



October — december 2010

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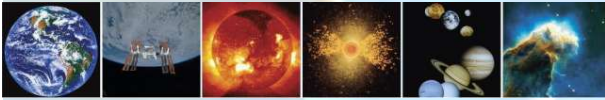


“Many people have remarked that human exploration lacks the kinds of long-range goals that stabilize NASA’s science programs; the NRC will now have a chance to address this issue in depth.”

—Charles Kennel, Chair, SSB

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SPACE STUDIES BOARD NEWS



FROM THE CHAIR

They said it couldn't be done. How many times have you heard it said that the Academy can't even choose a committee, much less write a report, in time to influence fast-breaking decisions? (On second thought, don't answer.)

But it has been done. It all started when the NRC's decadal survey of astronomy and astrophysics, *New Worlds, New Horizons in Astronomy and Astrophysics (NWNH)* was released last August. A joint product of the Board on Physics and Astronomy and the Space Studies Board, NWNH was the first decadal survey to take engineering, management, and independent analysis of technical readiness and cost issues into account in the formulation of its research strategy. The increased ability to estimate mission realism gave the survey the confidence to synthesize mission concepts from the many ideas that they heard from the research community. This played a role in developing NWNH's recommendation for the Wide-Field Infrared Survey Telescope (WFIRST) mission. The survey saw that such a space telescope could achieve not one but three goals of the astronomy and physics communities: to make much more precise measurements to determine the role dark energy plays in the dynamics of the universe by surveying hundreds of millions of galaxies in the infrared, to refine our understanding of galaxies and clusters using WFIRST's vast quantity of data, and to make progress on the detection of extrasolar Earth-like planets using microlensing.

WFIRST was not the whole story, of course, and the survey gave equal weight to a program of principal-investigator-class missions and broad disciplinary support. However, since WFIRST was NWNH's highest-priority large space-based mission, it was bound to attract attention. To add to the attention-getting, the survey recommended that the United States play a strong leadership role in implementing WFIRST, going it alone if necessary.

Meanwhile, major delays and very large cost and schedule overruns in the James Webb Space Telescope (JWST) project are taking place. These were and are going to affect NASA's whole astrophysics program. Moreover, the budgetary guidance given to the decadal survey was no longer pertinent. NASA, which did not want to see the United States shut out of dark energy research, had started to explore with the European Space Agency (ESA) the possibility of a 20% participation in ESA's *Euclid* mission, which will compete this summer for a 2018 launch opportunity.

The NWNH's WFIRST recommendation and the news that NASA was pursuing *Euclid* hit the streets at about the same time. At this point, the White House got involved, and the Office of Science and Technology Policy requested an Academy evaluation of the WFIRST-*Euclid* choice. Given ESA's short decision time and the approaching president's budget request for FY2012, any NRC study had to be done quickly, so that NASA could make a *Euclid* recommendation (or not) in its next budget request.

This is when the avalanche of work started. It would take too much space to recount here how a hard-working panel considered in depth the scientific merits of WFIRST and *Euclid*, and how it also interpreted what the survey committee had really meant. You can read the panel's report for yourself (www.nap.edu/catalog.php?record_id=13045), but in summary the *Report of the Panel on Implementing the Recommendations from New Worlds, New Horizons Decadal Survey* had three broad conclusions. The best outcome would be if JWST's budget overruns were magically solved outside the astrophysics program. Second best, or potentially first best, would be if NASA and ESA were to design a joint mission reflecting the WFIRST capabilities outlined in NWNH. Finally, minority participation in *Euclid* was not a recommendation of the decadal survey.

NASA and ESA have been put in a delicate situation. Very careful international negotiations will be needed. However, if the present goodwill

between NASA and ESA continues, we can hope for a reasonable outcome. In the end, it is all about the best science.

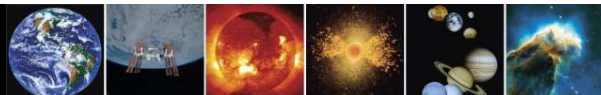
A hardy band of heroes—committee members and NRC staff—working days, nights, and weekends, completed this report in 8 weeks. All involved were heroes, but I would like to single out my panel co-chair Adam Burrows and NRC staff David Lang, Caryn Knutsen, Michael Moloney, and Don Shapero for special recognition. We also owe a great deal of gratitude to the speakers who came to our panel's workshop at very short notice and to the NRC reviewers who turned around this report's review in record time.

Would we do it again? Not too soon, please. Would we do it again if we had to? You bet. Only next time, our goal is that the SSB will be better prepared. In this regard we are exploring how to improve the NRC stewardship of our decadal surveys after they have been released. Our recent adventure emphasizes how important that function is.

(Continued on page 3)



"They said it couldn't be done. How many times have you heard it said that the Academy can't even choose a committee, much less write a report, in time to influence fast-breaking decisions? (On second thought, don't answer.)"



On another note, there is important news about human spaceflight. The president's human spaceflight 2011 budget submission provoked the most divisive congressional debate about NASA that I have ever seen. Ultimately, the Senate and House passed a NASA Authorization Act, which was quickly signed into law by the president. This legislation contains a special request to NASA to "contract with the National Academies for a review of the goals, core capabilities, and direction of human space flight, using the goals set forth in the National Aeronautics and Space Act of 1958, the National Aeronautics and Space Administration Authorization Act of 2005, and the National Aeronautics and Space Administration Authorization Act of 2008, the goals set forth in this Act, and goals set forth in any existing statement of space policy issued by the President." The legislation envisions that elements of the review shall include:

- (1) A broad spectrum of participation with representatives of a range of disciplines, backgrounds, and generations, including civil, commercial, international, scientific, and national security interests;
- (2) Input from NASA's international partner discussions and NASA's Human Exploration Framework Team;
- (3) An examination of the relationship of national goals to foundational capabilities, robotic activities, technologies, and missions authorized by the Act;
- (4) A review and prioritization of scientific, engineering, economic, and social science questions to be addressed by human space exploration to improve the overall human condition; and
- (5) Findings and recommendations for fiscal years through 2023.

Many people have remarked that human exploration lacks the kinds of long-range goals that stabilize NASA's science programs; the NRC will now have a chance to address this issue in depth. Together with the Aeronautics and Space Engineering Board, we have started to plan how best to carry out this mandate. At this early stage, it is difficult to say what the scope will be other than that it will be challenging project of a scope certainly no less than a science decadal survey.

Also of interest, you may have missed one of the most stimulating workshops I have ever attended: *Sharing the Adventure with the Public: The Value and Excitement of "Grand Questions" of Space Science and Exploration*. Held in Irvine, November 8-10, this workshop featured some of the international space science world's most thoughtful communicators along with leaders of the media—traditional and modern. Together we reviewed the achievements of the past 50 years and shared our visions for the next 50 years.

When we first started planning this workshop, our question was banal: Is NASA making use of the modern tools of communication? But as our thinking evolved, we realized that NASA communicates best by what it does and not what it says. The workshop became an extended discussion of the significance of the space enterprise, not only to science, but also to global civilization.

I want to thank SSB members and the former SSB chairs and members who spent valuable time over 2 years helping to set the magisterial tone of the workshop. All the speakers evidently devoted serious thought to their presentations. But the biggest kudos go to Ian Pryke, who combined his knowledge and international connections with persistence and hard work to bring it all together. All in all, these people created one of the most memorable events I have been privileged to be part of.

You can find more information about the workshop, including videos of the entire two and half days at http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_057195. A report recounting the workshop discussions will be released soon.

—Charles Kennel, Chair, SSB

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JULY 1, 2010—JUNE 30, 2011

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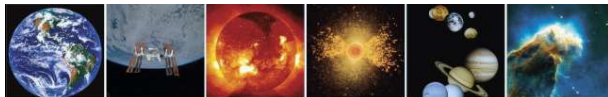
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For more information on the membership of the
SSB please visit our website at
www.nationalacademies.org/ssb.



DIRECTOR'S CORNER



With the beginning of a new year the space sciences community finds itself faced with a considerable challenge in figuring out how to construct the best science program for a decade that is likely to be subject to much more stringent fiscal constraints than might have been envisioned only a few months ago. Against this backdrop the SSB will continue to provide key advice for the nation's science community as well as the government's policy and decision makers by means of its set of decadal surveys in astronomy and astrophysics, Earth sciences, planetary science, solar and space physics, and biological and physical sciences in space. These reports take a decadal view of where the science priorities for a particular subfield lie. The key science questions they outline—such as the questions from the Science Frontier Panels of the recently released Astro2010 *New Worlds, New Horizons* (NWNH) survey of astronomy and astrophysics—lie at the core of the advice that the SSB provides. Those questions will be resilient to budget ups and downs, although the timelines for the questions being answered may be longer now than had been hoped or planned for. It is important that in these challenging times that the focus remains on maximizing the pursuit of science over the decade ahead and beyond, and so we can expect the SSB will discuss this focus and the related challenges with key federal decision makers at its board meeting on April 6-7, 2011, in Washington, DC.

Often in times of challenged budgets, more consideration is given to the possibility of cost sharing by collaborating or cooperating on large missions and projects. Such collaborations can be envisioned as multiagency and/or international in nature. In a recently released SSB report the Committee on Assessment of Impediments to Interagency Cooperation on Space and Earth Science Missions found that candidate projects for multiagency collaboration in the development and implementation of Earth-observing or space science missions are often intrinsically complex and costly. The committee concluded—following an examination of case studies, agency briefings, and existing reports, as well as drawing on personal knowledge and direct experience of its members—that a multiagency approach to developing these missions typically results in additional complexity and cost. Advocates of collaboration have sometimes underestimated the difficulties and associated costs and risks of dividing responsibility and accountability between two or more partners; they also can discount the possibility that collaboration will increase the risk in meeting performance objectives. The report makes some interesting and thought-provoking recommendations discussed elsewhere in this newsletter, recommendations that advise caution and planning before engaging in a collaborative approach.

That said, collaborative projects are all but certain to remain part of the panoply of missions at the core of our nation's space sciences program. Collaborative missions in operation—such as the current Fermi Space Telescope—are producing great science, and, at the end of the day, the science is the key story to tell. But how do we convey that excitement to the wider public? In an effort to do so for astronomy and astrophysics, the NRC will be issuing a follow-up booklet to the NWNH report later this year. Products such as this can play a key role in conveying the value and excitement of the “Grand Questions” of space science. But there are other avenues, and at its November board meeting the SSB engaged a workshop in a lively dialogue on issues such as these: “Inspiring Public Interest in Space Research and Exploration: Communication Challenges and Opportunities” and “Communication Pathways to the Public: Readable Content, Video, and Social Media.” The workshop focused on how to sustain public understanding of, interest in, and involvement with NASA science and exploration efforts that might take several years to decades to unfold. A lively discussion is reported elsewhere in this newsletter, and video from the workshop is available on the SSB's Web site. Stay tuned for further efforts by the board to diversify the way we reach out to the public in the months ahead.

“Collaborative missions in operation—such as the current Fermi Space Telescope—are producing great science, and, at the end of the day, the science is the key story to tell.”

—Michael Moloney, Director, SSB and ASEB

SSB STANDING COMMITTEE CHAIRS

COMMITTEE ON ASTRONOMY AND ASTROPHYSICS (CAA)*

COMMITTEE ON EARTH STUDIES (CES)

Chair: Berrien Moore III

Vice Chair: Ruth S. DeFries

COMMITTEE ON THE ORIGINS AND EVOLUTION OF LIFE (COEL)**

Co-Chairs:

Robert T. Pappalardo

J. Gregory Ferry

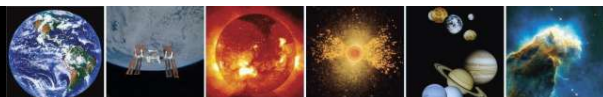
COMMITTEE ON PLANETARY AND LUNAR EXPLORATION (COMPLEX)***

COMMITTEE ON SOLAR AND SPACE PHYSICS (CSSP)***

*Joint with the Board on Physics and Astronomy; on hiatus during the Astro2010 decadal survey.

**Joint with the Board on Life Sciences.

***COMPLEX and CSSP are on hiatus during the planetary science decadal survey and the solar and space physics decadal survey, respectively.



SSB ACTIVITIES

THE BOARD AND ITS STANDING COMMITTEES

The **Space Studies Board (SSB)** met November 8, 2010 at the National Academies' Arnold and Mabel Beckman Center in Irvine, CA, for a short executive session. The Board then attended and participated in the workshop "Sharing the Adventure with the Public: The Value and Excitement of "Grand Questions" of Space Science and Exploration" (see more information in the study committee section on page 6 of this newsletter).

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

The **Committee on Earth Studies (CES)** did not meet during this quarter; however, SSB staff met with senior officials at the USGS Geography Division regarding their request for a study that would consider various issues related to the development of an operational land remote sensing capability. Members of CES reviewed a preliminary statement of task for this study, and preparations of a study proposal to the NRC were underway as the quarter ended. Members of the committee were also involved in developing a statement of task for a congressionally-mandated study that will assess Earth science programs at NASA at the mid-point of the decadal survey cycle (the first NRC decadal survey in Earth science, *Earth Science and Applications from Space*, was published in January 2007).

The **Committee on the Origins and Evolution of Life (COEL)** met last quarter at the National Academies' Jonsson Center in Woods Hole, MA on October 13-15. Discussions at this meeting included astrobiology, life on the titanian ocean, and life in extreme environments.

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)** is on hiatus until the completion of the solar and space physics (heliophysics) decadal survey.

STUDY COMMITTEES

A pre publication report from the ad hoc **Committee on the Assessment of Impediments to Interagency Cooperation on Space and Earth Science Missions** was issued in November. The report was subsequently briefed to NASA officials and to staff of the House Science and Technology's Subcommittee on Space and Aeronautics. Further briefings, including a January 18, 2011, briefing to the director and staff of the White House Office of Science and Technology Policy and publication of the final report are planned for the first quarter of 2011. The executive summary of this report is reproduced in the Reports section on page 8.

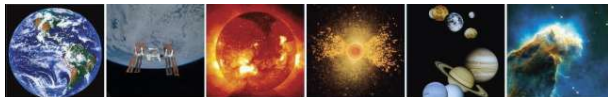
The steering committee for the **Decadal Survey on Biological and Physical Sciences in Space** held its final meeting on October 14-15 at the Keck Center in Washington, DC, to consider comments from the external reviewers of the decadal study. While most of the

reviews had not arrived by the requested date prior to the meeting, based on those early inputs, the committee identified and discussed some overarching issues and recurrent themes; made plans for working with the panels to address the most prominent issues in the panel chapters; and developed preliminary feedback for a large number of the review comments. Most of the remaining comments from the 40 external reviewers had arrived by early November, at which time the committee and the panels began making integrated changes to the report. The comments were quite extensive, and work by the committee and panels continued through the remainder of this period, with completion of the review expected by the end of January 2011.

Many activities occurred this quarter in connection with the initiation of the second **NRC Decadal Strategy for Solar and Space Physics (Heliophysics)**. More information is available at http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_056864. A solicitation to the community for mission concepts and related activities that might be undertaken in the coming decade drew 288 responses, all of which are posted on the Web site above. Representatives from the survey also conducted town hall meetings and outreach events at the University of California, Los Angeles; University of California, Berkeley; University of Maryland; National Center for Atmospheric Research; University of New Hampshire; University of Michigan; Arecibo Observatory; Southwest Research Institute; University of Texas, Dallas; and at the NSF Upper Atmosphere Facilities Fall 2010 Meeting in Roanoke, VA. The final town hall event of the quarter occurred in December at the fall meeting of the American Geophysical Union. Other activities included the first meeting of the survey steering committee on September 1-3 at the National Academies' Keck Center in Washington, DC, and the first meetings in November of the three discipline-oriented study panels that are supporting the steering committee. The survey's five cross-disciplinary working groups were constituted, and one—Theory, Modeling, and Data Exploitation—held a meeting in Boulder, CO. As the quarter ended, planning was underway for the second meetings of the disciplinary panels, all of which are scheduled to occur in January 2011 and meetings of the working groups and related events, including a February 7-8, 2011, town hall at the Beckman Center in Irvine, CA, that will examine issues in the transition from space weather research to operations and the flow from operations to research. Future meetings of the steering committee include a February 1-3, 2011 meeting at the Beckman Center in Irvine, CA, and an April 12-14, 2011 meeting in Washington, DC. Finally, many activities were underway in connection with the planned cost and technical evaluation of selected mission concepts.

The ad hoc **Committee on Planetary Protection Standards for Icy Bodies in the Solar System** was established in September, following arrival of NASA funding in August. The study will develop and recommend planetary protection standards for future spacecraft missions, including possible landers and subsurface probes, to the icy bodies in the outer solar system (asteroids, satellites, Kuiper belt objects, and comets) in light of current scientific understanding and ongoing improvements in mission-enabling capabilities and technologies. The committee will hold its first meeting on January 31-February 2, 2011, at the National Academies' Keck Center in Wash-

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ington, DC, and its second meeting on March 16-18 at the Beckman Center in Irvine, CA.

The **Planetary Science Decadal Survey** charge is to determine the current state of knowledge and identify the most important scientific questions expected to face the community during the interval 2013-2022. The report draft entered review in October, and the committee is currently responding to nearly 1,600 comments from 18 reviewers.

The decadal survey's target delivery to NASA and the NSF is early March 2011. The presentations from decadal survey meetings, together with meeting summaries and archived webcasts, are available at the decadal survey's Web site http://sites.nationalacademies.org/SSB/CurrentProjects/ssb_052412.

The importance of conveying an understanding and appreciation for the "grand questions" of space science and exploration that motivate the majority of NASA's programs—How is the universe evolving? Are we alone? Will the Earth remain a hospitable home for humanity in the future? What could the future hold for humans in space?—was the topic of a workshop, **Sharing the Adventure with the Public: The Value and Excitement of "Grand Questions" of Space Science and Exploration**, held on November 8-10 at the National Academies' Arnold and Mabel Beckman Center in Irvine, CA. The workshop was organized by an ad hoc planning committee and held under the auspices of the SSB, involved prominent space scientists and communications professionals and attracted an audience of more than 160. A report on the discussions that took place will be released in 2011. Workshop details can be found on the SSB Web site at http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_057195, along with videos of each session. A short perspective on the workshop, written by one of the session speakers, Linda Billings, research professor, George Washington University, is provided on page 7.

The SSB staff is in the process of forming an organizing committee for an upcoming **Workshop on the Effects of Solar Variability on Earth's Climate**. The committee will meet in the Spring, and the workshop will likely take place in the Summer of 2011.

OTHER ACTIVITIES

The **Committee on Space Research (COSPAR)** will hold its next scientific assembly in Mysore, India, on July 14-22, 2012. The annual business meetings will be held at COSPAR's Paris headquarters on March 21-24, 2011.

The **SSB outreach staff**, in conjunction with the Division on Earth and Life and Studies, exhibited at the American Geophysical Union on December 13-17 in San Francisco, CA. Also, in conjunction with the Board on Physics and Astronomy, the SSB exhibited at the American Astronomical Society meeting, held January 9-13, 2011, in Seattle, Washington. At the AAS we distributed 200 copies of the recently released report *New Worlds, New Horizons in Astronomy and Astrophysics*.

We plan to exhibit at the AAAS meeting on February 17-21, 2011, in Washington, DC; the Lunar and Planetary Science Conference on March 7-11, 2011, in Houston, TX and the National Science Teachers Association in San Francisco, CA on March 10-13, 2011.

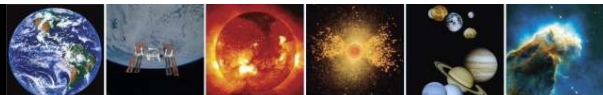
AMERICAN GEOPHYSICAL UNION MEETING DECEMBER 13-17, 2010



Celeste Naylor (SSB outreach staff) and Tiffany Small (National Academies Press staff)



Matthew Broughton (former SSB intern) and Celeste Naylor (SSB outreach staff)



A Participant's Perspective

Workshop on Sharing the Adventure with the Public: The Value and Excitement of “Grand Questions” of Space Science and Exploration



Linda Billings, Ph.D., is a research professor with the School of Media and Public Affairs at George Washington University and a principal investigator with the NASA Astrobiology Program. She has worked in the Washington space community for 27 years. She is commentary editor for the peer-reviewed journal Science Communication. She was a member of the Planning Committee for the Fall 2010 SSB workshop and also served as speaker and commentator there. The following are Dr. Billings

personal observations of the workshop and do not represent the views or conclusions of the NRC or the SSB.

Space scientists want to improve and expand their communications with public audiences about the work that they do, conveying its value and excitement. But in order to do so, they need to better understand their various audiences, get over their fear of new media, and dive into the world of Facebook, Twitter, and the blogosphere. A partnership between communication experts and space scientists is the logical path toward fulfilling these goals.

These themes, among others, emerged out of 3 days of dialogue, engendered by the Space Studies Board of the National Research Council, at a workshop on how to improve and expand communications about the U.S. space program.

The planning committee's decision to invite communication professionals to comment on science presentations and to have scientists comment on communication presentations was an experiment whose results were better than anticipated. This approach enabled workshop participants to sustain a lively dialogue over the course of 3 days. By all accounts from SSB members, staff, and workshop attendees, this event succeeded beyond expectations, providing insights into the different ways in which scientists and communicators think about science and communication and producing plenty of food for thought.

The aim of the workshop was to explore key questions driving U.S. space research and exploration and identify effective ways for communicating with public audiences about progress toward answering these questions. Participants were a mix of SSB members and other leading space scientists plus professional communicators ranging from journalists to scholars of communication. Discussion revolved around these questions: How did the universe begin, and how is it evolving? Are we alone? How did our solar system begin, and how is it evolving? Will Earth remain a hospitable home for humanity? What could the future hold for humans in space?

“NASA's success in public outreach has varied over time and across the spectrum of its programs,” the SSB noted in its statement of purpose for the workshop. “Notable successes such as the Apollo program and the Hubble Space Telescope have stimulated broad public excitement and a feeling of ‘ownership’ with NASA's science and exploration programs. A recent perception, however, is that there are fewer successes than in the past. One major reason for this per-

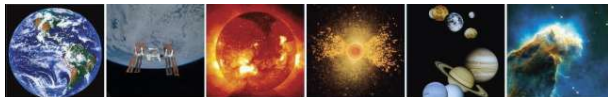
ception may be that many of NASA's missions now take years to develop to the point where noteworthy milestones occur or significant results begin to appear... Continuously involving the public and conveying the value and excitement of missions during their long development periods can be daunting.”

A common theme that was raised during the workshop was that “grand questions” in space exploration generate great stories: the challenge is how to tell them. Space science has no dearth of good stories to tell, and a well-constructed narrative is a powerful way to engage an audience. While numerous viewpoints were expressed on the purpose, goals, and intangible values of space research and exploration, many participants identified the search for life in the universe as an important driver of the narrative of space exploration.

Among many interesting and enlightening observations offered were the following:

- Ed Stone, former director of the Jet Propulsion Laboratory (JPL), recalled JPL's efforts to meet unanticipated and huge media demand for information during the Voyager mission's planetary encounters. Today, anybody with access to the Internet has access to data from planetary missions, he noted, but the science community still needs to find or make opportunities to explain what the data and resulting discoveries mean.
- Journalist Miles O'Brien, chair of the NASA Advisory Council's Education and Public Outreach Committee, said that including the public is not a part of NASA's standard approach to communication, “and that has to change.”
- COEL member Sara Seager discussed the “Gliese 581g” story, in which a U.S. research team announced its “first habitable exoplanet” detection via traditional communication channels. Two weeks later, at a meeting in Torino, a Swiss research team announced that it could find no evidence of this planet. This latter news broke via Twitter (a “tweet” from a scientist at the meeting). One lesson embedded in this story is that, thanks to social media, all meetings are, more or less, “open,” no matter what their organizers say.
- Former SSB member Berrien Moore gave an impassioned presentation on “the climate issue,” asserting that, despite overwhelming evidence, the science community has “failed” to communicate that climate change is a real crisis requiring immediate action.
- University of Wisconsin communication scholar Dietram Scheufele offered five sure-fire ways to fail in science communication: be reactive; ignore peoples' values; assume that science will always prevail in the end, no matter how the story first breaks; assume that new media don't matter; and assume that communication is an art rather than a science and depend on your intuition instead of communication experts.

In his concluding remarks, SSB Chair Charles Kennel said that,
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today, the “grand questions” of space research and exploration are intertwined, while communication is being “revolutionized.” There’s potential for producing a “second enlightenment” by means of a partnership between scientists and communicators. Communication is the way that science becomes a part of the policy making process. Thus, the science community needs engage in this partnership.

It was clear over the 3 days of dialogue that everyone present—an admittedly self-selected group—cared about science communication, though approaching the subject from many different perspectives. While audiences for information about space science and exploration are highly diverse—in gender, age, and education as well as in values and beliefs—the audience for the SSB workshop was admittedly limited, owing to it being held during the work/school week from 9 to 5. However, as discussed at the meeting, social media do provide a way to open up such events to broader audiences. For example, Alan Ladwig, deputy associate administrator for public outreach in the Office of Communications at NASA Headquarters, who participated in the SSB workshop, “tweeted” about the 3 days of proceedings (see <http://twitter.com/alanmladwig#>). Also, the SSB made a video recording of the workshop, which is posted on the NRC’s Vimeo page (Vimeo is a video-sharing web-based community) accessible through the SSB’s Web site. The NRC will issue a report on the workshop, prepared by workshop rapporteur and former SSB director Marcia Smith, early this year.

Toward building on the workshop’s proceedings and continuing to advance the cause of improving and expanding science communication, the SSB might consider, for example, inviting communication professionals to speak at Board meetings, or partnering with other groups interested in science communication—for example, the American Association for the Advancement of Science, the American Geophysical Union, the Association of Educators in Journalism and Mass Communication, and the National Association of Science Writers—to conduct studies or organize discussions at science or communication conferences.

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/.

Assessment of Impediments to Interagency Collaboration on Space and Earth Science Missions

This report by the Committee on the Assessment of Impediments to Interagency Collaboration on Space and Earth Science Missions is available at http://www.nap.edu/catalog.php?record_id=13042. The study was led by co-chairs, D. James Baker and Daniel N. Baker. The study was staffed by Arthur A. Charo, study director, Joseph K. Alexander, senior program officer, Abigail A. Sheffer, associate program officer, Catherine A. Gruber, editor, Carmela J. Chamberlain, administrative coordinator, and Terri Baker, senior program assistant.

Executive Summary

Through an examination of case studies, agency briefings, and existing reports, and drawing on personal knowledge and direct experience, the Committee on Assessment of Impediments to Interagency Cooperation on Space and Earth Science Missions found that candidate projects for multiagency collaboration in the development and implementation of Earth-observing or space science missions are often intrinsically complex and, therefore costly, and that a multi-agency approach to developing these missions typically results in additional complexity and cost. Advocates of collaboration have sometimes underestimated the difficulties and associated costs and risks of dividing responsibility and accountability between two or more partners; they also discount the possibility that collaboration will increase the risk in meeting performance objectives.

This committee’s principal recommendation is that agencies should conduct Earth and space science projects independently unless:

- **It is judged that cooperation will result in significant added scientific value to the project over what could be achieved by a single agency alone; or**
- **Unique capabilities reside within one agency that are**

necessary for the mission success of a project managed by another agency; or

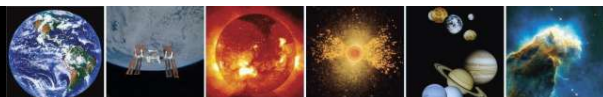
- **The project is intended to transfer from research to operations necessitating a change in responsibility from one agency to another during the project; or**
- **There are other compelling reasons to pursue collaboration, for example, a desire to build capacity at one of the cooperating agencies.**

Even when the total project cost may increase, parties may still find collaboration attractive if their share of a mission is more affordable than funding it alone. In these cases, alternatives to interdependent reliance on another government agency should be considered. For example, agencies may find that buying services from another agency or pursuing interagency coordination of spaceflight data collection is preferable to fully interdependent cooperation.

Lessons from International Collaboration

Important lessons for national interagency collaboration efforts may also be learned from experiences with international collaboration (i.e., more than one country working together). In particular, the committee found that the U.S. experience in international collabora-

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tive projects is instructive with regard to the degree of upfront planning involved to define clear roles, responsibilities, and interfaces consistent with each entity's strategic plans.

Experience has shown that collaborative projects almost invariably lead to increased costs. When additional participants join a project, the basic costs remain, but the costs of duplicating management systems and of managing interactions must be added. It is also important to recognize that even though the overall cost of the program may increase, the cost to each partner is often decreased, thus making a program more affordable to each partner. With international cooperation, the cost of a program to the U.S. government can be decreased, since a foreign government is absorbing some of the basic costs. With interagency cooperation, the cost to the government inevitably rises, because the basic cost plus the additional costs must all be absorbed by the participating U.S. agencies.

A prerequisite for a successful international collaboration is that all parties believe the collaboration is of mutual benefit. Proposals for interagency collaboration within the United States should receive similar serious attention as part of each agency's strategic decision-making process *prior* to proceeding with technical commitments and procurements. As with international agreements, interagency agreements should not be entered into lightly and should be undertaken only with full assessment of the inherent complexities and risks.

Impediments to Interagency Collaboration

Impediments to interagency collaboration can result from sources both internal and external to the agencies themselves. Internal sources can include conflicts that result from differing agency goals, ambitions, cultures, and stakeholders, and agency-unique technical standards and processes. External sources can include the differing budget cycles for agencies—especially for the National Oceanic and Atmospheric Administration (NOAA), which must first submit its budget to the Department of Commerce—each of which has different congressional authorization and appropriation subcommittees, budget instability, and changes in policy direction from the administration and Congress. These impediments manifest themselves as impacts to mission success and as changes in cost, schedule, performance, and associated risks.

The most serious impediments to collaboration are external to the agencies. They are typically symptoms of conflicting policies that are often not made explicit at the beginning of proposed cooperative efforts. Such impediments manifest themselves as different budget priorities by agencies, the Office of Management and Budget (OMB), and the Congress toward the same collaborative activity. While there may be acknowledgement of the value of collaboration at a national level, at the implementation level decision makers can be unwilling to prioritize collaboration above other agency mission assignments and constraints.

As detailed in Chapter 3 of this report, many of the impediments to interagency collaboration, both internal and external, manifest themselves as impediments to good systems engineering. Good systems engineering and project management techniques are important in any space mission, but especially when multiple organizations are involved. The inevitable creation of seams (i.e., divisions of responsibility and/or accountability between participants for planning, funding, decision making, and project execution) as a result of interagency collaboration is a source of technical and programmatic risks.

Such risks could include failure to meet agreed technical performance requirements, compromised system reliability, unacceptable schedule delays, or cost overruns, and mitigating such shortfalls requires proactive management and attention.

The committee identified a number of impediments that should be considered and addressed prior to the start of collaboration, and it outlines below a number of best practices to mitigate risk at various stages of mission development. From its consideration of numerous case studies (Appendix C), the committee found that interagency collaboration based on working-level collaborations among the agencies' technical staff is preferred to top-down direction to pursue collaboration (e.g., via policy edict), because top-down direction may be burdened from the beginning with a lack of working-level buy-in. Successful collaboration was also found to be more likely when each agency considers the partnership one of its highest priorities; such an understanding should be codified in signed agreements that also document the terms of the collaboration's management and operations.

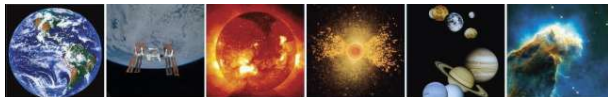
Governance and Interagency Collaboration

To facilitate interagency collaborations, there is a need for coordinated oversight by the executive and legislative branches. Because the current roles of OMB and the Office of Science and Technology Policy (OSTP) are not suited to this kind of day-to-day operational oversight, some other governance mechanism may be needed to facilitate accountable decision making across multiple agencies while providing senior administration and congressional support for those decisions.

The committee recommends that if OSTP, OMB, or the Congress wishes to encourage a particular interagency research collaboration, then specific incentives and support for the interagency project should be provided. Such incentives and support could include facilitating cross-cutting budget submissions; protecting funding for interagency projects; providing freedom to move needed funds across appropriation accounts after approval of a cross-cutting budget; multiyear authorizations; lump-sum appropriations for validated independent cost estimates; minimization of external reviews that are not part of the project's approved implementation plans; and unified reporting to Congress and OMB, as opposed to separate agency submissions.

The committee also investigated the particular problems associated with NASA-NOAA collaboration in support of climate research. Ensuring the continuity of measurements of particular climate variables, sustaining measurements of the climate system, and developing and maintaining climate data records are long-standing problems rooted in the mismatch of agency charters and budgets. As noted in the 2007 National Research Council decadal survey, *Earth Science and Applications from Space*, the nation's civil space institutions, including NASA and NOAA, have responsibilities that are in many cases mismatched with their authorities and resources: institutional mandates are inconsistent with agency charters, budgets are not well matched to emerging needs, and shared responsibilities are supported inconsistently by mechanisms for cooperation. This committee concurs with the decadal survey committee, which concluded that solutions to these issues will require action at a level of the federal government above that of the agencies.

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Facilitating Successful Collaborations

Successful interagency collaborations (i.e., those that have achieved their mission objectives and satisfied sponsor goals) share many common characteristics that are, in turn, the result of realistic assessment of agency self-interests and capabilities before and during the collaboration, and involve a disciplined attention to systems engineering and project management best practices. **The committee recommends that the following key elements be incorporated in every interagency Earth and space science collaboration agreement:**

- **A small and achievable priority list.** Projects address a sharply focused set of priorities and have clear goals. Agreement is based on specific projects rather than general programs.
- **A clear process to make decisions and settle disputes.** Project decision making is driven by an intense focus on mission success. This is facilitated by formal agreement at the outset on explicitly defined agency roles and responsibilities and should involve agreed processes for making management decisions, single points of accountability (i.e., not committees), and defined escalation paths to resolve disputes. Long-term planning, including the identification of exit strategies, is undertaken at the outset of the project and includes consideration of events that might trigger a reduction-in-scope or cancellation review and associated fallback options if there are unexpected technical difficulties or large cost overruns that make the collaboration untenable.
- **Clear lines of authority and responsibility for the project.** Technical and organizational interfaces are simple and aligned with the roles, responsibilities, and relative priorities of each collaborating entity. Project roles and responsibilities are consistent with agency strengths and capabilities. Expert and stable project management has both the time and the resources available to manage the collaboration. Specific points of contact for each agency are identified. Agency and project leadership provides firm resistance to changes in scope. When possible, one of the collaborating agencies should be designated as the lead agency with ultimate responsibility and accountability for executing the mission within the agreed set of roles and responsibilities, command structure, and dispute resolution process defined in a Memorandum of Understanding. In some cases the lead agency might change as a function of time, as for missions in which the lead agency differs between the implementation and operations phases.
- **Well-understood participation incentives for each agency and its primary stakeholders.** All parties share a common commitment to mission success and are confident in and rely on the relevant capabilities of each collaborating agency. Each agency understands how it benefits from the cooperation and recognizes that collaborative agreements may need to be revisited at regular intervals in response to budgetary and political changes. There is buy-in from political leadership (e.g., senior administration, Congress, and agency-level administrators), which can help projects past the inevitable

rough spots. There is a general spirit of intellectual and technical commitment from the agency workforce and contractors to help projects mitigate the disruptive effects of technical and programmatic problems that are likely to occur. Early and frequent stakeholder involvement throughout the mission keeps all stakeholders informed, manages expectations, and provides appropriate external input.

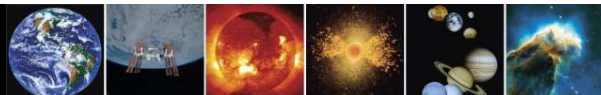
- **Single acquisition, funding, cost control, and review processes.** There is a single agency with acquisition authority, and each participating entity accepts financial responsibility for its own contributions to joint projects. Reliance on multiple appropriation committees for funding is avoided or reduced to the smallest possible extent. Cost control is ideally the responsibility of a single stakeholder or institution, because without a single point of cost accountability, shared costs tend to grow until the project is in crisis. Single, independent technical and management reviews occur at major milestones, including independent cost reviews at several stages in the project life cycle.
- **Adequate funding and stakeholder support to complete the task.** Funding adequacy is based on technically credible cost estimates with explicitly stated confidence levels.

In summary, engaging in collaboration carries significant cost and schedule risks that need to be actively mitigated. Agencies are especially likely to seek collaborators for complex missions so that expected costs can be shared. However, as the committee observed from historical experience and interviews, inefficiencies arise when collaborating agencies' goals, authorities, and responsibilities are not aligned. Thus, collaborations require higher levels of coordination, additional management layers, and greater attention to mechanisms for conflict resolution.

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STAFF NEWS

Christine Mirzayan Science and Technology Policy Graduate Fellowship Program

We are happy to welcome Heather Smith as the SSB's Winter 2011 Mirzayan Fellow. The Christine Mirzayan Science and Technology Policy Graduate Fellowship Program within the Policy and Global Affairs Division of the National Academies is designed to engage its fellows in the analytical process that informs U.S. science and technology policy. Fellows develop basic skills essential to working or participating in science policy at the federal, state, or local levels. More information about the fellows program can be found at <http://sites.nationalacademies.org/PGA/policyfellows/index.htm>.



Heather Smith recently completed her Ph.D. in biological engineering from Utah State University. After earning a bachelor's degree in psychology from the University of North Texas, Heather moved to California to work as a Space Camp counselor. While at Space Camp she volunteered at NASA Ames Research Center and was hired as a research associate for the SETI Institute at NASA Ames upon completion of an undergraduate degree in physics from the Evergreen State College. After working at NASA Ames for several years she decided to go back to graduate school. Prior to her doctoral degree she earned an M.Sc. in space studies from International Space University. Heather hopes to receive a NASA postdoctoral position beginning in the Spring.

Lloyd V. Berkner Space Policy Internship

During this quarter the SSB said good-bye to our Autumn 2010 Lloyd V. Berkner Space Policy Internship Program interns Gabriele Betancourt-Martinez (Yale University) and Jason Callahan (George Washington University). The Summer 2011 interns will be announced in our next newsletter.

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. Additional information on the program can be found in this newsletter and at http://sites.nationalacademies.org/SSB/ssb_052239.

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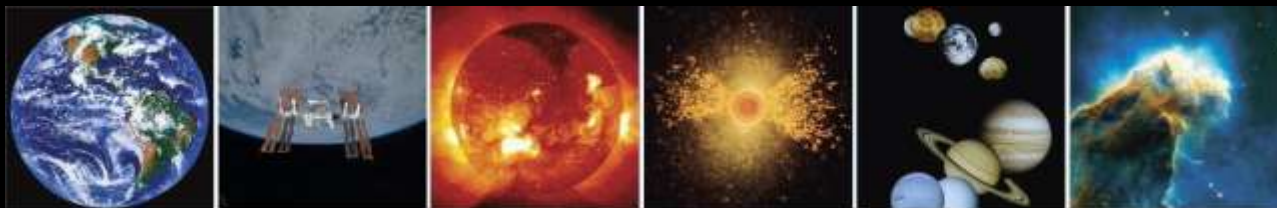
Lloyd V. Berkner Space Policy Interns

Autumn 2010

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JASON CALLAHAN

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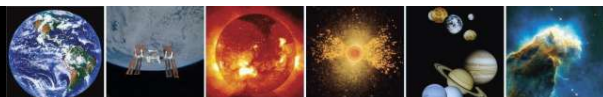
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- January 10-12 *Decadal Survey on Solar and Space Physics (Heliophysics): Panel on Solar and Heliospheric Physics—Washington, DC*
- January 12-14 *Decadal Survey on Solar and Space Physics (Heliophysics): Panel on Atmosphere-Ionosphere-Magnetosphere Interactions—Washington, DC*
- January 18-20 *Decadal Survey on Solar and Space Physics (Heliophysics): Solar Wind-Magnetosphere Interactions—Santa Fe, NM*
- January 31-February 2 *Committee on Planetary Protection Standards for Icy Bodies in the Solar System—Irvine, CA*
- February 1-3 *Decadal Survey on Solar and Space Physics (Heliophysics): Steering Committee—Irvine, CA*
- March 2-4 *Committee on Origins and Evolution of Life (COEL)—Washington, DC*
- March 16-18 *Committee on Planetary Protection Standards for Icy Bodies in the Solar System—Washington, DC*
- April 6-7 *Space Studies Board—Washington, DC*

Future ssb Meetings

- April 6-7, 2011, in Washington, DC
(April 6 is a joint session with the ASEB)
- November 8-10, 2011, in Irvine, CA
- April 4-6, 2012, in Washington, DC
(April 4 is a joint session with the ASEB)
- November 5-7, 2012, Irvine, CA



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