Advisory Committee for Geosciences
October 21-22, 2015
Meeting Minutes

**AC GEO Attendees:**

Dr. George M. Hornberger (Chair)

Ms. Vicki Arroyo

Dr. Mary C. Barth

Dr. Paul Bierman

Dr. Catherine Constable

Dr. E. James Dixon

Dr. Kip Hodges

Dr. Pamela Kempton

Dr. W. Berry Lyons

Dr. Joshua Semeter

Dr. Julienne Stroeve

Dr. Gregory Sullivan

Dr. Brian Taylor

Mr. David H. Voorhees

Dr. Roger Wakimoto

Dr. Joseph A. Whittaker

Dr. Mary-Elena Carr

Dr. Kim Prather

Dr. Carol Frost

Dr. Paul Shepson

Dr. Richard Murray

Dr. Kelly Falkner

Dr. Marge Cavanaugh

**Joining by Telephone:**

Dr. Scott C. Doney

**NSF Senior Staff:**

Melissa Lane

**Wednesday, October 21, 2015**

**Welcome & Introductory Remarks**

Dr. Hornberger opened the meeting and welcomed the group and members introduced themselves.

**Update on NSF GEO Activities**

Dr. Wakimoto provided an update on NSF GEO activities, beginning with a description of two new hires, Amanada Greenwell as Head of the Office of Legislative and Public Affairs and Rebecca Keiser as Head of the Office of International Science and Engineering.

Dr. Wakimoto next discussed merit review criteria, which include Intellectual Merit and Broader Impacts (BI). Focusing on the latter, he noted that the Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The Committee of Visitors report noted confusion and lack of common understanding regarding NSF’s BI implementation. Also, the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act of 2010 reauthorization mandates the BI review criterion and articulates its specific goals.

Also, the National Science Board (NSB) issued a report in 2012 on BI recommending NSF encourage institutions to coordinate and leverage BI activities to achieve benefits broader than those within a given project. (<http://www.nsf.gov/nsb/news/news_summ.jsp?cntn_id=122793>)

NSF’s Grants Proposal Guide (GPG) states that BI may be accomplished through the research itself, the activities that are directly related to specific research projects, or activities supported by, but are complementary to, the project. Dr. Wakimoto added that there have been questions raised regarding the meaning of the phrase, “the research itself.”

Dr. Wakimoto said AC/GEO’s guidance is needed regarding:

* What guidance do you recommend that we give to individual proposers? To institutions?
* What guidance should we give to reviewers and program officers?
* What should Committees of Visitors (COV) give priority to?
* Status quo or should we do more?
* Potential next steps for NSF, universities, and AC/GEO.

BI is on the agenda for later in the meeting, he noted, adding that it is also a subject for ongoing discussion. He signaled its importance, noting the director is focusing on the issue, and that it will come up during an upcoming mini-retreat with the assistant directors from all the directorates.

Dr. Wakimoto moved next to the subject of robustness and reproducibility. He said NSF has a very important role in this. In May he participated in a workshop convened by Marcia McNutt at the American Association for the Advancement of Science’s (AAAS). Draft recommendations for researchers from this Second Arnold Workshop on Reproducibility in the Field Sciences include:

* Basic training in data management should be part of the scientific curriculum. Data Carpentry, a program designed to teach basic concepts, skills and tools for working more effectively with data, is an example of such a training program.
* Data should be well described, well managed, and shared rapidly with professional repositories. Making “data professionals” routine members of research teams, especially with large projects, would help.
* Cultivate a culture that considers and values the stewardship and reuse of data at every step of the scientific process.

Draft recommendations for Federal agencies and other funders include:

* Provide resources to funded investigators to publish data that are usable by other researchers.
* Fund domain data repositories to accept and make available data cited in publications.
* Identify mechanisms that might provide the necessary education and training to achieve goals like those found in PARR (Public Access to Results of Research).
* Help researchers with implementation and provide oversight to achieve data management plans described in proposals.
* Fund studies to reproduce important findings.  Many researchers consider posting a PDF file of their data “publishing,” but this is not useful for further research.
* We need funding for data repositories, period. Not just new ones.

For GEO, Dr. Wakimoto focused, to begin with, on data management plans (DMP). He said it is the perfect time to step back and ask whether we’re way off target, whether the data management plans worked, whether PIs have responded and whether the plans are examples that should be publicized. Those questions haven’t yet been asked, he said, adding that now is a good time to begin.

The NSF requirement for inclusion in proposal submissions since 2011 has been:

* Expectation to share materials—data, samples, software—produced by the project;
* Description of the standards for data and metadata format and content;
* Policies for access and sharing, provisions for privacy, intellectual property;
* Provisions for re-use, re-distribution, and the production of derivatives;
* Plans for archiving and preserving access to research products.

GEO divisions have added additional guidance or requirements for GEO PIs:

* Data from field programs sent to national data centers or specified management groups;
* Preservation of data and physical collections needed for long-term research;
* Metadata prepared and posted on website, if no established repository;
* Plan for safe and secure archiving.

Dr. Wakimoto said now is the time to improve DMPs as several years have passed since implementation and because public access requirements are changing.

Currently, the GEO team is:

* Analyzing current DMPs;
* Identifying best practices for developing DMPs;
* Identifying best practices for evaluating DMPs and their compliance with NSF and GEO data policies;
* Developing guidance for revision of current divisional data policies to align with best practices;
* Reviewing efforts to maintain and to preserve data sets long-term, even after award expires;
* Consulting broadly and report to GEO Leadership and AC/GEO.

He said AC/GEO’s role is to:

* Provide input to GEO Team on community views and best practices;
* Provide feedback to GEO Leadership about report from GEO Team;
* Present report to AC/GEO at Spring 2016 meeting.

Dr. Wakimoto also discussed the Decadal Survey of Ocean Sciences, 2015-2025, noting that NSF’s Office of Management and Budget (OMB) examiner commended the report during a FY ’17 budget meeting as having been a difficult survey to carry out and because the recommendations are being implemented. Rep. John Culberson (R-Texas), Chair of the House Appropriations Committee’s Subcommittee on Commerce, Justice, and Science also called out the importance of following decadal survey priorities in the earth sciences.

Next, Dr. Wakimoto updated the timeline of the Antarctic Infrastructure Modernization for Science (AIMS) project stages and the Major Research Equipment and Facilities Construction (MREFC) process. It is currently at the beginning of the preliminary design phase, having received on October 5 the needed NSF director’s approval. The next stage is the final design phase, which will require NSB approval.

In July the White House issued an Executive Order creating a National Strategic Computing Initiative (NSCI) to:

* Maximize benefits of HPC for economic competitiveness and scientific discovery (hardware, system software, development tools, and applications;
* Emphasizes public-private collaboration;
* Exascale computing, simulations and data analytics;
* Lead agencies DOE, DOD, and NSF (central role in scientific discovery advances, HPC ecosystem for scientific discovery, and workforce development).

He said NSF is not as excited about going to exascale but is more interested in simulations, data analytics and scientific discovery. It is a very important time, he added, to highlight data simulation, which he called central to geosciences. This is something all directorates will soon be tackling.

Dr. Wakimoto, with NSF Director France Córdova and Chief Operating Officer Richard Buckias and, from GEO, Dr. Frost and Dr. Falkner, attended the Alan Alda Center for Communicating Science in July. The takeaways included:

* More is not more. Narrow your message to key points;
* State your goal early and clearly;
* Connect with your audience, including reading body language;
* PPT: The worst presentation is reading your slide and turning your back to your audience.

Also this summer, GEO hosted a well-attended event entitled, Communicating Science through Art, Film, and Music, which focused on communicating science more effectively.

Also of note are recently released NBC Learn videos on natural hazards narrated by Dr. J. Marshall Shepherd, who hosts the Weather Channel’s “Weather Geeks,” and directs the University of Georgia’s Atmospheric Science Program. Entitled, When Nature Strikes, the videos are available at: <http://www.nsf.gov/news/special_reports/naturestrikes/index.jsp>

For the FY ’16 budget, the House reauthorization of America COMPETES includes directorate-specific allocations that target GEO for a -8 percent reduction over FY ’15 and a -12 percent reduction over the FY ’16 request. The administration has issued a veto threat. The House Appropriations budget is less generous for NSF, with a 1 percent increase over the FY ’15 budget and -4 compared to the FY ’16 request. Also, it groups directorates with 70 percent of the total for BIO, CISE, ENG and MPS of R&RA, which would be a -16 percent reduction over FY ’15 and -20 percent over the FY ’16 request. Again, the administration’s position is a veto threat.

For the FY ’16 Senate appropriations, there is no change over FY ’15 and -5 percent compared to the FY ’16 request. However, directorate-specific allocations have been removed. Here too, the administration’s position is a veto threat.

There is currently a Continuing Resolution (CR) until December 11, which comes at the time of the AGU Fall Meeting, which starts December 13. Dr. Wakimoto said NSF is struggling with this because it may not be decided until the last minute. There might not be a single Federal employee at the meeting in the event of a government shutdown. Also, the NSF Director is scheduled to give the AGU Union Agency Lecture on December 15th in San Francisco and a shutdown would mean no NSF staff members in attendance.

Dr. Wakimoto said he was not allowed to offer any information yet about the FY ’17 budget, but there will be an update at the next AC/GEO meeting.

Rep. Mike Honda of California is the new Ranking Member of the House Appropriations Subcommittee on Commerce, Science and Justice. Recently he said, Earth science research “helps protect lives, business, and infrastructure. It is critical that we study and understand our ‘pale blue dot’ — our one and only home…. As our climate continues to change, Earth Science research is even more important for society to understand how these changes will impact our way of life. We should be increasing funding in these fields, not cutting them. It is shortsighted to disregard the societal benefits of earth, ocean, atmospheric, and polar research. I will continue to fight for robust Earth Science funding and stop Congressional attempts to deprioritize the Earth and Geo Sciences.”

Dr. Faulkner and Renee Crain organized a visit to Alaska for Dr. Córdova and others that included Toolik Lake and Barrow; the University of Alaska at Fairbanks and Anchorage; a helicopter tour of the Alaska pipeline; a permafrost tunnel; and a tour of the Sikuliaq.

Previewing a session later in the day featuring John Holdren, Assistant to the President for Science & Technology and Director of the Office of Science and Technology Policy (OSTP), Dr. Wakimoto noted that geosciences is interwoven into the OMB/OSTP FY ’17 Science and Technology Priorities, which include:

* GLOBAL CLIMATE CHANGE – USGCRP Strategic Plan and President’s Climate Action Plan;
* EARTH OBSERVATIONS – Advance the goals of the 2014 National Plan for Civil Earth Observations, including low-cost satellites. Space weather observations and R&D are essential. Prioritize investments according to the 2015 National Space Weather Strategy & Action Plan;
* NATIONAL & HOMELAND SECURITY – addressing the immediate risks to our national security posed by climate change;
* INFORMATION TECHNOLOGY & HIGH-PERFORMANCE COMPUTING — Innovation in HPC: Modeling and simulation. Priority to investments that address challenges and opportunities afforded by the expansion of Big Data;
* OCEAN AND ARCTIC ISSUES – National Ocean Policy Implementation Plan. ... future climate impacts on oceans…..advance the objectives of the IARPC Arctic Research Plan (FY13-17) and the newly created Arctic Executive Steering Committee.

The priorities also include a statement about taking “steps to ensure that underused existing facilities are made available to additional users through transparent and competitive methods.” Dr. Wakimoto said he wondered if this was a suggestion that there are underutilized systems not at full capacity.

Discussion:

Dr. Hornberger asked about discussions with Dr. Holdren regarding his upcoming AC/GEO presentation. Dr. Wakimoto said he told Dr. Holdren the GEO community is on edge because of the budget discussions in Congress targeting directorate-specific cuts and the committee would like to hear his thoughts. This may be the first time Dr. Holdren will address a geoscience audience directly on this issue.

Dr. Wakimoto answered a question about the separation between PI responsibility and the idea of data repositories saying this was exactly what we want to talk about. Do we feel either we’re not providing those repositories or is it our fault we’re not making it well known or that repositories don’t exist. Or is the PI saying his or her obligation has ended.

Responding to a follow-up suggestion that some PI’s feel data management plans are a waste of time and that they only need to commit to getting it to a repository by a certain date without writing another document, Dr. Wakimoto said this was important feedback. He added that GEO is one of the first directorates to examine this issue and has the opportunity to deeply impact data management plans.

Dr. Kempton noted mixed messages about the budget and asked how to frame a question for Dr. Holdren on the issue. Dr. Wakimoto said Dr. Holdren is caught between an anti-Earth sciences agenda among Republicans in Congress and representing the administration’s strong position for Earth sciences. Dr. Wakimoto said Dr. Holdren would not take any questions negatively and he’ll offer his honest opinion.

Ms. Arroyo suggested that a question might be put to Dr. Holdren regarding the potential government shutdown possibly occur at the height of the climate negotiations.

In response to a question about whether the committee should take a more bullish tone in its questions to Dr. Holdren, Dr. Wakimoto said he thought that would be okay.

Dr. Wakimoto also noted that the Director has started a review of the realignment for polar and cyber infrastructure. Co-leading the review are Dr. James Olds Assistant Director for the Directorate for Biological Sciences (BIO) and Dr. Joan Ferrini-Mundy, Assistant Director for the Directorate for Education and Human Resources (E&HR). They are to issue a report by April.

In response to a question from Dr. Hornberger about the MREFC timeline, Dr. Taylor responded that by the end of next year the project would potentially move to preliminary design. It will be at least four years before any MREFC appropriations. There would be another two years following that before construction. Dr. Wakimoto added that four NSB members will visit the site and will be focused on understanding AIMS.

**Release of New AC ERE Report,** ***America’s Future: Environmental Research & Education in a Thriving Century***

Dr. Hornberger introduced Andres Clarens, AC ENG representative to AC ERE for his presentation.

Dr. Clarens introduced himself discussed the rationale for the September 2015 ERE report, *America’s Future: Environmental Research & Education in a Thriving Century*:

* Past NSF successes and new developments in environmental research and education programing called for a new outlook;
* An effort to enhance and vitalize the dialog between the Foundation and the Advisory Committee; advocate strong and sustained support for interdisciplinary programs;
* Identify new challenges and advocate new opportunities.

Dr. Clarens described the purpose and audience for the report:

* To provide advice and recommendations concerning support of the NSF’s environmental research and education portfolio;
* Internal audience: NSF-wide, Director, and Assistance Directors;
* External audience: ERE funding stakeholders and the ERE science community.

He said the challenges outlined in the report include:

* The nation is at an environmental crossroads where the confluence of unprecedented global environmental change and transformative new capabilities create both an imperative and an opportunity;
* A time in which human society and technology are increasing the pace and rate of environmental change in ways for which no precedent exists;
* Human systems are becoming dominant forces in ecosystems and the environment resulting in novel landscapes, natural and managed ecosystems;
* Society looks to science for answers to help solve current and future challenges. And scientists are increasingly recognizing the need to work together with decision-makers, educators, community leaders, and other stakeholders to enable research and education that fosters well-being on our dynamic and rapidly changing planet.

The value propositions of ERE investments outlined in the report include:

* Unprecedented Environmental Challenges can be met head-on with science, engineering and an educated workforce;
* Worsening trends and accelerating damage can be reversed;
* Science and evidence-based decision making can provide societal benefits, increased environmental resilience and contributions to economic growth;
* Problems that are not solvable by disciplinary science can be addressed;
* Helping society to shape a better future;
* ERE is intrinsically attractive to diverse population.

The report’s main themes include:

* As with most science, environmental research and education fuels the economy;
* We must anticipate and shape our future, not merely adapt;
* Humans as Drivers of Environmental Change;
* Effects of Changes on Human Well-being;
* Changing the Socio-Environmental Trajectories toward Resilience, Well-being and Prosperity;
* Look for opportunities within NSF to ensure institutional capacity to maintain long-term sustainability and continuity for ERE;
* Advances in Environmental Science Capacity – observation systems, sensors, models;
* Integration of Social Sciences, Natural Sciences and Engineering;
* Multi-scalar Understanding;
* Capacity Building of Equal Weight to Discovery.

The report outlines understanding challenges as:

* Continuing NSF’s emphasis on understanding complex environmental systems but expanding to socio-environmental systems;
* Investments in systems science, coupled natural-human systems, improved abilities to forecast environmental change;
* Improved capacity to forecast complex environmental trajectories.

Another theme from the report is called designing the future and changing the forecast, which describes:

* A new area of emphasis in supporting science to inform and improve “resilient designs” in environment systems;
* Humans are dominant shapers of the environment; we can use science to inform active designs of environments that are sustainable, resilient, and contribute to improved welfare of our citizens;
* Resilient environmental systems – landscapes, managed ecosystems, urban areas – that support human needs and economic well being.

The report also focuses on enabling and securing the future:

* Stable investments in infrastructure, research partnerships, collaborations, and translational activities;
* Funding and Institutional Support;
* Collaboration and Partnerships;
* Diversity – watershed approach;
* Environmental Literacy and Translation.

Finally, the report discusses broader impact networks and nodes (BINNS):

* Multi-institutional Collaborations;
* Connect Education and Community Engagement Professionals with Researchers;
* Help achieve Broader Impact goals.

Discussion:

Dr. Semeter picked up on an expression Dr. Clarens used (“We’re designing and changing landscapes whether we like it or not.”), saying it was a good way to communicate an important point about the environment. Dr. Clarens said his point was that we are changing landscapes and need to be more deliberate about that point.

Dr. Hodges said many people believe the science is in and the need now is to identify the grand challenges and actually do something. Actually, he added, the science is in to know the risk, but not to know how complex environmental systems really work. He said a full integration is needed among scientists and engineers. Dr. Clarens clarified he is the only engineer on the AC ERE. He said the committee used a democratic process and the chairman is a biologist and many of the ideas are credited to him. The report does not argue for an increased budget for engineering, but for more integration of engineering with sciences and the social sciences.

Dr. Taylor said AC/GEO and the community has pushed back against over integration and asked if AC ERE was hearing that. Dr. Clarens said he was not aware of that perspective, though the committee was concerned about the sun-setting of Science, Engineering, and Education for Sustainability (SEES), and said he would like to know more about AC/GEO’s perspective.

Dr. Wakimoto added that SEES did a good job of breaking down barriers between directorates, but we may have gone too far. He said his plan has been to be more strategic and took Water Sustainability and Climate (WAC) and transformed that into Innovation at the Nexus of Food, Energy and Water Systems (INFEWS). We were also strategic about Interdisciplinary Research in Hazards and Disasters (Hazards SEES), he said. Dr. Wakimoto added that his program officers were behind the Hazards theme and that SEES had good elements and we are trying to assure those continue.

Dr. Tayor clarified his point, saying some thought this directorate was giving a lot to others and they wanted to own it themselves. INFUSE and Prediction of and Resilience Against Extreme Events (PREEVENTS) are exactly that. Dr. Wakimoto said he agreed.

Dr. Clarens added that an example of something new and exciting about SEES was a specific requirement of representatives from different communities to submit a proposal. That is an interesting way to get people working collaboratively. Some of the directorates are continuing to write calls in that way and some are not. The question of what worked and did not work in SEES has not been discussed frankly at the level of ERE. It is an important point in so far as it will color the implementation of the AC ERE report.

Dr. Constable said if the budget for GEO and social sciences is going to be smaller it will be difficult to achieve a complementary engagement from engineering, social sciences, and GEO. Dr. Tayor added that BINNS is a great concept.

Dr. Clarens asked about creative ways to engage the community to solicit lists of grand challenges that can be used by the ADs to build excitement and grow budgets.

Dr. Hornberger said there was there was an Association of Environmental Engineering and Science Professors workshop this summer at Yale to try to accomplish this.

Dr. Clarens said he attended the meeting but attendees mainly tried to defend their own research areas. A meta-activity at NSF may be required that would not require as much of an investment but where some of the recurring themes from different groups could be cherry picked and couched in a new way of thinking about design.

Dr. Hodges there is the ability when going to a national academy to describe the characteristics that are desired to be in the grand challenges. To cut across boundaries, you can say no grand challenges are sufficient without a clear articulated component of all three. Often, engineers are more used to thinking of grand challenges than scientists, who think more about questions that can be answered. Dr. Clarens said the ERE was formerly managed by BIO and then GEO. There is a transition now where the AC will be managed by the Office of Integrative Activities (OIA), which is part of the desire to cross boundaries more effectively.

Dr. Cavanaugh said OIA might have a meeting with the four division directors from GEO because each has engaged the Academy to work on different reports and each has done it in a different way for different kinds of reporting results.

Dr. Hornberger referenced an Academy committee of about 10 years ago that was a meta analysis of grand challenges in environmental sciences. The National Academy in Engineering had a grand challenge list that included four out of 12 that were environmental or geoscience orientated. Dr. Clarens said it was important to have a list of challenges that isn’t too long. A list with 10 might be appropriate but 100 challenges would not get the same attention.

Ms. Arroyo added there is growing interest on the National Academy of Sciences’ Transportation Research Board in adaptation, climate change, and preparedness and they want to know what they should be designing to. There is a task force at the executive committee level to talk about how the board can help to inform the community more broadly. They are not very strong on the basic science they would need translated for their audiences, so there might be a partnership there.

Dr. Clarens thanked the committee for its input and said he would report back to the AC ERE.

**OCE Research and Education**

Dr. Carr began by saying that the COV was very impressed with OCE programs and the OCE recommendations reflect the process as much as assessing ocean sciences.

She outlined four concerns:

* Mismatch between questions COVs asked in the NSF-wide template and the data provided to respond;
* Confusion in the charge and about what data can be used/shared;
* Insufficient transparency with regards to the consistency between programs;
* Inconsistency in the types of data that the programs record and shared (e.g., high risk, high reward or transformative, portfolio, underrepresented groups).

The COV’s recommendations fall under four headings, starting with: Best practices and improving communications with community. Under this heading, Dr. Carr listed:

1. Panel membership should reflect the balance of the sub-disciplines seen in the proposals.
2. (See #2 below).
3. Continue to educate the community about expectations for Broader Impacts. The reviewers, in particular, need to be educated.
4. Program Officers should indicate when reviewer assessments were inappropriate and not taken into account.
5. Continue to recruit “rotators.”
6. Ensure training and mentoring of “rotators.”
7. Post on website examples (not real) of good/poor reviews or elements of a good review.
8. Convey to PIs the link explaining the review process. When appropriate, include information on balance and priorities. (Especially in the internal documentation of decisions.)
9. Create an online system/database for conflicts of interest.
10. Consistency of transformative or high risk-high reward projects across OCE.
11. Explore and enact mechanisms to facilitate multi- and inter-disciplinary  proposals.

Dr. Donald Rice, Section Head, OCE, continued the presentation. He said the approach was to involve all of the OCE program staff in the assessment so managerial guidance and assessment of program performance will not surprise anyone.

Recommendations 1, 4, 6, and 11, above, deal with standard operating procedures and require internal discussion. A reason there is an impression OCE does not have panels that reflect the composition of the proposals, or not training mentors, is that the COV review process likes to show proposals in which the proposal recommendation might not be completely clear on the basis of the data, which can skew COV’s impression of the actual result for proposals as a whole. There is a need to discus this internally to see what if anything is being done wrong and what is not being kept in the minds of all Program Officers in the proposal review process.

Regarding the general community, Dr. Rice referred to Recommendations 1, 3, 5, 7, 8, 10, and 11, above. He said the OCE newsletter can be used for targeted articles to address each of these issues on how OCE does things, how panels are put together, how the review process works, and how OCE represents its demography and topical breadth across fields.

Regarding the general documentation of review, he referred to Recommendations 4, and 10 above, which are part of the standard operating procedures for explaining in the review documentation, internally, and in Program Officer comments sent to PIs. In terms of inappropriate review comments, he said every PO must point out when review comments are inappropriate or when reviews are not taken into consideration and why. Regarding Recommendation 10, he said OCE believes it is nearly impossible to use one definition of transformative and one criterion for high risk/high payoff across every discipline. NSF’s attempt to define transformative doesn’t make the grade for implementation. OCE will make sure every proposal designated by review, by POs and by panels, as transformative or high risk/high return, is designated that way and include an explanation. POs and panelists will be required provide this explanation.

Dr. Carr continued the presentation with two recommendations for the REU program:

1. REU to consider in-person or virtual panels.
2. Continue to strive for REU site geographic balance, consistent with program goals.

She noted, regarding Recommendation 2 that in-person panels may not be practicable.

Regarding underrepresented groups, she listed three recommendations:

1. Promote collaborations with Minority Serving Institutions.
2. Continue to explore mentoring programs for gender parity and maintain vigilance.
3. Continue to explore and enact strategies to attract and retain minorities.

Recommendation 15, she added, importantly includes mentoring programs because while junior PIs and women are gaining ground, this is not the case for other underrepresented groups.

Regarding the COV process, she listed one recommendation:

1. Clarify COV charge and provide data consistent with questions.

She said the charge is confusing, if not actually wrong.

Dr. Rice continued the presentation and said of the REU recommendations both were part of the standard operating procedure for the Ocean Education Program, but can benefit from internal dialog and there will be a report in one year.

Regarding underrepresented groups, he said this is a well-known, almost infamous challenge for GEO, but OCE and NSF are trying. When programs are developed higher in the foundation, OCE makes sure the community knows about them and will continue to do so.

He said there are some things that can be done without interfering with universities and PIs: OCE can feature success stories in the OCE newsletter; OCE can make it apparent in communications with male reviewers and panelists that this is something that OCE, GEO and NSF values very positively to inform the review process and to help get the word out into the community. With Program Officer comments, award abstracts, and research highlights, OCE can use language affirming the NSF, GEO and OCE commitment to evaluation of these processes. This will not have an instant impact everywhere but OCE is committed in the next three years to moving strongly in this direction.

Regarding COV process, he said there are two goals: making sure the COV response provided is not done once a year a few weeks before the AC/GEO meets. Rather, this should be part and parcel of a dialog within OCE programs and the division and part of the ongoing performance assessment OCE management makes. Also, OCE wants to do everything possible to assure the tools and data provided by NSF and OCE are adequate to meet the charge to the COV. That has not happened this last time. OCE wants to do three things to assure that.

The first is dialog with OIA. The second is a reexamination of OCE’s implementation of the NSF requirements for COV activities. Thirdly, Dr. Rice promised OCE will never return another annual progress report with the progress simply being stated as “done.”

Dr. Carr resumed the presentation, with Other Comments of Note:

* Suggestion that OCE carry out a Self Study prior to next COV. Though time consuming, can focus organization regarding goals and accomplishments.
* Questions about portfolio and priorities could not be addressed because of lack of information. All that is needed is a few sentences about the “areas” of funded projects for time period.
* Representation of women and young researchers show promising gains. Not the same for other underrepresented groups. Acquire, to extent possible, information about people with disabilities and veterans.
* In some responses to past COV, no explanation of how a recommendation was met. Important that award/decline decisions be clearly documented. Panel summaries also can appear ambiguous.

She elaborated on some of these comments, saying that in regard to the recommendation from the head of the COV that OCE conduct a self-study before the next COV, that Dr. Rice’s idea of having an ongoing process is equivalent without being a formal self-study.

Regarding questions that could not be answered because the necessary information was not available, she said it would not be a lot of extra work to allow the COVs to answer the specific questions there now.

She added that it would help to have more information to not only navigate through the eJacket but also interpret it, for example on what goes to the PI. She said some people were wondering, Are we just going through the motions? Most of us concluded that was not true. If there were problems, we would see them. It is a very valuable exercise, but it could be better if the questions were more targeted and data matched the questions. But overall we were very happy, she said. With outlier proposals, it could help to have a few more mainstream proposals; otherwise, it gives an incorrect impression to some.

Dr. Rice concluded by saying OCE was grateful for the review. It was more stringent than other recent reviews. But this is a good time for it. Within a 14-month period, The Division of Ocean Sciences had three Division Directors, lost two Section Heads, and gained two more, for a considerable loss of corporate memory at the upper management level at OCE. In conclusion, he promised results a year from now.

Action Item: The committee voted to accept the report.

**AGS NCAR & Facilities Section**

Dr. Stroeve began her presentation by saying the COV was very impressed with the Program Managers’ commitment to science and their service to the community. The COV was also happy with the effort to bring the Research Experiences for Undergraduates (REU) under a single program and the hiring of a deputy program director because NSF management is understaffed.

The COV also had concerns that mostly had to do with the merit review process. There needs to be a clearer role and justification for the National Center for Atmospheric Research (NCAR). There were also concerns with Unidata’s value to the community, its cost effectiveness, and whether it is duplicative. None of the committee had previously looked at the Unidata website and there was a lack of knowledge of its service to the community.

She said the COV was concerned NSF should consider a more traditional peer review process for some of the major scientific and educational components of NCAR. The mid-term reports from the site team visits lacked sufficient detail to evaluate scientific rigor, accomplishments, and future plans. They generally contained less information than a traditional peer review of individual PI proposals. There was information lacking for the COV to make more critical evaluations of how well the programs are doing. One recommendation is that more detail needs to be included in the mid-term reports or another way found to get some of the peer reviews of what NCAR is doing on the table.

Another concern was that not all of the reviewers provided critical information, and some were not useful. They did not provide a critical review. There is a sense of the committee that the reviews are not considered in depth. When the reviews are not adequate, they should be returned to the reviewer for modification or additional input or additional reviewers should be sought. There needs to be more guidance in the review process about the level of detail needed.

Regarding the management of NCAR facilities, the committee discussed the importance for the PMs to balance investment between innovate and high-risk/high-payoff research efforts compared to long-term commitments of the status quo. With a constrained budget, some of these decisions have to be made quickly. So there needs to be prior strategic planning. Some of the process for deciding should be driven by community research requirements in peer review. The committee was not clear what community input was driving some of the decisions and some of the resource objectives.

There was also concern about support for instrument development and discussion about whether NSF should engage with the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs at NSF, NCAR, other academic institutions, and private businesses for sources of funding for instrument development.

There was concern as well about the tension between the roles of scientific research and service to the community. One of the recommendations is that this tension be more specifically addressed in the budgeting process.

Another concern over Unidata high cost and management concerned the lack of critical reviews and the cost of Unidata without a rigorous review of what they are doing, why it is beneficial, the overall value to the community, and cost effectiveness. More critical review of Unidata is needed in the future.

The committee had a concern about the degree of interagency agreements. There was a concern over how much NCAR scientists are, e.g., competing with universities for some of these research dollars for doing proposal-driven research.

The committee also felt there should be more transparency in the overall Division of Atmospheric and Geospace Sciences (AGS) budgeting priorities to ensure confidence with the funding NCAR is receiving.

Finally, the amount of time required for the COV review was greater than the amount of time anticipated. A list of tasks each COV member could do beforehand would improve efficiency, as would a previous COV member serving on the committee.

**Sarah Ruth, Section Head, AGS & COV Chair/AC GEO Representative, with Dr. Stroeve, National Snow and Ice Data Center.**

The COV process was very useful. Everyone in the section found it refreshing.

Some of the main themes include how to ensure community input into a national center the size and scale of NCAR. It does not lend itself to most of the normal peer review mechanisms.

We also have to be cognizant that NCAR is managed by University Corporation for Atmospheric Research (UCAR). Our job is to charge UCAR with developing the scientific program and strategic priorities. We may not have explained the various mechanisms in place already that bring in community input, such as workshops, an external advisory committee and mid-term reviews. NCAR tries to think about how the whole is greater than the parts and have higher-level reviews to see how the NCAR program itself is addressing much broader needs in the community and how those pieces are working together.

The dialog is continuing with the COV and NCAR is thinking about how it might provide more visible review of its programs.

Regarding Unidata, NCAR accepts it can be doing more to work with Program Officers around the divisions and there have been meetings with Program Officers about how Unidata might be more visible to their programs and how they might have a stronger role in contracting with it. It is a very valuable resource but it is our responsibility to make sure we gather input and communicate with the other sections and with the broader community.

On the quality of written reviews, without exception NCAR’s written reviews come from people who came to a panel, so they in fact address gaps in the reviews. Where they have written skimpy reviews, they are in a position to be at the panel and take part in the discussion and that may be why they do not put everything in their written reviews. Although the jackets in some cases do not show reviews that are as lengthy or detailed as an ad hoc review, the panel summary will show there was a lengthy and thorough discussion.

The balance of facility and services is a division-wide question because every service and every bit of research NCAR provides should be seen in the context of the broader community and that community’s needs. When we have aircraft we run them because people in the community want and rely on them. So, perhaps the division’s strategic planning exercise underway will provide a strong framework for how those decisions are being made and how the budget is being allocated.

Finally, COV workload is a balance. Most of the work always gets done when they arrive, no mater what. But it is a good idea to have a strong assignment of tasks and perhaps more involvement with the chair and the members. The briefings perhaps should have been attached to action items. There was a previous COV member on the COV but she declined to mention prior involvement. There was also a member from the previous year who had to withdraw at the last moment.

The recommendations have been absorbed and have received considerable consideration and NCAR will continue to be informed by them going forward.

Action Item: The committee voted to accept the report.

**Meeting with OLPA Head, Amanda Hallberg Greenwell**

Ms. Greenwell began her presentation noting that she has been with NSF for three months. Early on she noticed eyes glazing over when the agency was presenting to members of Congress and others.

Her office received support from the ADs and other leadership on three key messages: NSF invests in people and basic research and that investment supports the economy, the nation’s security, and innovation to keep the United States a global leader. Depending on the audience, specific examples of successes can be used that have come from NSF funding. The Director has met with members of Congress with examples tailored specifically to who she is meeting with and this has been incorporated into her speeches.

Ms. Greenwell said a strategic communications plan is currently being developed as a coordinated effort. With the three key messages and the goal of wanting to get out the agency’s mission and its importance to a broader audience, she plans to use external affairs, public affairs, legislative affairs, a multimedia team, and a visualization team to reach a broad audience. The goal is to get a general audience to know who NSF is and understand why it is so important so they can tell others about us.

One of the pieces feeding into this, specific to GEO, is a strategy to highlight GEO’s platforms. Specifically, she has been looking at the fleet. NSF funds more than 60 percent of the scientific fleet. She said this needs to be highlighted. Members of Congress like to have something tangible, such as a ship home-ported in their area or research underway in their backyards. A plan should be completed in the next week or so to help get that message out to the Hill and a broader audience. The message is: If NSF funding went away, you would not get X, Y, and Z. This is one part of the strategic communications plan specific to GEO.

A social media staff person was hired recently and NSF is now on more platforms than other Federal agencies. Every directorate has its own Twitter account. There is also an NSF account and a Facebook account. These platforms reach a younger audience. This will start branding the agency more and building up a little of what NASA has.

Ms. Greenwell said another change coming up next year will completely alter the budget rollout. As opposed to a one-day event, it will include events over two months or more. This will include constituent briefings; leadership on the Hill doing briefings for staff; targeting specific members; and using the Director, the Chief Operating Officer (COO), and all of the ADs specific to the ties they have with the members’ areas. This is a hook to get in. You say you’re talking about the FY ’17 budget, but the real reason we’re going to go up there and the message to be delivered is why the agency is so vital and why they need to keep funding it at healthy levels. She said her office has tools to make the budget more fun and attractive.

Finally, Ms. Greenwell said the broader the audience that knows about NSF, and the more support NSF can get from more people, the more protected the agency will be. So, when a few people loudly object to funding climate research or the social sciences, there will be more members of Congress and members of the general public with a better awareness of why what is funded is so vital. They will be able to stand up and get the vocal opponents to be quiet, or ignored.

During some recent Hill meetings, the staff said that the Senate stayed away from the directorate-level cuts because of the geosciences and some of the groups that came up and talked about how vital the science and research in this area is to oil and gas. She said the external affairs piece of her job is to make sure we have more regular contact with the societies, universities, and others so her office can keep getting that information and statistics and examples to share about why the research and education NSF does is so vital to the country.

Discussion:

Dr. Hodges asked how to get the message across that funding geosciences is not just funding climate related work. Ms. Greenwell answered that it would help to have better materials and statistics that her office can plug into the Director’s talking points for when she is on the Hill, the budget rollout, the press releases, and social media. Regarding press releases, she needs help from the communities to do a better job getting NSF’s name out. Many times information is posted where it is not clear NSF provided funding. It should be clear that because of funding from this agency, this great discovery happened, or this great science is going on.

Dr. Carr asked if NSF is doing research that is positively contributing to the areas represented by those who are most opposed to funding GEO. Ms. Greenwell said her office is partially addressing that by focusing on oil and gas. And when meeting with members her office looks at their interests and pulls up NSF-specific funded research they would be interested in.

Dr. Stroeve mentioned a Congressional staffing lunch that NCAR hosted with three scientists to talk about Arctic issues, including oil and gas. She said her presentation mentioned funding sources so they could understand how their science dollars are being spent. Ms. Greenwell said this was helpful. She added there are NSF Hill days that her office puts together with the help of others to promote what the agency is doing and improve general awareness. Those don’t get the type of attendance that is most useful, she said.

Ms. Arroyo said institutionalizing the use of a two-sentence tag line that everyone can use when speaking of NSF work would be helpful. Ms. Greenwell said she is trying to identify buzzwords those on the Hill and others care about.

Dr. Voorhees asked about connecting the message he and others communicate to friends with a suggestion that this is something your congressmen might be made aware of. Ms. Greenwell responded that it is important to be careful not to lobby, but it is OK to put the facts out and have targeted messages about the specific benefits of funding.

Dr. Bierman asked how the community can provide follow-up results on projects that have closed. Ms. Greenwell said the relationship network needs to be kept open or a way found to bring people together occasionally. Dr. Bierman followed up with a question about writing up old data sets collected originally with NSF support. The new look at the data was valuable and he asked if Ms. Greenwell thought about fishing for those data. Ms. Greenwell said she would like to look at that and work with other directorates to get help there. She said her office does not have the bandwidth for that. There is a particular problem with fresh examples, she said.

Dr. Hodges said NASA is very good at getting its message out. They have labs that create an institutional memory, which NSF does not have. He asked if there was a way to use AC/GEO and others like it to get a broader spectrum of people who can feed ideas that can be used by Ms. Greenwell. Dr. Wakimoto added that NASA has about 70 people dealing with outreach. Ms. Greenwell said she is already trying to do some of what Dr. Hodges suggested, as well as contacting societies and universities and starting an external newsletter.

Dr. Lyons said that at the last AC/GEO meeting information was presented on specific students who had been trained through NSF support who are working in the oil and gas industries.

Dr. Bierman asked if there wasn’t valuable information hiding in grant proposals, which includes the intellectual merit and broader impacts of previous grants. Extracting that paragraph or two would include information leading to PI locations. Ms. Greenwell said that does take significant staff time, but some of it is being done.

Dr. Sullivan asked about the final grant reports, which include sections on project outcomes that are meant for non-scientists. Ms. Greenwell said she has access to those. Her office does a highlights report that gets information from the directorates and turns it into plain language. She said those project outcome statements are getting better but still do not put the point up front, rather than at the end.

Dr. Hornberger mentioned the *EAR to the Ground* newsletter that AC/GEO members might find useful. He then concluded by thanking Ms. Greenwell and said AC/GEO stood ready to help her efforts.

**John Holdren, Assistant to the President for Science and Technology and Director, OSTP**

Dr. Holdren divided his talk into three parts: 1) OSTP’s responsibilities and their relation to NSF and geosciences at NSF; 2) administration priorities germane to geosciences at NSF; and 3) budgets, Congress and public communication.

1. *OSTP’s responsibilities and their relation to NSF and geosciences at NSF*.

OSTP has two main functions: science and technology for policy; and policy for science and technology.

The first category includes making sure the president and his senior advisors have insights about science and technology that may bear on policy issues. This includes: advanced manufacturing to create jobs; cyber security; climate change; chemical, biological and nuclear weapons; clean energy; precision medicine; microbiomes; and natural disasters.

OSTP’s staff is twice as large as it ever has been in the past, at 135 members. OSTP pays for only 30 of these. The staff level is driven by the president’s interest in science, technology, and innovation.

Policy for science and technology involves the office’s work with OMB and government-wide with departments and agencies on R&D budgets for submission to Congress, including follow-up to help ensure funding. This includes: Science, Technology, Engineering, and Mathematics (STEM) education; intellectual property rights policy; immigration policy; investments in science and technology infrastructure; and broadband high-speed computing.

OSTP also works closely with the Council on Environmental Quality and The Domestic Policy Council’s Office of Energy and Climate Change; the National Economic Council on cyber security, advanced manufacturing and intellectual property rights; and the National Security Council on cyber security on issues related to arms control and non-proliferation, counter bio-weapons, and counter nuclear-proliferation.

OSTP’s specific responsibilities also include running an array of committees and commissions that oversee aspects of the Federal science and technology enterprise, including chairing and managing the interagency National Science and Technology Council (NSTC), which is responsible for promoting, implementing, and executing initiatives in science, technology, and innovation that cross department and agency lines.

OSTP also co-chairs and supports the President’s Council of Advisors on Science and Technology (PCAST). Of the 20 members, six have backgrounds in geosciences. OSTP also co-chairs the National Ocean Council and Dr. Holdren chairs the Arctic Executive Steering Committee, which develops coordination, communication, and collaboration among the 20-plus departments and agencies with responsibilities related to the Arctic. He also co-chairs the Interagency Council on Climate Preparedness and Resilience.

Of OSTP’s five divisions, the Environment and Energy Division is most closely intertwined with geoscience. Tamara Dickinson, a geologist, leads the division as Principal Assistant Director and was formerly Assistant Director for Disasters. Within this division there is an Assistant Director for Earth Observations, an Assistant Director for Climate Resilience and Information, an Assistant Director for Natural Disaster Resilience, an Assistant Director for Space Weather, an Assistant Director for Climate Adaptation and Ecosystems, an Assistant Director for Climate Science, and a Senior Policy Analyst for Energy Water and Ocean Sciences.

2) *Administration priorities germane to geosciences at NSF*.

OSTP is heavily engaged with the same issues that engage the Advisory Committee for Geosciences. These issues are also high on the president’s priority list.

The administration’s geoscience-related priorities include climate change. In June 2013, the president introduced a climate action plan that included three components: reducing domestic emissions of greenhouse gasses and heat-trapping substances; building preparedness resilience and adaptation against changes in climate that cannot be avoided; and leading internationally to get other countries to do what needs to be done in mitigation and adaptation preparedness and resilience.

Also, the president’s November 2013 executive order on preparing the United States for the impacts of climate change established the interagency council that Dr. Holdren co-chairs on Climate Preparedness and Resilience.

NSF and its geosciences have a key role in supporting the climate science that needs to be understood to know how to prepare, adapt, and build resilience; the climate science needed to understand how much mitigation is needed and how fast; and the climate science needed to assure communications with the public and policy makers are sound and impeccable regarding the science.

Regarding the Artic, Dr. Holdren referenced the NSF-run Interagency Arctic Research Policy Committee and noted that the United States chairs the eight-nation Arctic Council with Secretary of State John Kerry presiding. The Secretary is supported by Admiral Robert Papp, Jr. and Fran Ulmer, who chairs the Arctic Research Commission. He said these groups are doing extraordinary work, underlined by the president’s three-day visit to the Anchorage GLACIER (Conference on Global Leadership in the Arctic: Cooperation, Innovation, Engagement and Resilience) Conference. The president’s visit highlighted the issues in the Arctic and Alaska, including climate change, resource development issues, conservation issues, fisheries issues, and Native American issues.

NSF GEO also has an extremely important role in the oceans issue, he said. The president signed the first-ever ocean policy in July 2010, creating a National Ocean Council, represented at the level of deputy secretaries across the administration and the heads of relevant agencies. Council members include Dr. Córdova, along with the heads of the National Oceanic and Atmospheric Administration (NOAA) and NASA.

NSF GEO is also germane to interdisciplinary Earth systems studies, which is pursued in the U.S. Global Change Research Program (USGRCP), a subset of the subcommittee on Earth Science Research in the National Science and Technology Council. NSF is a key member of the USGRCP, which has a budget of about $2.5 billion. The 2016 request was for $2.7 billion. One USGRCP focus is interdisciplinary Earth system studies, including the climate-energy-water-food-land use nexus, which will be crucial going forward. NSF has a program on that nexus, as well as a risk and resilience program that he said is a great example of what is needed. GEO is very well positioned, he added, to continue and expand its role in interdisciplinary Earth systems studies.

Dr. Holdren said NSF is the centerpiece of the government’s efforts in polar research. So much is going on in the Artic and the Antarctic, one cannot overstate the importance to the country’s future and the world’s future from understanding what is going on there and drawing the appropriate conclusions about what should be done regarding management and response.

He also referred to geohazards, saying it is a big issue that includes earthquakes, floods, and space weather. Dr. Holdren said his key collaborators in this area are at NSF.

Turning to Earth observations, Dr. Holdren said, What you can’t measure you can’t manage. Though current activities are diverse, impressive, and capable, they are not enough, he said. Monitoring networks are too sparse and satellite constellations are too fragile in terms of backups against the possibility of an important satellite failing. Continued investment and collaboration in this domain is needed. The U.S. coordinates its activities in this area through U.S. GEO and NSF representatives are playing crucial roles in the U.S. GEO operation in the global GEO consortium. Dr. Holdren said he is hoping to build up a greater degree of international collaboration in Earth observation. He said it is crazy not to totally share Earth observation data across nations, as well as across departments and agencies in the U.S. government. There is an increasing private sector interest in those observations and translating them into forms others can use; he has encouraged partnerships in this area for the greatest possible efficiency.

3) *Budgets, Congress and public communication*.

The signals from Congress in authorizations and appropriations for science in general and Earth sciences in particular are troubling. Some in Congress have asserted Earth science is not science. One reason for this antipathy is that some members equate interest in Earth sciences with the climate change issue. They believe that by disparaging and defunding the geosciences, they can hold back the tide of public concern and the concern of many policymakers that climate change requires a powerful reaction by government and the private sector.

Dr. Holdren has tried to persuade members of Congress that Earth observations would make perfect sense even if one did not think the climate was changing or that humans were responsible for any change. Earth observations are desperately needed to understand floods, earthquakes, wildfires, water availability, agriculture, and forestry. He said it did not make sense to reduce efforts on Earth observation, given all the ways the nation’s economy and well-being depend on what is going on in this regard, no matter who is causing it or whether there is a long-term trend. This line has not met with much success, other than from those who are already in agreement, he said.

The House America COMPETES Reauthorization Act passed in the spring would have brought drastic cuts to the NSF GEO directorate. Social, behavioral and economic sciences, as well as education and human resources and international programs, would have all received meat axe cuts, he said. The administration issued a very serious veto threat for any bill that does not lift the sequester caps or has riders going after specific, important areas of the nation’s science and engineering enterprise.

He said there has been a proposal from Congress to use a sneaky and illicit mechanism to boost the defense budget without boosting the civil side of the budget. President Obama has vigorously rejected that approach, as has the Secretary of Defense, an eloquent spokesperson for why it is crazy to think you are improving national security by lifting the defense budget while starving the civil side. The Secretary has been explaining that our security is not just a matter of what we invest in weapons systems, but the strengths of the economy, the stability of the environment, and the strengths of the education system. Neither the Defense Secretary nor the president will accept an approach that disadvantages the civil side to boost the military side.

To address the problem, everyone must get better at telling stories. Stories matter more than statistics. We need, he said, to tell stories about how the work we do is improving the well-being of the public, improving the economy, improving our security, and improving our health.

The importance of basic research must also be defended. When the president spoke in 2009 to the National Academy of Sciences, he spent two-thirds of his time talking about the importance of basic research, explaining and underlining that basic research is the seed corn from which applied advances in applications and society must grow. If you consume that seed corn, the long-term consequences will be disastrous.

Dr. Holdren said his office is doing everything it can to protect basic research and knows that NSF is the preeminent agency in the government that has the custody of basic research, which is one of the reasons the administration is so determined to protect the NSF budget. Dr. Holdren recalled that he read to a House committee hearing the opening of the act creating NSF to remind them that basic research is part of the national interest. Some have suggested that the NSF Director is going to have to defend every grant in advance as to how it will help the national interest, defined as the economy, public health, or national security. But the administration will stick to the interpretation of the act that created the NSF that says the advance of science is in the national interest and NSF has to be allowed to continue to fund, support, and encourage basic research in the university community and elsewhere.

Discussion:

Dr. Hodges asked for specific suggestions on how to most effectively get across AC/GEO’s message to members of Congress. Dr. Holdren responded that in every Congressional district with a research university, that school is an important employer and generator of economic activity and knowledge that promotes the national interests. Presidents of universities who call members of Congress and explain the interest of their university and the community in the support of these activities can be quite effective.

The fraction of the American public that believes climate change is occurring, is largely caused by humans, is damaging, and that more needs to be done is between 60 and 75 percent, which is significant political support. The percentage of people in Congress who admit they have the same belief is half that number. This discrepancy ultimately has to be reconciled, perhaps at the ballot box, if people come to understand their views are not shared by representatives in Congress. Clear messaging about the importance of the climate change issue to everyone’s well-being, and the discrepancy between between public and Congressional beliefs about it, is an important lever. Another lever is using the Association of American Universities (AAU) and the public and land grant universities group to make these points.

Dr. Kempton asked if consideration is being given to ways to highlight the importance of geosciences to the competitiveness of the U.S., perhaps through an Engage to Excel type initiative that focuses GEO. Dr. Holdren answered that his office is linking the administration’s priorities in GEO to the private sector. There was a White House summit on climate change focused on business and science. The companies attending made specific commitments about what they are going to do in their operations about climate change, including a $160 billion investment in clean energy technologies and 5,500 megawatts of new renewable energy deployed by these companies, with many committing to reducing their greenhouse emissions by half over the next several years, on top of a similar reduction over the last five years. Companies are coming to understand that what is happening in the Earth’s environment is a concern for business, making life more difficult and sometimes offering opportunities to do things in a different way and to prosper by doing so. He said it was important to communicate what we are coming to understand about how the geosciences is influencing the economy. Very few understand how much damage to the economy could be done by a large space weather event for which we were unprepared. And today we are not adequately prepared for a large space weather event. He said there is a need to better understand the science of space weather and what produces these events, and to develop a better capacity to give more notice. This would be immensely valuable to the economy, he said, emphasizing again the importance of telling stories about why it matters.

Dr. Semeter distinguished between climate science and climate change and asked about managing the message that climate science is a real science, irrespective of its conclusions and how this community can better adjust how it approaches the public. Dr. Holdren said the best way to communicate about climate change is to start with the difference between weather and climate and explain that global warming is not just about temperature but disruption of climate patterns, and that a small change in the planet’s surface temperature conceals large changes in the climate patterns. An analogy is human body temperature, which is an index of the state of the system, not a description of everything going wrong in the system; it tells you that if your body temperature goes up by two degrees, you have a problem.

He also stressed the importance of telling people how we know. That is, the conclusions that have been reached by the scientific community about climate change are not based on flawed computer models, but on hundreds of thousands of measurements in thousands of locations by tens of thousands of scientists. They are based on fundamental understandings of the physics, chemistry, biology, and energy flow in the Earth system; on paleo-climatologicalstudies that enable a good understanding of what climate has been doing under natural influences for hundreds of thousands of years; and then, in addition, on computer models that help stitch together those other kinds of insights. These conclusions have been embodied in tens of thousands of peer reviewed scientific publications and this is probably the most intensively peer reviewed topic in science. Virtually every country that has a national academy of sciences has endorsed the fundamental conclusions about climate change: it’s real, humans are the main cause, it is already doing harm, it is going to do more, and we need to minimize it. When you tell them all that — how we know as well as what we know — you start to get through.

It is also useful to talk about uncertainty and prudence, and that all science is uncertain. But when people say, “Climate science is unsettled,” Dr. Holdren said he responds that no science is ever settled, including the science of gravity. But, he asks, Would you jump off a building with no parachute?

Occasionally, there is a scientific revolution that overturns the mainstream understanding of what is going on, but the more highly developed the scientific understanding and the mainstream is, the more different lines of evidence support it, the longer it has been studied and reviewed, the less likely such a revolution is. You can’t say it’s impossible, but it is extremely unlikely. Policy makers who are betting the future of society on the very long odds that some new discovery is going to overturn everything we know about climate science are imprudent.

Ms. Arroyo asked how the administration is helping to make data accessible to people at the community level, the State level, and to military officials who believe climate change is happening and are looking for help translating the best available science to something digestible for their planners and engineers.

Dr. Holdren referred to the data and tools dimension of the climate action plan, which is OSTP’s responsibility, and the climate section of data.gov (data.gov/climate), which is making government data available in forms that are scrutable and machine searchable. There is also the Climate Resilience Toolkit, which is online (noaa.gov). The toolkit is targeted at businesses, mayors, city councils, farmers, fishermen, individuals, and tribal leaders. It is constantly being refined, in response to feedback from those groups, by the Interagency Council on Climate Change Preparedness and Resilience. In addition, his office last December launched the Climate Education and Literacy Initiative with commitments from academic institutions, government institutions, and companies to work together on climate education and literacy. As an example, The National Park Service has 4,000 book stores at national parks and monuments that are stocking an increasing amount of education material on climate science and climate change and how it manifests in those particular locations. Dr. Holdren said he was open to more ideas and questions, which can be sent to him at jholdren@ostp.eop.gov.

Dr. Carr asked about the Paris Climate Change Conference in November and the administration’s views on what can be done, and will be done, in terms of commitments and follow-on. Dr. Holdren said he was an optimist about achievements that will be made in Paris, based on the enormous progress made over the last year with the Independent Nationally Determined Contributions (INDC), where countries have announced how much they are prepared to do in the post-2020 period to reduce emissions. That process received a huge jump start last November when President Obama and China’s President Xi Jinping jointly announced the U.S. and Chinese INDCs, which was the first time China officially committed to peak, and begin to decline, its emissions at a stated time. A large amount of bilateral analysis convinced the two leaders they could state a commitment they believed their countries could meet. That joint announcement had a transformative impact on the rest of the world. There are now 150 countries that have reported to the UN Framework Convention on Climate Change what they are prepared to do post-2020.

This will not keep the world below 2 degrees centigrade, but that is irrelevant, he said, because no one suspected what could be done out to 2030 would keep the world below 2 degrees centigrade. And a lot more will have to be done after 2030 to stay below that level. There are serous questions whether 2 degrees centigrade is still attainable and 2 degrees centigrade is not safe. There are already serious impacts at about .9 degrees centigrade above pre-industrial levels. But the amount of additional harm to be expected will be a lot less at 2 than at 3 or 4 degrees centigrade. It is perverse, he said, to trumpet the notion that these 150 commitments won’t keep the planet below 2 degrees centigrade. The latest analysis is that they will put us on a trajectory to 2.7. That’s the first time we’ve ever been in the twos and we’ll need to do a lot more.

The big issue in Paris will be finance and how much financing can be mobilized to help the poorest countries with both mitigation and adaptation. The developed countries together pledged that by 2020, we will be managing $100 billion a year in assistance to the developing countries for climate change, both mitigation and adaptation. There is a certain amount of hand wringing about how we have not figured out yet where the whole $100 billion is going to come from. So far $63 billion of that amount has been determined, Dr. Holdren said, adding he believed the target would be met. The developed countries understand that the poorest developing countries do not have the resources to do everything that they should do and we have a historic responsibility because the bulk of the greenhouse gasses added to the atmosphere by human activity were added by the industrial nations. China is now the biggest emitter in the world by a considerable fraction and it can afford to make its own investments in mitigation and adaptation. But we all need to work together to make sure the poorest countries have what they need in the way of finance.

Dr. Voorhees asked about progress in Engage to Excel, the American Graduation Initiative and other such education programs. Dr. Holdren answered that significant progress is being made. The Educate to Innovate initiative the president launched in 2009 to improve K-12 education has attracted $1 billion from the private and philanthropic sectors to improve science and math curricula, bringing practicing scientists, engineers, and mathematicians from universities, private companies, and national labs into classrooms to work with teachers to improve curricula. They can also serve as role models by having women who have successful careers in science and engineering in the classroom showing girls that people who look like them can have exciting careers in this field, and by having African American and Hispanic scientists and engineers in the classrooms, so students of those ethnic backgrounds can see that folks who look like them can have successful careers. Dr. Holdren also mentioned 100Kin10, a program to develop 100,000 new science and math teachers over a decade that is on target to meet its objective.

Regarding improving STEM education in college, he said amazing things are happening. PCAST studied the first two years of college STEM education and found two reasons that only 40 percent of those entering college planning on a STEM degree actually graduated with such a degree, with 60 percent changing majors. The reasons are: inadequate math preparation in K-12; and boredom from lectures with little connection to why the subject matters, why it is interesting, and how it connects with actual research projects. As a result, initiatives have been launched aimed at increasing the amount of active learning in the first two years, replacing lecture courses with problem solving groups that are given real world problems involving chemistry, math, physics or biology. The Historically Black Colleges and Universities and the Hispanic-serving colleges are moving faster than the larger research universities, but the latter are moving and it is starting to change the face of undergraduate education. The president has said that children are not taught to play baseball by lecturing them for six years before handing them a bat and, similarly, we should not teach science and math by lecturing students for years before letting them get their hands on interesting aspects of science and math. Inclusion has been added as a major thrust, getting more women and girls access, opportunity, mentoring, career paths, along with more inclusion of underrepresented minorities in science and math. There is also a standing committee on STEM education in the NSTC, which NSF co-chairs. It has a five-year strategic plan for STEM education that is being carried out.

The president told his Cabinet at the beginning of his administration that the single most important thing they can do for the future of the country is lift the nation’s game in STEM education. That initiative links back to public education about climate change and evolution. The country needs STEM education improvements not just to win the next generation of major science awards, but to prepare the tech-savvy workforce needed for the 21st Century and to get the science-savvy citizenry needed if democracy is going to work in a time when more and more decisions by elected policy makers have science and technology content. The president is getting the private sector and the philanthropic sector to step up on these national priorities.

Dr. Bierman asked whether today’s structure for funding science is optimal or whether there are other structures for funding scientific research. Dr. Holdren said it is not optimal because it has not produced as much resources as the challenges and opportunities warrant. We know it is not enough by looking at the opportunities going unfunded. He suggested looking at the NSF proposals that do not get funded and how many are meritorious, along with the NIH proposals that do not get funded. The National Institutes of Health (NIH) has a success ratio of about 15 percent, but there is also self-selection in who submits, as with NSF, because of the known odds of funding. Dr. Holdren cited NIH Director Francis Collins as saying the fraction of the proposals received that are worth funding is 50 percent. Therefore, we are funding a third of what we should be funding. Dr. Holdren said the numbers are likely to be similar at NSF.

The government’s share of R&D has been going down and the private sector share has been increasing. The government share in the U.S. is under 30 percent. The private sector is less interested in basic research than the government. Basic research will always be a fundamental responsibility of government because of the question uncertainty, appropriability of the results, and the timescale for returns. The private sector will never do as much basic research as the society needs. Dr. Holdren said his office is trying to get the philanthropic sector more interested in funding basic research. The Kavli Foundation is a leader in that domain and has assembled a consortium of six foundations to lift foundation funding of basic research. In March, the president had dinner with presidents of the major foundations interested in basic research to discuss what more the private sector can do. Also, everyone has to explain to the Congress why it is absolutely central to the national interest that we continue to lead in support for basic research.

Dr. Stroeve asked about how to get scientists spending more time doing science and less time writing proposals. Dr. Holdren answered that there was a need to reduce the bureaucratic burden on scientists. OSTP has been working this with OMB’s Office of Information and Regulatory Affairs, and it has been a theme for PCAST. PCAST did a study concluding scientists, engineers, and mathematicians spend too much time on routine reporting that does no good. Progress is being made on this, but the more difficult part is the proposal writing problem. Dr. Holdren said the effort involved in proposal writing and the subsequent care and feeding of sponsors is independent of the size of the grant. Supporting a $1 million operation on 10 $100,000 grants, requires spending about 10 times as much time on the care and feeding of sponsors, reporting, and writing renewals as would be spent for one $1 million grant. It might be better to increase the size of the average grant and not have the funding agencies hedging their bets by spreading the money as widely as possible in small grants. This will be difficult because of diversity issues and funding high-risk venture issues, but he said we have gone too far in shrinking the size of grants. The proposal preparation process can also be simplified, he said. He recalled writing proposals for The United States Agency for International Development (USAID) when a proposal of less than 100 pages did not have a good chance of being funded, adding that this is a problem that can be fixed at departments and agencies.

Dr. Taylor posed the final question, asking about the upcoming congressional budget process and the prospects of achieving the president’s priorities. Dr. Holdren said he could not predict the chances of success, citing news reports that Congress is close to dysfunctional. But with regard to what his office is doing, he added that he and his principal deputies and others are talking to members of Congress and staff on both sides of the isle about the merits of the president’s budget. Everyone is courteous, but say they are going to have to continue to disagree.

Dr. Hornberger thanked Dr. Holdren for his presentation to the committee.

**Update on NSF Activities for I-USE & Graduate Education**

Dr. Ferrini-Mundy, Assistant Director, E&HR, began her presentation by noting that NSF’s efforts in education are part of a larger administration and national effort to focus in new ways on how funding for education is used.

In this regard she discussed:

1. The administration’s College Opportunity Initiative;
2. OSTP’s emphasis on research courses and experiences for undergraduates;
3. The NSTC Committee on STEM Education;
	* Federal STEM Education 5-Year Strategic Plan;
	* https://www.whitehouse.gov/sites/default/files/microsites/ostp/stem\_stratplan\_2013.pdf

She highlighted the College Opportunity Initiative’s capacity to get more students to finish college. Nearly half of U.S. students who begin college fail to graduate within six years. STEM courses are often the barriers to completion.

Regarding #2, above, she said this effort helps students stay in college by getting them engaged. And part of the overall effort is preparing a public that appreciates and understands and can argue for the value of science.

She said #3, above, was part of America COMPETES 2010 and involves an investment of about $3 billion across all of the Federal agencies that invest in STEM education. The committee is an effort to coordinate this effort. NSF is a big player in this activities.

She highlighted two of the goals from the Strategic Plan:

* Enhance the undergraduate STEM experience of undergraduate students, with a goal of preparing 1 million STEM graduates in the next 10 years;
* Design graduate education for tomorrow’s STEM workforce.

She said there are many reports showing that the U.S. is not preparing graduate students broadly enough for the many kinds of scientific areas they will experience.

In this area, NSF is assuming a leadership role, she said, highlighting the following:

* Looking agency-wide at our portfolio in STEM education. The total investment is about $1.2 billion, $850 million of which is in E&HR with the rest across the directorates;
* Committed to coherent frameworks and strategic, coordinated investment across directorates;
* ADs are working as a team to shape the principles and directions;
	+ Needs and issues vary by discipline;
	+ Commitment to measurable outcomes and impacts of our investments.

She added that STEM education is a priority for the administration.

Discussing research, development, and model-building for STEM learning, she said investments are being made where questions inform development and model-building and, in turn, model building and development give rise to new questions. She said this means asking, How do we understand more fully the challenges, opportunities, and the good ideas that are in place and how do we scale those and make them available more broadly?

About 75 percent of the NSF STEM education investment goes to postsecondary education. But there is also a significant investment (5 percent) in outreach and informal science education. GEO has been a great partner with E&HR on a number of these informal STEM education partnerships.

At the undergraduate level for these investments, a third goes to scholarships and direct services to students. There are also efforts to improve learning environments (20 percent), professional development and institution change (17 percent) and experiential learning (13 percent).

She noted that the $1.3 billion the agency invests does not include research assistants, which accounts for 60 percent of the $985.68 million (FY ’14 estimate) in graduate education investments. There is a huge impact on the field in terms of direct support to students and their direct involvement in doing and learning science as a part of the research process. Fellowships and scholarships account for another 36 percent of the total. Another 3 percent goes toward traineeships and 1 percent goes toward the reform of graduate education.

The presentation continued with Jill Karsten, GEO Program Director for Education and Diversity, discussing GEO investments in the overall portfolio. She began with a discussion of undergraduate education and highlighted:

* Improving Undergraduate STEM Education (IUSE): GEOPATHS program (NSF 15-526);
	+ FY15: 12 EXTRA awards; 8 IMPACT awards;
	+ FY16: 37 EXTRA projects; 41 IMPACT projects;
	+ Revised solicitation with annual competition to be issued Winter 2016
* Tribal Colleges and University Program (TCUP)/Partnerships for Geoscience; Education (PAGE) program (NSF 14-572);
	+ FY15: 2 awards (out of 4 projects proposed);
	+ FY16: Next deadline February 05, 2016;
* ENGAGE Workshop;
	+ <http://www.iris.edu/hq/workshops/2015/01/engage_workshop>
* The Future of Undergraduate Geoscience Education;
	+ Summit on the Future of Undergraduate Geoscience Ed (Jan. 10-12, 2014);
	+ Geoscience Employers Workshop (May 2015);
	+ Upcoming: Department Heads & Chairs Summit (Jan. 8-10, 2016);
	+ <http://www.jsg.utexas.edu/events/future-of-geoscience-undergraduate-education/>

EXTRA, she said, focused on providing undergraduates with extracurricular experiences giving them exposure to research, career opportunities and internships that allow them to pursue a variety of trajectories in the geosciences workforce. An effort was made to increase capacity at smaller institutions, with many proposals from community colleges.

IMPACT is focused on institutional collaborations that support students as they transition at critical junctions, between high school and undergraduate, and between two-year and four-year colleges, with an emphasis on collaborations between majority institutions and minority-serving institutions or community colleges. The focus is on trying to build the infrastructure and support mechanisms that over time can support a lot of students as they transition through those areas.

For PAGE, the objective is to build capacity through partnerships. Many of the smaller institutions cannot afford to build new geoscience degree programs and sustain them because of lack of resources. The most successful strategy has been to get institutional collaboration as the model for building capacity.

The ENGAGE workshop was held to improve the capacity in the geosciences community to collaborate on relevant education research by bringing together early career geoscience researchers with geoscience-focused education researchers to find common language and identify common challenges they could mutually address. There is also an effort to build the PI community to be more successful in tapping into E&HR resources.

At the grand community scale, E&HR has been discussing needs going forward for the future of geoscience education. The first effort was to hold The Future of Undergraduate Geoscience Education. About 200 people attended, with a number of high-level department people. There was a consensus to think about competencies and skills vs. specific curricular sequences and a recognition that pedagogical best practices have not been widely adopted by the community, a discussion of how to continue tackling the problem of broadening participation, and taking advantage of the next-generation science standards that elevates Earth and space science content as an opportunity to get more public understanding of geoscience concepts.

Dr. Susan Singer, E&HR, Division Director, Undergrad Education, continued the presentation by discussing the importance of community colleges and the two-to-four-year transition, which is particularly challenging in the geosciences because so few community colleges have geoscience programs and may have a single geoscience faculty member.

* Improving geoscience education in community colleges;
	+ Community College Innovation Challenge – INFEWS theme;
	+ Ideas Lab ->Geoscience in 2-year Colleges (Geo2YC, $3M);
* InTeGrate – interdisciplinary teaching about Earth for a sustainable future ($10M);
* Geoscience Education Research;
	+ Conceptual change, teaching practices, research and practice.

She encouraged AC/GEO members to spread the word about the Community College Innovation Challenge, which is open through Feb. 15, 2016, with a focus on food and energy and water.

She said as a result of the Ideas Lab a proposal has been funded to do faculty development with community colleges, part of a broader initiative, On the Cutting Edge, a faculty development effort that has shown significant impact on changing the behavior of faculty in the classroom.

InTeGrate is geoscience centered but focused on interdisciplinary efforts and sustainability. There is a growing capacity for geoscientists engaging in education research.

Dr. Ferrini-Mundy continued the presentation with a discussion of graduate education. She reviewed:

* NRT
	+ INFEWS priority in FY2016;
	+ NRT track: Innovations in Graduate Education (IGE), 13 awards/$6.3 M in FY 2015;
* Graduate Research Internship Program (GRIP) (NOAA, EPA, USGS, Smithsonian, and ONR are partners) and GROW;
* Agency Priority Goal for 16-17*: Improve STEM graduate student preparedness for entering the workforce;*
* Strategic Plan for NSF Investment in Graduate Students and Graduate Education;
* EHR Division of Graduate Education Core Research investment in development of STEM professional workforce;
* NSB report, *Revisiting the STEM Workforce: A companion to Science and Engineering Indicators 2014.*

Discussion:

Dr. Kempton asked if there have been any outputs from the workshop for geoscience employers in terms of skills and competencies are important to them. Dr. Ferrini-Mundy provided handouts with the information Dr. Kempton requested and referenced a University of Texas at Austin website where this material is available, including survey data. ([http://www.jsg.utexas.edu/events/future-of-geoscience-undergraduate-education/)](http://www.jsg.utexas.edu/events/future-of-geoscience-undergraduate-education/%29)

Dr. Bierman asked about NSF programs that support informal science education and integrate with research grants. Dr. Ferrini-Mundy said the main E&HR program is the Advancing Informal STEM learning (AISL) program, which was formerly the Informal Science Education (ISE) program. Dr. Bierman also asked about how to publicly spread findings from a non-active grant that might be useful for education. Dr. Ferrini-Mundy said part of that could be broader impacts work and can be planned for on the front end of a project. But there is no existing, clear place to go for that, though it is of huge interest to the agency.

She added that the administration recently held an event on citizen science to engage the public more fully in participating in research. NSF also has a public participation in scientific research goal and is asking if there are areas of science across the agency that might be advantaged by more engagement of novel data collection approaches.

She also addressed a question about the absence in the presentation of online learning by saying it is important to understand why it works, for whom, under which conditions, and the features of the online materials.

Dr. Singer added that E&HR funded a workshop on learning science meeting online learning. The question is how to get all the good knowledge about learning science integrated into these systems. There are many examples from the undergraduate level of blended learning and standalone online learning. In the geosciences the outreach to community colleges and minority-serving institutions has been about whether it is possible to use Massive Open Online Courses (MOOC) to bring geoscience education into the many undergraduate settings where students don’t have access to that kind of learning.

Dr. Hodges said this is a field that is growing faster than the ability to respond to it, so it is something that needs to be gotten ahead of rather than reacting to.

In response to a question from Dr. Constable about the issue of metrics and assessment, where P.I.s have difficulty, Dr. Ferrini-Mundy said the geosciences community is not alone in this. A lot of this starts internally at NSF as it works to be more clear about why the agency is issuing any particular solicitation. When the goal is clear, every project can try to figure out how to bring data to the table about that particular goal. It would be even better to understand the quality of the preparation of the student, so the student is ready for the job market in particular areas, or has certain skills. E&HR is working with communities to be more clear about what they are seeking as a first step to shift the focus to specific goals that can be accomplished by specific methods, with tools to measure the attainment of those goals.

Dr. Ferrini-Mundy outlined three questions for further discussion:

1. What are the biggest challenges in undergraduate education for the geosciences?
2. How should the graduate preparation of students in the geosciences change for the future?
3. What do you wish you understood better about undergraduate and graduate preparation in the geosciences?

AC/GEO members discussed these topics among themselves before talking together again.

Dr. Hodges began this part of the discussion by addressing Question 2, noting inadequate preparation in quantitative and allied sciences going into the geosciences. Many don’t understand how integrated it is and go into geosciences because they think it is not quantitative. He also said many students are not prepared to do experiential learning. Dr. Ferrini-Mundy responded that K-12 education has long had learning trajectories, which look at sequencing the development of particular capacities or skills and performance.

Dr. Bierman brought up the heading, Lack of Pipeline, in terms of the lack of knowledge of the geosciences in high school and urban communities. The lack of broadly disseminated knowledge of the field leads to issues of recruitment. Very few students enter college declaring a geoscience major.

Dr. Voorhees raised the issue of being effective with entry level general education students, who are there because they have to be there rather than because they want to be there. Dr. Ferrini-Mundy asked if that was related to the point made earlier about a lack of preparedness.

Dr. Taylor said motivation and engagement has to be done to scale but big classes don’t achieve that. Dr. Ferrini-Mundy asked if there might be technological solutions to this issue, including online simulations. It is difficult to take 200 to 300 students out in the field, Dr. Voorhees added. This is the kind of problem of instruction where NSF’s investments out to be making an investment, Dr. Ferrini-Mundy said.

Dr. Constable said there was a need to make geosciences an accredited subject for college entry. She also raised the communication issue of how to get students to come to the course by communicating why the course is worthwhile.

Regarding the question of having the geosciences count as a pre-college subject, Dr. Ferrini-Mundy drew a parallel with the field of statistics. Thirty years ago statisticians became concerned that statistics was not being taught in K-12 and formed an alliance with the mathematics community so that now K-12 mathematics curricula include clear expectations of statistical knowledge that are very sophisticated. Engineering has taken a similar path. Dr. Constable said the problem with teaming up with math and physics is that a lot of students are turned off by those disciplines.

Dr. Whittaker suggested that geoscience is inherently integrative and cuts across science, policy and solutions, which resides in Earth sciences; international relations or political science; and engineering, respectively. At the undergraduate level, multi-department centers of research in education in geosciences might be effective at making students feel they are doing some impactful. There is a cultural resistance to this in many geology departments, Dr. Bierman suggested.

Ms. Arroyo referred to pressures at institutions to teach a certain number of courses and do research, adding that, as a result, in a larger classroom settings we’re losing people either at the bottom end who might be struggling as well as the talented students. Both problems could be addressed with a better teacher-to-student ratio. Dr. Ferrini-Mundy referred the committee to an engineering solicitation called Reforming Engineering Departments (RED) that focuses on the middle two years of the undergraduate curriculum.

Regarding graduate education, Dr. Constable said employers wanted employees who can communicate, do math, have computer science skills, are self-starters on projects they don’t necessarily know how to do, and get along with people. She said this has nothing to do with what they are taught, other than building enquiring minds. Also, students don’t think about where they’re going when they come in. Individual development plans address this and suggested possibly having every student answer the question yearly of where they are headed.

Dr. Hodges suggested that students cannot learn about alternative career pathways from faculty members who are not aware of them themselves; instead, online resources would be more effective. He also suggested integrating entrepreneurial training into graduate education to help students learn how to pitch an idea in the elevator. Dr. Ferrini-Mundy said these ideas constitute challenges NSF can turn around to the field where NSF would understand better what it takes to do an IDP process effectively.

She asked the committee whether, if a community challenge was put out to the geosciences or graduate education generally that said NSF wanted a small number of places to build innovative models for the preparation of doctoral students, where there is a way to build a buffer between the institutional practices and what you might like to try, would people spend time and energy answering that?

Dr. Taylor said there are 14 Science and Technology Centers in the country, each of which has 30 percent of its budget dedicated to education. It would be interesting to mine the experience of those centers as they have had dedicated education funding at multiple levels for a significant time, he said.

Dr. Kempton asked why it would be limited to Ph.D. students since far more Master’s students are generated. Dr. Ferrini-Mundy said NSF tends to focus on the Ph.D., but it spread resources more broadly.

Dr. Bierman supported the idea of trying a RFP for radical graduate training. He supported including Master’s students because of NSF funding cycles as Master’s students take 2.5 years, so it matches the funding cycle, with assessment on the way out. Another member added that there is more built-in variability with Master’s students.

In response to a question from Dr. Ferrini-Mundy about what it would look like to open a discussion about RAs, Dr. Constable said her institution felt it was important that graduate students are exposed to lessons on research integrity and had instituted a seminar called Ethical and Professional Science targeted at asking what it takes to be a professional in science of any kind.

Dr. Ferrini-Mundy said there are great educational research questions about the best way to engage students about any number of important topics. A course is one way. Another is to incorporate those topics within disciplinary content or research experiences.

Dr. Sullivan said support of RAs to do science is one of the great successes of the NSF and graduate education. He suggested increasing the number of science grants for graduate students. Dr. Ferrini-Mundy said NSF funds a relatively small number of trainees and fellows. Both investments are tracked closely. But RAs, where NSF invests the largest amount of funding, is the area where the least is understood. Little is known about the nature of their experience. It is not known: if they are being well mentored; if they are being well prepared for their own professional careers; whether they are seeing the choices and options they might have as professionals; whether different groups benefit differentially from the different types of investments; and whether fellows are more isolated without a cohort and are urged to find their own mentors and advisors. E&HR would like to better understand the advantages and disadvantages of these different types of investments so NSF could nudge the field to make all of them as powerful as possible for all the different goals they might have.

She also asked whether the experience of being an RA is an educative experience. She noted divided opinion on this question and whether it requires intentionality in the educational part or whether being at the elbow of a good scientist is sufficient.

Dr. Bierman said that proposals include post-doc mentoring plans, if they have post-docs in them, but never have graduate student mentoring plans. He said it would be good to have data about those RAs. He asked why funded graduate students shouldn’t be asked to take an exit and entrance survey about the quality of mentoring and other issues. Dr. Karsten said NSF had funded a survey through the American Geosciences Institute for Master’s degree level students. Dr. Ferrini-Mundy said the RAs, if they are aware they have received NSF funding, would be great ambassadors.

Dr. Hodges recalled an instance when an NSF program director, told that a proposed cut in a grant would mean loss of support for a graduate student, said NSF is not in the business of supporting graduate students that way — that’s what the graduate fellowship program is for. Dr. Hodges emphasized it was important to get across the message that a lot of the meta-support given to graduate education comes through grants. And he suggested adding into the funding criteria a factor such as past performance in mentoring.

Dr. Hornberger noted that writing a plan up front is not the same as assessing the outcome or executing the plan.

An audience member said that one of the good things about the current Grant Proposal Guide (GPG) is that it says to talk about results from prior support in terms of the broader impacts. Those individuals who do a good job with their students give valuable information on where the student went and what experience they had.

Another audience member mentioned a solicitation that this year inserted a new requirement for a formal mentoring plan for graduate students and says the PI can request funding for mentoring activities, especially those devoted to non-traditional, non-academic careers for graduate students and for the PI.

Dr. Hornberger thanked Dr. Ferrini-Mundy for her presentation.

**General Discussion: Broader Impacts**

Dr. Wakimoto opened with a discussion of themes from staff inputs gathered in June:

* The community seems to be increasingly comfortable with BIs, but more could be done to clarify what is meant by BI.
* The POs feel very strongly there should not be any set rating between intellectual merit and BI. In some examples (career, STCs and E&HR portfolio) BI is at least 50-50. The weighting should be left up to the PO’s discretion.
* The absence of broader impacts count strongly against a proposal.
* There should be an evaluation of the resources necessary to execute BI plans.
* Intellectual merit must be robust. There is a sequencing that begins with intellectual merit, then BI.
* Training modules or videos for panels on BI and panel dynamics (dominant personalities, implicit bias, managing group thinking).

Dr. Wakimoto said BI is very important to the Director and asked for AC/GEO input.

Dr. Dixon said BIs often read like an added-on laundry list. It would be better if the BIs were focused part of the proposal in a structured way and a well-defined product. Dr. Kempton said this is symptomatic of a feeling that one knows how to play the game of intellectual merit, but there is inconsistency in what BI means, what will count, etc. More clarity is needed re what is expected.

Dr. Bierman said the panels should be instructed to require the resources needed to accomplish BI. This will improve the quality of future proposals and stimulate thinking about BIs.

Dr. Hornberger addressed the issue of clarity, saying outreach is only one aspect of BI in the the NSF guidelines, though many proposals only include outreach. Regarding comments, he added some proposals to take advantage of a well established infrastructure are regarded as containing nothing new.

Dr. Constable distinguished between the ability to engage in BI without requesting resources to do so by leveraging existing resources; and where significant resources are needed. For the latter, many are reluctant to make such requests, either because they have not considered the costs or because it raises the cost of the proposal, decreasing the odds of funding.

Dr. Wakimoto asked if universities should be asked to play a large role in providing resources to help PIs with BI. Dr. Hodges answered that this would have to be done at the foundation level. Otherwise, the university response is to ask for grant funding. Universities will look for return on investment from NSF; otherwise, they are unlikely to be supportive. If a university does not want to make a strategic investment in geosciences, it will be difficult to get them to do that. Dr. Constable added that universities suffer from the problem of people doing their own thing in terms of outreach without knowing what the the full product looks like. She suggested targeted, well understood efforts to help NSF proposals receiving funding. Dr. Wakimoto added that there is a duplication of outreach effort at institutions.

Dr. Doney noted a similarity with the data management topic. There used to be more NSF investment for community activities in data management, he said, asking if NSF should consider investment in geosciences that people could plug into so they achieve continuity. Dr. Sullivan followed up with a successful example in physics, QuarkNet, where the infrastructure was set up by NSF for PIs to plug into locally with high school teachers.

Dr. Bierman said if NSF is valuing both intellectual merit and BI, NSF is judging the creativity and thoroughness of the investigators in how they come up with BI. Farming that out to a funded organization doesn’t make sense.

Dr. Sullivan said QuarkNet engaged the local high school community and was able to grow. There is limited time to engage the community productively. Good ideas can be put into BI, but this was something that was there and useful.

Dr. Kempton said not everyone is an ideal communicator but there is a need for impacts at all levels. She suggested identifying a small number of people for communicating at the highest level, with larger numbers of people for other tasks, so different people would be responsible for delivering different impacts. In response to a question she added that when talking about BIs, one should not expect everyone to have the same kind of BI. It might only be to help reach school children nearby. Others might offer something at a much different level. And the one that will impact a Congressman should not be evaluated more highly.

Dr. Bierman said a BI proposal should show thought has been given to the idea and fits the project, rather than a canned response.

Dr. Kempton said she was referring to evaluation and a proposal with a large economic impact should not be evaluated as highly because it will only benefit a few people. There needs to be a general consensus on how to evaluate a wide range of impacts. But Dr. Carr said such a consensus can never be achieved. Many of the people doing very valuable science with strong intellectual merit will have the BI be the knowledge from the science. She said that was good enough, even if not creative. But some reviewers are expecting a great science communicator like Alan Alda and that the children in the school next door are benefiting.

Dr. Wakimoto said geosciences was ahead of the game because a lot of work is in forecasting, and improved forecasting provides a good story. Also, it could be that BI, like intellectual merit, could take a decade to play out.

Dr. Bierman asked how to apply this to different panels in different places with different reviewers using different sets of criteria to do that evaluation and said there needs to be some guidance.

Dr. Hodges said many creative ideas are not for doing things with which the geosciences are familiar. They do not have to do with teaching undergraduate courses, mentoring graduate students, or saying the science will have great societal impact. Some of these great ideas do not include any evaluation or doing the associated education research. He does not give these ideas high marks: though creative, they are not going to understand how people use it and how society directly benefits. The only way to get sexier BIs to work is to put significant funding into that, not make it part of what the program directors and the sciences pay for. A good assessment strategy costs more than the average grant for many programs. Dr. Constable added reviewers do not have a follow-up mechanism for BI. Dr. Bierman said this should be found in the results of previous research.

Dr. Hodges said scientific research is evaluated though peer review and publication. Stating just that broader impacts have been done, without follow-up, is not a BI evaluation.

Dr. Dixon said there was confusion among the PIs and reviewers over the difference between outreach and actual impacts. Rational criteria need to be developed for judging whether they are appropriate and doable.

Dr. Kempton said if there are not the resources for BI, the acceptable activities have to be appropriate. A proper impact study would cost quite a bit of money, so there might be a smaller number of those. Dr. Hodges followed up, saying there might be a separate assessment program that NSF funds separately. Dr. Hornberger noted that only certain BIs lend themselves to assessment. Some are anecdotal. He added that the NSF guidelines are very diverse but many do not read the guidelines. He added that one BI would be data sets useful for hazards.

Ms. Arroyo said that despite data.gov, there are many questions from people on the ground. The website is not easily comprehensible by a lay person. A BI would be making sure some of the data are translated by someone to the community that really needs it.

Dr. Taylor said the America COMPETES Act goals are about how the research being funded is impacting these goals, not auxiliary activity in parallel with the research. Attention to this will help with evaluation, he said. Also, the COMPETES goals, which are very clear, should be compared to NSB’s goals.

**General Discussion: Data Management Plans**

Dr. Wakimoto reminded AC/GEO that the data management discussion includes robustness, replicability, and reproducibility. It is an ideal subject to examine, having been in place for only four years. He introduced Dr. Eva Zanzerkia, Program Director, Earth Sciences.

Dr. Zanzerkia is the lead for a geo cyber infrastructure group charged, in part, with understanding how data management plans are used within proposals and how they’re evaluated, including implications for PIs being able to maintain, access, and store data through those plans.

She asked the committee for their experience and suggested avenues for NSF to explore to better communicate what is needed in a data management plan and how they would be assessed.

Dr. Constable said it would be nice if submission to an archive was sufficient. For some fields that might be sufficient. In other areas people have not heard of data management. Even when with data repositories, Dr. Doney said a considerable two-way communication with the investigators is required.

It was also pointed out that in the UK, data management plans involve much more than submission to a repository and require both time and money. Dr. Kempton said most are not used to dedicating time and money to data management plans, limiting reproducibility.

Dr. Zanzerkia said there is language in the awards manual allowing resources for documentation of research, but there is not a good understanding of what that means.

From an atmospheric chemistry perspective, Dr. Prather said, a tremendous amount of data have been acquired from field studies and modelers constantly say they wish the data were available for modeling. It would be much less expensive to work with investigators to archive it properly, so people can mine that data, than doing more field studies.

Dr. Hodges said the technology is available for smart repositories that do not require separating out meta-data and so forth. An NSF investment in this technology would substantially increase the probability for success. Opposition comes from those who object to reformatting their data due to high overhead that can’t be recovered. NSF needs to be prescriptive at a high level, he said, for how data are entered.

Dr. Kempton said experience from the UK shows that data management costs about 5 percent of the cost of a grant and NSF should incorporate that amount.

Dr. Constable said a generation of scientists has to be trained to build data management plans into their workflow before this problem is solved. Web crawlers lead to misinterpretation and misuse of the data. Dr. Hodges said he was not referring to Web crawlers but software to transform the data into a mode the repository can use.

Dr. Zanzerkia agreed with Dr. Constable that training will be required to manage data in a new way, adding that each division and directorate has data management policies. She has tried to work with communities on polices that meet their standards.

Dr. Lyons returned to an earlier cost estimate, saying 5 percent was insufficient if the database is relational. He was also pessimistic about training students to be data managers. Professional data managers are needed, he said.

Many databases are top down, Dr. Bierman said. There is a large difference between the granularity they demand and what is used day to day. He said his community hasn’t bought into the type of solution Dr. Hodges suggested because the data structures are not appropriate for the work. There is also a big variation across investigators to manage data and workflow.

Dr. Dixon echoed the view that data management should be left to the archivists and professional data managers. He also raised the issues related to managing physical data that need to preserved. Agreements with repositories need to be made prior to proposals being awarded, along with safeguards for investigators. Dr. Wakimoto added that the biological sciences face the same problem with “bug boxes.” An NSF challenge was offered but has not been won. Dr. Hodges said this is going to become a huge issue and needs proper attention, emphasizing that the samples cannot be obtained again in many cases.

Dr. Zanzerkia asked if the community understands how to assess the data management plans, or what they require. Dr. Taylor answered that mining and oil companies have disposed of core collections and to prevent this from happening at institutions, there needs to be a shared cost structure. Dr. Zanzerkia responded that this is a problem shared by several government agencies and they too are looking for a solution. Dr. Murray suggested looking at where there are opportunities to leverage resources with other Federal agencies. Dr. Voorhees suggested samples could be used in classrooms and Dr. Dixon responded that some museums have teaching collections. He added that archeologists working on Federal land can have their samples stored in a repository, which receives a fee. He suggested this as a model.

Dr. Wakimoto brought up another aspect of data: computer simulations, such as climate simulation. PIs cannot save the entire output of a 1,000-year simulation. This raises the issue of replicability and reproducibility. The computer code is also hard to preserve due to changing platforms. Discussing an idea that he attributed to Marcia McNutt, who has been nominated to be president of the National Academy of Sciences, he said when a paper is accepted that is based on a simulation, that there be a period of some 11 months for re-simulation, but that it won’t be guaranteed beyond that period. Dr. Sullivan said even long-term storage of photos was a problem. Dr. Barth supported the idea Dr. Wakimoto referenced, saying model output is based on current knowledge that can evolve in as short a period as six months, after which point the results from the simulation may not be useful. Dr. Constable disagreed, saying that even though knowledge improves, one might want to go back and re-do the simulation to understand better how this knowledge has changed.

Dr. Kempton said the UK has concluded the average PI cannot be trusted with data management and has established disciplinary data centers with the responsibility of working with the PI to have the data entered correctly.

Dr. Hornberger concluded the discussion on data management plans and adjourned the meeting for the day.

**Thursday, October 22, 2015**

**Division Subcommittee Meetings**

AC/GEO subcommittees met separately and prepared their reports.

**Division Subcommittee Reports: EAR, PLR, OCE AGS**

1. EAR

Dr. Bierman presented the EAR subcommittee report, focusing first on the facilities report for future geophysical facilities based on the need to re-compete. There is enthusiasm for the current facilities but there were questions about whether future facilities should be driven by the model of what works well now, or the grander challenges that cover all of EAR. The NSF response was that this would come through the proposal process.

He also discussed a report on geochronology and its impact in the geosciences, including: access to laboratories and how to involve students at schools that do not have access to specialized facilities; using existing facilities more efficiently by supporting technicians to achieve close to 100 percent utilization; increasing the diversity who of who uses geochronology techniques.

Moving on to proposal loads and removing deadlines, he said proposal load decreased up to 50 percent when deadlines were eliminated. The effect on proposal quality is unclear, but success rates in instrumentation and facilities went up.

He also briefly discussed an EAR self-study to learn how to work better as an organization.

1. PLR

Dr. Lyons said PLR has not had a COV since the spring of 2013. The plan is to have the Antarctic in March to April this year and the Arctic COV in May to June. Names of potential members are being collected from across a wide breadth of communities with the recognition of the importance of including experienced members. Also committee liaisons are being discussed and chairs for both committees are to be selected in the next couple weeks.

Regarding future agenda items, he listed: increasing diversity in the research community; sexual harassment issues and policies; and dialog between the community and NSF about the ramification of a recently released NRC report on strategies for Antarctic research.

Also, the subcommittee is very interested in the ongoing review of the merger between GEO and PLR and is interested in ways it can help.

He also reported on the subcommittee’s discussions of data management reporting policies, data repositories, and data discovery, as well as the cost of data management, extraction, manipulation and visualization. The subcommittee did not discuss BI. The subcommittee was alerted to the science assistant opportunities and the need to encourage undergraduates to apply. There was also discussion of Dear Colleague letters for IPA opportunities. Finally, Dr. Lyons reported there was a discussion of Dr. Dixon’s new book, *Arrows and Atl Atls*.

1. OCE

Dr. Taylor reported that the subcommittee talked about BI and data management. There was recognition of the need for increased communication between the directorate and the divisions and the community about what BI they are looking for. For data management, the subcommittee was happy with databases in the oceanographic community of investigators that have been self-defined. But when other communities want to relate to those databases, some metadata are lost, so there is still work to be done, he said, when marrying databases.

There was a conversation with the POs about *Sea Change* implementation and the prospect of the restoration of funding to core and mid-scale programs that have been starved by the escalation of facilities costs.

Dr. Carr added there was a discussion of data products as comparable to a publication. Dr. Taylor mentioned discussion of DOI tags providing a mechanism for a reward in terms of citations to those who provide data.

1. AGS

Ms. Arroyo said AGS discussed current geosciences budget limitations that are informed by the misinformation campaign about the benefits of geosciences and the targeting of climate change. The subcommittee also identified the need for a conversation about bringing young people along and educating guidance counselors.

She referenced the Georgetown Climate Center, which works with elected officials, and said governors of both parties have historically supported climate change before the misinformation campaigns. They talk about the impact to their states and pivot to a story about solutions. The subcommittee talked about having ready examples that can be shared with those who would like to tell the stories of the impacts of a changing climate, along with solutions. Many of the members have opportunities to inform government and other reports. Some of the misinformation campaign is causing people to hide the word “climate” in those reports. The subcommittee also talked about NSF’s role in representing the concerns of the community of scientists and the science and how to do a better job of making sure this is part of the conversation. The subcommittee wants to pursue the idea of engaging professional science societies with the help of USGCRP in a climate wiki to provide more accessible information. The subcommittee discussed disseminating narratives about the impacts of climate change and the value to the economy of investing in related science. This includes the value to the economy of weather-related events and how science improves risk-based decision making. Narratives can be used to help policy makers understand that this information is critical to business investment decisions and to military readiness. The subcommittee would like to have a conversation with the Director and the security community and determine how to help NSF and the broader community.

Dr. Whittaker said the report discussed yesterday, *America’s Future: Environmental Research & Education in a Thriving Century,* uses the word “climate” in such a way as to bring up the idea that climate change can either be regarded as the biggest problem, but is subject to climate deniers, or it is part of a larger problem that cannot be denied, which is that humans interacting with their environment change the environment, such as an increased number of forest fires. Investigating why such changes are occurring will lead to conclusions about climate change. Dr. Wakimoto added that there has been a lot of work in social psychology on how climate issues are not effectively communicated.

Ms. Arroyo followed up, suggesting joint work with the group that works on sociology and behavioral sciences. People resort to agreeing with their tribe because not doing so comes at more of a personal cost than having argument about climate science. But presentations that spew facts are insufficient. Narratives, stories, examples and facts that can be weaved in about the changes being seen can make a difference. But if NSF does not do it in its own reports, conversations and presentations, others will not either. There are not many platforms supporting people credibly stating the science. Well meaning people, such as Bill Gates, criticize so-called environmentalists who link extreme weather because the cause is El Nino, without connecting the fact that climate change can impact El Nino. To help people who say the right thing more credibly would be a huge service, she said.

Dr. Dixon said archeology is full of examples where environmental degradation has resulted in the collapse of societies. There is a very good scientific tradition supporting this discussion, he said.

Dr. Carr distinguished two points in Ms. Arroyo’s presentation: the difficulty of interpreting information at data.gov; and compelling stories for people to understand what is happening. Regarding the former, she pointed to a gap in the link between academic knowledge for practical purposes. The Columbia Climate Center, she said, tries to be a translator to help bridge that gap. Efforts in this area tend to be localized. These efforts also get sidetracked onto the second of Ms. Arroyo’s points regarding compelling stories. It is easy to get drawn into refuting the skeptics, she said. She asked if it was part of the NSF mission to discuss practical impacts, such as who should buy an electric car, and in which states. It is a BI, but the intellectual merit falls through the cracks of the classic NSF proposal framework. She noted a statement that the Intergovernmental Panel on Climate Change (IPCC) is not useful for people who want to make an adaptation decision because there are no regional scale models. She contrasted advancing knowledge and advising someone on what to do for his gutters. Ms. Arroyo responded that subcommittee thought this was a role NSF could support with multiple supporting partners, without NSF itself hosting such a website.

**Preparation for Meeting with NSF COO** **Richard Buckias**

AC/GEO members prepared and assigned questions to ask during their upcoming session with the COO.

**Meeting with NSF COO Richard Buckias**

Dr. Buckias began by discussing yesterday’s presentation by Dr. Holdren, who referred to a success rate for proposals of 50 percent.

Dr. Buckias reviewed his own success rate calculation. The average rating for successful awards, he said, is 4.2 out of 5. All proposals declined that are 4.2 or higher, would equal about $2 billion. That is the amount needed to fund proposals of the quality that are currently funded. That would bring the total NSF budget from approximately $7 billion to approximately $9 billion. The funding rate in 2014 agency-wide for research proposals, he added, was about 20 percent. By adding $2 billion to the budget it is possible to get to 30 percent, so the proposal success rate should be about a third. NSF would like to see at least a third of its proposals funded and it can be argued that would require about a $2 billion increase.

Moving to a discussion of the budget, Dr. Buckias discussed preparations for a potential government shutdown, which he called a crazy situation. He said the planning takes weeks, but compared that to nuclear laboratories, where planning takes much longer.

If there is a one-year continuing resolution (CR) it will not be as bad as it sounds. That keeps the agency at the ’15 budget. The ’16 request and budget authorization and appropriation were not that good. So being stuck at ’15 isn’t that bad. It also does not enact the directorate-level allocations.

Regarding new starts, he said NSF has to go through all of the wording very carefully to ensure what is said in the budget request can be handled under current activities. He said he does not think this would impact many of the things planned for ’16.

The agency is continuing to put out the message that directorate-level allocations are not in the best interest of science in the U.S. The agency is working very hard to try to ensure it does not happen. Everyone at NSF understands this will be a ruckus for everyone.

Dr. Taylor said the directorate-level cuts to geosciences and SBE are a great concern. Last year there was no increase. This year is more dire. One scenario is a shorter CR followed by an omnibus, in which the issue of directorate-level funding will have to be dealt with. And what if the Senate side does not prevail? What is NSF thinking about how to deal with that?

Dr. Buckias said if that occurs, NSF will abide by what it is told to do. However, crosswise NSF investments can deal with some flexibility. We have thought this trough, he said, and will ensure we fund the best science we possibly can. We have no intention, he said, of ensuring that GEO and SBE scholars aren’t having their high quality work funded. We are with you all the way, he said.

Dr. Taylor said AC/GEO is pushing in ways it can as well.

Dr. Buckias said that if a university budgeted down to the department, it would become so compartmentalized and un-collegial that you really can’t get anything done. To get around this at a university using the Responsibility Center Management(RCM) model, you pool funds in other ways by trying to find taxes to ensure being able to do the high-quality things you need to do.

Dr. Kempton asked what NSF is doing to make the case for geosciences. Dr. Buckias said NSF cannot lobby or tell AC/GEO to lobby. So The Office of Legislative and Public Affairs can talk to Hill staffers and elected officials about how detrimental it could be to science in the U.S. NSF is doing everything possible within the constraints of a government agency. We elect members of Congress from the populace and the populace doesn’t understand us. The populace doesn’t understand data and so we need a better educated populace that appreciates data so they will understand us. But he said most people like stories and “science types” like data. He said the agency is pitching the impact of the science that our scholars do around the country.

Ms. Arroyo noted that geosciences’ association with climate change is driving some of the difficulties with the budget and asked about NSF’s strategy in managing priorities and navigating the different constituencies that have to be served.

Dr. Buckias said there is a person telling us we should be able to model the priorities and science in this country and come up a data mining technique to predict where we should fund science in this country. NSF is only here because of its scholars and researchers. How can we algorithmically predict what the highest quality science is going to be in the future? To do priorities, NSF depends in the end on people like AC/GEO, including its reports, studies, and input to advisory committees and COVs, to figure out the priorities. But there is no metric for this. The *Sea Change* report, he said, was the most usable piece of information he’d seen at the agency.

All directorates at NSF are behind getting rid of directorate-level funding. The consequences could be severe should this come through. Everyone is concerned about this.

Dr. Taylor asked if NSF might back off in championing the importance of science to society and the planet in the face of some of the rhetoric coming out of Texas and shy away from extolling the virtues of the geosciences and the climate change issues that are budgetarily sensitive.

Dr. Buckias said everything we do involves politics and maneuvering through this might involve not saying some particular words. We have other folks that can say them. We have to be very careful and try to do the best we can and maneuver this political environment and you might not hear the words you want to hear.

Turning the Division of Polar Programs, he discussed the review of the realignment, which will be done in 2016. NSF will work with NSB on the review so there will not be many details available until after the NSB meeting in November. In addition to GEO, all the other directorates, staff, NSB, all the ACs, the professional societies, and the community will be involved to make a decision on whether this was the right move.

Dr. Taylor asked if NSF was sharing with the other communities the internal metrics of success. Dr. Buckias said this has not been done yet because the process will not start until January but these metrics will be included. In response to another question he said that stakeholders and the community broadly would be included.

Turning to BI, Dr. Buckias said some want to limit it only to underrepresented groups, adding he didn’t think AC/GEO wanted that. Another discussion has been about why there is not the same confusion with intellectual merit. Dr. Bierman responded that few have been trained to think about the BIs of their science. He said he knows a good BI impact statement when he reads it in a proposal and they are not all the same. Dr. Buckias said that unlike quality and intellectual merit, where there is a general understanding of what it is, that does not exist in BI. The scholars who have that kind of a background don’t come to review panels.

In response to the request for AC/GEO input, Dr. Dixon said there is confusion between outreach and impacts that could benefit from clearer definition. Also, he said, few are trained in assessment to objectively determine the values of outreach and impacts.

Dr. Bierman added there was interesting data in the Webinar with the EAR subcommittee showing through contextual analysis that for all but PLR in the subdivisions of EAR the proposals that were declined had more of the traditional vocabulary words associated with BI than the funded proposals, but we don’t have the data to understand why. Results also differed by program, suggesting cultural differences either in the PIs or the panels. Dr. Buckias said the panels are not necessarily started off so that each member understands the differences in intellectual merit and BI. Dr. Bierman suggested letting the reviewers and the PIs know there is not a one-size-fits-all for BI and that they will not be judged on the number of BIs but on their perceived efficiency.

Dr. Whittaker added that a group Dr. Buckias had referenced (CISE?) as wanting to limit the interpretation of BI, had a very clearly defined mission and the BI definition was within that context. Dr. Buckias said he was hearing that people with BI expertise should be included in panels. Dr. Sullivan suggested that might create a priesthood.

Dr. Constable said she served on a panel with BI specialists from the education community who said what they saw did not meet the standards necessary for BI. If NSF did this, there would be the potential for doing twice as much work, i.e., in addition to the science, also educate the community. She said it would be expensive and not all scientists would be competent to enact it.

Dr. Hodges followed up to ask about what BI outcomes are desired, not just their existence in proposals. To make BI a fundamental part of the evaluation process for proposals, it is necessary to assume a measurable positive BI outcome. But the community does not necessarily have the assessment capabilities. And the cost of assessment is equal to the cost of the scientific research, so it will be hard to do that. Given that, he asked, What do we think about what we want to see in BI? The answer needs to be communicated to everyone involved. Dr. Buckias agreed with Dr. Hodges that if people report more they will think about it more and if more questions are asked, there might be better reports.

Dr. Whittaker asked about replication in other settings. The ability to replicate and translate some of the approaches in CISE is usually not possible. He asked about how to define what is needed and the anticipated outcomes. Dr. Buckias referenced Inclusion across the Nation of Communities of Learners that have been Underrepresented for Diversity in Engineering and Science (INCLUDES), which is trying to translate and have a much bigger impact. He agreed that the question is how to assess, write about, and quantify it from the point of view of individual proposals.

Dr. Taylor said he was very concerned with the recommendation for BI specialists on panels. The breadth of knowledge on a panel would be lost in the process, he said. A narrower sense of BI would be preferable, he added. If BI is confined to the research itself, existing panels work well. Dr. Buckias agreed that if confined to the research itself, panels do well.

Dr. Bierman raised the issue of scale. Assessment and BI differ accordingly. For panels, it is possible to choose scientists who can represent the intellectual sub-disciplines who also have BI experience. He opposed having a hard split between BI and intellectual merit experts on panels.

Dr. Hornberger said it was important not to de facto define a narrow niche for BI, focusing everything on outreach and assessment because there are six NSF criteria.

Dr. Semeter emphasized that a proposal with high intellectual merit, must have impact. Dr. Buckias, said in some more esoteric areas than GEO, where the impact would occur decades later, this might be more difficult.

Dr. Taylor asked about transitioning to the next administration and whether NSF was looking to position the agency with particular key candidates in terms of position papers, etc. Dr. Buckias said the agency does not spend as much time on that as on many other things.

Dr. Hodges said NSF staff was overwhelmed with workload and asked about distributing resources to support work done in the directorates. Dr. Buckias agreed with the statement of the problem, adding that the number of funded PIs and co-PIs has doubled between 1989-1990 and 2014, and the number of proposals has grown by 64 percent. The number of people at NSF has grown 21 percent and they are being asked to do more cross-agency activity and serve on more committees. The number of Federal employees has stayed constant over the last five years. Also, NSF overhead is 6 percent. And 40 percent of NSF’s workforce is temporary. This turnover is worrying, he said. The biggest problem is recruiting. A year ago the time from announcing a job to the day the person started was 256 days. And NSF has never reached its allocation for Federal employees of 1,340, which makes it difficult to request more positions from Congress. The big push is to fill these positions and then make the argument that it is not functional to have so few people, with so little overhead managing so much responsibility.

He added that the burden on PIs is too heavy and he is thinking about how to make it easier for them to submit proposals and get them funded, including making policies transparent and uniform. His worry, he said, is return without review, which he said is not right. Three percent are returned without review. He is trying to solve it electronically, so the submission process cannot be completed until the proposal is in acceptable form.

Responding to a question about possible disruptions from moving to a new NSF headquarters, he said systems, safety, and conference rooms will be much better, but it will be more difficult to travel to and some employees will be impacted. A concern is the large fraction of eligible retirees among Federal employees.

Finally, Dr. Buckias thanked the committee on behalf of the director and reminded members that their input is listened to and valued.

**Program Update: Risk & Resilience**

Dr. Gregory Anderson, EAR Program Director, discussed the Risk and Resilience activity. This is an evolution of an activity under the Hazards SEES (Interdisciplinary Research in Hazards and Disasters) program. In 2015-2016 there was participation across five directorates. There were 130 proposals with 11 awards. The original budget was about $21 million but with more money coming in from other directorates and other places, the program ended with $27 million. That was the final Hazards SEES competition.

This has been replaced in the ’16 budget by Risk and Resilience, which has two components: Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP) and PREEVENTS. CRISP looks at how infrastructures interdepend with each other and how they behave under normal and perturbed circumstances. The CRISP budget request for ’16 is $34.5 million. PREEVENTS is the next evolution of Hazards SEES, which seeks a fundamental understanding of the processes undelaying natural hazards and extreme events in the geosciences to improve forecasting of their behavior and impacts, along with the development of new tools to improve resilience. The ’16 PREEVENTS request is $23.5 million.

The program was announced in a Dear Colleague letter on September 9th that reminds the community GEO has funded natural hazards research for a long time and that this is a new way of encouraging somewhat different thinking. It asks for proposals appropriate for a core program already existing in GEO that have a PREEVENTS flavor.

A solicitation is currently being prepared, in anticipation of the approved budget.

Risk and Resilience is a five-year program with three tracks: co-funding for proposals appropriate for an existing program with a PREEVENTS flavor; workshops and/or research coordination networks for areas ready for further development that need boundary crossing conversations; and PREEVENTS Nucleus, projects that do not fit a core program but are PREEVENTS related.

There has been a lot of outreach inside NSF and across agencies. There was a meeting in May with representatives from 10 agencies, including a branch of NIH that deals with environmental health (The National Institute of Environmental Health and Safety).

Solicitations are envisioned every couple years.

Discussion:

In response to a question Dr. Anderson said any program that does projects in the vein of Risk and Resilience can contact their program officer and submit a proposal. It will go through the review process in its home program and then Risk and Resilience will examine it for co-funding.

He added that there was a specific cross-directorate solicitation for Hazards SEES. It had to have meaningful scientific integration across three disparate scientific disciplines that represented in the aggregate scientific areas supported by at least three of the participating directorates.

In response to NIH input, Dr. Anderson said there was traction based on relationships with a couple of individuals for work on human impacts from natural hazards that affect the coastline or dense population areas.

**Program Update: INFEWS**

Dr. Tom Torgersen, EAR Program Director, representing the NSF (Food, Energy and Water) FEW Working Group, said these issues are intertwined on many levels with complex interlinkages. Working across agencies with differing missions is difficult, so there is support for NSF to lead a multi-disciplinary initiative. With a true understanding these systems, higher-level integrated systems knowledge will determine that the most important piece of information is a given bit of information from the core programs. New discoveries from the core programs will be fed up to a higher-level systems understanding.

Reviewing progress to date:

* A Dear Colleague Letter was issued in February;
* Webinar was held in February to inform POs and the community (due date March 30);
* By June 17 workshops and 27 supplements funded $6.3 million;
* August 2015 press release announcing new grants to foster research on food, energy and water.

Dr. Torgersen reviewed the INFEWS goals for FY ’16:

* Significantly advance our understanding of the food-energy-water system through quantitative and computational modeling, including support for relevant cyberinfrastructure;
* Develop real-time, cyber-enabled interfaces that improve understanding of the behavior of FEW systems and increase decision support capability;
* Enable research that will lead to innovative system and technological solutions to critical FEW problems; and
* Grow the scientific workforce capable of studying and managing the FEW system, through education and other professional development opportunities.
* Major scope is a solicitation (interdisciplinary tracks with “fuzzy” boundaries)
* Dear Colleague Letter: FY 2016 Innovations at the Nexus of Food, Energy and Water Systems (INFEWS) Funding Opportunity on Nitrogen, Phosphorus, and Water, August 12 2015; Chem and CBET;
* NRT will have an INFEWS focus;
* EPSCoR Track 1 will have an INFEWS focus ;
* All utilize a common intro paragraph;
* Renewing the MOU with USDA/NIFA;
* Establishing an MOU with NOAA NSF-level (GEO, ENG, SBE, CISE).

He said the new solicitation DCL and companion calls establish a context for the research:

* An INFEWS context for research across NSF and “disciplines”;
* A focus for interaction with sister agencies.

He added that the central solicitation track definitions provide a focus for a new type of research that will:

* Enable creative interdisciplinary research;
* “Fuzzy” track boundaries focus research on major challenges but also represent Pasteur Quadrant opportunity.

And he emphasized future continuity to maintain interdisciplinary thinking, build a new breed of scientists and interact with core programs:

* Strong links to the core sciences as exhibited in the DCLs;
* Utilization of a common introductory paragraph “as glue.”

Discussion:

In response to a question from Dr. Hornberger about feedback from the workshops, Dr. Torgersen said in Rapid City there is a radically different view of agriculture than in Virginia.

Dr. Wakimoto said there is a strong partnership with the Engineering Directorate, which is a co-lead with GEO. Whereas NSF is often reacting to the administration’s priorities, he said this is an example where the reverse is true. The NSTC Committee on Environment, Natural Resources, and Sustainability (CENRS) is scrambling to come up with a food, energy and water effort to catch up with what NSF has identified.

Dr. Bierman asked about the balance between the initiative’s three pieces. Dr. Torgersen said it was requirement to work in all three, explained in a required context statement, and three distinctly separate disciplines within at least three directorates or two directorates and an agency. He added proposals will have critical elements subject to threshold responses to identify the criticalities in the system. The program will balance across all of the scope of problems.

Responding to a question about the Bio directorate, he added they were interested in the concept but are not participating.

Dr. Torgersen was asked by Dr. Taylor about where expertise related to food was located at the foundation. He responded there was understanding of certain food processes in the hydrologic community, and knowledge in the engineering community. Genetics will probably not be included.

**Open Discussion, Wrap-Up and Action Items**

The committee discussed sending a letter to the director. Dr. Hornberger agreed to draft a letter for the committee and Dr. Wakimoto to vet.

The spring meeting will be an appropriate time to discuss data management, Dr. Wakimoto said.

Dr. Wakimoto opened discussion for a debrief of the AC/GEO meeting.

Dr. Constable said there were good presentations from Dr. Holdren and the NSF staff. She also appreciated the opportunity for time on the agenda to talk offline.

Dr. Hodges said there were issues discussed during last week’s EAR teleconference that would have been good to discuss during AC/GEO. Dr. Wakimoto said agenda topics can be sent to Dr. Hornberger or to him for consideration and noted the teleconferences could have been held earlier.

Regarding a suggestion that a thorough discussion in the future of cyber-infrastrucutre and data management will require more than the half hour allotted for this meeting, Dr. Wakimoto said that for now he received enough information for internal NSF discussions and could foresee a more structured discussion in the future.

Dr. Bierman said the meeting was well paced and stimulating and appreciated doing the subcommittees in person and having the associated program personnel present. Dr. Wakimoto said the format should be repeated once per year or more. Dr. Lyons said once per year was appropriate. Dr. Hornberger agreed.

Dr. Wakimoto said he invited Dr. McNutt to speak to AC/GEO at the spring meeting. He also thanked Melissa Lane for her hard work. He also thanked those who are rotating off the committee (Dr. Barth, Dr. Carr, Dr. Taylor, and Dr. Whittaker).

Dr. Hornberger adjourned the meeting.