**Advisory Committee for Geosciences (AC/GEO)**

**April 13-14, 2016**

**Meeting Minutes**

 **AC GEO Attendees:**

Dr. George M. Hornberger (Chair)

Ms. Vicki Arroyo

Dr. Paul Bierman (via teleconference)

Dr. Catherine Constable

Dr. E. James Dixon

Dr. Scott C. Doney

Dr. Rana Fine

Dr. Jose D. Fuentes

Dr. Kip Hodges

Dr. Pamela Kempton

Dr. W. Berry Lyons

Dr. Shirley A. Pomponi (via teleconference)

Dr. Joshua Semeter

Dr. Julienne Stroeve

Dr. Gregory Sullivan

Dr. Cindy Lee Van Dover

Dr. Roger Wakimoto

**Absent AC GEO Members:**

Dr. Gregory J. Hakim

Dr. Kim Prather

Mr. David H. Voorhees

**NSF Senior Staff:**

Melissa Lane

**Wednesday, April 13th**

**Welcome & Introductions**

Dr. Hornberger convened the meeting and welcomed all participants. He noted two new members present: Dr. Jose D. Fuentes and Dr. Cindy Lee Van Dover, as well as Dr. Shirley A. Pomponi, a new member who would join the meeting by teleconference. Dr. Hornberger noted that Dr. Paul Bierman would also attend via teleconference.

Dr. Hornberger led a round of brief introductions, and asked board members to attend to a recent *Dear Colleague* letter requesting nominations for the new GEO Assistant Director. If the letter does not provide alternate directions, nominations can be forwarded to Dr. Hornberger.

Dr. Hornberger reminded AC GEO members that a review of the Polar Program had begun; this review is headed by Dr. Joan Ferrini-Mundy and Dr. Jennifer Holmes, who had expressed interest in receiving input from AC GEO, particularly members of the Polar subcommittee.

Dr. Hornberger requested and received a motion to approve the minutes of the Fall 2015 AC GEO meeting; this motion was seconded and passed by voice vote without objection.

Dr. Hornberger briefly reviewed the meeting agenda, noting that subcommittees act as committees of the whole. He introduced Dr. Wakimoto.

**Update on NSF GEO Activities**

*Roger Wakimoto, AD GEO*

Remarks from the Assistant Director of GEO Sciences. Dr. Wakimoto thanked AC GEO members for their attendance; he noted that he had recently returned from a 2-day offsite Assistant Directors’ retreat with NSF Director France A. Còrdova, focused on future direction for the NSF and the priorities of the Executive Director. Dr. Wakimoto also announced that Brian W. Stone, who had served as Section Head for Antarctic Infrastructure and Logistics (AIL), was named to serve as Chief of Staff in the Office of the Director.

Dr. Wakimoto offered thanks and congratulations to GEO staff, noting the successful close-out of the year, and a smooth transition to a new travel system. Dr. Wakimoto noted a number of GEO staff had been recognized, both internally and externally. A number of staff received the NSF 2015 Director’s Awards; Sonia Esperanca and Robin Reichlin received the AGU’s 2015 Edward A. Flinn III Award; Donald Rice received the AGU’s 2015 Ocean Sciences Award, and Linnea Avallone was named an AMS 2016 Fellow.

Dr. Wakimoto offered highlights and updates from AC GEO, including:

* The successful transition of the NSF Ocean Observatory Initiative into an Operations and Management status. Dr. Wakimoto noted interest from Congress and the National Science Board (NSB) in the OOI. Data from OOI are now streaming, and have captured two major deep sea earthquakes.
* Antarctic Infrastructure Modernization for Science (AIMS) is moving forward; snow modeling to inform upgrades to McMurdo Station and other South Pole facilities is underway, and will help to assure that buildings are optimally oriented, given prevailing wind directions and snow drift.
* The Prediction of and Resilience against Extreme Events (PREEVENTS) program released a Dear Colleague letter in September 2015 and will release a solicitation in the near future. Gregory J. Anderson will serve as contact for that solicitation. Dr. Wakimoto noted a January 2015 article in the *Atlantic*, noting the absence of a standardized method for predicting or estimating the costs of major storms, such as Winter Storm Jonas. PREVEENTS seeks to address events such as this.
* The Innovations at the Nexus of Food, Energy and Water Systems (INFEWS) solicitation has been very well received by the scientific community.

FY16 Budget. The NSF budget request for Research and Related Activities (R&RA) in 2016-17 included a 4.8 percent increase; the approved budget included $7.4 billion for the NSF, an increase of 1.6 percent overall, and 1.7 percent for GEO. Dr. Wakimoto noted that Social, Behavioral and Economic Sciences did not include an increase from 2015 levels. By way of context, Dr. Wakimoto noted that the National Institutes for Health (NIH) received a 6.65 percent increase; the Department of Energy (DOE), 5.51 percent, and NASA Earth Sciences, 6.5 percent. Dr. Wakimoto acknowledged that the NSF did not fare as well as agencies with which it interacts.

Within GEO, the directorates received budget increases of just more than 1 percent; Dr. Wakimoto noted these were the largest increases within the NSF, and that Directorate-specific allocations for GEO were avoided.

Dr. Wakimoto shared highlights from an interview with Representative John Culberson, Chair of the House Appropriations Committee’s Subcommittee on Commerce, Justice and Science. Dr. Wakimoto noted Rep. Culberson’s strong support for NASA, as well as his commitment to full funding for the NSF. Dr. Wakimoto also noted Rep. Culberson’s focus on the “hard sciences,” and the budget stipulation that funding for SBE not be increased. In discussion during testimony from Director Còrdova, Rep. Culberson asserted that politicians should not impose their priorities on the scientific community. Dr. Wakimoto noted his appreciation for Rep. Culberson’s consistent support, and remarked that Rep. Culberson seemed to be more comfortable speaking to NASA’s work and value than to that of the geosciences.

Dr. Wakimoto noted that he did not have as much familiarity with the Senate, but that he had met with Senator Cory Gardner’s staff recently, and the staff reported strong support for basic science.

FY17 Budget. The FY17 budget request includes a 6.5 percent increase for R&RA, included a 6.1 percent increase for GEO. Dr. Wakimoto noted that a signification portion of the request falls into the category of “mandatory funding,” and so is not subject to discretionary caps. Dr. Wakimoto noted that Representative Eddie Bernice Johnson had publically stated it would be “unrealistic to hope [this request] will be fully accepted by Congress.”

Dr. Wakimoto shared the requested FY17 budget within the GEO Directorate, noting a significant increase for Integrative and Collaborative Education and Research (ICER), which includes a Regional Class Research Vessel (RCRV). The budget includes continued support for INFEWS and Risk & Resilience.

Public Access Plans. The requirement to upload publications in PDF form is now incorporated into NSF proposals. A website with Frequently Asked Questions (FAQs) has been developed. Providing public access to data is still under discussion; grantee data management plans are under review within GEO. A broad public access request has not yet been made to Principle Investigators (PIs), but public access to data is moving forward.

NAPA Report. Dr. Wakimoto recommended AC GEO member download a review a recent report from the National Academy of Public Administration (NAPA) on the NSF’s use of cooperative agreements (CAs). Dr. Wakimoto noted that NSF uses both contracts and CAs; CAs can provide greater flexibility. The use of CAs has come under scrutiny, and the Inspector General requested a review by an external group. The report concludes that CAs are appropriate mechanisms to support large-scale research facilities.

NAPA also recommended the elimination of management fees; Dr. Wakimoto noted that some organizations survive through management fees, and some may not apply for funding that does not include these fees. He asked AC GEO members to review this portion of the report; a response to the NAPA recommendation is under development.

Elimination of Proposal Deadlines. Dr. Wakimoto noted that NSF ADs had been tasked with developing novel ways to address proposal pressure. As an experiment, Earth Sciences eliminated proposal deadlines as of mid-January 2015. The number of proposals received dropped immediately. Feedback from the community has been positive, as investigators report having more flexibility to work more effectively with collaborators.

Potential metrics to evaluate this approach are being considered. Dr. Wakimoto noted the two most important considerations are whether the elimination of deadlines results in higher quality proposals, and whether this approach can be sustained. There is also interest in determining what types of proposals are “lost” in the decline in numbers received, and if the absence of deadlines affects resubmissions. If the evaluation shows no loss in quality, the no-deadline approach may be adopted more widely.

Discussion. In response to questions regarding logistics of this approach, Antarctic Earth Sciences Program Director Alexandra Isern noted that Program Officers assemble virtual review panels when a “critical mass” of proposals is received, and the quality of the merit review has not changed. She noted some increased challenge in budgeting, but noted that Program Officers had always had to manage funds across the year, given other program deadlines, supplements, shared proposals and other reasons, A review of proposals received since deadlines were removed shows no change in investigator type: no loss, for example, of early career investigators.

AC GEO members expressed support for the no-deadline approach, noting that it might facilitate the co-funded projects. Dr. Bierman noted that submissions of two proposals from his institution were delayed to address quality concerns; this would not have been possible with deadlines. Dr. Bierman also suggested that spending more time on a first submission may reduce the total time spent on proposals that otherwise are resubmitted multiple times. AC GEO members noted the likelihood that selection rates are rising with the absence of deadlines; these data are not yet clear.

Paul Shepson, Division Director for Atmospheric and Geospace Sciences (AGS) reported that most of the programs in AGS do not have deadlines. AGC Program Directors appreciate that submissions are spread throughout the year, and community members prefer to submit when their proposal is of appropriate quality. He noted that AGS has consistently had higher success rates than other division; the assumption has been that deadlines would result in more proposals of lower quality, resulting in lower success rates.

Richard W. Murray reported that the Division of Ocean Sciences (OCE) has had informal discussions regarding a no-deadline approach; he noted that the 50 percent drop in submissions has significantly increased interest in this approach. There are some concerns about the impact on infrastructure and ship schedules, Dr. Murray noted that not all OCE proposals require ship time.

Dr. Constable noted that some programs only solicit proposals every other year, and asked if there were areas in which a no-deadline approach would not work. EAR Division Director Carol Frost replied that this approach might be feasible in any area, if it is desired. Dr. Murray remarked that an across the board change is not being suggested; he noted programs that are heavily dependent on international and crew scheduling are unlikely to adopt a no-deadline approach.

Dr. Semeter asked if the size of requests had changed; Dr. Isern replied they had not. Dr. Frost noted that deadlines were removed just 11 months ago; she acknowledged AC GEO members were “asking the right questions.”

Dr. Wakimoto noted young university faculty members receive pressure from their deans to submit proposals. He also noted some trepidation regarding rising success rates, and suggested that this concern might be raised during discussion with the NSF Director.

Dr. Wakimoto returned to his presentation, noting that Marcia McNutt, Editor-in-Chief of *Science*, and next President of the National Academy of Sciences, would be speaking to the group. He noted that Dr. McNutt will be the first female President of NAS, and a geoscientist succeeding a geoscientist, which is a bit of a break in a NAS tradition of alternating physical scientists and life scientists.

Rebecca Keiser, Head of the Office of International Science and Engineering, will also speak to the AC GEO; Dr. Wakimoto noted that Dr. Keiser’s arrival at NSF had elevated these programs. In addition, several board members had described Dr. Keiser’s presentation to the board as the best overview of international programs they had ever received.

Dr. Wakimoto closed by noted the website to which nominations for the next GEO AD can be submitted. He noted parallel searches for ADs in Math and Physical Sciences (MPS) and Engineering (ENG). The deadline for nominations is May 20, 2016.

Discussion. Dr. Fine asked about the requirement to upload publications to the NSF website, particularly the deadline for uploading a document, and managing journal embargoes. Dr. Wakimoto referenced the FAQ website, and shared his understanding that authors are asked to upload the final PDF of the manuscript accepted for publication. He also noted a session scheduled later in the day, which will address this requirement.

Ms. Arroyo asked for more detail regarding alternative to management fees in NSF proposals, and distinctions between contracts and cooperative agreements. Dr. Wakimoto replied that the official response to the recommendation to drop management fees has not yet been finalized. Regarding contracts and cooperative agreements, Dr. Wakimoto noted that contracts include very clear deliverables and thus are easy to account. Some had suggested that contracts are thus superior to cooperative agreements, but the NAPA report does not support that conclusion. The report concludes that both contracts and CAs can be accounted for in equal quality. Jamie Allen offered examples of how the flexibility within CAs can facilitate cooperation and result in cost savings.

Preparation for Discussion with Marcia McNutt. Dr. Hornberger facilitated a discussion of topics AC GEO members would like to raise with Dr. McNutt during her time with the group.

**Update on NSF CI Activities**

*Eva Zanzerkia, GEO; Amy Friedlander, CISE; Irene Qualters, CISE*

Update on Public Access. Irene Qualters, Division Director, Advanced Cyberinfrastructure, began with an overview of public access activities at NSF. In 2012, a small internal technical group and an interagency information exchange were developed. The White House Office of Science and Technology Policy (OSTP) released a memo in February 2013, directing all agencies involved in research to develop public access plans. A partnership with DOE Office of Scientific Information (OSTI) was developed, to make use of the infrastructure developed by OSTI. The draft plan received two rounds of public comment; the final plan was accepted by OSTP in 2015.

The plan focuses on journal articles and juried presentation; consistent with OSTP policy, these materials are required to be publically available through a repository no later than 12 months after publication. Waivers of the 12-month deadline are available, if needed. The NSF plan retains current data management plan (DMP) requirements, cost allowances, and data citation. It calls for community engagement to support the consistent use of identifiers and metadata.

Public search is supported through existing award search mechanisms, search capabilities of the NSF Public Access Repository, and future access to metadata through third party search systems. The plan leverages current programs, policies, and systems, and calls for a Working Group to provide oversight. A website has been established to allow for feedback and FAQs. The plan calls for regular updates to the NSB and OSTP or the Office of Management and Budget (OMB), and allows for evolution to other products of NSF-funded research.

Ms. Qualters noted that the deposit of materials in support of public access is a new requirement; it is integrated with reporting in Research.gov to minimize burden and support deposit of materials after the award period ends. This requirement builds on existing reporting, and, per current policy, article process charges can be requested as a direct cost. Current DMP policies remain in place.

The plan has been publically announced; revisions to the Proposals and Awards Policies and Procedures Guide (PAPPG) were released, effective January 25, 2016. The NSF Public Access Repository is currently operating in beta form, and can be accessed through Research.gov. Searching provides information on materials deposited and embargoed, along with the date that embargoed materials will be available.

Ms. Qualters noted that FAQs and a 5-minute tutorial on the repository are available through Research.gov; she demonstrated an example search. Results are automatically ingested into the reporting system and visible in eJacket, which should simply that process. Publications will be automatically included in project reports; PIs can access the digital object identifier (DOI) on materials deposited, and can view full texts and citations.

Discussion. Dr. Hornberger noted that the American Geophysical Union has stated they will fully release materials after one year, but some journals embargo indefinitely. He noted the opportunity to upload the last manuscript accepted, but these documents will not include a DOI.

Deputy Division Director Amy Friedlander replied that PIs are required to provide a PDF of the last accepted version of the manuscript. When a cooperating publisher provides access in 12 months or less, the default is to the published version. In other cases, the public document is the manuscript. All available information is made public at all times. Formal citations should reference the published version. Dr. Friedlander noted that the 12-month deadline was imposed by the OSTP.

Dr. Van Dover asked about PI responsibility for papers published well after the end of the grant award. Dr. Friedlander replied that the current iteration is intended to capture publications during the period of the award; it’s estimated that this will capture 60 percent of publications. She noted that awards also capture prior awards, and additional publications will be captured in that manner. Publishers that provide metadata to NSF will also provide data to show subsequent publications, even if the document has not been uploaded.

Dr. Hodges asked if the repository would provide information regarding the journals’ embargo period, to help PIs avoid violating these policies. Dr. Friedlander replied that the NSF has license to publications from research it supports, so no rules will be broken even if manuscript uploads violate journal policies.

Dr. Friedlander and Ms. Qualters both remarked on the ease of the uploading process. Dr. Friedlander noted that a copy of the manuscript, NSF credentials, and the award number are required for the upload; lists of awards for which an investigator is authorized are available. The DOI is also required, and is supplied by the publisher. Uploads are not required until publication, to avoid confusions regarding versions. The entire process is intended to require 15 minutes, and will automatically populate required reports.

Dr. Bierman remarked that the bulk of his publications and his students’ publications typically come just after the end of an award; he asked if it would be beneficial for these manuscripts to be uploaded. Dr. Friedlander replied that the terms and conditions of awards required reporting of all publications, even beyond the grant award period. This will facilitate the sharing of metadata with DOE and other agencies that operate digital libraries. Upload of materials is available to anyone with an active award; depositing materials beyond those required after January 25, 2016 is encouraged. Dr. Bierman noted that uploaded older manuscripts may help to provide broad access to these materials beyond the period the publishing journals make the available. Another member noted that uploading manuscripts helps the NSF to compile reports on the publications resulting from the research it funds.

Dr. Friedlander announced that publications will be included in award searches, beginning in April or May 2016.

Dr. Van Dover noted the costs paid by institutions for access to journals, and asked if Google Scholar would be able to search and report manuscripts available through the NSF Repository. Dr. Friedlander replied that the metadata would be made available to Google Scholar if requested by Google Scholar.

National Strategic Computing Initiative. Ms. Qualters introduced the National Strategic Computing Initiative (NSCI), noting that it was created through Executive Order in July, 2015. The NSCI seeks a whole of government, long-term (10-15 year) approach to maximize the benefits of computing for scientific discovery and economic competitiveness. The intention of the NSCI is to leverage collaborations beyond what is possible through individual programs.

The NSCI defines high performance computing (HPC) as the most advanced, capable computing technology available; it recognizes and support multiple styles of computing and their necessary infrastructure(s), as well as learning, workforce development, theory and practice, software and hardware: “everything necessary for a fully integrated capability.”

Ms. Qualters presented the NSCI policy principles, noting in particular the intent to foster public-private collaborations in all areas, from research and development to deployment; the intention to be technically and scientifically comprehensive, and to support collaboration between industry and academia as well as between these entities and government agencies.

Three levels of agency involvement are defined. Lead agencies (DOE, DOD, NSF) are charged with developing and delivering the next generation of integrated HPC capability; foundational agencies (IARPA, NIST) are charged with fundamental discovery work; and deployment agencies (NASA, FBI, NIH, DHS, NOAA) develop mission-based HPC requirements to influence the early stages of design.

Dr. Sullivan asked how the FBI would deploy HPC for research; Ms. Qualters replied that HPC might be used in forensic sciences.

In response to a question regarding the separation between deployment and development, Ms. Qualters noted that these elements are defined as being part of a continuum. Deployment agencies will be involved in co-development projects, and development is intended to address the needs of deploying agencies. Ms. Qualters noted that disruption is envisioned as part of the process, and that DOE, DOD, and NHS will have roles to play across the continuum of activities.

The roles envisioned for NSF are threefold: providing leadership on scientific discovery advances that would benefit from HPC; utilizing the broader HPC ecosystem for scientific discovery; and workforce development. Five objectives have been identified; objectives 204 fall within the purview of NSF’s envisioned role:

1. 100x performance increase in HPC simulations
2. Technical synergy in platforms for modeling data analytics
3. Research into new devices and architecture to scale beyond current limits
4. Increased capacity and capability of the national HPC ecosystem
5. Public-private partnership.

Governance will be provided by an Executive Council co-chaired by the OSTP and OMB Directors. The council will include heads of all involved agencies. The implementation plan for the NSCI was approved in March 2016; the NSF plan builds on current activities, setting an ambitious future.

As an example, Ms. Qualters noted the goal to establish, over the next 15 years, a viable path forward for future HPC systems in the post-Moore’s Law era (Objective 3). A series of new materials, devices, architectures are envisioned; some of these projects are already underway. The intent is to move these forward in alignment with the needs of scientific discovery.

Objectives 2 and 4 involve ensuring that the technology base (hardware and software) have synergy to allow them to be used effectively together, and to examine scaling, foundational algorithms, software, and workforce development, to assure science continues to advance through the next decade or more of predicted disruption. The NSF role will be driven by Directorate science priorities. Additional collaboratives with other agencies and international collaborators are envisioned.

Ms. Qualters briefly reviewed the NSF timeline for the NSCI. In 2016, a series of workshops were held and a joint DOE-NIH-NSF RFI was issued to capture scientific priorities for the next decade; a synopsis of these responses has been developed. Other activities focused on gathering input from the scientific community are ongoing.

In 2017, pilots are anticipated on a number of topics, including data assimilation, dynamic workflows between computations and instruments. The necessary architecture for complex coupled models and other complex scientific software needs are also being addressed. Full scale funding is anticipated for 2018 and beyond.

Ms. Qualters offered some examples of ongoing activities, feeding into the NSCI planning. These include: workshops on topological insulators, uncertainty quantification for data assimilation, and on “Intelligent Cognitive Assistants;” the joint RFI; a White House NSCI workshop; and a joint NSF (CISE/ENG) solicitation on “Energy-efficient computing from devices to architectures.”

Ms. Qualters concluded by noting that the NSCI is a long-term initiative that has achieved a high level of coordination and collaboration across Federal agencies. Representatives from all involved agencies continue to meet biweekly, and a number of workshops are being planned.

Discussion. Dr. Wakimoto commended Ms. Qualters for “getting her hands around” this complex project, and for keeping AC GEO informed and update. He noted the need within the geosciences for data assimilation, and the opportunity represented by the NSCI to advance that capability. Dr. Wakimoto remarked that other disciplines, such as biology and astrophysics will likely also find that they need HPC for data simulation.

Ms. Qualters noted that image analysis, across disciplines, is also increasingly requiring HPC. As with data assimilation, Ms. Qualters noted the need to address dynamic workflows to assure that sensors, instruments, computing, and systems develop in tandem with one another.

Dr. Doney remarked on an ongoing long-term collaboration between DOE and NSF on climate modeling, and expressed concern that this collaboration might be destroyed as DOE moves onto a different computer infrastructure.

Dr. Shepson noted that the geosciences are investing heavily in earth observations via satellites and distributed arrays. These result in the gathering of huge amounts of data; the usefulness of these data depends upon the capacity for data assimilation ad modeling.

Dr. Doney noted Ms. Qualters comments regarding public-private partnerships; he suggested that NSF might work well with the private sector in commodity computing, given the shift from centralized computing to distributed computing in clusters. Ms. Qualters agreed this is an important consideration of science drivers. An open science grid (OSG) was developed for the Large Hadron Collidor, which allows computing to automatically burst to additional resources once available resources are saturated. She noted another project focused on assisting campuses and researcher to determine when such bursting is worthwhile. Ms. Qualters remarked that these are the right experiments to develop the ability to connect and use resources appropriately and dynamically.

Dr. Sullivan noted that computing already allows more data to be gathered and analyzed than can be made publically available. He asked Ms. Qualters for her thoughts about open data requirements, and advancing data sharing capabilities. Ms. Qualters replied that data was originally defined in terms of “3 Vs;” velocity, volume, and veracity. As data capacities have advanced, variety and value have also come to be seen as equally important characteristics. Ms. Quality noted that data value varies substantially over time.

Dr. Friedlander noted that data availability remains an area of unsettled law, as investment in data does not equate with ownership of that data. She noted a project in which data from Twitter are used, and remarked that funding to work with Twitter data does not mean that the data no longer belong to Twitter. Dr. Friedlander remarked that legal requirements, community expectations, and appropriateness must all be weighed in data sharing.

Dr. Wakimoto suggested three buckets for data collection: NSF facilities, broadly defined; simulations; and crowd sourcing. He noted that crowd-sourced data is not supported at the moment, but can still be valuable. Some smart phones have pressure sensors; all have GPS. Newer cars function as mobile weather stations; drones will serve to exponentially expand the data available for collection and use.

Dr. Hornberger noted machine learning, text data mining, and data assimilation as similarly challenging areas. Ms. Qualters suggested that efforts to define these parameters would be ongoing; she shared her hope that they might advance at a pace sufficient to avoid being overtaken by events.

**USGS-NSF Collaboration: Powell Center for Analysis & Synthesis**

*Kevin Gallagher, Associate Director, Core Science Systems, USGS*

Mr. Gallagher thanked AC GEO members for the opportunity to present the John Wesley Powell Center for Analysis and Synthesis. He described the Powell Center as an outgrowth of the US Geological Services (USGS) science strategy to integrate the scientific disciplines. Mr. Gallagher noted that USGS is well known for its geology and hydrology expertise; the Powell center seeks to bring these data together.

Mr. Gallagher noted that scientific synthesis is driven by both the need and desire to address questions on the leading edge of science, as well as pressing global change and societal and human health issues. Synthesis centers promote collaborative discovery and are efficient and cost-effective ways to leverage and extract additional value from existing investments in researchers and host institutions.

The Powell Center hosts Working Groups of 8-15 people who collaborate intensively around one or more questions for about 2 years. These groups generally include a PI from USGS, and have broad international participation. These groups offer time for in-depth analysis without distraction, all-expense paid collaboration with colleagues, virtual meetings and face-to-face meetings at the Powell Center, fellows for scientific support, and unlimited computing capabilities.

The Center seeks to support big, important idea that may require large, complicated and heterogeneous data sets. Mr. Gallagher noted that conceptual advancement is equally valued at the Powell Center. The Powell Center seeks well-structured, clearly articulated complex and interdisciplinary proposals with the potential for high impact in terms of discovery. The Working Groups are a proposal-driven process. The Powell Center does not support data collection, basic research, on ongoing work that has run out of funding.

As examples, Mr. Gallagher noted Powell Center Working Groups on induced seismicity, Bayesian models, and amphibian decline. The Powell Center has supported Working Groups since 2009-10, and has partnered with the NSF throughout that time. Mr. Gallagher noted the value of the NSF in advertising the opportunities at the Powell Center, and the growth in proposals submitted as evidence of a maturing partnership.

In 2016, $2.2 million in Working Groups were proposed; only $550,000 could be funded. The average cost of a Working Group is $150,000 for 2 years. Since 2009, 706 people have participated in Powell Center Working Groups; about one-third of participants are from academia, 95 have been international. Both industry and non-governmental organizations have been represented. Women have comprised 33 percent of Working Group members; approximately 30 percent of participants identify as early-career investigators.

Climate and Land Use (23 percent) and Ecosystems (34 percent) are the most common themes in Working Groups; Water (15 percent) is third. Other themes include Hazards (10 percent) Environmental Health (8 percent), and Energy and Minerals (5 percent).

Citations of Working Groups have been steadily increasing.

Mr. Gallagher reported on Powell Center workshops since 2014, noting that these gathering address rapidly evolving issues, such as pollinator collapse. Workshops are intended to bring investigators together to conduct synthesis work.

Mr. Gallagher concluded with appreciation to the NSF for their support and collaboration; he encouraged AC GEO members to disseminate these opportunities for research, internships and workshops.

Discussion. Dr. Hornberger noted that the Powell Center addressed broad, interdisciplinary questions. He asked about the participation of social scientists. Mr. Gallagher replied that the USGS Fort Collins Science Center includes a Social and Economic Analysis Branch, and that the Powell Center generally does not address these disciplines. He noted, however, that there are only a few (6-7) synthesis centers in the world, and that they all work collaboratively. An international meeting of synthesis centers will be held in Colorado in September; the NSF is invited to participate.

Dr. Hodges remarked that the geosciences are intrinsically synthetic; he asked what topics lay outside the scope of Powell Center interest—how many kinds of geosciences must be involved to capture the Center’s interest, or how many representatives beyond geosciences? Ms. Gallagher replied that the Powell Center does not have a limit, and is looking simply for high-quality, science-driven proposals. The Center seeks proposals that bring together data in ways that create opportunities for breakthrough.

Dr. Kempton noted that all but one of the example Working Groups included ecosystem sciences, and asked if that reflected the Powell Center’s definition of interdisciplinary science. Mr. Gallagher agreed that ecosystem proposals represent a large portion of those funded. He noted that many synthesis centers emerged from the biological sciences, and that much of the work they support is inherently interdisciplinary. If the ecosystem aspects of these topics are not addressed, a big piece may be missing.

**Working Lunch: Meeting with Marcia McNutt, Editor-in-Chief, Science, and President-Designate, National Academy of Sciences**

*Marcia McNutt, Science*

Dr. Hornberger introduced Dr. McNutt, who thanked him, Dr. Wakimoto and the AC GEO membership for the invitation to speak with them. She stated that she planned to address three major topics: the geosciences issues that have made it onto the pages of the *Science* journals during her tenure as editor-in-chief; the work of the open-science, open-data movement; and her priorities for the NAS.

Topics in *Science*. Dr. McNutt noted that *Science* publishes the topics believed to be important by the editors, whether or not the research is NSF-funded. She remarked on her interest in sharing with AC GEO the research the editors believe are driving discovering in the geosciences.

Among the topics Dr. McNutt shared from the pages of *Science* were:

* How will climate change affect drought? Dr. McNutt noted that dryness depends upon the trade-off between precipitation and evapo-transpiration, making it possible to have both more precipitation and more drought. Given water’s centrality to food and economies, these are important considerations.
* Groundwater and drought. Dr. McNutt shared a *Science* cover, representing findings from weighing California over a 10-year period, in order to measure the loss of water from all sources. She noted that there is currently no federal agency tasked with measuring groundwater. Between 2002-2013, California loss groundwater volumes equivalent to the entire water storage capacity of Lake Mead.
* An article by Benjamin Cook and colleague, predicting the future of drought in the Central Plains and Southwest, based on tree ring data. Seventeen models were compared to make projections for future drought. Between 1950 and 2000, the chances of a 35-year drought were less than 10 percent. Between 2050 and 2099, the chance of that drought is greater than 85 percent.
* How lightning strikes respond to climate change. Researchers predict that the number of lightning strikes will increase 12 percent for every degree rise in global average air temperature.
* How will changing climate affect ocean circulation? Monthly heat extremes are associated with low eddy kinetic energy, and heat waves are connected to climate change.
* How will oceans respond to acidification? Dr. McNutt noted that this was one of the few “good news” stories published on climate change, as it reports on one organism that responds positively to acidification. Dr. McNutt noted that these stories were important for rebutting the charge of bias toward the negative in science.
* How does the frequency of tornadoes respond to climate change? Dr. McNutt reported findings that tornado frequency does not increase, although tornado clusters do.
* How will the ocean’s ability to absorb CO2 evolve with climate change? Previous concern that warming slowed CO2 absorption is rebutted, in a paper demonstrating the dynamism of the system.
* Was there a warming hiatus? Dr. McNutt noted that evidence for a hiatus spawned Congressional hearings; this article demonstrated that the “hiatus” disappears from the data once adjustments are made to account for differences between buoy data and ship data.
* Can individual events be attributed to climate change? The 2010 Russian heat wave, the 2013 Australian heat wave, the California drought are attributable to climate change.
* How quickly will ice sheets collapse? A theoretical study demonstrating the difficulty of identifying models in which ice sheets gradually melt; all practical models showed catastrophic collapse is more likely.
* The relationship between energy use and sea level rise. If all available fossil fuel is burned, the Antarctic ice sheet will disappear.
* Atmospheric Chemistry. Dr. McNutt remarked that this paper did not receive very much attention when published, but that she believes it is extremely fundamental.
* Plastic inputs from land into the sea. Dr. McNutt noted that researchers used social sciences data—population, trash habits, regulations on plastic disposal, GDP, input into the plastic economy—in order to estimate relative contributions of nations.
* Induced seismicity in Oklahoma. The paper demonstrated that 20 percent of the earthquakes in the central US could be attributed to injected fluids at four wells; the Oklahoma State Geological Survey changed its position on wastewater disposal as a result of this publication.
* Methane Emissions. Using gas emissions to estimate the leak rate of the Aliso Canyon methane leak. Researchers found that the leak itself doubled the methane emissions for the entire Los Angeles Basin.
* GPS network catches the Nepal earthquake. The first large earthquake captured by a dense GPS network, the Nepal earthquake was found to have only moderate ground shaking at high frequency; damage in Katmandu was a result of long period shaking to which tall towers resonated.
* 2011 Tohuku Earthquake. Researchers set new records for ocean drilling, and found that the plates slipped 50 meters, in a 5-meter think layer of clay. Very little thermal heating was generated by the slip.
* MyShake smartphone early warning system. An app that can serve as an early warning system for earthquakes, it can detect magnitude 5 earthquakes at 10 kilometers or less. An algorithm in the app confirms the earthquake, assesses location and magnitude in real time, and issues an alert. Dr. McNutt noted that all of the *Science Advances* papers published made the top 5 percent of papers, according to Altmetrics.
* A single-issue paper demonstrating that ruptures on the San Jacinto fault can trigger earthquakes on the San Andreas fault; the 1812 San Francisco earthquake followed this model.
* Polar motion. The authors demonstrated that the poles are moving in unexpected ways; deviating from decades-long trends. Primary contributors are terrestrial water storage and changes in the cryosphere, such as the loss of the Greenland Ice Sheet.

Data Sharing. Dr. McNutt noted that open-science, open-data is an important issue, as it further leverages the investment in science by making science more transparent, making results more reproducible, and encouraging data reuse. Dr. McNutt reported that an editorial in the *New England Journal of Medicine* warned that data sharing would lead to research parasites, who would reuse data in order to disprove earlier results. Dr. McNutt reported that scientists responded via Twitter, noting that *NEJM* maintains a fee barrier to its data.

Dr. McNutt wrote a responding editorial, “The Imperative of Sharing,” which noted, among other points, that events in field sciences are ephemeral—if data from events such as the Tohuku earthquake or a major oil spill are not shared, the understanding of these events is limited. Data on topics such as climate change must be shared in order for researchers to understand earlier events; the full story emerges from many collective efforts.

*NEJM* suggested that researchers seeking to use data should collaborate with the original researchers; Dr. McNutt countered that such a requirement would slow progress and discourage independent thinking.

Dr. McNutt acknowledged that it is not cheap to share data; data repositories must be funded, and data professionals must be supported. Apps to automate data deposit and extraction are needed, as is education on the importance of quality control. Dr. McNutt remarked on the need to establish metadata standards, and to change science culture to support relinquishment of data ownership. Data and samples should be treated as citable objects, with DOIs.

Dr. McNutt reported on a marine metadata project which uncovered an issue of different standards being used to measure and report temperature at zero in the ocean. Some used the temperature at the shallowest depth their instruments could measure temperature; some used air temperature at the surface, some water temperature at the surface, some the temperature of a bucket of water. Dr. McNutt noted the irreproducible research costs society, because the results cannot be trusted; in addition, re-collecting data that are not shared takes funds away from new projects.

More than 50 journals have now signed on to a June 2015 paper recommending standards for transparency and openness promotion (TOP). The paper establishes data standards, sample standards, and code standards in eight categories. Journals can determine the level at which they sign on: at Level 0, authors are encouraged to state whether data are available or not; authors are required to state this at Level 1. At Level 2, data are required to be available without author contact; at Level 3, the journal verifies that the data have been deposited in a repository. Dr. McNutt reported that *Science* meets Level 2: authors are required to deposit all data on which findings are based into an acceptable repository at which they are available without contacting the author.

Dr. McNutt reported on recent workshops on liberating field science samples and data, and on coding to assure that data that are shared are usable. Reports from these workshops are forthcoming.

Priorities for NAS. Dr. McNutt’s term as NAS President begins July 1, 2016. She stated that she plans on conducting a review of the report writing function of the academies. An introspective study of how each division meets stakeholder needs is ongoing; these internal reviews will be rolled up to determine how the NAS can be better organized and situated overall to function as the government’s advisory group. Input from each division will serve as a starting point; an overall review considering how NAS might do better will also be conducted.

Dr. McNutt noted that she is also considering the development of a “skunkworks” group within NAS. She noted there will always be a need for a traditional consensus report, but that mechanisms to capture out of the box thinking are also needed. A skunkworks team would be focused on out-of-the-box, fast, clever responses to particular needs. As an example, she suggested addressing a gap in weather satellites that needed to be filled quickly.

Dr. McNutt stated that she would like to deal with issues of gender equity, sexual harassment, inequalities in opportunities, biases in peer review and other inequities. She shared her intent to continue to address issues of scientific integrity, reproducibility, and open science.

Dr. McNutt concluded by noting her interest in addressing scientific communication, including the dissemination of reports. She noted her interest in the NAS being seen as a broad resource, and her concern that good science is being lost. She reported facing questions regarding why issues of concussions in sports were only being raised now, when the topic was raised in an NAS report published in 1969.

Discussion. Dr. Hodges noted Dr. McNutt’s discussion of her priorities as she assumes the NAS Presidency; he asked what she would like her legacy to be. Dr. McNutt replied that she would like to see the NAS membership to be much more diverse, not just in terms of gender, but also in terms of disciplines, the types of problems that are addressed, and the kinds of institutions represented. She noted that the current election process makes it very easy for current members to recognize talent within their institutions, but that is it not necessarily easy for member to clearly recognize talent at institutions with which they are not directly involved. Similarly, it is easier for the current membership to recognize talent within their own field than in fields in which they are not currently working. Dr. McNutt noted a growing divergence between the skill sets needed to report on today’s problems and the skill of NAS members, which were suited to solving the problems of 30 years ago.

Dr. McNutt stated that she would hope people would say that she reformed the process of writing reports, to make them more helpful and more timely, without any compromise of quality. She noted that she does not intend to change the review process.

Dr. McNutt offered the example of an engineering project, on which a project manager is assigned a schedule, budget contingency and time contingency. Everyone involved in the project would be apprised on the schedule and held to milestones; de-scope options would be outlines to meet the schedule, as well as plans for necessary workaround and back-up plans. She noted that the NAS does not adopt this approach, and may benefit from doing so.

Ms. Arroyo mentioned her prior experience with applied sciences, working with States and cities to address issues such as how to make decisions to disinvest in infrastructure that is now prone to flooding. She noted the need for science to be translated into user-friendly terms for those on the front lines, as well as the disconnection between data generation and the needs of its users.

Dr. McNutt agreed, noting that the USGS has large amounts of seismic data, but that most decision-makers in State and local government do not know how to read a seismogram. USGS has developed applications that help to make their data more usable; one application allows the USGS to place sensors on critical infrastructure, such as bridges in southern California. When an earthquake occurs, every DOT officially receives an alert about the level of shaking on each bridge, to help them decide whether to close the bridge, review it later, or trust that it is safe. The application offers this information in a green light, yellow light, red light format for ease of use and understanding.

Dr. McNutt suggested that this kind of data translation is needed for sea level; the understanding of sea level rise rates must be improved. She noted the importance of the paper on ice sheet collapse to advancing this understanding. Dr. McNutt offered the example of coastal dependent infrastructure with a 30-year lifetime. If it is abandoned early, investment has been wasted; if it is abandoned too late, citizens can be harmed. She noted the need to determine when the runways at San Francisco International Airport will be inundated, and to determine when to fortify those structures and when to abandon them.

Dr. Doney noted the perspective of some policy makers, that geosciences is not a hard science, and is not important to the national economy. Dr. McNutt replied that she believes geosciences and life sciences are the most important; we live on a single planet. Dr. McNutt noted that geosciences and life sciences are intertwined, and it is necessary to make the case that people ignore them at their peril. When people assert that these sciences are not part of the national economy, they are not accurately valuing them.

Dr. Kempton raised concern about the earthquake application described by Dr. McNutt, noting the potential for legal liability; she remarked on the volcanologist who was arrested in Italy because of inaccurate predictions. Dr. McNutt replied that did not know how USGS addressed the potential for liability. She noted another example, an application that translates earthquake data into geographic zones of expected fatalities and damage. The application incorporates population and building code data into its estimates. Dr. McNutt reported receiving a letter from the Red Cross noting the value of these estimates, which allowed them to move resources into a region a week sooner than they otherwise could have, given the reluctance of some governments to make bad news public.

Dr. Kempton noted that many of articles Dr. McNutt shared from *Science* addressed climate change, and noted the disconnection in the US between a scientific community consensus on climate change, and a large portion of the population that chooses to ignore these concerns. She asked what role the NAS might play in closing the gap between the scientific community and the public.

Dr. McNutt remarked that she had been interviewed on this issue by *National Geographic*, and had said at that point that the problem is not that people don’t understand the evidence—so the solution is not to provide better evidence, or better explanations. Dr. McNutt described people as being “very tribal;” she noted that those whose tribe is a small town in America in which everyone wants to continue their lifestyle find it easier to disbelieve the evidence than to face the possibility of disruption caused by, for example, a mine closure. Dr. McNutt asserted that the most important policy to mitigate climate change is the Montreal Protocol; she noted that the findings which led to the protocol—the atmospheric damage caused by chlorofluorocarbons—were resisted by industry and industry scientists until a replacement for these chemicals was developed. It was only after the potential lifestyle disruption was mitigated that progress could be made.

**OCE Subcommittee Meeting (Committee of the Whole)**

*Rick Murray, OCE/GEO & Rana Fine, AC GEO*

Dr. Murray began by noting that Drs. Van Dover and Pomponi were new members of the subcommittee; Drs. Doney and Fine continue on the subcommittee. The OCE subcommittee held a telephone meeting a few weeks prior, and identified three topics for the current update: personnel, implementation from the last Committee of Visitors (COV) review, and updates on key projects, including the OCE response to the decadal survey of OCE, *Sea Change*.

Personnel. Dr. Murray noted that continuing changes are to be expected, as individuals leave and enter details through Intergovernmental Personnel Act (IPA) assignments. Dr. Murray remarked on the strength of the staff within OCE, and announced that Donald Rice received the 2015 AGU Ocean Sciences Award.

Physical oceanography staff will expand by 1 IPA, focused on coast and shelf processes. Marine geology and geophysics will also gain an IPA, bringing that staff total to 5. There is also an ongoing search for a geophysicist. These positions will allow OCE to conduct more community outreach and other projects for which they did not have personnel resources previously.

An additional permanent staff position for ocean policy specialist has also been added. This position will support Roxanne Nicolas and will provide direct assistance to program officers involved in interagency working groups (e.g., ocean acidification, facilities and infrastructure). Dr. Murray noted that OCE is successfully integrated with the other agencies involved in ocean policy (NOAA, NASA, Office of Naval Research). The new position will help to address growth in these areas.

Implementing COV Recommendations*.* Dr. Murray noted that Mr. Rice and others had reported on these recommendations in August, and a more detailed report would be made at the Fall 2016 AC GEO meeting, but that an interim update seemed appropriate. The COV made a number of recommendations, in three general areas: assuring future COVs receive adequate information to conduct their review; reviewing the 2015 COV in light of NSF guidance to COVs in general; and assuring that the information provided in all review analyses is sufficient for all who receive them to understand the mechanics of the review process.

OCE is focusing on this last area first, with a particular focus on high risk-high return projects. Program Officers are now being asked to explicitly explain why they believe a proposal should be classified as high risk-high yield. Rather than seeking to develop a definition in advance, OCE believes it will be more useful to ask Program Officers to develop justifications and explanations specific to each project that is so classified.

At the November, physical oceanography panelists were asked to identify which proposal most excited them, independent of whether they felt the proposals were in need of further refinement. Approximately five projects stood out across the board, including some that were very expensive. Holding the discussion with the perspective of most exciting, however, allowed these projects to stand out.

In light of Dr. McNutt’s remarks about gender equity, Dr. Murray noted that the Mentoring Physical Oceanography Women to Increase Retention (MPOWIR) is undergoing a large scale community survey to assess its impact. Overall, OCE continues to be involved in outreach to early career scientists; as the last Ocean Sciences Conference, officers from every program were involved in early career workshops.

OCE thus continues to address issues from the COV, beginning with a strategic focus on issues that are relatively well-defined.

Key Projects. The OCE reply to the decadal survey was issued in May 2015; the program continues to implement recommended changes. Two RCRV were approved through the NSF and NSB process, and are included in the current NSF budget request.

Dr. Murray noted that Dr. Wakimoto had remarked on the transition of the OOI program to operations and maintenance (O&M); the cooperative agreement for OOI will be recompeted in May 2017, at the recommended 20 percent budget decrease. A *Dear Colleague* letter was released in February to outline the process and invite community feedback regarding the OOI recomplete.

Dr. Murray noted that the academic research fleet was noted in the *Sea Change* report; in addition to the new RCRVs, other strategies are being undertaken to decrease costs while increasing technological capabilities.

The International Ocean Discovery Program was also tasked with decreasing O&M costs; OCE is confident that the infrastructure can be maintained, with significant transfer of funding into research. By FY18, it is anticipated that $12-14 million will be transferred from infrastructure to basic core science.

Dr. Murray noted that OCE is a large player in PREEVENTS. And is working with fellow divisions in this initiative; some significant resonance between OCE and EAR has emerged in addressing cross-shoreline events (e.g., earthquakes, volcanoes).

Dr. Murray concluded with a discussion of cyberinfrastructure, noting that OCE efforts on this front will benefit and benefit from other initiatives, such as EarthCube. Dr. Murray convened a small committee to represent these related initiatives. OCE has taken a small step toward quantifying their data repositories, and how data are handled. A science assistant reviewed a few hundred proposal DMPs, to see where data are being stored.

The review identified 12-15 significant data repositories. Next steps will be to explore who is using these repositories, to determine which ones are used solely by OCE, and through which ones OCE supports data management of other federally supported science. This project fits into the larger NSF architecture about reproducibility, open data, and the ease of access to data. The Open Sciences Data Group will continue to meet month, and will review data policy to assure clear alignment.

Discussion. Dr. Doney and Dr. Murray briefly discussed the Armstrong, which Dr. Murray noted was operated through partnerships between federal agencies and academic communities. Dr. Murray noted that these partnerships are not well known, and OCE is seeking to bring more public attention to them.

Dr. Constable asked if OCE knew whether PIs were in fact deposit data in repositories in accordance with their DMPs; Dr. Murray said they did not, but would move to confirming data deposit as a next step. He noted that some data re produced after grant awards ends, and, due to repository policies and practices, there may be a lag between data submission and data availability. Dr. Constable suggested it might be of interest to track whether PIs change their minds regarding the data repository they use.

Dr. Hornberger asked about how OCE addresses the uncertainty surrounding fuel costs; Dr. Murray acknowledged that fuel costs are high variable. He also remarked that seeking to predict fuel costs is not a good strategy for addressing budget issues, and that the savings he had discussed were built into structural budgets and independent of fuel costs. Currently, OCE is using savings due to low fuel costs to address deferred maintenance.

Dr. Doney asked how data dissemination might be strengthened through the O&M recompete. Dr. Murray acknowledged the challenge, and noted that the amount of data processed through the website has increased in the past year. Data workshops have been held, and outreach is increasing. Dr. Murray noted that the Consortium for Ocean Leadership recently released virtually all their raw data, in an effort to engage the community in data processing. A program has been developed through which community subject matter experts can provide feedback on the contextual usability of these raw data.

Dr. Murray noted that he felt the community was justified in feeling shut out of the data aspects of OOI in the past. He noted that the situation should improve as the project moves from construction into O&M. The recompete will include the expectation of real time or near real time data access; the recompetition will focus on capability rather than a particular cyberinfrastructure approach.

**PLR Subcommittee Meeting (Committee of the Whole)**

*Kelly Falkner, PLR/GEO & Berry Lyons, AC GEO*

Dr. Lyons presented the agenda for the PLR Subcommittee report, and noted that its membership includes Drs. Stroeve, Dixon, and Sullivan, as well as non-AC GEO members. He invited questions during the course of the presentation, rather than at its end.

Personnel. Dr. Falkner offered a personnel update, noting a number of changes in the division: 13 departures, 14 additions, 2 pending selections, 4 vacancies and 5 staff out on detail. She reiterated congratulations to Brian Stone, who was chosen as Chief of Staff for the Director, and described the dominoes that will move to address his responsibilities: Scott Borg will become Section Head of Antarctic Infrastructure and Logistics; Eric Saltzman will serve as Section Head of Antarctic Sciences, and Simon Stephenson will return to Arctic Sciences. Dr. Falkner expressed her confidence that quality work will be continued through these staff changes.

AIMS. Mr. Stone reported that the AIMS project is in the preliminary design phase. The focus of the AIMS project is McMurdo Station; other efforts at other sites are ongoing, but are not part of AIMS.

Warehousing and storage consultants have been brought into the project and have completed a LIDAR survey and geotechnical work. The next milestone will be 15 percent of the design completed, which will encompass the layout of buildings and walls. The research community will be invited to undertake a virtual review at that point; they were engaged in a similar way in the preliminary design. This preliminary design review is scheduled for Spring 2017.

A website (future.usap.gov) website has been developed, and provides access to information on the master plans and projects. The intention is to maximize transparency on this project.

Mr. Stone reviewed changes in the design that have been made based on feedback received to date. These include the consolidation of vehicle maintenance into a single facility; changes to the layout of the field support center, and the development of a sea ice support facility.

International Engagement. Dr. Falkner noted that the PLR Division is very internationally engaged, and presented a plot of increasing international award investments for PLR, ARC, GEO and all NSF. The trends are robust and increasing, with PLR increasing at a somewhat higher rate. Dr. Falkner noted a sharper increase in PLR near the time of the International Polar Year, and that this increased investment has been sustained since. She noted that Alaska is an important part of the Arctic portfolio, and the program has responsibilities to the people and government of Alaska. Nearly 80 percent of the value of funded awards includes significant international engagement.

Dr. Falkner noted that frustration regarding the apparent inflexibility of some systems has been expressed; researchers have reported difficulty in aligning funding. Ongoing bilateral funding agreements have been worked out, and other strategies for improvement are being explored.

No-deadline solicitations. Dr. Saltzman noted that the Galway Agreement convenes a tripartite international group, the US, European Union and Canada. The methods by which these nations will coordinate have not yet been outlined. The Norwegian Research Council has developed a bilateral process with the NSF, adopting a single review process. This approach has been very helpful for scientists and could serve as a model for future collaborations.

Dr. Saltzman noted that the PLR Division is considering dropped deadlines for some of its programs; these would not include the Arctic Observing Network. The Division believes dropping deadlines where possible will help ease the review workload and may assist scientists in synchronizing their efforts across funding countries.

Discussion. Dr. Fine asked Dr. Saltzman about plans or anticipated challenges to sunsetting activities of the Arctic Observing Network. Dr. Saltzman noted that some activities required continuing commitments that could not be sustained. The program is being realigned so that it can be sustainably supported. This realignment will require reduced aspirations, and leveraging the use of infrastructure. Locations may be reduced, with activities at each location increased.

Dr. Falkner objected to the notion of reducing aspirations, and instead noted the need for community assistance in finding ways to make more efficient and clever observations. Dr. Saltzman agreed, noting significant discussions about ways to capture the observations desired, at lower cost.

Preparations for the PLR COV. Dr. Borg reported that COV preparations are on track. Staff have worked with the Antarctic COV chair and liaison to determine an approach to selecting jackets for review. Some random selection was made, with filtering to assure a reasonable representation of large and small schools, minority institutions, and close calls. A telephone meeting with the chair and Dr. Sullivan is scheduled, and will be followed by a teleconference with the entire committee, to begin the proposal review; the COV is scheduled for May 17-19, 2016. Dr. Saltzman reported that a review template for the Arctic portfolio review has been created, and this review will proceed on the same schedule. The COV report will be released in October.

Dr. Falkner announced that PLR staff will accompany a Congressional delegation to Greenland; an early season report of unprecedented melting has been received.

Discussion. Dr. Stroeve reported that one of the satellite sensors for sea ice analysis is failing; its data stream has been shut off to avoid misuse. Scientists in Denmark released an email about unprecedented melt, based on station data. The PLR Division is seeking to find a way to confirm these with satellite data.

Dr. Stroeve noted than another sensor has been built and has been stored in warehouse, awaiting Congressional approval for its launch. In the absence of this approval, the sensor may be demolished, which would break all links to this data stream.

Dr. Hornberger asked for further detail, and Dr. Stroeve replied that the most recently launched satellite failed quickly, after which the Division reverted to an early satellite sensor, which is now showing spurious data. A similar sensor, from Japan is available; since it is not identical, data will have to be aligned, however.

Dr. Semeter noted that a large group of interdisciplinary investigators depend upon the data stream; he asked if this would strengthen the argument for deploying the warehoused sensor. Dr. Semeter noted that GEO is also looking to other ways to address this gap.

Dr. Falkner stated that the subcommittee would continue to work on this issue, and would report back to the AC GEO through Dr. Lyons.

Dr. Hornberger noted these concerns as an example of the complexity of interagency cooperation: the sensor must be put into the queue for launch, and room must be available for the instruments. In this case, the sensors are on satellites used for the Defense Meteorological Satellite Program (DMSP), which involves other agencies with other priorities.

Dr. Semeter asked if AC GEO had a connection to DOD through which the value of the program to NSF might be communicated; he suggested the AGS Section Head may be of assistance. Dr. Falkner agreed that the issue extended beyond PLR, and suggested AC GEO seek to express its viewpoint to OSTP. Dr. Hornberger suggested the discussion might be raised with France Còrdova.

A short film on the wind modeling for AIMS was shared with AC GEO.

Dr. Dixon asked for a brief update on the social science revisioning effort. Anna Kerrtula de Echave reported on proposal from a consortium of six institutions, to hold 5 workshops to gain input from the arctic community. Each workshop is somewhat thematic and interdisciplinary, involving social scientists, natural scientists, engineers and others. The last workshop will be held in late May, after which a Synthesis Committee will meet at the Jefferson Institute to review this feedback. As an example, Dr. Kerrtula reported that a workshop held in Fairbanks focused on indigenous scholars, and issues of indigenous scholarship and indigenous peoples working with scientists. Another set of workshops is likely to be supported, given the success of these. The summary report will be released in early October, and reviewed as broadly as possible.

**Preparation for Meeting with the NSF Director & Chief Operating Officer**

*George Hornberger & AC GEO Members*

Dr. Hornberger facilitated a discussion among AC GEO members regarding topics they wished to address with Dr. Còrdova.

**Meeting with the NSF Director & Chief Operating Officer**

*France Córdova, Director, Richard Buckius, Chief Operating Officer, NSF*

Dr. Còrdova asked AC GEO members to introduce themselves; she congratulated them on an exciting lunch presentation from Dr. McNutt, which she attended.

Challenges facing NSF. Dr. Fuentes began the discussion by asking Dr. Còrdova to describe the challenges she sees the NSF facing in the next few years, and how those challenges might impact geosciences. Dr. Còrdova replied that there is no way to make predictions beyond the next year, given the upcoming presidential election. She noted that every presidential administration brings priorities to the NSF that shape its budget; administration priorities do not directly impact the core budget, she noted, but they do shape new initiatives. Congress also has priorities, which may impact the NSF; Dr. Còrdova acknowledged consistent Congressional discussion and debate that address topics within geosciences. She remarked that the leadership of the House of Representatives would likely remain through the election; leadership in the Senate may change.

Dr. Còrdova noted, unless the new administration brings very new plans, the budget for 2018 is worse than the budgets for 2016 and 2017. The 2018 budget will include much less flexibility than previous budgets because of sequestration and budget caps, which converge in 2018. Dr. Còrdova reported that the NSF budget has not substantially changed in constant dollars since 2003; it has been reduced since the beginning of the decade.

Dr. Còrdova asserted that the largest challenges facing NSF or the scientific priorities set by the scientific community. She noted that the NSF has greater flexibility than many other federal agencies, and reported on a conversation with a congressman, regarding NSF objections to directorate-by-directorate funding. Dr. Còrdova reported that she thanked the legislator for this flexibility, given the inability to predict where the next big breakthrough will emerge.

Core vs. Initiative Funding. Dr. Doney noted that many people believe most NSF funding should be directed to the core; he noted, however, cross-directorate initiatives such as INFEWS. Dr. Còrdova observed that today’s broad initiatives are tomorrow’s core. She noted that her university was the first to have a planetary sciences department, which was considered radical at the time. She shared her view that the NSF should consistently propose increased funding for the core and new initiatives identified through the scientific community. When the final budget is approved, it is generally the initiatives that must be cut.

NSF Skunkworks. Dr. Constable reminded Dr. Còrdova of Dr. McNutt’s comments regarding a “skunkworks” group, and asked if Dr. Còrdova saw a role for a similar group at NSF.

Dr. Còrdova replied that she did; she reported on a recent retreat focused on new ideas, out of which emerged six proposals within the intellectual space, and three new process ideas. Dr. Còrdova described the NSF as a type of process agency: the community sets the big new goals, and the NSF seeks to support them, which the context of administrative priorities. She agreed the NSF could reshape its processes to be more open to more creative ideas. She noted that the Office of Integrative Activities has a kind of skunkworks group.

Dr. Constable noted the ongoing challenges of data management, noting that community consensus was unlikely to resolve these challenges. Dr. Còrdova agreed that EarthCube and other data management initiatives qualified as “big ideas.” She noted that the Board would meet in a few weeks, and that the board has a role to assist her in running the NSF, as well as an advisory role to the President. The NSF will present one of the data management initiatives to the board at this meeting. Dr. Còrdova noted the need for more common and creative thinking throughout the agency, and said that a structure to support such a development would be presented; it draws resources for data management and data mining, as well as HPC facilities. She expressed her hope that this initiative could be preserved with the flexibility that is currently envisioned, and that it might have as great an impact as the NSF had in shaping the Internet.

Interagency communications. Dr. Semeter asked Dr. Còrdova to address interagency dialogue. He noted investments made by NASA, NOAA or DOD which are heavily leveraged by the NSF, about which decisions can be made without NSF input. He asked if there were opportunities for high level dialogue to influence the future of such programs.

Dr. Còrdova replied that the National Science and Technology Council has committees and subcommittees that are directed toward the different enterprises; Dr. Còrdova co-chairs the Committee on Science and the Coordinating Committee on STEM Education. Dr. Còrdova noted that many of the most successful collaborations have been developed from conversations between program officers and scientists, who then bring their ideas to the agencies. She remarked on the number of strong collaborations between the NSF and DOE, and noted that each project has its own path of development.

Dr. Dixon noted consensus within the scientific community and from funding agencies that the public health mission of NIH thrives best when basic sciences discoveries from NSF are robust and well communicated. Dr. Còrdova agreed, noting NSF’s partnership with DOE and DOD on the NSCI, and bilateral and multilateral agreement developed to address Vice President Biden’s “Moon Shot” on cancer.

Dr. Stroeve noted Dr. Semeter’s earlier remarks about interagency dialogue and projects. She reported that a DSMP program, which has provided five decades of data on sea ice, is being discontinued. She informed Dr. Còrdova that one of the sensors currently in use is failing, and a new sensor is in a warehouse and may be scrapped instead of being launched.

Dr. Còrdova deferred to Dr. Wakimoto, who said he would be looking into the situation, as the loss of this record of sea ice change is an important problem. Dr. Còrdova remarked that one of the roles of AC GEO is to alert leadership to problems such as this one. She noted that many of those gathered in the room likely serve on committees with DOD personnel; if more information is gathered regarding the location of the DMSP is located, leadership can follow up.

PLR Programs Merger. Dr. Sullivan asked for an overview of the merger of the PLR Program; Dr. Còrdova deferred to Dr. Buckius, who reported that two Assistant Directors had been appointed to lead the groups; they have been holding internal interviews, and will host a public website to gather broader input. AC GEO will be involved in ongoing communications; the goal is to report back to the NSB in August.

Dr. Dixon reported that the process of taking input is underway; the website is up and running. Dr. Buckius stated that a *Dear Colleague* letter is being developed to disseminate information about the website, and how to provide input to the program. Dr. Buckius noted that input could be offered from individuals, or from groups such as AC GEO as a whole.

Lessons from the FY17 Budget. Dr. Kempton noted that AC GEO was pleased, given the context, at the outcome of the budget, and felt geosciences might have “dodged a bullet” in terms of discipline-specific allocations. She asked if there were lessons to be drawn from this experience.

Dr. Còrdova replied that she felt there were, although she noted that different aspects of the geosciences likely made a difference to different people. Dr. Còrdova noted that the NSF appropriator had made a public statement against directorate-by-directorate funding; she stated that she believed no single thing brought him to this conclusion, but that it was instead the combination of input that was persuasive.

Dr. Còrdova noted that those in favor of directorate-by-directorate funding continue to push for it. Dr. Còrdova underscored the importance of building relationships with staff and legislators, and of being vigilant in this process. She noted that she works on Capitol Hill two days per week, and all of the ADs make legislative visits. She noted the need for a unified and consistent message against directorate-by-directorate funding, and the historically siloed nature of science.

Dr. Wakimoto noted that his remarks to legislators—and those of other ADs—are made on behalf of NSF, not any specific directorate.

Eliminating deadlines. Dr. Dixon reported on presentations to AC GEO on the elimination of deadlines for proposal reviews, and initial promising results in terms of reduced workload for staff and reviewers. He noted some concerns regarding metrics used to evaluate programs: that, for instance, the number of proposals has been used as a metric for the size or need for a program, and that proposal success rates have been interpreted as a metric for the rigor of reviews.

Dr. Buckius noted that the elimination of deadlines is understood to be an experiment, and that everyone has been surprised by the results. He shared his perspective that this approach could be a win-win for everyone, and that the quality of reviews will not diminish as the success rate increases. Dr. Buckius asserted that programs should not be run based on the numbers of proposals received. He noted that the no-deadline approach might allow PIs to be more thoughtful in their proposals and might reduce the burden of reviews. Dr. Còrdova suggested that proposals scores are the most important metrics for quality, and noted that funded proposals continue to have very high scores.

Broader Impacts Criteria. Dr. Hodges asked Dr. Còrdova to speak to the efficacy of the “broader impacts” criteria, noting that PI seek to have broader impacts and attend to the suggested approaches, but that reviewers may look only to innovation. He asked if NSF leadership believed the criteria were working well, or had ideas about how they might be changed or refined.

Dr. Còrdova reported that leadership also has concerns about these criteria; she noted that very divergent views emerged from an internal workshop among senior leadership on what constitutes broader impact. Dr. Còrdova described the criteria as more confusing than elucidating at the moment, and that there was also divergence regarding the relative importance of broader impact in a proposal review. She noted that ideas regarding how to improve the situation were emerging.

Dr. Buckius asserted that broader impact does not have to be orthogonal to science, but that more work was needed to prepare panels to consider it. Dr. Còrdova noted that institutions consider broader impact in different terms than do individuals, and that this difference may need to be considered; asking individuals to address broader impact may make applications more difficult than they should be. Dr. Wakimoto agreed that centers are held to a very high standard in terms of broader impact; he suggested this is not appropriate for individuals PIs.

Dr. Dixon noted that PIs often ask him about the value of explaining science in plain English so that it is comprehensible to stakeholders, and whether this serves as a broader impact.

Dr. Còrdova remarked that a Congressional definition of broader impact would be among the most frightening outcomes of the current lack of clarity, and asserted the need for some flexibility to allow peer groups to determine this value. She agreed the more clarity was needed, but underscored the value of the current level of flexibility on the topic. A staff person remarked that the definition of broader impact also varies by discipline.

Dr. Semeter asked how well broader impacts were communicated to Congress; Dr. Còrdova replied that broader impacts and directorate-by-directorate funding are the two most challenging topics in communicating to Congress. She noted that the mission of the NSF is to further the progress of science, and that great impacts in defense and infrastructure have emerged from following that mission. Narrowing the definition to focus on impacts runs the risk of moving the NSF to applied science, rather than basic science.

Dr. Còrdova noted that both directorate-by-directorate funding and broader impacts are value-based topics; she stated her belief that scientists should follow where their curiosity leads. In her estimation, this approach has paid off in the success of NSF scientists.

Dr. Còrdova concluded with appreciation to Dr. Wakimoto for his tenure as AD.

**Final Discussion**

AC GEO members discussed next steps regarding the DSMP satellite and the potential loss of data. Dr. Wakimoto noted that the discussion thus far had been valuable to him as an AD, and that he was exploring ways to involve the Office of the NSF Director.

In discussion about the challenges of interagency communications, Dr. Hodges reported similar discussions occurring at NASA, while he served a NASA AC subcommittee. He suggested that it might be helpful to bring these communities together to discuss ways to improve communications on cross-cutting issues of concern.

A working group, comprised of Drs. Stroeve, Semeter and Lyons and Ms. Arroyo, was convened. Three charges to the working group were defined:

1. To quickly gather information for Dr. Wakimoto to communicate concerns about the current situation regarding the potential loss of sea ice data, if the DSMP sensor is not launched or is discontinued.
2. To discern and summarize the larger issues reflected in this specific situation, regarding the usefulness of long-series data and the need for interagency dialogue about infrastructure, the ways infrastructure is leveraged, and the impact of decisions about infrastructure on the development and preservation of long-series datasets.
3. To provide input to the NASA decadal survey in light of these issues.

Dr. Semeter remarked that the DMSP satellites also house particle detectors which provide valuable data for atmospheric science. Ms. Arroyo noted that this situation speaks to many of the topics raised in conversation with Dr. Còrdova, including the cross-cutting initiatives, the broader impacts of basic science, and the danger of losing the data collected over time.

Dr. Cavanaugh suggested that Melissa Lane forward a goal report from ACRE, which makes a similar argument for long-term data on environmental observations. She suggested the report might serve as a model for the working group. Dr. Hornberger suggested a linked argument might be developed regarding the value of long-term datasets.

Dr. Kempton remarked that any communication to Dr. Còrdova from AC GEO should include a statement of appreciation for her vigilance and support of NSF funding.

**Meeting Adjourns for the Day**

**Thursday, April 14th**

Dr. Hornberger convened the AC GEO meeting for the day, and introduced the EAR subcommittee presentation.

**EAR Subcommittee (Committee of the Whole)**

*Carol Frost, EAR/GEO*

Dr. Frost greeted AC GEO members and offered a report of the results of the prior year’s planning and self-study activities. After her arrival at EAR, a retreat was held among the science program officers, at which the challenges and issues facing the discipline were address. Six committees were formed to further explore specific issues: Education/Workforce, Organizational Best Practices with the Division, Communication and Outreach, Research, Facilities and Infrastructure, and Facilities and Infrastructures for Advanced Computing and Data Management.

Dr. Frost noted that these activities were undertaken in order to assure resources are being used in the best way to advance the mission of EAR and NSF. She noted that larger budgets allow more room for experimentation, but that leaner budgets are anticipated. Dr. Frost noted that difficult decisions may have to be made, and consensus was unlikely; she expressed her intention to invite broad involvement and engagement in these considerations.

Each committee is headed by a section hear or member of the science committee; each has a rotating member. Recommendations have been received from these committees; Dr. Frost announced she would be sharing recommendations for communications and outreach strategies and the need for technical support in earth sciences; she invited AC GEO input, advice and support.

Communications and Outreach. This committee was charged with developing successful programs to communicate the value of EAR investments to Congress, the public, and other stakeholders as well as to the EAR scientific community. The committee reviewed current activities and came to the realization that EAR speaks to two distinct communities, each of which requires its own communications strategies.

The first community is the public, including government and other stakeholders. The Office of Legislative and Public Affairs (OLPA) is responsible for crafting and distributing messages to this community, but relies on EAR staff and science community for the content of these messages. Recommendations from the committee including enhancing communications with the EAR science community in order to quickly and systematically identify discoveries for OLPA to develop into news releases, media advisories, and other public messaging. EAR should then collaborate with OLPA in developing the stories they choose. In addition, EAR can develop and distribute within the EAR science community stories that OLPA does not pursue.

Dr. Frost noted past frustration that stories of EAR discoveries have been lost; she invited AC GEO members to discuss the most effective ways to engage the science community in order to identify important discoveries and impacts, emerging research topics and trends, and constraints. She noted that EAR publishes a quarterly newsletter to a listserv, but that it requires a lengthy approval topic that sometimes results in the newsletter being dated upon its release.

Committee recommendations include an online open blog may allow more open, two-way communication with the community, increased frequency of EAR Twitter and Facebook posts, and the development of an NSF-EAR LinkedIn group to track the professional development of EAR PIs.

Discussion. Dr. Frost asked AC GEO members to comment upon communication via social media, versus the existing listserv; the maintenance of a single GEO social media presence versus the development of distinct GEO-EAR blog, Twitter and FaceBook accounts; and direct communications from EAR staff to the Earth science community versus feeding material through OLPA.

Dr. Fine suggested that each of the four divisions might maintain an online presence, in addition to the GEO presence. She noted the potential challenges of social media communications, including harassment.

Dr. Doney noted that blogs can be curated and filtered. He noted that the social media strategy would need to be targeted to very specific audiences; undergraduate and graduate students use social media in different ways and on different channels than PIs.

Dr. Bierman suggested that determining the desired outcome for the communication may help to determine its audience and media. He noted that his students use social media less and less, and that he appreciates the newsletter as a single source for information.

Dr. Hornberger asked if PIs and graduate students were likely to invest in the two-way communication a blog would make possible. Dr. Bierman replied that this would depend on the topic and on how busy individuals were; he described the last 10 years as being marked by information overload.

A staff member noted that the Division of Environmental Biology uses a blog to communicate information such as progress in the review process; information of interest to some specific portion of the community. Dr. Bierman agreed this was a good communication strategy, but noting that the audience must be informed about the blog. He suggested an automatic email with a link to the blog be sent to every applicant.

Dr. Van Dover suggested that early career scientists might be the best audience for a blog, as students are not yet aware of the relevance of NSF. A suggestion was made that PIs might forward information about a LinkedIn group to their students, who could then be encouraged to subscribe to the blog.

Dr. Bierman suggested targeting senior graduate students before they transition to faculty; he noted that a student of his had never seen the EAR newsletter before.

Dr. Dixon remarked, from his experience with museums, that no particular program or exhibit will appeal to all people. Target audiences must be well understood, and messages and messaging vehicles tailed to those audiences. Assessments are also needed to evaluate the effectiveness of outreach.

Staff reported that EAR has more Twitter followers than subscribers to the newsletter; a Program Officer remarked that she receives questions via Twitter.

Dr. Hodges underscored the need to target messages and media to specific audiences; he noted that public relations offices exist because this work is so challenging. He suggested EAR may focus on identifying their most important audience, and employ the media that most effectively reaches them. He agreed that 99 percent of the EAR audience appears to use social media for communications, but cautioned that stories from EAR must be interest to that audience, no matter the media used.

Dr. Hodges turned to the topic of two-way communications, and remarked that many PI do not understand the workings of NSF, and may fear repercussions if they communicate openly with NSF. He suggested a need to develop an anonymous dialogue through which members of the scientific community feel safe to air complaints and concerns.

Dr. Hodges also noted the need to engage internationally in order to remain informed about cutting edge research around the globe.

Regarding the proposal for an EAR-specific blog, Ms. Arroyo reported receiving feedback about the value of having curated resources made available. Ms. Arroyo stated that her institution is developing portals through which users can recommend resources to one another, and encouraged EAR to consider a more networked approach.

Drs. Hornberger and Hodges remarked on the need to encourage PIs to build relationships with the press and to bring stories to their university public relations officers. Any stories that develop in this way can be linked through the OLPA. Drs. Bierman and Hodges both remarked on the value of relationships they had built with journalists, and the need for young investigators to be encouraged and trained to build these relationships.

Technical Support at Facilities. In the past, the Instrumentation and Facilities (IF) Program offered a separate call for technician support; this call included the requirement that the university pick up the support of these technicians after 5 years. About 7 years ago, such required costs shares were disallowed. As a result of this decisions and separate budget cuts, the technician support portion was eliminated from the IF solicitation.

A call that provides technician support for early career investigators—with no requirements for further funding—was recently released, and has generated significant discussion within the scientific community. Many community resource labs have argued that they could be more efficient if they had technician support. Groups involved in HPC have made similar arguments.

Discussion. AC GEO members were asked to address these questions:

1. Is more technician support is needed, especially if it might come at the cost of instrument support if budgets are not raised:
2. Is the facility support mechanism in the current solicitation adequate, or is a more specific call or track for technician support needed?
3. By what criteria might successful technician support proposals be ranked?
4. How competing needs for technician support in different EAR sub-disciplines should be weighed.

Dr. Lyons stated that he would like to see more technician support, even if it comes at the cost of instrumentation support. He reported being aware of people who are not writing proposals because they lack technician support.

Dr. Hodges remarked that technician support was likely to develop into a critical issue in the future; he asserted that NSF will have to find a way to provide technician support, as universities cannot be relied upon to do so. Dr. Hodges suggested that most universities would go so far as to refuse a requirement such as used to be included in the IF solicitation.

Dr. Hodges reported that he sought to assure technician support was included in the start-up costs for new facilities, but noted the lack of support for long-term labs. He noted the number of labs that invite others to come in to use them, and the lack of opportunity for these users to be trained. Technician support, Dr. Hodges remarked, not only keeps the pump working, it assures that instruments are used to their maximum capacity. He suggested that NSF interest in or support for community labs must be backed by technician support.

Dr. Hodges also remarked that there may be too many labs, and fewer, better supported labs might be more effective and efficient.

Dr. Lyons agreed that much of the work of technicians includes training students, and that a lack of technician support is a detriment to researcher and students. He suggested that instruments might be more effectively shared, and that the costs of instruments for each facility could instead go toward technician support for shared instruments.

Dr. Doney noted that NSF supports some national labs, which might serve as an intermediate step toward providing community labs and technician support. Dr. Hodges suggested that labs which allow time to outside users should have priority in funding for technician support. Other criteria might include a plan for technician responsibilities, including training, building online resources, etc. He argued against technician support that only helps a few investigators in private labs.

Dr. Kempton asked about limitations that might be built into solicitations, such as limits on the timing of requests for funding (e.g., once every 5 years). Staff replied that technician support for a lab serving a large part of the community might be needed—and worth supporting—indefinitely. Another staff member suggested that renewable applications could include the requirement to show impact in publications or other terms.

NSF also offers a Major Research Instrumentation (MRI), an agency-wide funding mechanism. Supporting EAR PIs to pursue this funding may make it possible to reserve more EAR funds for technician support. Dr. Hodges cautioned that only a limited number of applications can be submitted by a university in any given year, and that cancer research tends to always take priority. Some instruments might be acquired through this mechanism, but Dr. Hodges remarked that this avenue for instrumentation funding would not be robust for EAR.

Dr. Fuentes remarked on the value to technician support for assuring consistency in data quality.

Dr. Wakimoto remarked that the requirement for university funding of technician support was dropped in order to allow smaller universities to compete. He noted the absence of a national facility from the discussion, and spoke of the value of the National Center for Atmospheric Research (NCAR), a facility created 50-60 years ago, to serve everyone.

Dr. Wakimoto also noted the value of recompetition, to assure that the funds are being effectively used as intended.

Dr. Hornberger suggested that regional labs might be needed for some uses; Dr. Hodges replied that regional labs were not needed so much as distributed facilities. He suggested 5-7 labs, distributed throughout the US and open to the community. These need not be big facilities, but could be supported by a few hundred thousand dollars of annual support each. Dr. Hodges also remarked that these labs should received priorities for upgrades.

**Data Management Plans**

*Eva Zanzerkia, EAR/GEO*

Dr. Zanzerkia noted that her presentation would address two topics: DMP practices and a report from the reverse site visit for Earth Cube. She acknowledged the members of the Cyberinfrastructure group, noting that much of the work of the presentation was completed by others on this team.

Data Management Plans. Dr. Zanzerkia noted that Ms. Qualters had spoken to AC GEO about the OSTP requirements for sharing research publications; she noted that the requirement for open data is a bit more complex, as data availability will differ across data types and disciplines. DMPs have been identified as an avenue to address these requirements.

The guidance for DMPs identifies three products: primary data; other materials and products; and software, inventions and products. There are also three levels of data policies: at the GEO level, the Division level, and the Program level.

The DMP group was charged to analyze current DMPs, identify best practices in the reviewer community and research community, revise the current divisional data policies, and attend to issues concerning how data might be maintained after the award expires.

Dr. Haffke reported that DMPs became a required part of NSF proposals in 2011; the study one which she is reporting looked at recent GEO DMPs to see how the community has responded to this requirement. DMPs from one year’s funded projects were reviewed in each division. Dr. Haffke noted that the review was limited to funded projects because the DMPs in these proposals presumably were found to be sufficient.

Each of four staff involved in the study reviewed more than 200 DMPs; 913 DMPs were reviewed overall. Two characteristics became immediately apparent: PIs used different format to describe their DMPs, from freeform narrative to templates that appeared to be provided by the data repository. Also, PIs produced many different kinds of data, including code, physical samples, and observations. Different types of data repositories were needed for different types of data.

The team also reviewed data service entities (DSE), which were defined as any facility used for the storage and/or creation of data. Different DSEs offer different services, which can include data routing and metadata services; physical sample storage, and the development of unique sample IDs; long-term data storage; and real-time data services. In most cases, DMPs included some data management at the host institution; in some cases, host institutions were the only DSEs planned.

Dr. Haffke presented a slide on the top 15 DSEs mentioned in the DMPs reviewed. On average, 1-3 DSEs were noted in each proposal.

Dr. Doney noted the importance of differentiating between data storage at a host facility for a particular time and archival data storage. He noted that the National Centers for Environmental Information (NCEI) provides archival storage, but is not a facility through which data can be accessed.

Dr. Zanzerkia noted that the group simply reviewed the plans described in the DMPs; this information will help to determine how best to engage PIs as data requirements are refined.

Dr. Haffke presented the top 10 DSEs for each division, noting that differences between divisions were apparent. In PLR and EAR, for example, more unique DSEs were mentioned. Dr. Haffke presented characteristics of DSEs. She noted that EarthCube was mentioned, but the uses of EarthCube were not clearly described. For the most part, PIs were utilizing projects funded by EarthCube that included data systems management aspects.

Dr. Haffke summarized the findings of the DMP review:

* Host institution storage is a popular data management methods; it is difficult to assess whether data stored in this way is discoverable by the community or preserved for the long-term.
* Data management needs and practices are diverse.
* Ten of the top 15 DSEs are funded by GEO; many others are funded by other federal agencies.
* DMP templates provide advantages and disadvantages: investigators who used a template tended to offer a lower level of detail, perhaps because of perceived template restrictions.

Dr. Wakimoto noted that GEO was the only directorate to attempt such a review, and suggested this model and findings might be shared with others in NSF.

Dr. Zanzerkia reported that link to the grant proposal guidance on DMPs is now included in GEO proposals; GEO data policies will be reviewed and revised to provide better feedback. Division policies will also be reviews and revised; the PLR revision was completed in January, and may serve as a model for other divisions. The group will also develop guidance for PIs, Reviewers and GEO staff regarding how to assess DMPs.

Dr. Zanzerkia remarked on the need to balance a number of factors, including the value of advancing future geosciences through easy sharing, discovery and access to data and products; balancing the flexibility and diversity of research practice within GEO with the value of creating GEO-wide principles; guiding and evaluating DMPs while ensuring the PI and community judgment is respected; and consideration of PI and Program Officer workload as well as the cost to science in evaluating the burden of any policy.

Dr. Zanzerkia briefly reviewed the diversity of data, including:

* Model studies and computational outputs, from which model code, input criteria and output results would be desired.
* Environmental sensing, which would generate data to include observations, on-ground sensors, non-physical samples about the Earth and Earth systems.
* Experimental results, for which input parameters, experimental designs, and outputs would be needed.
* Physical samples, including cores and samples collected in the field, by individual investigators and through community initiatives. Dr. Zanzerkia noted the need, at some point, to assess the comparative values of these; she also noted that these samples included solid, fluid, gaseous, and air samples.
* Live cultures.

The divisions will be asked to consider elements of data management, including standards, data discovery and access; best practices and/or templates; specific community standards and acceptable DSEs; award and reporting requirements, and the use of COVs to evaluate DMPs. After these reviews are complete, GEO level policies will be considered, with the intent to identify basic guideline principles for data practices throughout geosciences; reduce redundancy, develop a clear statement about “host institutions,” and to provide an example list of appropriate DSEs.

Dr. Zanzerkia stated that the DMP should cover, as appropriate: types of data; standards used for data and metadata format and content; storage resources and facilities; policies and provisions for re-use, re-distribution and the production of derivative products; and policies for access and sharing, including privacy, confidentiality, security, intellectual property and other protections.

Discussion. Dr. Zanzerkia requested AC GEO feedback on:

We would like feedback on:

* Host Institutions: Under what conditions would data stored at host institutions satisfy GEO Data Policy and the intentions of Public Access?
* Interagency Cooperation: What should be guiding principles for engaging with other agencies for data management?
* Data: Is the definition of Data (model studies, observations, experimental results, physical samples, live cultures) an appropriate GEO-wide definition? Should all of these products be covered by the Data Management Plan?
* Cost Models: What are the considerations to understand the aggregate cost of various financial models to support data stewardship?

Dr. Hodges referred to access as the “elephant in the room.” He noted that the DMP must explain access if open access is the goal, and noted that his concern about the use of host institutions was a concern about access. Dr. Hodges noted that the preservation of physical samples may not be a high priority for a university; he suggested that NSF make a statement to universities regarding their responsibilities in this area.

Dr. Dixon agreed, suggesting the need for documentation of a commitment from a university when a PI submits a proposal that includes the university in the DMP. He expressed his doubts that universities would, in fact, commit to maintaining access to data.

Dr. Doney suggested that a group be convened to clarify the definition of long-term storage—particularly whether storage beyond the grant period or archival storage is intended. He suggested that grant reports include a reporting on the DMP.

Dr. Kempton remarked on the need for the community to develop a better understanding of and methods for curating and storing samples.

Dr. Sullivan remarked on the need to differentiate different types of data. He noted an experiment within the PLR program that captures continuous electrical samples which are reviewed to identify events. The ratio of noise to event is 10billion:1, and yet investigators are required to keep the original samples.

Dr. Sullivan noted, in addition, that digital data are unlikely to be readable in 10-20 years, given changes in software.

Dr. Van Dover noted the example of deep sea samples, which can be very expensive to collect, storage, and curate for discoverability. She asked how much of a 3-year proposal should realistically be devoted to managing the samples.

EarthCube Update. Dr. Constable reported that she and Dr. Semeter served as AC GEO liaisons to the EarthCube reverse site visit; they were asked to help guide the development of EarthCube by providing external scientific advice to the EarthCube Leadership Council and NSF Geosciences management. Presentations and discussion on EarthCube funded projects to date, strategic plans and synthesis documents were made.

Dr. Constable noted that projects to date include community workshops to discuss the groundwork needed to advance the intended goals; efforts to develop tools that could interface with various databases and software to promote interdisciplinary activity. She remarked on the challenge of evaluating these projects, as there were several, and they began before EarthCube goals were well defined.

The Advisory Council sought to address four questions: whether the strategic vision represents the goals of EarthCube; the quality of the roadmap; how well integrated and coordinated the scientific community is in the EarthCube roadmap and activities, and what next steps should be taken.

Dr. Constable described the project as having many moving parts and an extremely board scope; workshops and community polls were held prior to the development of the Leadership Council governance structure. The Advisory Council noted the exceptional level of volunteer commitment among the Leadership Council, but noted significant cultural, social and scientific challenges to the initiative.

Findings from the reverse site visit include:

* The definition of EarthCube remains unclear to the GEO community.
* There is a need for a transition to an LC-empowered governance model
* “System of systems” is a critical concept in the EarthCube program, but it is not clearly defined.
* The competing “innovation” and “production” elements of EarthCube need better articulation to alleviate the ambiguity and lack of realistic program scope sensed by the geoscience community.
* There is insufficient emphasis on enabling cross-disciplinary science through EarthCube.
* Strategic “Imperatives” are ambiguous

Regarding the roadmap, the Advisory Council noted that the program has not yet developed a 5-year implementation plan, and that the development of a functional infrastructure is impeded by the broad scope, lack of standards, and lack of metrics of the initiative. She suggested these problems could be addressed, if work begins from a more structured environment.

Further findings, regarding community coordination and integration were that the roadmap placed insufficient emphasis on data science objectives, that the gap between the Building Blocks projects and a functional EarthCube architecture is enormous, and that the proposal solicitation structure may not be conducive to broad interdisciplinary involvement.

Recommendations included that the Leadership Council seek to extract best practices from the workshops reports, and that further interaction between NSF and the Leadership Council is need as solicitations are structured. Standards and formats must be better defined in order to guide investigators in proposal planning.

The Advisory Council recommended a re-evaluation of the role of the Leadership Council, and a better articulation of the roadmap in order to promote sustainability. EarthCube is now entering “Phase II,” and may require a new structure that is deliberately designed to meet the goals of the implementation plan.

Overall, the Advisory Council expressed concern about the lack of a clear definition for EarthCube, and its reliance on a largely volunteer Leadership Council and fully voluntary structure through which self-selected stakeholders advance individual understandings of EarthCube, rather than seeking a common vision and milestones. The Advisory Council noted a lack of interconnection between Leadership Council activities, proposal solicitations, and the assessment of outcomes from funded projects.

The Advisory Council recommends a full technical review, and recognizes this may result in a revamping of program objectives, governance structures, and the implementation plan.

Dr. Semeter noted that the decade-long project is approximately halfway through its timeline, and suggested the midway point was an appropriate time for this rigorous reevaluation.

Dr. Zanzerkia reported that the EarthCube Leadership Council is developing a response to the review; she suggested the AC GEO Subcommittee on Infrastructure might identify appropriate expertise to receive and review their reply.

Dr. Hornberger tabled the discussion in light of time; he suggested AC GEO members might return to the topic later in the day.

**Meeting with Head, Office of International Science and Engineering**

*Rebecca Keiser, OISE/OD*

Dr. Hornberger introduced Dr. Keiser, noting her experience with OSTP and NASA; Dr. Keiser remarked that she had just celebrated her 1 year anniversary at NSF; prior to that, she worked at NASA. Her background is in international relations.

Dr. Keiser noted that she had been reviewing different kinds of strategy, including even considering what was meant by “strategy” within the context of NSF. She asked how many of the AC GEO members had participated in a retreat in which they were asked to identify goals of the organization; all had. Dr. Keiser described that exercise as a traditional approach to strategy, in which participants seek to predict future contexts and develop goals to meet it.

As an alternative, Dr. Keiser spoke of Henry Mintzberg and emergent strategy. Mintzberg’s approach recognizes the value of future oriented goals, but also recognizes that the future cannot be predicted, and so future oriented goals will frequently change. The approach begins with gaining a clear understanding of where we are at present, and seeks to develop a strategy that is flexible to change as times change. Dr. Keiser noted, in the field of international relations, the need to adjust goals and strategies as political, economic or other circumstances change within countries with which collaborations have been developed.

Dr. Keiser reported on the scientific investments of nations; offering a slide depicting both research and development spending as a percentage of the GDP, and the number of scientists and engineers per million people. She noted that nearly three-quarters (73 percent) of the world’s spending on research and development is spent outside the United States; collaboration allows the US to leverage these investments.

Dr. Keiser noted that international collaboration advances the progress of science just as all work within the NSF seeks to do. Transformative science and engineering, in turn, drive the US economy, enhance US security, provide the US a competitive edge, and advance knowledge and global understanding.

Dr. Keiser briefly reviewed the ways that NSF engages internationally. The foundation invests in people, working with the best minds around the world and building a globally engaged workforce. Dr. Keiser noted the Graduate Research Opportunities Worldwide (GROW) program, noting that it currently undersubscribed.

NSF also drives research, participating in cutting edge research internationally, and ensuring access to real-time events and phenomena. She noted the Belmont Forum, and the Partnerships in International Research and Education (PIRE) Program, which involved 22 international partners.

NSF international engagement is also advances through partnerships on facilities and infrastructures, including the Atacama Large Millimeter Array and CERN, and through international forums, such as the US-founded Global Research Council, which will bring together more than 60 international agencies in May to discuss women and science and interdisciplinarity.

Strategic international engagement, addressed in an emergent way, offers guidance—rather than criteria—for international engagement. Dr. Keiser noted the need for a body which could coordinate international policy issues. She noted that the community develops much international collaboration, which the NSF should better understand. She noted the need to identify the issues to consider in agency to agency, government to government, and university to university international collaboration.

Dr. Keiser noted the need to focus on transparency and accountability in international engagements, in order to understand what activities are happening, and where gaps exist. Better data analytics are needed to fully understand the areas in which the largest collaborations occur, and where collaborations can be developed. The Office of International Science and Engineering (OISE) will begin to release an annual report on international engagement, and will pursue and external review of the balance of efforts.

Enhanced cooperation with partners on tools is also planned. Dr. Keiser noted the opportunity to collaborate with partners who are collaborating in emergent economies. As an example, the OISE lead for Africa will travel to Germany to participate in a meeting of an ongoing Germany-Africa collaboration, in order to better understand these relationships. OISE seeks also to coordinate with other US agencies (e.g., the Air Force) on analytics and foresight. Dr. Keiser noted that NSF has three overseas offices, in Beijing, Tokyo, and Brussels. She suggested these staff could collaboration with other US agencies with overseas offices, as well as other nations, in order to maximize resources.

Dr. Keiser shared a draft model of questions to consider in assessing potential international partnership. Context is the starting point, and questions of context include: why is this partnership being proposed? Why this particular partner? What is the benefit to NSF or the US? Science is the priority for these partnerships, and raises questions regarding the scientific rationale for the partnership, how the partnership will advance science, how robustness and reliability might be built in, and whether the partnership is potentially transformative. Broader impacts and management and sustainability are also key areas in evaluating potential partnerships.

Dr. Keiser shared her planned next steps, to include evaluation of the OISE programmatic portfolio, the development of criteria for NSF’s international collaborations, foresight and analysis, and further developing relevant relationships.

Discussion. Dr. Keiser asked AC GEO members to consider how collaboration in the geosciences might be enhances, how NSF might work more collaboratively with emerging economies, and what criteria are most important to them in assessing international collaboration.

Dr. Kempton asked Dr. Keiser to address the various scales of collaboration. Dr. Keiser began by noting the importance of PI to PI collaborations, which often emerge organically. OISE can assist with these, through planning workings and match-making. OISE also helps to facilitate program to program collaborations, through individual programs and division.

Agency to agency collaboration represents the next largest scale; Dr. Keiser asserted the need for more of these collaborations. She noted that NSF has moved away from these collaborations in the recent past, in part because of the effort required to think through the structure of such collaborations, and to determine how directive NSF should be about them. Dr. Keiser noted that there are several ongoing agency to agency collaborations with the UK, some of which include joint calls for proposals. A method has been developed for deciding which national is the larger contributor, who conducts the review, and assuring respect for that review.

Dr. Keiser noted a US-Israel collaboration on a bi-national science fund. The NSF portion of that collaboration includes the release of *Dear Colleague* letters in particular areas, and the agreement from Israel to respect the NSF review in these areas. She remarked that this arrangement is more successful in some areas than in others.

Dr. Fine asked about the role of the OISE: whether proposals are submitted directly to OISE or through the directorate, and whether OISE provides funding and/or coordination.

Dr. Keiser replied that OISE can fund and coordinate initiatives. She noted that request for support for activities such as workshops might best be submitted through GEO, with OISE providing supplemental support. Dr. Keiser noted that some programs within OISE provide direct funding, primarily through 3-year grants.

Dr. Fine noted the importance of clearance for international scientists such as seagoing oceanographers. These clearances are generally provided by the US State Department. Dr. Keiser remarked that OISE understands itself to have an enabling role for science collaboration, and invited AC GEO members to contact OISE if they encounter a problem or delay. Dr. Wakimoto remarked that Dr. Keiser and OISE has been very helpful to him in this arena.

Dr. Doney noted the challenge of getting US investigators onto foreign ships. The timing of funding solicitations can be difficult to align. He noted, however, many places of interest to which US ships cannot go. Dr. Keiser invited further discussion of these concerns, noting her interest in helping, as she better understands the issues involved.

Dr. Hodges remarked that he often works as part of international teams in emerging economies, and has noticed that the structure of US funding can put investigators at a disadvantage. While American funding is based on the project, many of his international colleagues are funded as individual contributors to the project, which allows them greater discretion to, for example, bring in other consultants. He noted that he would be travelling to Turkey in August with investigators from the Netherlands; he was invited to serve as part of the research team and to provide feedback and training.

Dr. Keiser noted that this funding concern was relevant throughout NSF, due to the inherent constraint in funding institutions rather than PIs. She noted that this structure provides more control and accountability, but places significant responsibility on the institution for export control, clearances and other international concerns. It also reduces flexibility.

Dr. Keiser encouraged Dr. Hodges and others to apply for OISE funding for international components to a project; she noted that her office is happy to add money to an existing project pot.

Dr. Murray noted that he has substantive interaction with Dr. Keiser and OISE on a nearly weekly basis; information exchanges between OISE and the division is robust, and is not solely focused on problem-solving. Dr. Murray noted that some problems can only be addressed through OISE or the State Department.

Dr. Murray also noted the number of opportunities which are not widely known, and so not fully leveraged. He stated that he tends to discover international activities at almost every site visit, and seeks to connect those involved with OISE. He encouraged AC GEO members to capitalize on the growth in international science.

Dr. Keiser noted the flexibility of NSF to establish international collaborations, and the presence of opportunities of which she is not yet aware. She announced that OISE will be establishing workshops around the US to engage scientists in discussion about their interest and international opportunities to address them.

Dr. Van Dover asked about NSF’s view of international territories, including the high seas and areas beyond national jurisdictions. Dr. Keiser replied that OISE will facilitate activities in these areas, through coordination with the State Department and the White House. OISE can inform investigators when high level issues are involved, and can generally help facilitate their resolution.

In response to a question from staff, Dr. Keiser noted the open question within NSF, of whether overseas branches of US institutions are fundable as US entities, or are overseas entities. She remarked that institutions that lack brick-and-mortar facilities in the US are generally understood to be overseas entities, but invited input and thoughts from AC GEO about the growing practice of, for example, New York University opening a campus in Shanghai.

Dr. Hodges reported on difficulties in conducting field work in Tibet, noting that Chinese officials will sometimes provide clearance and permissions that are then not honored by Tibetan local authorities. He asked if the NSF office in Beijing might be of assistance here; Dr. Keiser replied that the Beijing office is there for precisely these kinds of issues, and expressed her interest in further pursuing these concerns.

Dr. Keiser encouraged AC GEO members to inform OISE when investigators seek to work in areas such as Tibet, and to encourage investigators to contact her office. She noted that advance notice of these efforts can help the office to facilitate them.

Dr. Wakimoto asked Dr. Keiser to comment on international data and data access. Dr. Keiser replied that access to data varies from country to country. The G7, other multilateral organizations and some bilateral structures are currently negotiating data access. Dr. Keiser reported that the EU is currently advocating a very open international data sharing approach, encouraging free, open, and instant access.

Dr. Keiser described the US position as making data as open as possible; she noted that the US cannot meet the administrative burden of EU-style instant access. Regarding other countries, she noted, the struggle is for access to any data. Dr. Keiser commended GEO on is openness regarding data, and noted that data access will depend upon the type of data and the particular project involved.

Dr. Kempton asked for further clarification of Dr. Keiser’s questions regarding collaboration with emerging economies. Dr. Keiser replied that she invited policy ideas that might facilitate these collaborations, and would like to hear more about ongoing collaborations in emerging economies. She noted that she had received criticism that US investigators were seen to be merely extracting data, and “collaborating” with international researchers by allowing them to drive the Jeep.

Dr. Kempton suggested that funders might smooth the way, helping to bridge cultural differences in how science is approached. She suggested a few targeted, strategic initiatives to begin to build understanding.

Dr. Keiser agreed, noting ongoing initiatives within INFEWS, as well as the Basic Research to Enable Agricultural Development (BREAD) Program, co-funded by the Gates Foundation. Dr. Keiser noted the challenge of cultural differences; investigators in emerging economies may have very different ways through which they are funded, and different views of research. Some have never before participated in a merit review.

**Continued discussion of EarthCube**

Dr. Cavanaugh asked Dr. Constable to clarify whether the Advisory Council planned to meet with EarthCube leadership again. Dr. Constable replied that EarthCube leaderships had been asked to develop a more detailed implementation plan, and to work with NSF on developing a Leadership Council with greater enforcement capabilities. The Leadership Council received the report and will meet with the EarthCube community in June; a response to the report is expected in September.

Dr. Doney suggested postponing the investment in Phase II, in order to allow the broader computer science community more time to develop its approach to data.

Dr. Constable noted that, while EarthCube appears to be a large initiative, its funding only represents about 10 percent of data management funding throughout GEO. She noted the success of well-defined, uniform institutions and structures, and remarked on the heterogeneity of much geosciences data and the need for mechanisms through which the community can develop an approach to these data.

Dr. Doney noted that data ontological work preceded EarthCube and is ongoing apart from EarthCube. He noted that NASA also sought to develop a single way to address everyone’s data needs, and failed. Dr. Doney expressed his concerns that EarthCube had “bitten off too big a chunk,” and that it could not succeed without quickly developing very specific goals.

Dr. Semeter noted that there were members of the Advisory Council who expressed similar overall concerns about EarthCube; the charge, however, was to advise the Leadership Council. Dr. Semeter noted that the preamble to the report calls for a broader review of the entire program.

Dr. Constable stated her belief that a different model for the Leadership Council’s roles and responsibilities is needed; she suggested they might, most effectively, develop standards and metrics. Dr. Doney suggested they might work more closely with existing funded data groups.

Dr. Semeter noted that EarthCube is defined both as a solution to data concerns, and as an enabler of innovation. Advisory Council recommendations called for two distinct tracks: development of an infrastructure, and support for collaborative research in the next between cyberinfrastructure and the sciences.

Dr. Hodges asserted the need to underscore this dichotomy to the Leadership Council; he suggested the infrastructure portion of the project should receive ongoing funding, while the research portion should be experimentally funded.

**Working Lunch: AGS Subcommittee Meeting (Committee of the Whole) with Discussion of Geospace Portfolio Review**

*Paul Shepson, AGS/GEO & Vicki Arroyo, AC GEO*

Dr. Shepson noted that the AGS Subcommittee was facing a diversity of topics and questions; the AGS report would begin with a summary of discussions from the subcommittee meeting, and would focus primarily on the geospace science portfolio review.

Ms. Arroyo noted two new members of the subcommittee: Drs. Fuentes and Hakim. She reported that the recent subcommittee call was comprised primarily of updates on ongoing self-assessments; Dr. Semeter led much of the discussion. Ms. Arroyo noted the need for these exercises in light of flat funding and the need to balance investment in new science and support of existing facilities. Highlights from the subcommittee call include:

* The Atmospheric Science Section COV visit went very well; a report is expected within weeks, and will be discussed at the Fall meeting.
* Sylvia Edgerton reported on a review of Atmospheric Chemistry; the report from that activity is currently under review.
* Patrick Harr discussed ongoing work on the AGS Strategic Plan.
* AGS has primarily conducted ad hoc reviews, without many proposal deadlines. The Division enjoys a large success rate and a manageable work load.

Dr. Shepson remarked that the development of the strategic plan focuses on AGS processes and community. He noted enthusiasm in the division for the framework of the plan, and for the perspectives that will be brought by new members of the subcommittee.

AGS Portfolio Review. Dr. Shepson described the current theme of AGS as self-assessment. The geospace sciences portfolio review, which began in February 2015, is a large part of that self-assessment.

Geospace science is concerned with all of the processes that occur between the sun and the Earth; it includes heliospheric physics, magnetosphere physics, interactions with the ionosphere and upper atmosphere, and how gravity waves influence the upper atmosphere. The current portfolio review is motivated by the opportunity to assess the AGS portfolio in the context of the decadal survey *Solar and Space Physics*. Dr. Shepson noted that some of the contents of that report are more relevant to NASA, while others speak directly to AGS-specific science. The report was completed in 2013; the portfolio review will assess how well funding is aligned with the recommendations and findings of the decadal survey.

The division is also considering how well AGS is adjusting to the changing needs of the community, which is moving toward full systems science and modeling. Observations that support these full systems approaches are needed. In addition, growing interest in space weather required the ability to simulate space weather events.

Dr. Shepson commended the amount of science the community achieves within the current AGS budget. Approximately 40 percent of the budget is devoted to infrastructure to support the sciences. Dr. Shepson noted that all infrastructure has a lifetime; one of the objectives of the review is to address the question of how well the infrastructure is supporting the best possible science and developing strategies to address situations in which it is not.

The review committee was charge to consider the future of geospace science, assuming a flat budget. The intents were to examine the balance across the portfolio, assess the extent to which it aligned with the decadal survey, consider what new activities must be accomplished and what activities and capabilities will be lost in enabling the new. William Lotko served as chair of the review committee; Dr. Shepson commended Dr. Semeter for his significant contribution to the effort.

Dr. Shepson noted that OSTP created a task force to create a National Space Weather Action Plan to address rare events that might do damage or pose a substantial risk to infrastructure such as satellite communications or GPS-based navigation. That report, which assigns tasks among a number of agencies, was released in October 2015.

If the portfolio review report is accepted by AC GEO, an NAS consensus study will begin. The NAS will convene an ad hoc committee to assess the report, and issue there assessment in Fall 2016/ AGS will respond by year’s end.

Dr. Lotko presented the AGS Portfolio Review Report to AC GEO, beginning with a report of community input and recommendations from the Decadal Survey.

The committee solicited community input, and received 47 written responses from 62 signatories; each committee member read all of the email responses. In addition, three town-hall meetings were held, in conjunction with summer workshops: Coupling, Energetics and Dynamics of Atmospheric Regions (CEDAR), Geotechnical Engineering and Materials (GEM), and Solar, Heliospheric and Interplanetary Environment (SHINE).

The thrust of the community comments received was that NSF should provide new facilities, data measurements, and observations to support community research in geospace, atmospheric and solar sciences. Comments addressed four broad themes: geospace management and process; programmatic other than facilities; existing facilities, observations and infrastructure; and new facilities, observations and infrastructure.

Recommendations from the decadal survey, pertaining to NSF, were:

* Support existing ground-based facilities and complete programs in advanced stages of implementation: Status quo *$43.6M per year*
* Maintain and grow basic research programs at NSF (and at NASA, AFOSR and ONR) for a more effective transition from basic research to space weather forecasting applications: *$1M? per year*
* DKIST base funding for M & O, data analysis/service, development of advanced instrumentation: *GS − AST coordination*
* Data exploitation and systems: *$0.5M? per year*
* Midscale project line for SSP @$4-30M: *up to $6M? per year for 5 years*
* CubeSats: $2.5M per year @ NSF ⇒ augmentation *of $1M per year*
* International collaborations, e.g., EISCAT 3D: *$1M? per year*
* Grand Challenge Research (HSCs): NSF contribution at *$2M? per year*
* Education: Continue FDSS | Develop curriculum program |FDSS for 4-year colleges | Continue summer schools *$$??*

Dr. Lotko noted that these recommendations would require a budget augmentation of $11 million per year, or 25 percent of the total budget. Key issues of the portfolio review were defined as:

* An inability to implement the Decadal Survey recommendations, if the budget was held to baseline.
* How best to accommodate the increasing emphasis on cross-disciplinary, integrative and predictive geospace sciences?
* Should efforts be made to reverse the trend toward declining grant program investment and declining proposal success?
* CubeSat: a broadly valued program that demonstrates some of the value of NSF innovation.
* How to support facilities upgrades without squeezing other programs, accommodate innovations and vitality, and initiate a mid-scale projects line.

The review committee considered the 2015 geospace facilities investments, dividing facilities into two categories. Class I facilities included hard-line infrastructure, such as scattered radar; Class II facilities included data centers, and other resources to provide data to the community. Requests for Information (RFIs) were sent to PIs at all facilities, and interviews were held with each to better understand the value of each facility.

Sent out RFIs to PIs at all facilities, followed up with 1-hour interviews to better understand value of facility

Dr. Lotko noted that Arecibo was originally funded by the NSF in 2008 for $1.8 million; these costs have increased to $4 million, without much change in capabilities. Interest in the facility from the astronomy community is waning, and these costs now comprise nearly 10 percent of the geospace budget.

Dr. Lotko presented the recommendations for the current elements from the review committee:

* Core Grants Programs (AER, MAG, STR): Maintain current budget share. Dr. Lotko noted these programs are absolutely essential and support the core of innovation in geospace.
* Targeted Grants Programs (CEDAR, GEM, SHINE): Maintain current budget share out to ~2020; transition a portion of the budget thereafter to IGS (SWM, GCP) programs
* Faculty Development in Space Sciences (FDSS): Maintain current budget. Dr. Lotko noted that the community considers these grants to create a bulwark for geospace science within academia.
* Space Weather Modeling (SWM) Program: Maintain current budget to 2020; grow thereafter with reprogrammed funds from targeted grants programs
* Facilities Program:
	+ Maintain current budgets for 4 “Class 1” facilities (ISRs at Jicamarca, PFISR, RISR-N, Millstone Hill less Madrigal Data Center). Dr. Lotko noted that Millstone Hill is an older facility, but that it has one of the widest fields of view available.
	+ Maintain current budgets for 4 “Class 2” facilities (AMPERE, SuperMag and SuperDARN and Community Coordinated Modeling Center (with NASA)

Recommended changes:

* CubeSat Program: Reduce budget by ⅓ by 2020. Dr. Lotko remarked that the majority of publications from the CubeSat program are in engineering, and that many other agencies and participants are beginning to build standard platforms for CubeSat. The committee felt that NSF should focus efforts on missions and tools that might go on this platform.
* Facilities Program:
	+ Reduce funding for Arecibo ISR by ¾ by 2020; ancillary instruments funded via grants programs and peer review
	+ Terminate funding for Sondrestrom ISR by 2020; remaining site instruments funded via grants programs and peer review
	+ Consortium of Resonance and Rayleigh Lidars (CRRL) to be funded via grants programs and peer review; operates as PI-led project rather than community facility

And new elements:

* Redirect funding to 5 new program elements by 2020
	+ Grand Challenge Projects: Element of Integrative Geospace Science (IGS) grants program together with SWM
	+ Data Systems: Facility(ies) to exploit emerging information technologies for integrated software and data analysis tools, geospace data mining and data assimilation. Peer-reviewed projects receiving support from this program are expected to become Class 2 facilities by 2025
	+ Distributed Arrays for Scientific Instruments (DASI): Development of distributed measurement systems. Peer-reviewed projects receiving support from this program are expected to become Class 2 facilities by 2025
	+ Innovation and Vitality: Peer-reviewed grants for innovations in facilities and models and upgrades (as needed) to maintain state-of-the-art
	+ European Incoherent Scatter Scientific Association (EISCAT): Begin forging a partnership with the EISCAT consortium to use new EISCAT-3D capability and EISCAT-Svalbard as a replacement for Sondrestrom

Discussion. Dr. Shepson remarked that the work of the committee would not have been possible without the data and information provided by their colleagues; he expressed his appreciation for this support.

Ms. Arroyo commended the work of the review committee; she asked about the extent to which historical value of facilities was taken into account in the review. Dr. Shepson noted two different concepts of historical value: Arecibo is 50 years old, and has played a role in the history of the geospace community; another aspect of historical value is the baseline data from the facility. Dr. Shepson noted that both of these aspects were discussed by the committee, but that its cost required the committee to consider whether it was contributing value at the same level.

The committee considered the primary value of Arecibo to be that it is the most sensitive ISR on the planet and is used to probe the ionosphere as a plasma laboratory; it has also been used to infer gravity waves. It is not particularly effective in system science, which appears to be the direction in which the field is moving. While seeking to avoid bean counting, the committee asked each facility to report users and publications; they considered how much Arecibo reviewing time is used for geospace, and at proposal pressure geospace uses of the facility. Dr. Lotko reported that only 9-12 percent of proposals incorporate Arecibo, and 40 percent of these incorporate the facility only during “world days,” in which every facility is turned on.

Dr. Doney asked the degree to which Arecibo supported the training of under-represented groups, and whether other mechanisms might be used to maintain facilities with benefits other than direct science.

Dr. Wakimoto remarked that Arecibo is one of the most well-advertised facilities, and considered to be a treasure of Puerto Rico; there have been some discussions of Puerto Rico taking on the facility.

Dr. Shepson reported that Astronomy had released a *Dear Colleague* letter requesting ideas of operations of Arecibo; replies have been received, and AGS and Astronomy are currently reviewing them. He noted that the committee was charged to consider relative value.

Dr. Doney supported the committee’s charge; he remarked that other issues, from wider perspectives, might be at play. Dr. Wakimoto suggested that Math and Physical Sciences should also be included in discussions of Arecibo.

Dr. Semeter remarked on the 50-year dataset from Arecibo, and asked about the relative value of very good measurements from one location over 50 years, or measurements from 50 facilities that are not as strong. He noted the value of magnetometer networks dating back to the 1850’s, which are kept in operation because of this value and very low cost.

Dr. Hornberger asked about the distinction between Class I and Class II facilities. Dr. Lotko replied that the review committee did not seek to create a balance between the classes; they felt proposal pressure should set that. They did feel it important to distinguish between the two, as new Class I facilities require a much larger investment.

Dr. Kempton noted that international engagement was not addressed in the report; she suggested this might provide opportunities for leverage. Dr. Lotko agreed; he noted that the majority SuperDARN radars are note funded by NSF; other distributed arrays are also significantly funded internationally. Dr. Lotko remarked that this type of cooperation has a long history.

Dr. Lotko noted the new EISCAT partnership, which appears to provide access to all data immediately upon membership; the cost for membership is approximately $1 million. He noted that all distributed arrays, by their very nature, are international.

Dr. Hodges suggested considering CubeSat as a third class of facility. Dr. Lotko asserted his confidence that the scientific community would eventually develop the full capacity of CubeSat, but noted that the NSF was unlikely to do so on its own. He noted that NASA is hosting a competition for students to propose CubeSats. Dr. Lotko described the committee’s intention as improving the balance of funding to scientific value; they believe their recommendations regarding CubeSat do so.

A staff member noted that technological advances may make it possible to develop a Class II ISR system; this could allow Class I facilities to be phased out.

Drs. Semeter and Hodges spoke of the role of proposal pressure in finding the balance of value; Dr. Hodges cautioned that proposals will, in the short-run, follow historic directions. Dr. Hodges noted that the capabilities of CubeSat are likely to become much less expensive as technology costs decline.

Dr. Lotko noted that the review committee recommended a senior review between Decadal Surveys; if the costs of CubeSats had been reduced in this interim, adjustments could be made. Dr. Shepson reminded participants that the report is advisory and will be reviewed by NAS.

A staff member asked if the review committee had considered decommissioning costs. Dr. Lotko replied that they had not. The recommended budget milestone is 2020; the committee felt that allowed sufficient time to address these costs.

A staff member noted that an independent study of CubeSats is underway at NAS, commissioned by NASA and AGS. The report from this study should be released in the next few months.

Dr. Hornberger requested and received a motion to accept the review committee’s report; the motion was seconded and passed by voice vote without opposition.

**Report on the AC ERE meeting in March 2016**

*Scott Doney, AC GEO*

Dr. Doney offered a brief report from the Advisory Committee on Environmental Research and Education (AC ERE). He noted that the committee includes members from advisory councils to every directorate.

AC ERE has been moved, and is now part of the Office of Integrative Activities, which reports directly t o the Director. The ERE working group includes members from each directorate.

A gold report, *America’s Future*, was releases in September 2015; it included several grand challenges and big ideas, but was short on specifics. The AC ERE was charged to develop more specific recommendations. This process is ongoing; a community survey will be released shortly, focused on identifying key emerging questions to serve as focal points for NSF investments. Dr. Doney noted that the survey would be distributed to AC GEO members, and ask that they disseminate it within their communities.

At its last meeting, AC ERE received a number of presentations from external speakers, to assist them in refining their thoughts about interconnected systems, the role of engineering and design, sustainable urban systems, and resilience.

Dr. Doney underscored the need for AC GEO members to disseminate the survey, when it is released. The AC ERE committee will synthesize the results; a report to AC GEO will be made at the Fall meeting.

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

*George Hornberger & AC GEO Members*

Dr. Hornberger reported that Dr. Zanzerkia had expressed interest in convening a subcommittee to assist with the ongoing EarthCube review. Dr. Zanzerkia confirmed the names of those who had expressed interest in serving on such a subcommittee: Drs. Constable, Semeter, Lyons, and Kempton.

Dr. Cavanaugh reported that a group of Program Officers had been convened based on their interest in cyberinfrastructure; this group has grown as discussions have broadened to include issues of data access and DMPs. She noted that the group may need to split in time, to address these issues separately.

Dr. Hodges suggested that AC GEO endorse a pilot program to improve two-way communications between EAR and community stakeholders. Dr. Hornberger agreed, noting the need to determine what forms of communication work best, and the opportunity for EAR to pilot this effort.

Dr. Hodges suggested AC GEO endorse efforts to address technician support through the IF program, and to clarify the criteria used to evaluate technician support proposals for funding. Dr. Hornberger agreed.

Dr. Hornberger asked AC GEO members to suggest speakers and topics for the Fall 2016 AC GEO meeting:

* Dr. Hornberger suggested a speaker from the Division of Computer & Information Science & Engineering (CISE) might be invited to address AC GEO at the Fall meeting; Dr. Wakimoto will invite Victoria Stodden, co-chair of the Advisory Committee on Cyberinfrastructure (ACCI).
* Dr. Doney suggested an update on broader impacts from the Office of Integrated Activities would be appropriate for the Fall meeting.
* Ms. Arroyo suggested an update on the Director’s Innovation Initiatives.
* Drs. Van Dover and Hornberger discussed the need to better understand the potential role of NSF in international science initiatives. Dr. Cavanaugh suggested that Division Directors might be asked to consider these topics within their subcommittees, in order to identify ongoing initiatives and initiatives of interest in their communities. AC GEO members expressed interest in learning more about gaps NSF might seek to fill and places where other countries can be left to take the lead.
* Dr. Fuentes suggested an introduction to the new staff person leading efforts to recruit and retain minorities in the STEM sciences.

Final Thoughts from the AD. Dr. Wakimoto noted that Dr. Doney had asked him to consider the future of GEO and the scientific community. He remarked on the importance of core research in GEO, particularly in light of budget strictures. Dr. Wakimoto expressed some concern that GEO is perceived to be moving away from this core with initiatives such as INFEWS, and he noted the importance of reassuring the community that core science is essential to GEO.

Dr. Wakimoto noted the challenge of maintaining a balance between facilities and science, and regretted that these are places at odds to one another. He noted that GEO-wide, the financial balance is relatively stable at 50/50. Dr. Wakimoto remarked that this balance can be difficult to sustain, as facilities costs tend to grow. This balance will have to be monitored carefully. Dr. Wakimoto noted that the RCRV and AIMS programs are proceeding.

Dr. Wakimoto commended the good ideas emerging from the geospace review.

Dr. Wakimoto recalled that, during his tenure as AD, GEO faced hostile scrutiny from the House Science Committee; the scientific community came together to support the value of geosciences with a single, unified voice. Dr. Wakimoto expressed his hope that this unity would not be disrupted as budgets shift; he noted the power of the community, when it is united.

Dr. Wakimoto reported that he routinely urges faculty to engage their legislators in support of geosciences; the funding is not an entitlement. The university community also needs to come together in support of geoscience, and to understand this support is now part of their responsibility.

Dr. Wakimoto noted that the IPA program had come under scrutiny from the Inspector General; he encouraged AC GEO members to encourage faculty to consider the IPA program. He noted that this program allows NSF to function in a middle ground, between a true federal agency and university communities. This allows NSF to avoid becoming insular; the IPA program supports continuing movement of personnel between universities and the NSF.

Dr. Wakimoto noted Dr. Fuentes’ concern about minority recruitment and retention. He remarked on the Director’s support of these efforts, and nearly $700 million in funding for broadening participation. He noted that money does not seem to address the root issues; and encouraged AC GEO to think about and explore these concerns.

Regarding his successor, Dr. Wakimoto stated that the best gifts he can offer are the Division Directors. He commended their leadership and the stability they will provide through the transition in his position. Dr. Wakimoto acknowledged the GEO staff are the greatest strength of the organization, and assured the AC GEO members that they are in good hands.

Dr. Wakimoto concluded by acknowledging that the realignment of the polar program could have a huge impact on GEO; this is yet to be seen.

Dr. Hornberger commended AC GEO on a good meeting; updates on many topics will be offered at the Fall meeting. Dr. Hornberger expressed his thanks to Melissa Lane and adjourned the meeting.

**Meeting Adjourned**