recommended to the full Senate Appropriations Committee without criticism or adjustments. The bill was passed by the Senate Appropriations Committee on June 25 (see summary below).

Senate Appropriations Committee
Full Committee Markup of the FY 2010 Commerce, Justice, Science, and Related Agencies and Interior, Environment, and Related Agencies Appropriations Bills
June 25, 2009

Attended and written by Angie Wolfgang, Abigail Fraeman, Jordan Bock, SSB Interns, and Abigail Sheffer, Research Associate

Barbara Mikulski (MD-D), chair of the Commerce, Justice, Science, and Related Agencies subcommittee, urged that the full Appropriations Committee report favorably on the bill. She praised the bipartisan nature of the bill and thanked Senator Richard Shelby (AL-R) for his help. Senator Mikulski noted that the CJS bill funds 80% of the nation's climate change science.

The Senate CJS bill contains $64.9 billion of discretionary funding, an increase of $7.2 billion over the enacted 2009 budget and $200 million over the president's requested 2010 budget. Highlights from an official summary of the bill are listed below, and the full summary may be found at http://appropriations.senate.gov.

- **Office of Science and Technology Policy (OSTP)—**The bill provides **$6.15 million** for OSTP, equal to the budget request.
- **National Aeronautics and Space Administration (NASA)—**The bill provides **$18.68 billion** for NASA, $903 million above the FY 2009 level and equal to the president's request. The total funding includes $3.16 billion for space shuttle operations; $2.27 billion for ISS operations; $3.5 billion for development of the next generation Crew Launch Vehicle and Crew Exploration Vehicle and Cargo Launch Vehicle; $4.5 billion for science; and $507 million for aeronautics research.
- **National Science Foundation (NSF)—**The bill provides **$6.9 billion** for NSF, $426 million above the FY 2009 enacted level. The total includes $5.55 billion for research, $122 million for research equipment and facilities; and $857 million for education activities.
- **National Institute of Standards and Technology (NIST)—**The bill provides **$878.8 million** for NIST, $59.8 million above the FY 2009 enacted level and $32.7 million above the President's request. The bill provides $69.9 million for the **Technology Innovation Program (TIP)**, equal to the president's request. The bill also includes $124.7 million for the **Hollings Manufacturing Extension Partnership (MEP) Program**, equal to the president's request. Funding TIP and MEP are consistent with the recommendations of the America COMPETES Act.
- **National Oceanic and Atmospheric Administration (NOAA)—**The bill provides more than **$4.77 billion** for NOAA, $407 million above the FY 2009 level and $299 million above the president's budget request. The bill includes: $551 million for the **National Ocean Service**; $980 million for the **National Weather Service**; $872 million for the **National Marine Fisheries Service**; $1.2 billion for satellite programs; and $430 million for oceanic and atmospheric research, including climate science.

The bills were unanimously passed by the full committee.

Senate Full Committee on Commerce, Science, and Transportation
Executive Session and Nominations Hearing
July 8, 2009

Attended and summarized by Lewis Groswald, Research Associate

Nominees: Charles F. Bolden, Jr., to be Administrator of NASA and Lori Garver, to be Deputy Administrator of NASA. Additionally, nominees for the National Transportation Safety Board, Federal Maritime Commission, and the Department of Transportation were also present.

Senator Barbara Mikulski (D-MD), Senator Lindsey Graham (R-SC), Senator Jim Demint (R-SC), Senator Kay Bailey Hutchison (R-TX), Senator Bill Nelson (D-FL), Representative James Clyburn (D-SC), and Representative Sheila Jackson Lee (D-TX) all praised Bolden's experience and showed enthusiasm for his nomination in their opening statements.

Sen. Rockefeller began the question and answer session, describing his own misgivings about NASA. He noted that there are places other than space to seek innovation, including the ocean floor. Reiterating

previous remarks made by President Obama in an interview March 12, Sen. Rockefeller said that NASA has drifted and does not inspire as it should. He also said that NASA has to earn respect, and its funding, or even existence, is not a given.

Mr. Bolden's began his opening remarks by citing priorities that include building upon the ISS's research capabilities, accelerating the next generation of spacecraft to replace the shuttle, enhance NASA's ability to understand Earth's environment, and inspiring the next generation of American's by making NASA's work relevant to their lives.

He also stated that safety and efficiency were important, and he would like to see NASA become a preeminent research and development agency. Mr. Bolden acknowledged that NASA is not the R&D institution it once was, and he wants to renew its investment in basic science and technology research. Additionally, Mr. Bolden intends to make a concerted effort made to revamp the aeronautics program. He stated that involving commercial entities and space entrepreneurs in cargo and, potentially, crew transport is critical to NASA's mission and its future, which lies beyond low Earth orbit.

Lori Garver told committee members that she shares Sen. Rockefeller's concerns. She explained that the world today has moved beyond the Cold War rationale that impacted much of the country's space policy during the inception and early years of NASA. The nation's investment in NASA has led to new industries entirely independent of government funding, and international cooperation is still very important. She said that NASA needs to communicate better with the public. Ms. Garver also agreed with Mr. Bolden that commercial support is crucial to NASA's continuing operations.

Charles Bolden and Lori Garver were confirmed by unanimous consent on the floor of the Senate on July 15, 2009.

House Committee on Science and Technology Subcommittee on Space and Aeronautics Hearing
Enhancing the Relevance of Space to Address National Needs
July 16, 2009

Attended and summarized by Jordan Bock, SSB Intern

Witnesses: General (Ret.) Lester L. Lyles, Chair of the National Research Council's Committee on the Rationale and Goals of the U.S. Civil Space Program, Space Studies Board and Aeronautics and Space Engineering Board; Ms. Patti Grace Smith, Board of Directors of the Space Foundation; Ms. Debbi Adler Myers, General Manager of the Science Channel, Discovery Communications; and Mr. Miles O'Brien, journalist specializing in space and aeronautics.

Subcommittee Members in Attendance: Gabrielle Giffords (D-AZ), Chair; Parker Griffith (D-AL); David Wu (D-OR); Donna Edwards (D-MD); Charles Wilson (D-OH); Suzanne Kosmas (D-FL); Pete Olson (R-TX); Dana Rohrabacher (R-CA); and Ralph Hall (R-TX).

The hearing began with opening statements by Subcommittee Chair Gabrielle Giffords and Ranking Member Pete Olson. After noting that it was appropriate to hold a hearing on this topic on the 40th anniversary of the launch of Apollo 11 to the Moon, Chair Giffords emphasized that the future of the space program rests in its relevance to the American people: "America's civil space program must be relevant to our broad national needs if it is going to continue to be supported."

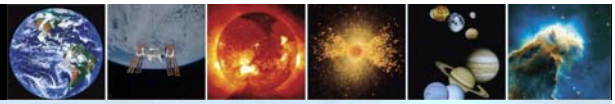
In his testimony, General Lester Lyles explained the ways in which civil space activity is a national imperative: "Civil space activities are central to the R&D enterprise of the nation, often in a transformational way, and thus present powerful opportunities to help address major national objectives." The other witnesses concurred with this position and discussed the necessity of engaging the public. Patti Smith emphasized that "Congress has an obligation to make that message come alive and to recognize that if it affects the economy and the national security of our nation, then yes it is a bread and butter issue."

Debbi Myers noted that the word "science" is the first barrier in engaging the general public, and she showed several videos produced by the Science Channel that use popular cultural figures such as Morgan Freeman and Will Smith to make space, and science in general, exciting to the nation's youth. Miles O'Brien posited that, "Public affairs should always be a mission requirement—and a high priority requirement. The TV cameras are worth their weight in gold." He further commented that astronauts should give greater access to the public, that the successes of the ISS have not been communicated well, and that while NASA has multiple centers it does not have one united voice which it uses to communicate with the public.

When asked how Congress could help, General Lyles noted that they could let the agencies know that public relations and other advertising efforts are not only permissible but encouraged. Ms. Meyers stated that it is important to match agencies and other sectors and interested participants so that they can collaboratively determine a way to communicate science. Mr. O'Brien highlighted the fear at NASA of being "off-message" that deters and often shuts down public outreach efforts through new social media such as blogs and twitter. He also asked Congress to help by more freely allowing agency employees to share their thoughts with the public, regardless of whether those thoughts reflect congressional interests.

The discussion spanned such topics as the difficulty in communicating the ISS's successes when its construction has been slow and incremental, and when its story is just beginning; how people sometimes relate more to failure than success, and that NASA can communicate its failures by highlighting the lessons it learned as a result of those missteps; the future of fields such as space tourism and space commerce; and the fact that much of day-to-day business on Earth is made possible by satellites.

One overriding theme of the discussion was how Congress and the federal agencies, particularly NASA, can do a better job of engaging the public and demonstrating the significance and relevance of the U.S. civil space program. General Lyles' discussed the importance of NASA's role as a communicator, educator, and source of inspiration. Chair Giffords concluded the hearing by summarizing the necessity of publically establishing the relevance of the national space program: "Our space program is incredibly important to this country's future well being, but we can't assume the public will just take that assertion on faith. We need to be able to demonstrate it."



STAFF NEWS

DEPARTURES

Three members of the Space Studies Board are moving on to new opportunities. Theresa Fisher, program associate for CES, CSSP, and many ad hoc studies, retired on May 15, 2009. Victoria Swisher, research associate, will be leaving the SSB to pursue a masters degree in International Policy Studies with a focus on nonproliferation at the Monterey Institute of International Studies. And finally, Brian Dewhurst, who began his Academies career as an SSB research associate, moved to the Board on Physics and Astronomy as an associate program officer, and then became an ASEB staff officer, will be leaving the Academies July 31 and starting his new position at NASA's Program Analysis and Evaluation Office (PA&E) on August 17. We all wish them well in their future endeavors and hope our paths continue to cross.

PROMOTIONS

We are happy to announce that Lewis Groswald, the Fall 2008 Lloyd V. Berkner Space Policy Intern has become a full time research associate. He is also completing his second year in the International Science and Technology Policy program at George Washington University, concentrating on space policy.

NEW FACES

We are happy to announce that we have added two new faces to our full time administrative staff—Dionna Williams and Terri Baker. We have also added new temporary employees—Abigail Sheffer, Abigail Fraeman, and Elana Amador.

Dionna Williams is a program associate who previously worked for the National Academies' Division of Behavioral and Social Sciences and Education for 3 years. She has a long career in office administration, having worked as a supervisor in a number of capacities and fields. Ms. Williams will be working with CES and on the Planetary Sciences Decadal Survey panels.

Terri Baker is a senior program assistant. She comes to SSB from the National Academies' Center for Education. Mrs. Baker has held numerous managerial, administrative and coordinative positions. She will be working with the ad hoc Committee on the Assessment of Impediments to Interagency Cooperation on Space and Earth Science Missions.

Abigail Sheffer is joining the SSB as a temporary research associate for the summer and will be participating in the Christine Mirzayan Science and Technology Policy Fellowship in the fall. Dr. Sheffer earned a Ph.D. in planetary science from the Lunar and Planetary Laboratory at the University of Arizona and a B.A. in geosciences from Princeton University. Her doctoral research explored the relationship between the high pressures and temperatures caused by meteorite impacts and the extremely reduced chemistry of impact glasses such as tektites and lunar regolith agglutinates.

Abigail Fraeman is rejoining the SSB for her second summer internship, having formerly worked as a 2007 Summer Space Policy Intern. She graduated from Yale University this past May where she was a double major in physics and in geology and geophysics. Ms. Fraeman is going to attend graduate school at Washington University in St. Louis in the fall to study Earth and planetary sciences. She has spent summers researching planetary science at Brown and Cornell universities and spent the past year at Yale completing her senior thesis modeling geophysical properties of Mars.

Elena Amador (University of California, Santa Cruz) has been selected to participate in the Lloyd V. Berkner Space Policy Internship Program for the Autumn 2009 session. The goal of the program is to provide promising students with the opportunity to work in the area of civil space-research policy in the Nation's capital, under the aegis of the SSB. The program will begin accepting applications for undergraduate students for its 2010 summer session after Thanksgiving. Additional information about the program is available at <http://www7.nationalacademies.org/ssb/Berkner_Space_Policy_Internships.html>.

STAFF TRAVELS

Research associate Lewis Groswald attended the launch of STS-125, Shuttle *Atlantis'* Hubble Servicing Mission, in May. Also in attendance were Congressman Alan Grayson (D-FL-8) and Congresswoman Gabrielle Giffords (D-AZ-8), member and chair, respectively, of the House Science and Technology Committee's Subcommittee on Space and Aeronautics, and their families. Prior to the launch, Mr. Groswald toured the grounds of Kennedy Space Center where he visited the Vehicle Assembly Building (VAB), the Space Station processing facility, and launch pads 39A and 39B, where Shuttles *Atlantis* and *Endeavour* awaited launch—the last time two shuttles were on the pad simultaneously. While at the VAB, his group was shown the latest Ares hardware, the flight hardware for the Ares 1-X sounding rocket launch.

THE SPACE SUMMER SEMINAR GIVES AN INTRODUCTION TO CAREERS IN SPACE

by Lewis Groswald

This past May, I attended the Space Summer Seminar through the Eisenhower Center for Space and Defense Studies. Based out of the Air Force Academy in Colorado Springs, the program brought together students from the Air Force, Navy, and Army academies, MIT, and my own graduate program at George Washington University's Space Policy Institute.

The Space Summer Seminar group visited many locations in California, Colorado, and the greater Washington, DC, area, including Boeing, SpaceX, Northrop Grumman, the Vandenberg and Los Angeles Air Force bases, the Jet Propulsion Laboratory, United Launch Alliance, Johns Hopkins University Applied Physics Laboratory, and NASA Goddard Space Flight Center.

The trip meant different things to different people depending on each person's background. For many in the military and for civilians with a more technical background, it was an introduction to a possible post-graduate career path in aeronautical engineering or computer science. Presenters from the military emphasized the importance of a career in satellite or missile technology, space objects tracking, and acquisition and procurement, and they provided a comprehensive overview of potential career avenues in the military. The private companies also actively recruited, since many of their employees are retired military personnel. Acquisition and procurement, as well as general workforce issues, dominated many presentations and were discussed at almost every location the group visited. These are issues that many SSB committees have addressed, including such reports as *Building a Better NASA Workforce: Meeting the Workforce Needs for the National Vision for Space Exploration* (2007) and *America's Future in Space: Aligning the Civil Space Program with National Needs* (2009) (http://www.nap.edu/catalog.php?record_id=12701).

Other recurring themes from the trip, which are also mentioned frequently in SSB reports, include the future of military and civil space procurement and policy direction and the working relationship between industry and government. The commercial aerospace companies also highlighted their successful partnerships with NASA by talking about the Commercial Orbital Transportation Services (COTS) program, and they discussed how they can play a vital role in America's future in space.

As someone whose work focuses on civil space and aviation, this trip provided valuable insight into military space and presented a broad cross-section of the nation's space infrastructure. I look forward to using the lessons learned in this experience in my work at the SSB.

GRADUATE STUDENT OPPORTUNITY TO PARTICIPATE IN PLANETARY SCIENCE DECADAL SURVEY

The Planetary Science Decadal Survey extends an invitation to graduate students to act as observers/rapporteurs during meetings of the Planetary Science Decadal Survey's Steering Group and its five panels. These notes will be posted on the decadal survey's website for use by survey members and the larger planetary science community.

Attending a meeting will give students the unique opportunity to experience an insider's view of the activities of Planetary Science Decadal Survey, plus the opportunity to interact with committee members, briefers, and agency officials. The SSB is not able to provide travel or lodging expenses; however, students will receive a small honorarium as well as meals during the meetings. Please note that students will need to sign a non-disclosure agreement to participate in closed sessions.

More information, including the application procedure and list of meeting dates and locations, can be found at http://www7.nationalacademies.org/ssb/planetary_decadal_grad_students.pdf.

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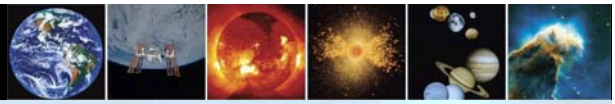
ABIGAIL FRAEMAN
Space Policy Intern

*Staff of other NRC Boards who are shared with the SSB
**Retired May 15, 2009
***Promoted from Intern May 23, 2009
******Joined the Board June 8, 2009



SEEKING NOMINEES FOR COSPAR AWARDS AND MEDALS

The Space Studies Board—the U.S. National Committee for COSPAR—is seeking candidates to be nominated for COSPAR awards and medals, which recognize the outstanding achievements of space scientists throughout the world. The awards will be presented at the 38th COSPAR Scientific Assembly, to be held in Bremen, Germany, July 18-25, 2010.

It is important to honor the contributions of your colleagues. Please take a moment to consider nominees for the following awards and medals:

- **COSPAR Space Science Award** honors a scientist who has made outstanding contributions to space science. Previous recipients include: G. Gloeckler (2008), A. Nishida (2006), E. T. Gruen (2006), J. Blamont (2004), V. Moroz (2004), S. Krimigis (2002), C. Russell (2002), R. M. Bonnet (2000), D. Hunten (2000), M. Neugebauer (1998), C. Cesarsky (1998), M. Oda (1996), N. Ness (1996), J. Trumper (1994), G. Haerendel (1994), E. Stone, Jr. (1992), J. Simpson (1990), S. Mandelshtam (1988), K. Gringauz (1988), L. Biermann (1986), and J. Van Allen (1984).
- **COSPAR International Cooperation Medal** is awarded to a scientist (or group of scientists) who has made distinguished contributions to space science and whose work has contributed significantly to the promotion of international scientific cooperation. Previous recipients include: M.A. Geller (2008), R. A. Greenwald (2006), S. Holt (2004), A. Brack (2002), J.H. Carver (2000), R. Lust (1998), A. Grigoriev (1996), R. Daniel (1994), H. Curien (1992), B. Hultqvist (1990), C. de Jager (1988), The Inter-Agency Consultative Group (1986), and R. Sagdeev (1984).
- **COSPAR William Nordberg Medal** is presented to a scientist who has made a distinguished contribution to the application of space science. Previous recipients include: J. Waters (2008), J. P. Burrows (2006), L. Lanzerotti (2004), M. Chahine (2002), K. Ijiri (2000), A. Thompson (1998), C. Elachi (1996), P. Morel (1994), J. Houghton (1992), D. King-Hale (1990), and S. I. Rasool (1988).
- **COSPAR Distinguished Service Medal** serves to honor extraordinary services rendered to COSPAR over many years. Previous recipients include: I. Révah (2008), S. Grzedzielski (2001), R. Hart (1996), A. Somogyi (1994), J-F. Denisse (1993), and Z. Niemirowicz (1992).
- **COSPAR/Massey Award** is awarded by the Royal Society of London in recognition of outstanding contributions to the development of space research in which a leadership role is of particular importance. Previous recipients include: G.G. Fazio (2008), C. Elachi (2006), Y. Tanaka (2004), J. Paul (2002), G. Bignami (2002), S.C. Bower (2000), R. Sunyaev (1998), J. Geiss (1996), R. Wilson (1994), H. Friedman (1992), and H. van de Hulst (1990).
- **COSPAR/Vikram Sarabhai Award** is awarded by the Indian Space Research Organization for outstanding contributions to space research in developing countries. Eligible candidates for next year's award must have performed relevant work mainly in 2002-2007. Previous recipients include: M.A. Abdu (2008), M. E. Machado (2006), A. Willmore (2004), R. Xu (2002), Z. Liu (2000), J. Baker (1998), U.R. Rao (1996), J. Blamont (1994), C.-Y. Tu (1992), and V. Kotelnikov (1990).
- **COSPAR/Zeldovich Medal** is conferred by the Russian Academy of Sciences to scientists 35 years of age or younger, for excellence and achievements. Medals are presented to a scientist in each of COSPAR's Scientific Commissions. Recipients of the 2008 Zeldovich Medals were: S.S. Contell (Scientific Commission A); (Scientific Commission B, no award); J.J. Makela (Scientific Commission C); O. Podladchikova (Scientific Commission D); S.A. Bogachev (Scientific Commission E); T. Bogachev (Scientific Commission F); F. Zoueshtiagh (Scientific Commission G); and T. van Zoest (Scientific Commission H).
- **COSPAR/Jeoujang Jaw Award** is bestowed by the Chinese Academy of Sciences and is intended to recognize scientists who have made distinguished pioneering contributions to promoting space research, establishing new space science research branches, and founding new exploration programs. The first award was made in 2008 to J.L. Burch.

Additional details concerning the awards, together with instructions and nomination forms, can be found at http://cosparhq.cnes.fr/Awards/awards.htm. Completed nominations forms must be received by the COSPAR Secretariat in Paris no later than November 30, 2009.

SSB CALENDAR

JULY

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AUGUST

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July 6-8	*Planetary Science Decadal Survey-Steering Committee*—**Washington, DC**
July 13-15	*Committee for the Review of Near-Earth Object Surveys and Hazard Mitigation Strategies-Survey/Detection Panel*—**Santa Fe, NM**
July 14-15	*Astro 2010-The Galactic Network Panel*—**Santa Barbara, CA**
July 16-17	*Astro 2010-Planetary and Star Formation Panel*—**Washington, DC**
July 29-31	*Committee for the Review of Near-Earth Object Surveys and Hazard Mitigation Strategies-Mitigation Panel*—**Boulder, CO**
July 30-31	*Assessment of Impediments to Interagency Cooperation on Space and Earth Science Missions*—**Washington, DC**
July 30-31	*Astro 2010-Galaxies across Cosmic Time Panel*—**Boulder, CO**
August 4-5	*Space Studies Board Executive Committee*—**Woods Hole, MA**
August 5-6	*Astro 2010-Cosmology and Fundamental Physics*—**Seattle, WA**
August 10-11	*Committee for the Review of Near-Earth Object Surveys and Hazard Mitigation Strategies-Steering Committee*—**Woods Hole, MA**
August 19-20	*Committee on NASA's Suborbital Research Capabilities*—**Boulder, CO**
August 19-21	*Decadal Survey on Biological and Physical Sciences in Space-Joint Meeting of Panels*—**Washington, DC**
August 24-26	*Planetary Science Decadal Survey-Satellites Panel*—**Washington, DC**
August 24-26	*Planetary Science Decadal Survey-Giant Planets Panel*—**Washington, DC**
August 25-27	*Astro 2010-Optical and Infrared Astronomy from the Ground Panel*—**Washington, DC**
August 26-28	*Planetary Science Decadal Survey-Inner Planets Panel*—**Washington, DC**
Sept. 1-3	*Committee for the Review of Near-Earth Object Surveys and Hazard Mitigation Strategies-Steering Committee*—**Irvine, CA**
Sept. 1-3	*Committee on the Origins and Evolution of Life*—**Bozeman, MT**
Sept. 4-6	*Astro 2010-Radio, Millimeter and Submillimeter from the Ground Panel*—**Woods Hole, MA**
Sept. 9-11	*Planetary Science Decadal Survey-Mars Panel*—**Pasadena, CA**
Sept. 9-11	*Planetary Science Decadal Survey-Primitive Bodies Panel*—**Washington, DC**
Sept. 17-19	*Astro 2010-Particle Astrophysics and Gravitation Panel*—**Woods Hole, MA**
Sept. 21-23	*Planetary Science Decadal Survey-Satellites Panel*—**Irvine, CA**
Sept. 23-25	*Astro 2010-Electromagnetic Observations from Space Panel*—**Washington, DC**
Sept. 23-25	*Committee on NASA's Suborbital Research Capabilities*—**Irvine, CA**

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