

## NATIONAL SCIENCE FOUNDATION (NSF)

Advisory Committee for Polar Programs (AC-OPP)  
Fall Meeting, October 30-31, 2019  
National Science Foundation Headquarters  
2415 Eisenhower Avenue  
Alexandria VA 22314

### MINUTES

#### Action Items Arising out of the Fall 2019 AC-OPP Meeting

1. Dr. Patricia Quinn volunteered to serve on the Arctic Committee of Visitors (COV). Dr. Kelly Falkner will work with AC members who are not present to gauge their interest in serving on a COV. AC members eligible for the COV who are not present at this AC meeting will be contacted by email about their interest in joining. The AC will be informed by email of the outcome of the COV membership.
2. An AC-OPP subcommittee will be established to work on promoting diversity in the polar sciences. Resources on the topic will be disseminated. Dr. Weingartner will email the committee for thoughts on the subcommittee charge with the goal of having a draft by the spring meeting and possibly an individual to take the lead. He will also solicit suggestions for membership on the subcommittee. The AC-OPP spring meeting will discuss the draft charge, whether to go forward, membership and leadership. Dr. Brandon Jones and Dr. Elisabeth Rom, OPP Polar Education Liaison, will be asked to provide a list resources on what NSF has done so far.
3. The next AC-OPP meeting will build in sufficient breaks to allow for productive side conversations.
4. The spring meeting will discuss the overall state of Office of Polar Programs (OPP), including program financials against priorities and future plans.
5. An update will be provided at the spring meeting on the modernization of McMurdo Station.
6. At the spring AC-OPP meeting, Dr. Simon Stephenson will further elaborate on the NSF Response to the Arctic Portfolio Review.
7. Dr. Alexandra Isern will provide a detailed time breakdown for the Long-Term Ecological Research (LTER) subcommittee via email.
8. The spring AC-OPP meeting agenda will include an update on the JASON report NSF has commissioned to advise the Foundation on the tension between international scientific collaboration and security concerns over IP, dual-use technology and related issues. Links to recent articles in the magazine *Science* will be provided to ACC-OPP members. Dr. Rebecca Keiser, who has been involved in the JASON study, may speak to the AC-OPP at its spring meeting.
9. Further consideration will be given to holding a joint session with the Advisory Committee for Advanced Cyberinfrastructure at a future AC-OPP meeting.

## Attendance and Membership

### AC-OPP Members Present:

Dr. Thomas J. Weingartner, College of Fisheries and Ocean Sciences, Institute of Marine Science (Ret), Chair, AC-OPP  
Dr. Douglas H. Bartlett, Scripps Institution of Oceanography, University of California, San Diego  
Dr. Aron L. Crowell, University of Alaska, Anchorage  
Dr. Michael D. DeGrandpre, Department of Chemistry and Biochemistry, University of Montana, Missoula  
Dr. Mark Flanner, Department of Climate and Space Sciences, University of Michigan, Ann Arbor  
Dr. Patrick Heimbach, Institute for Computational Engineering and Sciences, The University of Texas at Austin  
Dr. Allyson Hindle, University of Nevada, Las Vegas, School of Life Sciences  
Mr. Steve Iselin, U.S. Navy (Ret), Iselin Consulting Enterprise, LLC  
Dr. Vera Kuklina, Department of Geography, George Washington University  
Dr. Brice Loose, University of Rhode Island, Graduate School of Oceanography (via telephone)  
Dr. Meredith Nettles, Lamont-Doherty Earth Observatory, Columbia University  
Dr. Eric Steig, Earth and Space Sciences, College of the Environment, University of Washington (via telephone)  
Dr. Abigail Vieregg, Kavli Institute of Cosmological Physics, Eckhardt Research Centers, University of Chicago, IL (via telephone)

### AC-OPP Members absent:

Mr. Raymond V. Arnaudo, Department of State (Ret), member, Advisory Committee, Environmental Research & Education  
Dr. Amanda Lynch, Institute at Brown for Environment and Society, Brown University, Providence, RI  
Dr. Michelle Mack, Center for Ecosystem Science and Society and the Department of Biological Sciences, Northern Arizona University (via telephone)  
Dr. Adam Marsh, School of Marine Science, University of Delaware  
Dr. Patricia Quinn, Pacific Marine Environmental Laboratory, National Oceanic and Atmospheric Administration (NOAA)  
Dr. Sharon Stammerjohn, Institute of Arctic and Alpine Research, University of Colorado

### Office of Polar Programs and other NSF staff present:

Dr. Kelly K. Falkner, Director, OPP  
Dr. Scott Arnold, Senior Advisor, OPP  
Dr. Greg Anderson, Program Director, Arctic System Sciences, OPP  
Dr. Andrew Backe, Management and Program Analyst, OPP  
Dr. Scott Borg, Deputy Assistant Director, Directorate for Geosciences (GEO)  
Ms. Kimiko S. Bowens-Knox, Program Analyst, OPP  
Ms. Renée Crain, Research Support & Logistics Manager, OPP

Dr. Paul Cutler, Program Director, Antarctic Glaciology, Antarctic Sciences Section (ANT),  
OPP  
Dr. Xujing Jia Davis, Arctic Sciences Section, Arctic Natural Sciences  
Dr. Roberto Delgado, OPP Program Director, Arctic Observing Network  
Dr. Irina Dolinskaya, PD, Division of Civil, Mechanical & Manufacturing Innovation (CMMI),  
Directorate for Engineering (ENG)  
Ms. Amanda Greenwell, Director, Office of Legislative and Public Affairs (OLPA)  
Dr. Karla Heidelberg, Program Director, Organisms & Ecosystems, Polar Education, OPP (via  
telephone)  
Dr. Claire Hemingway, Program Manager, Office of International Science and Engineering  
(OD/OISE)  
Dr. Alexandra Isern, Program Director, Research & Logistics Integration, Antarctic Sciences,  
OPP  
Dr. Brandon Jones, GEO Front Office, Program Director  
Dr. Yekaterina (Katia) Kontar, American Association for the Advancement of Science (AAAS)  
Science and Technology Policy Fellow, Office of Polar Programs  
Ms. Pawnee Maiden, Administrative Officer, OPP  
Mr. Timothy McGovern, Ocean Projects Manager, OPP  
Dr. Kendra McLauchlan, PD, Division of Environmental Biology (DEB), Directorate for  
Biological Sciences (BIO)  
Dr. Jennifer Mercer, Arctic Research Support and Logistics Manager, OPP  
Dr. Peter Milne, Program Director, Ocean & Atmospheric, OPP  
Mr. Robert C. Moller, Supervisory Legislative Affairs Specialist, Congressional Affairs Group  
(OD/OLPA)  
Dr. Robert Moore, Program Director, Aeronomy and Astrophysics, OPP  
Dr. Vladimir Papitashvili, Acting Section Head, Antarctic Sciences, OPP  
Dr. Frank R. Rack, Arctic Research Support and Logistics Manager, OPP (via telephone)  
Ms. Kate Ruck, Contractor, Section for Arctic Sciences, OPP  
Mr. Wilson W. Sauthoff, Science Assistant, OPP  
Mr. Paul Sheppard, Deputy Section Head, Antarctic Infrastructure and Logistics, OPP  
Ms. Stephanie Short, Section Head, AIL, OPP  
Mr. Simon Stephenson, Section Head, Arctic Sciences Section (ARC), OPP  
Dr. Marc Stieglitz, Program Director, Arctic Natural Sciences, OPP  
Dr. Cynthia Suchman, OPP Program Director, Arctic Natural Sciences  
Dr. James Swift, Chair, AC-OPP Ad Hoc Subcommittee on the U.S. Antarctic Program's  
Research Vessel Procurement, (via telephone)  
Dr. James Ulvestad, Chief Officer, Research Facilities, Office of the Director (OD)  
Ms. Beverly J. Walker, Science Assistant, OPP

### **Wednesday, October 30**

#### Opening Remarks, Introductions, and Conflict of Interest (COI) Review

Dr. Weingartner; Dr. Falkner; Dr. Isern

The meeting began with introductions of all those attending and with Dr. Falkner thanking everyone for attending. She noted the committee is subject to the Federal Advisory Committee

Act (FACA) and reviewed some of its elements. Dr. Weingartner reviewed some changes to the agenda. Next, Dr. Isern provided the committee with a COI briefing. Dr. Falkner also discussed her recent trip to an Ohio State University event commemorating the 50<sup>th</sup> year since women were first allowed to go to South Pole Station. The event at Ohio State occurred at the same time as the first all-woman walk in space. Those two women came through the Antarctic Program as part of their careers, Dr. Falkner said. A live link was established between the International Space Station (ISS) and McMurdo Station while the two women were in space. A live link was also established with South Pole Station. Dr. Heidelberg, joining the AC-OPP meeting from McMurdo, said it was a standing-room-only event at McMurdo Station. Dr. Falkner also briefly discussed the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAIC), the largest single Arctic field program OPP has ever supported.

#### Final: Advisory Overview Document

Dr. Weingartner; Dr. Falkner

Dr. Weingartner said that *An Overview of Advisory Studies for the Office of Polar Programs*, the report AC-OPP has been working on for the last 1.5 years, is complete. He thanked everyone for their input and, in particular, Ms. Walker. Dr. Falkner said the report synthesizes a number of studies and she expressed her appreciation for the committee's ability to roll up a large number of current documents and recommendations into one picture. She predicted it would be immensely helpful for interacting with other advisory committees, for individuals on the Hill, and for those in other parts of the government that OPP works closely with, such as the State Department. She said the report is of very high quality and again expressed her appreciation.

Dr. Weingartner and Dr. Falkner asked committee members to individually sign the document.

#### Committee of Visitors Discussion & Subcommittee Formation

Dr. Weingartner; Dr. Backe; Dr. Isern; Mr. Stephenson

Dr. Falkner discussed the origins of COVs at NSF. They started out of a concern in Congress that an old-boy network might be influencing funding decisions. One of the responses was a new process that used outside experts to review procedures for making these decisions, which is what COVs do. The COVs have stemmed off the impression that the process was unfair. Every Foundation program is currently required to be reviewed every four years. In OPP there is an Arctic COV and an Antarctic COV. Each COV must have a member from the AC. Dr. Quinn has volunteered to serve on an Arctic COV. Dr. Falkner said another volunteer is needed for an Antarctic COV.

Dr. Weingartner said the COV reports are comprehensive and NSF is required to respond. He described the COV as a committee of external experts that provides NSF with their judgements on the quality and integrity of the merit review process, program operations, and program-level technical and managerial matters pertaining to proposal decisions. Now that NSF has transitioned into not having deadlines for proposals, it is important to see how that is working as intended. Volunteers will be solicited after tomorrow's COV presentations, he said. One of the conditions of COV service is not having been funded through the particular division within the past five years.

Dr. Isern said a member cannot have an active award and 25 percent of the members can't have had an award within the program under review for the past five years. A member can have an active award in Arctic, but not Antarctic, to serve on the Antarctic COV. Dr. Weingartner added that the AC member cannot chair the COV. Dr. Falkner said when one gets to sit on the other side of the table, one gains a fuller appreciation of the complete process. The COV looks at a representative sample of both declines and awards and answer a number of questions. Much of the work is online and can be done from where you work prior to meeting face-to-face. The COV's work is done in closed session as the information needs to be safeguarded.

Dr. Isern added that between the time of appointment to when the COV ends, one cannot submit a proposal. The COV chair cannot submit a proposal until the report is delivered to the AC. Dr. Falkner said her COV service was a good learning experience. Dr. Nettles said she did an Antarctic COV in 2013 that was fun and educational and recommended it to her colleagues. It was also useful to be able to go back to communities she interacts with to say it is a well-run process and give insight about how the process is handled.

Dr. Backe outlined the timeline. The planning process begins five to six months out. Policies and procedures are reviewed and a date for the COV is set. The COV chair is appointed. A list of COV-suggested members is developed. Within a five to six-month period the selected COV members are appointed and charged. Within four to five months, NSF staff start assembling data sources. Some committees involve a self-study by NSF, but it is not mandatory. But he said staff will look at, for example, responses to core questions. Also scheduled for this period is conferring and discussing results with the COV chair. One to three months before the COV, Webinars are initiated with COV members for procedural briefings. Any further data collected over that time are shared with the COV members and chairs via Webinars. About two weeks before the COV, a final Webinar with COV members is held to make sure they are able to use whatever system is being used to view proposals. Next is the COV meeting. Its work product is a draft consensus report that includes completed COV report templates. There is also a required briefing to NSF. It is advised that approximately one to two weeks after the COV, the chair will have close to final report for NSF. The Foundation looks at the report for factual inaccuracies or disclosures of confidential information and adjustments are made, if required. At least four weeks prior to the fall 2020 AC-OPP meeting, the COV report is presented to the AC for it to review prior to its meeting. At the meeting, it is reviewed and the AC votes whether to accept the report. After AC approval, NSF will start preparing its response. For Antarctic sciences, they do an April COV and the COV report is presented at the fall AC meeting. At the next AC meeting in the spring, a response is presented by NSF. Once that response is reviewed, the report and response go to the Office of Integrative Activities (OIA), which posts them on a public website, as does OPP on its site.

Dr. Crowell asked about the importance of COV results to shaping the grants programs in light of two examples: 1) the 2016 Arctic COV identified that the majority of proposals were taking more than 180 days (dwell time) and recommended that be improved, which was behind the removal of deadlines; 2) The COV identified the problem of program mortgages, which comes from multi-year grants and having a significant amount of money committed several years out, and not having money for the current round of proposals.

Mr. Stephenson said quite often members of the committee do not have expectations for what they will discover and take an open-minded view. The dwell time issue was something NSF was aware of, but it was important to see it written out. The lack of deadlines reduced the number of proposals received, which has helped with dwell time. Regarding Dr. Crowell's second example, Mr. Stephenson said some data were misinterpreted. Looking back at the outyear commitments, all programs were well within the NSF guidance. A correction was made in the response. The issue had also come up with the Artic Observing Network (AON) program and the Social Science program, whereas Arctic Natural Sciences (ANS) and the Arctic System Science Program (ARCSS) had low commitments. We wanted to give ourselves the impetus to do the right thing, he said. In the intervening time, his office has drawn down further the issue of out-year commitments. It is an NSF standard to have out-year commitments, he said. But if they are low, it gives the Program Directors (PD) flexibility to do different things from year to year.

Dr. Falkner said that across the Foundation, COVs have recurringly raised the issue of not understanding what Broader Impacts (BI) are. In response, OIA put together a video guide and reached out to panels to explain what NSF intended by BIs. It also emerged that people were not satisfied with the quality of some of the reviews. These types of findings that come from the reports are taken very seriously by NSF, and the BI training OIA developed addressed the whole Foundation. Sometimes it takes fresh eyes to identify things we might not see because we're so busy, she said.

Dr. Isern said when she was a Section Head in Earth Sciences (EAR) the COV noted the burden on the community regarding the number of review requests, which led to a positive discussion about the workload on the staff. In response, her section dropped deadlines, one of the first Divisions to do so.

Dr. Weingartner noted that in the Arctic report's comment on panel summaries, the COV said they only combined what the ad hoc reviewers provided; presumably, he said, that has changed. He asked what the anticipated time commitment is for serving on the COV.

Dr. Nettles said every proposal has its own jacket and includes everything from the reviews to panel summaries to the Program Officer's (PO) summary and any emails or notes of phone calls with the Principal Investigators (PI) that track progress, budget decisions, etc. It is necessary to read everything in the jackets you are assigned. It requires less time than reviewing the proposal would. She said it was not a burdensome amount of time. At NSF there is a meeting that lasts from one and a half to two and a half days. Afterwards there is a small amount of email follow-up.

Dr. Isern said, in response to a question, that COV members are given a set of topics to address. COV members would also receive the section's take on that set of topics, along with data on the new deadline experiments.

In response to a question from Dr. Steig about COI, Dr. Isern said if an AC member has a current award with Antarctic, that member cannot serve on the Antarctic COV. AC members who have

no award with Artic can serve on the Arctic COV. She said there are AC members eligible to serve on the Antarctic COV. Dr. Steig is not currently eligible to serve.

Dr. Loose asked about the requirement that COV members be significantly impacted by the program they review. Dr. Falkner read the requirement: “COV membership should include representatives of those disciplines, fields and activities that are significantly affected by the outputs and outcomes resulting from NSF awards recommended by the programs under review.” We wouldn’t go out on the street and ask someone who runs a hot dog stand to take this on, she said.

Dr. Isern added that for Antarctic, there are about 10 members and membership would be distributed to represent those areas of research covered by Antarctic Sciences.

Dr. Loose asked about including members who have recently retired. Dr. Isern that was a possible pool. Out of the 10, there have to be three who have not had an award in five years and the rest cannot have active awards but could be previous awardees. Dr. Falkner mentioned including people funded by other agencies or those in an allied field in lower latitudes.

Dr. Bartlett asked if it was correct that about 30 percent of proposals are funded. Dr. Isern said that was correct for Antarctic. Each submission is considered unique. If someone resubmits, it is considered a new proposal. Dr. Falkner said overall statistics for the agency are made public as part of what the National Science Board (NSB) reports.

Dr. DeGrandpre commented on the workload when he was an Ocean Sciences (OCE) COV member in 2003, noting the chair did most of the work. Dr. Isern said the chair carries a lot of the load. Dr. Falkner said one of the first actions is identifying an individual with the appropriate expertise and skills to make the committee effective and productive. Dr. Isern said OPP chooses the chair, who is someone of significant reputation willing to devote the time. The COV members are chosen with the chair and the AC member. AC members are free to suggest possible chairs and members.

Dr. Falkner said she would like to identify AC COV members before the AC-OPP meeting ends. Dr. Quinn, who is not in attendance, has volunteered for the Arctic COV.

Dr. Isern said a balance of experience is sought. Dr. Nettles noted that since Polar Programs includes a review of the logistics programs, it might be helpful to have people with that expertise. Dr. Isern said the COVs have evolved since Dr. Nettles served and Antarctic field logistics would be included in a limited way. Mr. Stephenson said the same holds for the Arctic COV.

Dr. Weingartner closed the discussion, which will be taken up again at tomorrow’s session.

### Advancing the Earth System Modeling

Dr. Easterling

Dr. Easterling noted that Earth System Science (ESS) is not a new idea and that when he was hired at The Pennsylvania State University, he joined the Earth System Science Center and his title remains Professor of Geography and Earth System Science.

He discussed a new National Academy of Sciences ESS study. The idea originated, he said, with several conversations he had with members of the community and those working in facilities and across the Foundation where ESS comes into the conversation or is being practiced almost every day. He also referenced conversations with The University Corporation for Atmospheric Research (UCAR) board of trustees and noted the community climate model that the National Center for Atmospheric Research (NCAR) is working on, which is a showpiece for doing work on long-term climate change and climate variability on shorter timescales. They have learned that the most significant scientific progress, which leads to increasing accuracy and predictive reliability of their models, comes with the fuller representation of more than just the atmosphere to include the oceans and what's fluxing both materially and energy-wise between the Earth's surface on land as well. What started as the Community Climate Model has been renamed the Community Earth System Model. The board of trustees that advises NCAR has repeatedly pointed out that the Foundation needs to think more broadly and in a more integrated way about what goes into Earth's climate today and the climate in the future. ESS is not simply a focus on climate prediction and understanding dynamics. It is a model for understanding how the Earth as a whole operates.

He said there are many definitions of ESS but recommended one: "ESS is the application of systems science to the Earth. In particular, it considers interactions and 'feedbacks,' through material and energy fluxes, between the Earth's sub-systems' cycles, processes and 'spheres' — atmosphere, hydrosphere, cryosphere, pedosphere, lithosphere, biosphere, and magnetosphere— as well as the interactions of human societies with these components."

Dr. Easterling presented a diagram depicting the evolution of ESS, which attempts to capture the processes inherent in the concept of ESS. It includes atmospheric exchanges with terrestrial biota and the oceans and the cryosphere to Earth processes in deep time. He said it is important to understand that solid Earth science and the ability to look back in Earth history is an important component of ESS.

Dr. Easterling listed some of the benefits of an ESS approach:

- Can study any one component of the Earth system (atmosphere, hydrosphere—including oceans—lithosphere, cryosphere, biosphere, and human interactions) with explicit couplings to all other components of the Earth system
- Enables new discoveries not possible when studying individual Earth system components in isolation, e.g., recent discovery of warming atmospheric rivers changing hydrologic balance in west coast mountains—water management challenge
- Earth history analogs to understand environmental change, e.g., recent discovery of 2.7M year-old-Antarctic ice—potential for new insights into the chemical composition of the atmosphere and Antarctic climate during times of comparable, or even greater warmth, than the present day

- Improved forecasting skill, for example, in operational weather forecast systems—from medium-range to seasonal—that are beginning to include ocean and sea ice coupling, also terrestrial processes, allowing a fuller representation of their interactions and hence better forecasts
- Engineering systems that provide resiliency to natural hazards, geoengineering for stabilizing Earth’s climate
- Human activities are explicit and part of the Earth system, e.g., importance of understanding processes driving energy use for predicting future trace gas emissions.

Dr. Easterling elaborated particularly on the second bullet point, explaining that atmospheric rivers that transport water vapor from the tropics in the Pacific Ocean to the mid-latitudes in the west are changing the hydrologic balance in the western U.S. mountains. Commonly referred to as the Pineapple Expresses, they have typically been cold core systems that dropped snow in the higher elevations of the coast ranges. That snow is extremely important from a human standpoint. It becomes the source of runoff and water for irrigation in the summer months and for water supplies more generally.

Now, these atmospheric river systems are warming up because of their traverse across extremely warm water and they tend now to arrive even in the higher elevations as liquid precipitation. The water runs off immediately and hits reservoirs in California at a time when hydrologists are trying to manage for flood, and they pass the water on through, whereas it normally would have been captured and used in the summer for public water supply and irrigations. This is a major change affecting many parts of the Earth system and involves many different kinds of scientific expertise to fully understand what’s happening, forecasting it, and understanding what is happening downstream to the impacts.

ESS touches on a lot of the major priorities across the fabric of the nation’s science. Looking at science priorities developed at the Office of Management and Budget (OMB) in collaboration with the Office of Science and Technology Policy (OSTP), Earth system prediction is now explicitly mentioned as a major national priority this year for the first time.

At the Foundation, ESS is interwoven through the 10 Big Ideas, for example, Growing Convergence Research. Much of what needs to be done under ESS would fit well within convergence research, bringing together deep integration of different disciplines and bringing to bear new methodologies, like big data assimilation and the ability to access high performance computers in new ways. This all provides the opportunity to converge our science on a collision path where theories merge together between different disciplines, which is the ultimate goal of convergence science. In GEO, many of the research frontiers identified in *Dynamic Earth: GEO Imperatives & Frontiers 2015-2020* point directly at ESS. There are also longstanding GEO and OPP programs and new investments, such as Coastlines and People (CoPe) that are drawing on the structure of ESS to solve scientific problems in a fundamental sense and delivering useable knowledge to society in the process.

An ESS initiative at NSF would provide the ability to enter into partnerships beyond the Foundation. NCAR, he said, has bought in fully to the notion of ESS as the underlying approach

for advancing its main climate model. Another example is developing linkages between NCAR and the National Ecological Observatory Network (NEON).

NSF is asking the Academy to take a four-pronged approach:

- A broad overview of the current state of the science Earth systems
- Develop a framework to enable NSF to develop and deploy an ESS research program that fully exploits facilities, for example NCAR, NEON, Ocean Observatories Initiative (OOI), Seismological Facilities for the Advancement of Geoscience and Earthscope (SAGE), Geodesy Advancing Geosciences and Earthscope (GAGE), and University-National Oceanographic Laboratory System (UNOLS)
- Advise NSF on how to integrate workforce training in Earth System education at all levels, with an emphasis on growing diversity
- Identify ESS synergies between NSF and other Federal agencies.

Dr. Easterling concluded with a draft timeline for the study:

- September – November 2019: Engage NSF, other Federal agencies, ACs
- October – November 2019: Study framing with the U.S. National Academy of Sciences, Engineering and Medicine (NASEM) leadership
- December – January 2020: Solicit NASEM committee member nominations
- February 2020: Charge Committee
- February 2020 – December 2021: Committee deliberations and writing, periodic NSF engagement
- December 2021: Receive committee report and recommendations.

#### *Discussion:*

Dr. Steig asked about renaming NCAR to the Center for System Science because many researchers see it as for atmospheric sciences only. Dr. Easterling said the UCAR trustees have had an ongoing conversation with NSF on that topic. He said because of its standing, changing the name will be a heavy lift, but NCAR's staff scientists include ecologists, ocean scientists, boundary layer Earth scientists, aeronomists, and people looking at space weather and people who study the cryosphere. Dr. Steig, said he was not actually suggesting changing the name.

Dr. Weingartner asked about interest from the private sector. Dr. Easterling said the private sector has not fully explored the ramifications of ESS. But climate science has given rise to a lot of private sector interest in everything from climate prediction to smart sensors that can go under ice. And financial institutions are interested in what sorts of environmental changes are coming and how to anticipate the risk of extreme events that interrupt economic activity.

Dr. Flanner asked if the Academy has agreed to do the report. Dr. Easterling said the NASEM Director was convinced of the idea's scientific merit and the timing of doing a study and she gave her full endorsement. An NSF committee reviews every proposal for a NASEM study and this one has been approved.

## R/V Laurence M. Gould Live Interaction

Ms. Walker introduced a live video link with the Laurence M. Gould (LMG) in the Southern Ocean facilitated by The Inner Space Center (ISC) at the University of Rhode Island (URI) Graduate School of Oceanography. NSF is working with ISC on new capabilities for education and outreach. ISC was funded to do a test case of getting new high-bandwidth transmission capabilities on the LMG, one of two research vessels in the Southern Ocean.

The ISC Director, Dr. Dwight Coleman, addressed the committee via the video link to ISC. Before switching to the Gould, he described the project, Antarctic Broadcasts for Broader Impacts Through Telepresence (ABBITT). He said it is a pilot study to test that this type of communication will work with a ship in the in the Antarctic. During the summer, a larger program conducted more than 40 live broadcasts from the Northwest Passage onboard the Icebreaker Oden. The audiences are museums, science centers, zoos and aquariums. With school in session the focus is on K-12 school groups. One broadcast done recently had more than 1,000 individuals join from 48 different groups in 13 states. A Facebook Live event had 75 live views and more than 2,000 views of the video that was posted after the event. He said it is an effective way to communicate science and showcase the activities onboard the ships in remote locations and connect the general public, students, and scientists to what is happening live aboard NSF-funded research platforms. ISC conducted a national baseline study for the Northwest Passage project, which found the majority of U.S. citizens do not understand much about the research being funded in the Arctic or Antarctic. He said there is a large demand for this sort of content to be communicated. Audiences are learning more about what is happening by following along. The ISC can also capture content throughout a project and mix that into the programming with a production team that queues up content relevant to the discussion. Going forward, it will allow the public to understand research NSF is funding. Also, live science can be recorded and shown to broader audiences later. ISC can do follow-up work with researchers from the studio or their home offices. It is a broader impact tool that can be incorporated into research proposals and he looked forward to a future ISC doing more with NSF and other partners.

Next, a live link was established with Dr. Holly Morin, marine biologist and ISC Education Specialist, outside the bridge of the LMG in the Southern Ocean's Gerlache Strait, trending north back from Palmer Station, where she said the temperature is 1.5°C with a windchill of -15°C.

She talked about pushing the envelope of available technologies to put together interactions to connect individuals at schools and elsewhere with those conducting important research in the Southern Ocean and at Palmer Station. The interactions so far have been very successful with very engaged audiences and very good questions about the science and life in Antarctica that have impressed the scientists.

She introduced Dr. James Girton, an oceanographer at the Applied Physics Laboratory and affiliate assistant professor of oceanography, University of Washington, and Dr. Ryan Newell, an oceanographer at the Applied Physics Laboratory, University of Washington.

Dr. Girton discussed a device called the WaveGlider, which he described as an autonomous surfboard propelled by wave power and solar power for electronics. It collects meteorological

and ocean data. He said the measurements are important because the Southern Ocean is the hub of global ocean circulation and the gateway to Antarctica and the key to the heat transport involved in sea level rise.

Dr. Newell discussed prepping the WaveGlider for its deployment, which he said is tricky due to the many pieces that are connected by long wire. The boat's crane is used to deploy the WaveGlider. Dr. Girton said the WaveGlider continuously sends back data and will be used for open ocean surveys across some of the fronts in the Antarctic as well as on the Continental Shelf. Dr. Newell said the plan is to retrieve the WaveGlider in mid-February.

Dr. Newell and Dr. Girton also briefly discussed how much they enjoyed their trips aboard the LMG.

Dr. Morin asked about the LTER project at Palmer. Dr. Girton said this is one of the treasures of the climate observing system. He said he was interested to see if the WaveGlider and other autonomous platforms can expand the project's reach.

Dr. Morin thanked the two scientists and said she was excited at being able to bring that into classrooms. She discussed an upcoming session with a high school with a robotics program.

### *Discussion*

In response to a question from Dr. Crowell, Dr. Morin said sometimes she is able to view remote participants. During an Arctic cruise, the Northwest Passage Project, there was a monitor so she could see her audience, but that was not set up for this presentation.

Dr. Crowell asked about the WaveGlider sensors. Dr. Girton mentioned an atmospheric package, surface stress measurements, turbulence measurements and multiple types of wave measurements.

Dr. DeGrandpre asked about the ship's satellite system. Dr. Coleman responded that for the Northwest Passage Project, ISC installed on the Oden a very small aperture terminal (VSAT) antenna, with a Ku-band 1.2-meter dish, which is a portable system. It was shipped there in an NSF lab van. On the LMG, ISC is using the ship's existing Fleet Xpress system, which ISC was familiar with from UNOLS ships, but had to make some changes to make it work, including paying for expanded bandwidth and working with the provider, World-Link Communications, and the satellite owners for dedicated service-level treatment. He noted that, nonetheless, the video sometimes freezes and has audio dropouts. ISC is continuing to evaluate the technology to determine how effective and easy it is, when paying for the extra bandwidth, to use it for video conferencing and live video broadcasting, which was not necessarily an intended use. The geostationary satellites are mostly equatorial so the terminal on the ship must look at a low angle through a lot of atmosphere, which can be affected by weather and other factors. Data are being collected on weather conditions, geographic position within the satellite footprint and for evaluating the capabilities of the satellite communication technology.

Dr. Easterling asked about the room and board on the ship. Dr. Newell described two-person bunkbed cabins and a day room; he said they have their own bathrooms. Dr. Morin said she had her own room with a desk and lots of closets for gear. She said the food is very good.

Dr. Crain asked about the video that has been interspersed during the current link with the Gould, which has shown different parts of the ship, including people working on instrumentation, and whether that type of footage has changed the interactions and influenced the ability to talk about the science. Dr. Morin said it creates a sense of place for students and helps them connect. She said it is a real bonus to have that capability to tell the story and it enhances the broadcast. Dr. Coleman added that audience surveys demonstrate the value added from cutting in other camera angles and content to help explain the story and make it more engaging. Between broadcasts from the ship, ISC shoots footage and the same satellite link is used to transfer those video files to ISC, where there are editors who turn that into content that looks good on the screen. Because of limited bandwidth, the video would not be as good if it was played back from the ship; instead, those shots are played in high definition from URI.

Dr. Hindle asked about the network of schools. Dr. Morin said ISC has been working with different schools across the U.S. on a variety of projects for some time, so the connections are well established. There are also strong relationships with Rhode Island teachers and ISC goes back to those teachers to see how a project fits into their curricula. There is also an application process for new teachers.

Dr. Bartlett asked about how long the WaveGlider can be out at sea and its high seas capability. Dr. Newell says it does well in seas of most any size. Because the power unit is eight feet below the float part and is heavy, and because of the WaveGlider's low profile, it rides well, bobbing up and down with the waves. It could possibly roll with large breaking seas, but it should flip back over. Currently it is in four feet of seas and is transmitting okay. It should continue to operate until February, which is possible because of solar power and batteries.

Dr. Morin thanked everyone at NSF before signing off.

NSF Response to the Polar Research Vessel Requirements Subcommittee Report  
Mr. McGovern; Dr. Weingartner

Dr. Weingartner said that in April 2018 the AC formed a subcommittee to look at the U.S. Antarctic research vessel procurement program. The subcommittee reviewed the existing science mission requirements for the vessels, prioritized each proposed vessel's capabilities and operational requirements. The subcommittee was also tasked to consider the two-ship operational model for the U.S. Antarctic program and evaluate the advantages and disadvantages of a one-ship operating model. The subcommittee conducted a community survey and assembled a report, which was submitted in early August, 2019.

Mr. McGovern said the response he will be offering to the report is preliminary and thanked the subcommittee for its effort and complemented it for the community survey. He said it was also beneficial to have the freshest and most realistic requirements for a new vessel. The willingness

of the subcommittee to hear NSF's potential budgetary challenges and produce some alternate approaches to meeting the needs of the seagoing community was also helpful, he said.

OPP is following its internal procedures for advancing its efforts to recapitalize the ships. Earlier this week there was a meeting with GEO leadership to present the current status of the ships and the vision OPP would like to see going forward. The idea of a government-owned vessel vs. a contractor owned vessel was discussed. At the next AC-OPP meeting Mr. McGovern hopes to have more information to share.

### *Discussion*

Dr. Nettles asked about the scope of OPP's coming response. Mr. McGovern said he could not yet share exactly what OPP will do, but there are a number of gates to pass before it becomes an official project.

Dr. Ulvestad said that for major facility construction there is a separate budget account called Major Research Equipment and Facilities Construction (MREFC). For an NSF-owned vessel, it would have to go through MREFC, which includes a design stage, with a number of phases. To get into that stage, OPP and GEO would have to bring this forward as a project to the Office of the Director (OD). One of the things under consideration at NSF is whether more projects should be put in that design stage and not necessarily committing to all of them. The practice over the last decade has been that something put in the design stage carefully advances and nothing else is allowed in the design stage until it is a certain distance along because of trying to stage when the construction is done; everything can't be put in the account at the same time. But that also constrains the Foundation in some ways because sometimes the national science strategy might move in a different direction and it might be good to have a project that is in the design stage and is close to ready to go when the country decides that is an area to invest in. If there is only one project in design and the Foundation didn't guess right, that becomes an issue. But the basic process of advancing through design will hold. We would expect the directorate and the office to invest some money in development so the concept reaches a stage where it is mature enough that we can start putting it in this design process, he said. OD is trying to look at a broad strategy for the whole agency, looking at the priorities for science across the country in all the areas NSF invests in and having to play off an Antarctic research vessel against a telescope against a next-generation gravitational wave detector.

Dr. Swift said, via a note to the AC, that the subcommittee appreciates the letter of thanks from NSF; it was an interesting assignment, a good group to address it, and the subcommittee enjoyed its work. He thanked Mr. McGovern and others for their assistance.

Dr. Falkner said the report is comprehensive and very useful. There are many questions OPP has and many avenues have been explored, though not all, about how to handle a one vs. two vessel operation and other things. She said the group is making significant progress and OPP is behind Mr. McGovern's goal and she is hopeful it will be achieved. But she said it is necessary to go through the process.

Dr. Ulvestad added that one could imagine starting the concept of a government-owned vessel into the MREFC design stage, which does not preclude OPP from later deciding it is a better deal to have a contractor-owned vessel that is leased. He advised OPP and GEO that if they are not sure, to get started on the process of moving toward the MREFC queue and if they decide later it is better to lease, that will not be a problem. Dr. Falkner said, based on that, she is more confident of reaching the goal for the next meeting.

Dr. Borg said comments on the report would be welcomed and he urged patience. The concept of how to redo ship renewal has been around for a long time. He also thanked the subcommittee.

Dr. Weingartner said the AC reviewed the report and submitted comments. If there is a more extensive design, how many more committees will be needed, he asked.

Dr. Easterling also thanked the subcommittee and OPP. He offered assurance that NSF is moving forward and starting to focus on some potential directions. He and others are straining at the bit, wanting to say where they are going but are still trying to bring things into focus.

#### Navigating the New Arctic (NNA) Update

Dr. Anderson; Dr. Dolinskaya; Dr. McLauchlan; Dr. Mack

Dr. Falkner said OPP had been hoping for many years to have an increased level of investment in Arctic research, knowing the magnitude and pace of change and that research needed to be accelerated to catch up with that because of its important implications for the nation in terms of economics and security and ways of life. She said the next presentation is from the core working group at the Foundation who have been amazing. They are the poster child of how to work together across the Foundation in seamless ways. They have cut across the different possible disciplines that could be involved in this endeavor and have been able to communicate well with each other and work through numerous issues.

Dr. Flanner said there will be a joint presentation from Drs. Anderson, Dolinskaya and McLauchlan.

Dr. Anderson introduced his colleagues said that although he works for OPP, he is from NNA when he is here. He and the others think of themselves as being a team that crosses a lot of boundaries.

Dr. Anderson presented a graphic showing the change in the average November to April temperatures during his lifetime, 1969 to 2019. He said there has been a 1°C global average change during that time. The Arctic is warming at significantly higher rate: almost 7°C. As the world and the Arctic warm, we know the Arctic is changing and that's what drives him and the others. It changes through the natural and built environment and the effects on the people who live there. This is causing the permafrost to degrade, and the ground becomes more vulnerable to erosion. As the sea ice retreats, and ocean waves hit the coast with greater force, the effects include coastal villages in Alaska that suffer. Wildfires are more widespread, more intense and more frequent. These changes affect the people who live there and the distribution of animals and plants. As the ice melts in Greenland, it has an effect on sea level rise. He said the U.S. East

Coast is dealing with the effects of sea level rise, partially from the melting. There are also new opportunities for taking shipments across the Arctic, vs. the Panama Canal, which has an effect on economic structures across the globe. What happens in the Arctic doesn't stay in the Arctic, he said. NNA is NSF's new response to these challenges and opportunities resulting from changes in the Arctic.

NNA has three goals for FY19:

- Improved understanding of Arctic change and its local and global effects
- New and enhanced research communities that are diverse, integrative, and well-positioned to carry out NNA-relevant research
- Research outcomes that inform U.S. national security and economic development needs and enable resilient, sustainable Arctic communities.

He said these components occur in the overlap of the natural environment, the built environment and social systems.

Dr. Anderson said the familiar programs in the Arctic sciences are not going away as a result of NNA. NNA is another way of supporting science of the Arctic. NNA is different from other initiatives because it crosses geographic boundaries, NSF organizational boundaries, and intellectual boundaries. NNA has people from all over the Foundation, but when they work together, they're NNA, he said.

The idea of convergence is central to NNA, Dr. Anderson added. He described the concept in terms of a marble cake. Think of the classic disciplinary science project as a layer cake. A multidisciplinary research project is like stacking multiple layers on top of one another. One layer can be taken out and a different one inserted. It is a different cake, but still a multidisciplinary project. And you can take it apart without too much of a mess. A convergence research project can't be taken apart. If you try to take it apart it is going to be a mess and there isn't any way to take its pieces apart. Beyond going multi-disciplinary and trans-disciplinary, it is bringing together approaches from different intellectual fields in a way you can't meaningfully take apart.

Dr. Anderson turned next to the co-production of knowledge, which NSF defines as the integration of different knowledge systems and methodologies to systematically understand the phenomena, systems, and processes being studied in a research project. This can include research in which local and indigenous people and organizations fully engage in the complete research process.

Co-production is a feature and is encouraged for an NNA project, when it is appropriate, but it is not always appropriate. Also, co-production is not synonymous with either BI or social science. It is a way of thinking holistically and bringing knowledge systems together.

Last year NSF put out the first stand-alone solicitation for research proposals and planning grants and a 2020 solicitation is underway. The NNA initiative is to last at least five years and will be refined based on the progress of projects and feedback from the scientific community.

In FY18, 20 projects were funded with a total budget of \$22.7 million. He discussed a soundscape ecology project to assess environmental and anthropogenic controls on wildlife behavior. The project quantifies changes on an Arctic scale. Audio sensors and cameras are being set out all over Alaska and the Yukon to record the soundscape, which is processed using big data and cyberinfrastructure tools to automate the identification of different species that are making sounds and how those species are showing up early or later and their distribution.

He also discussed MOSAiC, the largest ever Arctic expedition, which is freezing the Polarstern icebreaker into an ice flow for a year to measure the biogeochemical and physical environment above the ice, in the ice and below the ice to understand the hierarchic climate. The Polarstern has just recently begun drifting north, he said. There are more than 600 participants from 19 countries. NSF's support is approximately \$27 million. The mission can currently be followed [live online](#).

In FY19 there were 47 awards comprising 21 projects, with a budget of \$37.6 million. Thirteen are research projects and eight are planning grants. There are 123 senior personnel involved and two awardees are new. The new awardees were new indigenous organizations. The awards include the sought-after overlap of different disciplines. Other parts of NSF saw projects in the portfolio as beneficial to their research and so there was co-funding of about \$7.6 million from across the agency. He also discussed an NNA project on the Arctic impacts and reverberations of expanding global maritime trade routes (PIs: Elise Miller-Hooks, George Mason University).

Dr. Dolinskaya discussed an NNA planning grant award, for up to two years and \$250,000 (PI: Julie Brigham-Grette, University of Massachusetts at Amherst). This award looks at water security and the impact coastal erosion and global warming and permafrost thawing have on water infrastructure and the impact on the resilience of Arctic communities. The scientists are partnering with the Alaska Native Tribal Health Council and organizing workshops in Alaska that will invite participants from 30 communities to discuss their concerns about the water infrastructure. This project integrates the study of natural environment, the built infrastructure and social systems. The project team includes engineers, natural scientists, indigenous knowledge holders, and includes community needs and community assessments.

Dr. McLauchlan discussed another example, The Permafrost Discovery Gateway (PI: Anna Liljedahl, University of Alaska at Fairbanks). This project looks at the intersection of the natural and built environment (cyberinfrastructure and stable platforms for constructing other physical objects on the Arctic surface). She discussed a map illustrating permafrost locations, densities and carbon storage in the Arctic. There is a potential feedback with the Earth's climate system where the carbon that stored in permafrost could be released to the atmosphere and serve as a positive feedback to climate warming. That highlights the need to map not just the static locations of permafrost but the dynamics also. This project proposes an online platform that takes big data imagery and machine learning to identify the areas of change. This will allow investigations of the drivers of change.

Dr. Anderson also discussed what is coming next:

- Continued outreach: Webinars and office hours for prospective PIs and presentations to advisory committees and other groups
- Workshops: Arctic Change Workshop, October 31 to November 1, 2019, and NNA PI meetings
- FY20 solicitation: Coming soon.

### *Discussion*

Dr. Steig asked about the fast turnaround time and how it disadvantages new investigators. Dr. Anderson said this is the reason for Track 2 in the solicitation. Those planning grants are to help teams develop over time. The Webinars and office hours are also helpful for bringing in new recruits. Dr. McLauchlan added that the new awardees are institutions that have never before submitted a proposal for NSF funding. Career stage has been well represented in the awardee base.

Dr. Steig also asked about PI workshops being broadened to those who don't have funding. Dr. Dolinskaya said the PI annual meetings are for those who have received NNA awards, including planning awards, to build up the community. Another goal is to bring in new researchers; for that, there are outreach workshops.

Dr. Loose asked about the review process, including novel approaches to choosing reviewers and merging panelists from different disciplines. Dr. Anderson responded that there was good success with the review process. All the panels were interdisciplinary. It was interesting to watch the panelists work together to understand each other's ways of thinking. There was a lot of thought put into having panels with the appropriate breadth.

Dr. Kuklina asked if members of indigenous communities who do not have qualifications, such as traditional knowledge holders, can be PIs. Dr. Dolinskaya said yes, and that it is being encouraged. When researchers claimed they would bring in indigenous knowledge without having the right partnerships from those communities, that was called out during the review and the proposal was dinged for that. Dr. McLauchlan added that there are many ways indigenous communities chose to engage, from coproduction to community engagement or interaction. NNA is trying to be careful not to overwhelm the indigenous communities with too high expectations and to make sure they have choices about how and when and with whom they engage.

Dr. DeGrandpre asked about selecting for certain disciplines due to the needed connection with social sciences. Dr. McLauchlan said the connection with social scientists is not a requirement. Dr. DeGrandpre also asked about selecting technologies based on program design. Dr. Anderson responded that there was a diverse set of projects and there is not an unusual skew.

Mr. Stephenson distinguished between NNA and the rest of the Arctic section of science programs that are open to supporting work on sensors that don't include the intersection of different disciplines. Dr. DeGrandpre asked if the advice was not to submit proposals that do not have overlap between disciplines. Dr. Anderson said the solicitation requires a question in the overlapping space. But for a disciplinary or interdisciplinary project that is not in the overlap, approach one of the Arctic programs. For a project with an aspect of social science and an aspect

of physical sciences or physical sciences and engineering, the proposal can be submitted to another program, if it doesn't fit with NNA. And Dr. Anderson said if he sees it, he can determine if there is interest in ENG to do a co-review.

Dr. Flanner asked if there is a grand plan for how solicitations will evolve over the years. Dr. Falkner noted that she did not provide a budget update because nothing has changed since the spring meeting and NSF continues to operate under a Continuing Resolution. What will happen at the Foundation will depend on the appropriations. But the idea for all the Big Ideas was that they needed to be out there for about five or more years to gain traction. The working group has thought about the evolution of where the solicitations will go, but there is an internal approval process that requires vetting of all the solicitations, the frequently asked questions and the management plans behind the scenes. Dr. Anderson added that NNA anticipates the solicitation will evolve over time to enable the community to come forward with ideas that have a big impact. But if you make too abrupt a change, it can throw the community for a loop.

Dr. Bartlett suggested that for programs that are likely to be continued there be some placeholder on the OPP website, so the community is aware it is under discussion for the next year to provide continuity and visibility. Dr. McLauchlan said there is an NNA website, which she said perhaps should be linked to the OPP site. It says NNA is a five-year program and provides an email address, which currently provides a response to please wait for the solicitation. It isn't possible to provide details yet, she said. Dr. Bartlett said the lack of a link is a big problem. Dr. Anderson said there could be a glitch. Also, for NSF programs, if you have written a solicitation and have released it and are revising a solicitation, typically the other solicitation is on the Web as a marker that there is a program with this name. But when the new solicitation comes out it will say that it supersedes the other document; also, it is possible to view the history.

Dr. Falkner said the NNA site is meant to have an OPP page. She said it may have only been there while the solicitation was open. She said it will get sorted and thanked the presenters.

#### Polar Field Safety Risk Management

Ms. Renée Crain; Dr. Jessie Crain; Dr. Nettles

Dr. Nettles said this presentation is a follow-up to some of the discussion from a year ago. Ms. Renée Crain said that in Polar Programs there are many different types of risk that must be managed with people deploying to the Arctic or Antarctic. It is especially useful to have a conversation about researchers deploying to the field and the ways in which NSF can help enable them to have safe and productive field seasons. The discussion evolved out of asking where we can have those conversations and how to engage the stakeholder community to enrich the resources to researchers.

She said there are three key pieces to focus on:

- Field Risk Management Board for Higher-risk Antarctic projects
  - Engaging subject matter experts on particular field activities
  - Using feedback to modify field plans to enhance safety
- Polar Field Safety Risk Management Conference

- Following up on previous meetings: 2013 (Arctic)
- Including researchers, field safety experts, university risk management offices, field station operators, and other stakeholders
- Propose holding a meeting in spring 2020
- Guidance and “Good” Practices.

Dr. Jessie Crain discussed the review of Antarctic Projects. She said work has started on identifying the sorts of the things we would want a board to work on. One would be flagging projects for further evaluation at the award stage and after awards are made getting assistance looking at the details as people are putting together specific field plans. A lot of this work is handled by a support contractor. It breaks down into identifying needs for teams to bring field safety guides with them to certain types of sites and whether a field site needs some additional safety evaluation. The Antarctic Support Contract (ASC) has compiled some information about how much of this they do, how many field guide resumes they are working on and what sorts of expertise they might be looking for from the community. She asked for recommendations on how best to bring community members into a process like this. Options would include a standing group of people who would serve for a particular term or having a pool of people who could be called on for particular needs.

Ms. Renée Crain said the idea is to get academic researchers who have first-hand experience with similar work to provide additional insights without putting them in a position of liability or risk to themselves for having provided input on a potentially risky project.

Dr. Nettles said not all Antarctic projects would go through this process. It would be just a few projects a year that needed extra input on whether there needs to be ground-penetrating radar on a particular traverse, whether special precautions are needed on a particular ice edge environment and who in the community can provide that feedback and at what stage of the review that happens.

Ms. Renée Crain said her office was interested in engaging the community of researchers, mountaineers, field guides and university risk management offices, field station managers and others. There was a productive discussion in 2013 specific to the Arctic that engaged a broad array of stakeholders, including early career researchers and more seasoned researchers. She would like to build on that workshop. At the end of the season there is a discussion with the support contractors in the Arctic and Antarctic to discuss some of the things that came up and how to address them and learn from them. There is consideration being given to having another field safety risk management conference, possibly in the spring, for Arctic and Antarctic researchers and the other stakeholders. She is particularly interested in having university risk management offices involved. The institution is responsible for the conduct of the research under the award and her office would like to have that engagement from risk management offices. And they typically provide 24-hour, 7-day-a-week emergency coverage. They have a lot of expertise to bring to the conversation. She said she'd like to have the AC help develop the steering committee and the agenda.

She also discussed good practices. The term used to be “best practices,” but she raised the question of who decides what is a best. These include guidance and procedures to address specific activities:

- Field manuals for field stations in the Arctic and Antarctic
- ASC-developed Field Safety Procedures, e.g. sea ice edge
- CH2MHill Polar Services (CPS) developed Arctic-specific risk management procedures, e.g. avoiding wildlife encounters
- Sharing information about incidents and near misses broadly on the CPS website enables reflection and learning.

Dr. Jessie Crain said that over the last couple of years ASC has been working on revising the field manuals and procedures. The revised versions are divided into a continental field manual for people deploying to the field through McMurdo and a peninsula manual for people working on the peninsula islands. The new manuals are easier to handle and use in the field. They are also finalizing a glacier travel technical guideline for people doing snowmobile traversing in glacial areas. They are also working on products that are more internally focused for programmatic operations like deep field emergency response planning. Also, better practices for notification.

Ms. Renée Crain said feedback and ideas are welcomed, especially from those with their own experience or if the communities they represent have brought you things that might improve field safety. She said she would like to have regular conversations with the AC on this topic and make sure the research community is involved and engaged in helping develop these field safety risk management processes and tools.

Dr. Nettles emphasized how much everything is feeding together as a set of good practices. Some of the things that NSF and the contractors are doing now came partly out of the discussion at the previous workshop and have helped develop a community of practice around safety that Ms. Renée Crain and Dr. Jessie Crain have been working to foster.

Dr. Falkner commented that plenty of times things are set in play and that it is clear to all how they participate. At times, we learn that things aren't as clear as intended. That was demonstrated with respect to recent Title IX challenges pertinent to field work. The AC committee spent time talking about harassment in field settings that was reported to have been a problem in polar research. The Foundation responded with clarifying award terms and conditions that should help to better connect university sponsored program offices and Title IX offices and diversity inclusion offices. Risk management would be another area where increasing connectivity will help everyone in the system. Some universities that may have only one or two people at their institution conducting fieldwork may not appreciate NSF's expectations. We need all involved, to be sure the university systems as a whole understand the responsibilities and roles and help contribute to solutions.

She thanked everyone involved and said there would be more at an upcoming meeting.

Dr. Weingartner closed the meeting for the day.

**Thursday, October 31**

NSF Response to the Arctic Portfolio Review

Mr. Stephenson; Dr. Lynch

Dr. Falkner told the AC that Dr. Lynch, who headed the portfolio review, could not attend the AC meeting for reasons outside her control. In addition to today's session, the issue will be revisited in the spring, when Dr. Lynch can attend.

Mr. Stephenson briefly reviewed the charge to the committee:

The Arctic Portfolio Review Committee was asked to:

- recommend the critical programmatic capabilities needed to enable progress towards building a vibrant and relevant scientific program
- recommend the balance of investments in the new portfolio of grant programs, facilities, and other activities within budgetary constraints.

He also reviewed the committee membership, noting that it was constituted in March 2018 and had:

- a balance of observational, experimental, analysis, and modeling
- eight women, eight men
- two early-career scientists
- one member who has never received OPP funding.

Mr. Stephenson said the spring discussion went well. He had prepared response remarks but did not get to deliver them because the committee engaged well with Dr. Lynch. The committee required give and take to get to some of the recommendations. All of the recommendations are intended to push for better support for the research community. He added that the committee could have used more time together.

The committee recommended that ARC be re-constituted as three standing programs that invite proposals using one or more defined approaches:

- Natural Sciences and Systems (NSS)
- Social Sciences and Systems (SSS)
- Coupled Human-Natural Systems (CHNS)

Mr. Stephenson said he will refer to CHNS as Social and Environmental Research since there is already a Coupled Natural and Human Systems (CNH) program. He said there is agreement that the Social and Environmental Research has had stop-start support. NNA, he added, is the game in town now and most Social and Environmental Research should be supported under that \$30 million program. ARC will also make it clear that Social and Environmental Research is welcome in ARCSS. ARC would like to keep ARCSS in part because of the issues Dr. Easterling

discussed yesterday. The Arctic community made similar points in 1988 at NCAR and NSF started ARCSS to do the same functions that Dr. Easterling discussed. Even it might not have always been on the mark, the rationale for the ARCSS program remains in place. In about 2010, NSF created an environmental science program and was being drawn to fund smaller projects that were supported in ANS and less of the more complex and risky projects that were being proposed in the system sciences. At the time it was thought they should be separated again, and the community encouraged to do system science. These are strategic investments and the same is true of the AON. The community had a lot of input in the creation of AON. The portfolio correctly pointed out that no one knows what the network piece is for AON.

The portfolio review committee also recommended ARC be re-constituted as three standing programs that invite proposals using one or more defined approaches:

- Deep Dive Investigation
- Strategic Envisioning
- High Risk and Exploratory Research
- Synthesis and Integration
- Long Term Perspectives

Mr. Stephenson said ARC should be more strategic about its strategic envisioning, particularly in ARCSS and AON. There are changes being made to the solicitation now and it should be out by the end of the year. The recommendations from the review committee that can be adjusted now, without a further review by the AC, will be picked up on and ARC will work more with the community to shape and adjust ARCSS and AON.

Mr. Stephenson said ARC will learn from what was heard yesterday from the NNA committee. They held open office hours for POs and Webinar Town Halls for input. That is an approach that can be used to become informed about where the community sees NSF taking ARCSS, AON and other programs. When NNA ends, the portfolio of projects will have outgrown a home in ARC and the recommendation for a separate program will have to be revisited.

Returning to the review committee recommendations, Mr. Stephenson said synthesis and integration, along with long-term perspectives, will be left as programs, with emphasis more on the long term and less on the network. In the spring, ARC will come back to the AC and the COV and discuss the portfolio.

Balance of investments was a matter of considerable tension in the committee, but it concluded:

- Field logistics is recognized as critical and should be supported at the current level
- Existing field research facilities should be maintained but do not need to be expanded nor added to
- Cyberinfrastructure needs serious investment, particularly with regard to innovative approaches to data services
- CHNS can start small but should grow over time.

Mr. Stephenson said the review committee talked about cyber and education and engagement with communities and talked about logistics but didn't have much to say except that the program was well synced with the science requirements, which was nice to hear. The review committee pushed for more in the cyberinfrastructure area and ARC agrees with that and Dr. Falkner has moved on hiring for a new position and the AC can push ARC more in that direction. There were also supportive comments about education and yesterday there was discussion of potential new tools for bringing the work that is done to the world in real time. If the AC wishes to strengthen one or two paragraphs in the report, that would be welcomed.

Regarding engagement with communities, Mr. Stephenson said the committee meeting was before the release of the FY19 NNA call and it did not have the portfolio of proposals. The committee emphasized NSF support to help researchers engage with communities and communities to engage with the research enterprise. This is something we've been hearing a lot more, he said. It was picked up as part of the spring meeting's discussion of the principles of conduct that we should be helping the research community and the indigenous communities in coupling with the enterprise. The highest bar is probably co-production, where projects are built together, recognizing that in some cases it makes complete sense for the people living in the system, that they have their own questions and they can benefit from working with scientists and scientists can benefit from working with the community members. A lower bar is letting people know what you are going to be doing before they do it, and at the end of the process when results are coming out and helping set the fall research agenda. This has been tried, but it hasn't always been successful. There is a good way of doing it now. Other agencies have their favorite town or village where they have good on-the-ground relationships. We wouldn't want to replace those but want to use them by bringing them into a bigger picture. He said this is a Federal interagency objective. The comments there are appreciated: Webinars do not work well given bandwidth limitations; Facebook is the tool of choice for engaging with communities, as well as travelling to them for face-to-face interactions.

### *Discussion*

Dr. Falkner suggested questions be asked now, but for the sake of timing they will be answered later in today's meeting.

Dr. Kuklina asked about human-natural systems. She asked if NNA is for larger projects and the other for small systems.

Dr. Heimbach asked about cyberinfrastructure. He said the breadth of it is not just software infrastructure and machine learning but also the hardware and providing data as a service to allow everyone to do expensive analysis.

Dr. Flanner asked about how long long-term is in reference to AON and about the type of extended measurements NOAA is involved with.

Dr. DeGrandpre said AON is a unique program and if it has its own individual separation it will not be possible to have sustained, five-year projects and the generation of data products that are the focus of that program.

Dr. Nettles said she was surprised by how much the response is clarification of wording in the solicitation as opposed to grappling with the restructuring that the committee recommended. It is a good time to think about where you want to be at the end of NNA and whether that should have a bigger home in the Arctic and preparing for that now could be strategically useful.

#### Enhancing Diversity in the Polar Research Community

Dr. Delgado; Dr. Jones.

Dr. Jones, who manages education and diversity programs, discussed Inclusion across the Nation of Communities of Learners that have been Underrepresented for Diversity in Engineering and Science (INCLUDES), which he described as the oldest of the 10 Big Ideas. Its vision is to catalyze the Science, Technology, Engineering, and Mathematics (STEM) enterprise to work collaboratively for inclusive change, resulting in a STEM workforce that reflects the population of the nation.

INCLUDES has five design elements:

- Shared vision
- Partnerships
- Goals and metrics
- Leadership and communication
- Expansion, sustainability and scale.

INCLUDES was launched in 2016 and included Design and Development Launch Pilots (DDLp) and conferences. In 2018 and 2019 INCLUDES gained a Coordination Hub that is beginning to connect the DDLps. It also added five Alliances in FY18 and three in FY19. One, the Inclusive Graduate Education Network, includes the American Geophysical Union (AGU) as a partner. The FY19 Supporting Emerging Aquatic Scientists (SEAS), is an all-islands alliance, led by the University of the Virgin Islands.

Dr. Jones discussed a planning grants solicitation to build capacity for the development of collaborative infrastructure to facilitate innovative partnerships, networks and theories of action for broadening participation in STEM and to lead the establishment of future centers or alliances or other large-scale networks to address broadening participation in STEM. These grants allow individuals or groups or institutions to start to pull together teams or ideas to continue to expand the INCLUDES network.

Dr. Jones turned next to Geoscience Opportunities for Leadership in Diversity (GOLD). The idea behind GOLD came from a long-standing GEO program that looked at diversity and inclusion at the K-12 and undergraduate level. That program found that there were individuals and teams who were successful in sustaining those efforts and there was an effort to isolate those characteristics of success and scale them up in an effort to broaden participation.

He said the data on diversity and inclusion in the geosciences is pretty bad. But there has been a lot of money and support going into efforts to increase diversity over the last 40 years and most

of that energy is going into increasing numbers of people who have not been involved. There has been an effort to pitch and sell geoscience and Polar Programs, advertising them in a way believed to be attractive to students.

But he said the institutional culture was not supportive and was, in fact, quite toxic in many instances. If we are serious about different perspectives to address all of the social and environment issues, we want individuals to bring all of themselves to the scientific enterprise.

Previous successful NSF diversity programs had a common element of an individual strongly committed to leading the effort. GOLD is seeking to identify these leadership qualities. The five GOLD pilot projects are:

- Academic Success Program to Improve Retention and Education (ASPIRE): Spanning Boundaries
- Hearts of Gold: Leveraging Status
- Sparks for Change: Unifying Change Agents
- Geoscience Diversity Experiential Simulations (GeoDES): Developing Affinity (mixed reality)
- FIELD: Reducing Barriers.

ASPIRE seeks to connect geoscience expertise with communities that need it to address an issue. The leadership piece is developing individuals who have credibility in both of those worlds so there is a natural bridge.

Hearts of Gold seeks to leverage individual senior scientists who have the social and scientific capital to push this effort in science and geosciences.

Sparks for Change is focused on underrepresented early career faculty at institutions and providing support externally and internally with two different types of mentors that form triads. The individuals are connected to empower them to be change agents.

GeoDES uses a mixed reality method for training, such as avatars and online training, for bystander training and anything related to diversity and inclusion.

FIELD is to look at barriers to recruitment and retention and the issue of harassment in the field culture as it relates to geosciences.

For FY 20, Dr. Jones said a draft document is being worked on to see what can be done to expand the GOLD network and figure out ways to onramp to INCLUDES.

### *Discussion*

Mr. Iselin asked Dr. Jones how he will know if he is successful. Dr. Jones said the critical element to push GOLD forward is the inclusion of the social scientists and the necessity to have that expertise in the room when dealing with education and diversity issues when dealing with the geosciences. Success will not look like what the typical scientist would deem successful

because we are working that out with our social scientists who are bringing different ways to evaluate these programs. He noted that a new issue of the *Journal of Geoscience Education* about diversity and inclusion in the geosciences and several GOLD PIs are authors and there is an article that provides an overview of GOLD. Dr. Falkner said the journal issue describes the current state of affairs. She said that over time there were explicit policies to exclude people that were active in polar research for a long time. Those have evolved and there has been progress, but we would be remiss not to realize we live a legacy of that. Also, for a long-time people perceived that polar regions are disconnected from the major systems on our planet, they were remote, and that there were some nutty people who chose to go there and work under extreme conditions. And maybe you were somewhat interested in the heroic exploits of what they were doing but otherwise it was not central or important socially. As we have moved to a planet of nine billion people, and we are stressing resources and all kinds of social and environmental systems, we have come to realize they are not disconnected. Even if you grew up in Detroit, you have a direct stake in polar regions. We remain challenged to make clear those connections. But we do know we have a changing demographic in this country. For those who truly believe these regions matter to our understanding and how we'll move forward, we need to think of new ways to reach out past the barriers that exist and engage a more diverse polar research community. The articles paint a pretty stark picture, despite the 40-plus years of effort of trying to be sure we are pulling people in. "Let's use the current moment as an opportunity to think forward about what we are not doing and should be and what we can do differently," she said.

Dr. Weingartner asked about the failing undergraduate experience. Dr. Jones said the connection of polar research to the majority of the student body is not there. Students ask why they would want to go to Greenland or Antarctica. We need to discuss and figure out better ways to offer workforce opportunities, office and research opportunities and service learning opportunities and he referenced a 2017 Academies report on the importance of service learning in the geosciences. This generation of students, he said, is not necessarily approaching science from a discovery perspective. When you are talking about underrepresented groups it is not discovery. They are thinking there is something is wrong in my community and I know that science is going to provide me with some opportunities or tools or connections to address that issue. Or there are things going on in the world that I want to be a part of. He spoke of packaging the importance of the polar regions in that context to attract students and said he wanted to continue the discussion on the best way to start to do that.

Dr. Nettles said she had worked with graduate students in one capacity or another who are smart and successful and doing well. But when she has a conversation with them, they say they do not feel they fit in or are making it. Her perception is that they were doing fine and so not the same perception as theirs. And they are moving toward that mode of a broken bridge because they are not feeling as though they fit it. And sometimes it is having the conversation so that you know that and can reassure them, but sometimes it is something much more serious that we, having survived the whole system, are unaware of. A lot of us got where we are because we were OK with the system that existed and may not be that sensitive to the elements of the way that it works that are making it feel unwelcoming for some students. The idea of supporting the successful programs and figuring out what it is working in those is very useful. She asked Dr. Jones to say more about the next steps. She also said there is a psychologist at Columbia University who is helping us understand there are things to do in a classroom that can help

students in a meaningful way and figuring out how to move forward from a few stellar examples of programs and leadership that works to broadening our participation in the good practices that could support diversity and inclusion in broadening participation in a more long term, meaningful way for the next 40 years.

Dr. Jones responded that, moving forward, the social scientists have to be a part of this. He referred to the co-creation of ideas or research approaches with Arctic populations. You want to move together with those groups. And we want to move together with the social scientists to not only develop the methods, figure out the ways to scale, identify the qualities, but also the appropriate evaluation methods. And that brings up the question of what success is in an academic system, the meritocracy, the just-work-harder-and-stick-to-it elements that have been part of the master-apprentice model for millennia, which he said is being unraveled. He said undergraduates are not approaching their degrees in the traditional way. They will cobble together credits from a community college and some from an online college and a certification over here and they'll put it together and do what they want to do. The education and training models are changing. He said it also brings up a unique issue with the history of the United States and certain groups that science still struggles with. Good inroads are being made with women and the Lesbian, Gay, Bisexual, and Transgender (LGBT) community but we still struggle with Hispanics, African Americans, and Native Americans and you can't pull that apart from this history of this country and how science has been a part of that history. That's why social scientists need to be involved, to not only help us deal with those pieces but to help us walk through the history and figure out how to move forward with the blind spots Dr. Nettles was hinting at. With her students that she described, from her perspective they were doing okay and then she had a conversation with them and found out differently. How many advisors or mentors or professors do that? Where is the mentorship training, which is another big piece for these efforts? There is so much that needs to be addressed.

Mr. Stephenson said ARC works with northern communities, in Alaska and Greenland, and the Greenlandic government is interested in bringing in students from Greenland, most of whom are indigenous. We are beginning to recognize this is generational. Our measurement system might have to be longer term.

Dr. Jones agreed and said that was part of a different way of evaluating. He used an example of recruiting African American girls into the ocean sciences who had stellar grades and experiences. But they had an issue with being able to care for their hair. So longer-term evaluation metrics have to include all these other elements that the traditional or normal culture may not be aware of. That is going to take time, but hopefully not a full generation.

Dr. Iselin referenced the Department of Defense, where there were mandated legal, socioeconomic programs that required a certain number of contract awards to go to small disadvantaged business, businesses from Hub zones, disadvantaged geographic areas, etc. He said he did not know if there are any mandates within the NSF that suggest awards to investigators go to people from underrepresented communities or reward investigators for bringing along a colleague from the underrepresented constituencies. He said it would be a more direct approach.

Dr. Delgado said organizations such as the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) offer an opportunity for the Foundation to excite those diverse communities and engage them in opportunities for research, training and workforce development. Other organizations, such as the American Indian Science and Engineering Society (AISES), is another good venue to engage traditionally underrepresented communities in the types of research activities OPP supports. He also commented on his background starting out in graduate school as a field researcher in the jungles of Congo and Borneo and said it was difficult to meet those challenges not having been raised in an academic society. Having survived the graduate experience made him more sensitive to being a good mentor and sensitive to his graduate students and trainees. In his academic career he focused on Latino students and taking them to remote field sites and ensuring they were capable of responding and dealing with the different stresses and challenges of that type of effort. He has been talking to colleagues about ways NSF can reduce barriers to field work in various disciplines. He also discussed working with early career scientist groups, such as the Association of Polar Early Career Scientists (APECS) last year at AGU, which brought in scholars to talk about their experiences and brainstorm ideas for better inclusion. There is a satisfactory number of efforts to expand awareness, but not the inclusion aspect, which involves taking time for conversations about whether early career scientists are doing well under the surface. APECS is planning a task group on diversity and inclusion to continue these conversations, including at the upcoming AGU meeting to develop these ideas.

The Interagency Arctic Research Policy Committee (IARPC) is another good venue that brings together program staff from different Federal agencies working and supporting research in the Arctic, as well as academics, Alaska native and other indigenous communities, and stakeholders from Alaska nonprofits. The intent is to implement the Arctic research plan and develop ideas and work together to meet challenges. There are different collaboration teams that help to implement the research plan and work on other topics. There is now an IARPC diversity and inclusion working group, which provides a good venue for different individuals and groups to come together and identify the key challenges that should be addressed by the broader communities. Providing these types of venues and having good individuals and champions to provide some of the guidance who are listeners and able to identify what those priorities should be and bring it back to bodies like the AC-OPP and other leadership in the Foundation to potentially develop some initiatives like GOLD and others that can help advance efforts for promoting diversity and inclusion.

Dr. Falkner said there have been a number of targeted programs. The question is whether we are doing the right thing, why isn't it working, and whether there are other things that can be done.

Dr. Jones discussed a Committee on Equal Opportunities in Science and Engineering (CEOSE) report, which lists most of NSF's broadening participation programs across the research directorates. The GOLD program is highlighted in the report, as are two projects that are referenced as successful approaches.

Dr. Heimbach asked AC members about examples at their institutions of successful programs. Dr. Weingartner referred to his university's interview process for prospective faculty hires. Part

of the interview and the application covered how they would promote diversity, with specific examples of what they might bring to the faculty to promote diversity.

Dr. Hindle said many universities, including the University of California, require faculty applicants to write a diversity statement describing how the individual would broaden participation of underrepresented groups at the undergraduate level and in classes. Investigators from underrepresented groups often do a good job of engaging with their own communities and she wondered if there is a top down approach to support those investigators for a top-down approach.

Dr. Kuklina said many women have family responsibilities that cause career breaks and there need to be opportunities that address this issue.

Dr. Suchman said she represents OPP on the Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE) working group, which was started 20 to 30 years ago to promote women in science and now supports institutional change. The group has begun discussing broadening ADVANCE's mission to address intersectionality issues, which will bring broader diversity issues to bear. She said there are institutional change projects trying to move best practices made at the institutional level to other institutions.

Dr. Jones said INCLUDES was approached by Boeing for matching funds. He said part of the \$1 million that Boeing gave was related to re-entry of women into the sciences. There is energy behind public-private partnerships to also look at re-entry of veterans and the formerly incarcerated. He added that geoscience and polar content needs to be included in the K-12 system. By the time students reach undergrad, this content is new to them.

Dr. Flanner talked about a trip to Greenland over the summer with 13 undergrads, several of them from underrepresented communities. He said combining experiential learning was key and he could see how enlightened students were just from walking up onto the ice for the first time. Out of the 14 undergraduate students who took an earlier such trip, nine went on to do graduate studies in glaciology or Earth science.

Dr. Weingartner suggested revisiting the topic of this section during the wrap-up to the AC meeting with the thought of establishing a subcommittee of the AC to work on this issue of promoting diversity in the polar sciences. Dr. Heimbach added that there are resources that are new to many members and he suggested finding ways to disseminate that information.

#### COV Member Selections

Dr. Weingartner; Mr. Stephenson; Dr. Isern,

Dr. Weingartner asked if there were any volunteers for the Antarctic COV and recommendations for others outside the polar science community. Dr. Backe added that these recommendations are welcome but should not be discussed during the open meeting; they should be sent to Ms. Walker.

Dr. Isern listed the COV members who are eligible: Dr. Viereg, Dr. DeGrandpre, Dr. Quinn (previously volunteered for Arctic), Dr. Weingartner, Dr. Lynch, Dr. Flanner, Dr. Mack, Dr. Marsh and Dr. Nettles.

Dr. Weingartner said some of the members listed are finishing their rotation next fall, but they remain eligible; COV membership would continue after AC-OPP membership ends.

Dr. Isern said the COV would meet the third week in April.

Dr. Weingartner said he would be willing to be considered. January, February and part of March will be busy for him, he said. He also suggested that eligible members who are not present should be contacted by email. Dr. Weingartner said the membership issue will remain unresolved for now. Dr. Falkner said the chair can have conversations with the section heads and the AC can be informed by email of the outcome.

Dr. Backe said the guidelines state that the COV report should be presented at the next AC. Therefore, the next AC should, optimally, meet before. The AC could meet in mid-April and the COVs after that. But he said that might be a technicality.

Dr. Falkner said holding an AC meeting a week after the COV met would not be reasonable. The spring AC will probably be in the same time window but not on top of each other.

Dr. Falkner clarified that Dr. Weingartner would tentatively volunteer and Dr. Nettles cannot. She will work with AC members who are not present to gauge their interest. Anyone with input may communicate with Dr. Weingartner.

#### NSF's Communication Strategy Evolution

Ms. Greenwell; Mr. Moller

Dr. Falkner thanked Ms. Greenwell and Mr. Moller for their participation, adding that the world around us is rapidly changing in how we communicate. Everyone has experienced disruption relative to the old days and in that context NSF has to be constantly adapting.

Ms. Greenwell said OLPA's vision is to advance awareness of NSF and its entire mission through strategic communications to external audiences. Everything that NSF does supports basic research in people and that strengthens our economy, security, and keeps us a global leader.

OLPA's goals and priorities include:

- Broaden awareness and understanding of NSF
- Communicate NSF's vital mission
- Highlight our success stories
- Strengthen the NSF brand and image
- Leverage expertise and credentials of NSF.

She said OLPA is constantly evolving with the times:

- Communications are dynamic and the media landscape is constantly changing
- We need to evolve the way we communicate to make an impact for NSF
- We're assessing our process, organization and products to meet the needs of our audiences.

Discussing integrated communications, she said NSF has gotten better at integrating communications within OLPA, breaking down stovepipes. She discussed a coordinated, proactive approach to internal and external communications that involves:

- Collaboration during agency-wide campaigns
- Strategic communications group
- OLPA open house events
- Monthly directorate leadership/communications meetings.

She highlighted NSF-wide educational campaigns and what is being done on the media side, which includes more active pitches, which involves creating a story. She said there was a successful pitch with a National Public Radio (NPR) show, 1A. She also discussed a Facebook live event from Palmer Station, with over 5,000 people joining, including a lot of student questions that scientists at the station answered.

Next she discussed leveraging breakthrough discoveries. When it is done right OLPA can really capture on it, she said. The announcement of the first image of a black hole in April took a year of preparation. There were six simultaneous press conferences around the world. It was a good example of weaving in the NSF story. There was front page coverage around the world and NSF gained 40,000 Instagram followers in one day and won an award for the best social media campaign of the year.

Regarding engaging the media, she said there has been a focus on setting OLPA up like a newsroom, with a more centralized media team process, making sure the office does not drop things and is responsive to the requests that come in, building more relationships with reporters and getting better at active pitching. Priorities also include talking points on key topics, focusing more on daily science in the news, and pitching behind the scenes tours for reporters.

OLPA is also trying to improve how it identifies newsworthy stories:

- We are always looking for experts to speak to the media on a specific topic
- We maintain a list of subject matter experts
- Is the story timely and relevant to a national conversation?
- Is there a major announcement or ground-breaking discovery?
- Is NSF central to telling the story? Is there public/media interest?

Her office is also trying to improve engagement with the public:

- Reach new audiences
- Implement tech (artificial reality (AR) & virtual reality (VR))

- Develop touchscreen, interactive software
- Build exhibits, branding materials and educational items
- Speakers bureau
- External communication channels and campaigns.

She is also working on engaging the science community, with efforts that include:

- Host NSF booths at science events/conferences
- Amplify research news
- Feature significant award announcements
- Highlight community videos/photos
- Host quarterly meetings with science associations
- Attend and participate in Hill events.

Ms. Greenwell discussed how the directorates engages the science community, using:

- Directorate newsletters
- Research area Web pages
- Virtual office hours (webinars)
- PI workshops/conferences
- Distinguished lectures
- Email lists
- Events/conferences
- Branded materials.

Mr. Moller continued the presentation to discuss engaging Congress, saying it was important to maintain a two-way conversation with the Hill, making sure Congress is engaged and aware of the activities going on, have the information needed to make decisions about funding requests. His team spends a lot of time assuring that Congress gets a heads up when something might go wrong or is going well so they can take credit. He discussed the funding subcommittees and their current work. The broader mission of his office is to educate the other members of Congress more broadly. For that, the greatest strength is the 2,000 institutions NSF funds. It is important to tell how those funds are being used and impacting people in their community, supporting researchers and making their institutions better. There are State factsheets that highlight the impact that members might not be aware of. His office is also always looking for opportunities for events and outreach on the Hill and in districts.

He also emphasized that NSF:

- Identifies topics and announcements with congressional interest from researchers
- Coordinates Hill events targeted to policymakers with topical or regional interest
- Identifies opportunities to bring congressional staff behind the scenes in the field.

He said OPP is popular when it comes to bringing members of Congress to see NSF research. The more that Hill staff and members can see the research going on, it gives them more insight

into projects. Events are also held on the Hill. An AAAS fellow is working in OLPA on ideas for a more broad-based educational campaign on the Hill tying together thematic issues.

Ms. Greenwell said that the better we get at this communication, the easier it is for appropriators and others to get us more funding, she said. Mr. Moller added that Congress has been incredibly supportive of NSF and the polar programs. There is broad bipartisan support.

Ms. Greenwell discussed a multichannel review:

- Reviewed 45 communication channels
- Assessed audience, channel effectiveness, strategy
- Evaluated metrics, best practices and unique NSF content
- Held meetings with directorates, OLPA teams, stakeholders, science associations, etc.

Focusing in on social channels, she said they are important to:

- Share compelling images and viral-capable videos on Instagram
- Engage educators on Facebook and Pinterest
- Create opportunities for two-way engagement
- Develop Web stories and blogs with categories based on audience interest
- Implement digital asset management system
- Focus on storytelling and human-interest content.

Discussing how to tell the NSF story, she said her office:

- Identifies outstanding researchers to feature, e.g., Facebook Live, Instagram Q&A
- Shares content from the community for social media, videos, and campaigns
- Maintains a blog written for public interest
- Has a speakers' bureau—a new initiative
- Represents NSF at scientific events and conferences

And she put out an invitation to tag NSF on social media, using: @NSF and #NSFfunded.

The fastest growing platform is Instagram. OLPA's strategy is to look for unusual, short (10-seconds or less) videos that compel viewers to stop scrolling and learn more.

The goal with the website redesign, which is nearing completion, is to completely change the look and feel of nsf.gov and make sure there is a consistent brand and experience across all the pages. She said there is a lot of great content on the site, but it is hard to and it is all over the place in terms of what audience the Foundation is trying to reach. All the information needed for those writing proposals will be clearly identified and the basics will be improved to make it more user friendly.

Video channels are, she said, a huge content piece. The in-building studio is a big help and is used for Facebook Live and her office is trying to do more:

- NSF 101 “tip” videos for the research community
- Facebook Live events from remote locations
- Behind the scenes videos
- Science behind the news
- Compelling researcher vignettes
- The Discovery Files weekly series
- Television series on broadcast TV.

A new branding strategy was announced over a year ago, which was a huge agency-wide effort. There were a lot of places inside NSF that were using an older logo, which doesn’t help with people recognizing who we are and what we’re putting out there. One of the big pieces that came with the first branding guideline was adding language to the Large Facilities Manual to make clear what was required of facilities in terms of signage to get the brand and mission out there. There are thousands of constituents who go through the education centers of some of these facilities every year who didn’t know that it was NSF-funded, or even that it was Federally funded. A branding 2.0 strategy is coming out soon that will focus on social media guidelines and give guidance to the community on the type of content OLPA is looking for.

Looking ahead, Ms. Greenwell discussed plans for 2020 that include:

- 70th Anniversary Symposium & Gala
- Public awareness campaign
- Major events: Science & Engineering Festival, South by Southwest
- Dynamic communication initiatives and strategies
- Strategic Communications Plan 2020
- Engage new audiences and key stakeholders

### *Discussion*

Dr. Falkner added that OLPA, with a staff of 50 (including contractors), covers a very broad remit. Therefore, having to be strategic is very important. She contrasted that with the National Aeronautics and Space Administration (NASA), which has broader authorities and many more people and resources for public affairs. She said NSF has a new childcare center with a display of children’s clothes prominently featuring a NASA jumpsuit. She contacted Ms. Greenwell and the display was changed to feature a “super scientist” cape with the NSF logo. Dr. Falkner said that if people do not know that NSF is providing support, it makes the Foundation less competitive for resources. She also discussed the evolution of how news is handled. Traditionally, a scientist put out a paper with an embargo period allowing NSF to put the news out first, followed by the university.

Ms. Greenwell said the media team is focusing more on the pitches and the reporter relationships, but she also wants to make sure they are receiving content from universities and institutions. Her office is taking the research news from the field and making the clear connection to NSF’s involvement, adding quotes from POs and others, and putting that out on the Website. She wants to focus on stories that are unique to NSF where there’s interest from the media.

Dr. Falkner referred to a service that many university public affairs offices subscribe to that consolidates science news releases, EurekAlert! OLPA monitors those alerts for NSF involvement and augments the stories, which is a large change from past practices.

Dr. Weingartner said people who learn about the peer review process are blown away by the fact that one's competitors evaluate proposals and determine whether it is worth of funding, which he said does not happen in the private sector. He encouraged OLPA to publicize this.

Ms. Greenwell said this is emphasized on the Hill and there is a merit review video, though it needs to be updated.

Dr. Heimbach asked if EurekAlert! provided information too late. Ms. Greenwell said that her office does need to get that information ahead of time. She said NSF has relationships with public information officers at other institutions and her office relies on Program Managers and POs at NSF and the relationships they have with the PIs.

Dr. Crowell asked about how aware awardees are of OLPA's resources and whether responsibility for publicizing results can be made part of the award. Ms. Greenwell said there have been discussions about those kinds of changes.

Dr. Bartlett said a partner for communicating NSF science is the NSF-funded PIs, who often do Broader Impacts. He also suggested making researchers more aware that they should send videos and photos to POs.

Ms. Greenwell said her office is working on communicating about that and plans a roadshow throughout the agency. She said it is a culture change to take credit.

Dr. Nettles compared use of the term "NSF-funded" with "NASA scientists," even though most of the people doing that work for NASA are NASA-funded scientists. She asked if it would be okay to use "NSF scientist," "NSF science" and "NSF research."

Ms. Greenwell said her office is actively going over this and opinion is sharply divided. But the forthcoming public awareness campaign will make that same kind of personal connection.

Dr. DeGrandpre asked about improving bandwidth on polar research vessels. Ms. Greenwell agreed, saying Polar is a goldmine and there is much that can be done. Dr. Falkner discussed the live feed demonstrated at yesterday's session, noting the key role of having someone well trained as a host asking the questions. She was amazed to see a biologist at URI being that interface and transmitting the questions in a way that broadened the accessibility of the answers she would elicit. When there was a question about the food onboard, video was served up from URI showing shots of food preparation on the ship as the answer was being provided.

Dr. Heimbach asked about the connection between communications and artists. Ms. Greenwell said the director has been discussing this and there are discussions about a memorandum of

understanding (MOU) with the Smithsonian. Also, there are two science illustrators working for the office and their work is being widely used.

Dr. Loose asked about facilitating visits by members of Congress to research institutions in their districts. Mr. Moller said it has to be a partnership. NSF wants members and their staff to understand how important funding is to their districts and States and do it in coordination with the local institutions. He said getting more of those visits is on his team's priority list for next year.

In response to a question from Dr. Loose, Ms. Greenwell said information researchers have can be sent to [ResearchNews@NSF.gov](mailto:ResearchNews@NSF.gov).

### Wrap-up Discussion and Looking Forward to Spring Tasking

Dr. Weingartner; Dr. Falkner

Dr. Weingartner invited members to advance items for the spring meeting. Two ideas were offered earlier: The Arctic portfolio review response and forming a subcommittee to promote diversity.

Dr. Heimbach suggested that the subcommittee could consider and evaluate OPP resources, with a one-stop shop within OPP for everyone who is funded. He also suggested something similar to the Arctic advisory overview for diversity.

Dr. Bartlett said there is a need to continue the earlier discussion of going to the one-ship model in the spring when there is a full report available. Dr. Weingartner said NSF is not ready to make its plans available.

Dr. Weingartner added that more effective diversity training materials are needed.

Dr. Falkner suggested that a subcommittee could explore what has been tried as a way of starting an exercise. It would be useful to work with Dr. Jones and others to think about what it is that could be done differently. She said such a subcommittee would have a member from the AC but would include outside groups with the appropriate interest and expertise. She understands that the community is not necessarily aware of things that have been tried and said there are opportunities the AC is not fully aware of that the community is doing that might be successful models. She suggested that before the spring meeting AC members could work with NSF staff to iterate on what a charge might be for a subcommittee. At the spring meeting the AC could discuss if that is the right charge, whether to go forward and who to include. The NSF staff to work with are Dr. Jones and Dr. Elizabeth Rom, who is the Polar Education Liaison.

Dr. Weingartner said that after the AC meeting he will email the committee to contribute thoughts on the subcommittee charge with the goal of having a draft by the spring meeting and possibly an individual who will take the lead. Dr. Weingartner will also solicit suggestions for who to include on the subcommittee.

Dr. Crowell suggested asking Dr. Jones and Dr. Rom to list resources to review what NSF has so far. Dr. Falkner said she will also work to make the AC more aware of what is available.

Ms. Walker read a note submitted from Dr. Steig that noted recent actions in the Antarctic glaciology community, including an annual meeting of glaciologists, oceanographers, geologists and atmospheric scientists called the West Antarctic Ice Sheet (WAIS) meeting. It includes early career researchers and encourages women and graduate students to give talks at the expense of older researchers. The meeting is more inclusive, with a snowball effect where more researchers at early stages of their careers feel emboldened to participate. There is a pending proposal likely to be funded to lead the next big U.S. ice drilling program that will fund a research platform for scientists to propose work on. There are planning efforts designed to provide opportunities for the involvement of new people. Dr. Steig expressed optimism that the project would reach more women and other underrepresented groups and said there has been strong encouragement from NSF.

Dr. Delgado said a representative from AC-OPP is needed for the fourth decadal review of the LTER program. The program was established in 1980 for the long-term study of ecological phenomena and now comprise 28 active sites, including four that are managed or supported by Polar Programs. The sites provide an opportunity for integrated, wholistic understanding of populations, communities and ecosystems not possible through short-term awards. The external review occurs every 10 years. The review will be part of a subcommittee of the AC to the Biological Sciences Directorate. It will evaluate the significance of the long-term scientific findings and approach to research of the network over the last decade as well as evaluating the readiness to support continued research for future decades. The evaluation will culminate in a report to NSF assessing both the significance of long-term ecological environmental science produced by the network, as well as strengths and weaknesses of the network model of support. The review is scheduled to start later this year and continue on to early 2020.

Dr. Falkner confirmed the date with Dr. Delgado and said it was a short time frame. She said the charge should be sent out in writing to members, allowing Dr. Weingartner to assure he interfaces appropriately to get whatever feedback is received.

Dr. Iselin said that as a new member he is not clear on how the program is doing overall and suggested that for a spring topic. He would like information on how the program is doing financially and against priorities; also, priorities for the future and what are the things you've done that everyone should know about. Dr. Falkner said she will take that into account for the spring meeting.

Dr. Falkner reminded the AC members of the massive overhaul of McMurdo Station that is underway, known as Antarctic Infrastructure Modernization for Science (AIMS), which is an MREFC project. She said an update would be provided in the spring.

Dr. Falkner added that she typically starts off her remarks with a few highlights, including recent budget developments and major activities. She did not provide that overview because the budget did not change. She hopes that will be different in the spring.

She also asked AC members to read the document they signed yesterday. She said the AC did a massive job rolling up what we feel our current drivers of priorities are. She plans in the spring to look at that document and report out with respect to some of those elements.

Dr. Weingartner returned to Dr. Delgado's request and asked him about what the expectation would be for AC members with respect to time and effort. Dr. Delgado said he wasn't able to publicly share the LTER working group's charge, but he will provide it to Dr. Weingartner. He said the first step is generating a list of names of available and willing candidates and the Biology AC would issue the invitation, along with a timeline and expectation of responsibilities. Dr. Isern added that a package can be assembled with the charge to the committee, along with the comprehensive COI list. Dr. Weingartner said his concern is the time commitment and how that will fit with his schedule over the next five to six months. Having been on another subcommittee, there is a lot of work, he said. It is fair that AC members know the time commitment before they nominate themselves or someone else. Dr. Isern suggested assembling the time commitment and Gantt Chart, the need for COV members, and LTER and put it on a schedule and give a time commitment estimate. She said the last LTER report can be shared to show the scope of the review.

#### NSF Response to the Arctic Portfolio Review, Continued

Mr. Stephenson

Mr. Stephenson returned to questions posed earlier in the AC-OPP meeting that had been deferred due to time considerations.

In response to Dr. Kuklina's question about whether NNA is for larger projects and the other for small systems, Mr. Stephenson said it was not necessarily the case. The award size under the research piece for NNA is fairly large, with \$3 million as a cap. They also had the planning grants last time and next year is expected to look similar to FY19. There is flexibility in ARCSS, he said. He spoke to a prospective PI who was thinking along the lines of NNA, adding different communities, but wanted to propose a research coordination network type activity, which wouldn't fit the NNA call per se, but it could potentially fit under the rest of the Arctic programs. He said he did not think it would be split out by size. And NNA will adjust its plans; each year will look a little different from the last year. But ARCSS can be more flexible.

In response to Dr. Heimbach's question about cyberinfrastructure and providing data as a service, Mr. Stephenson said Dr. Heimbach plans to write a note that will circulate to the AC elaborating his point. It will not modify the committee's report, but it will be useful input as thought is being given to building out the polar cyber infrastructure position.

In response to Dr. Flanner's question about how long long-term is in reference to AON and the type of extended measurements NOAA is involved with, Mr. Stephenson referred to LTER, which is going on 40 years. When NSF created that program, it was transformative for the Foundation to commit to long-term measurements for the purpose of understanding processes that took that long to unfold. The same issue should be in play for AON and we could consider that as the framework. That creates issues, such as to how to add things if you are going to

commit to certain things for a long time. The answer is slowly. This is where strategic thinking with community input is going to be important.

In response to Dr. DeGrandpre's question about AON, sustained five-year projects, and the generation of data products, Mr. Stephenson said he wasn't clear enough on the social-environmental part under ARCSS and NNA. We want to build that out now with a mind to what happens when NNA ends in about five years, he said. The imperative is to plan what is coming. He said it is a great cross-agency partnership, but the money may be an issue in five years if it is not a set-aside program. But he wants to avoid a stop-start approach. We want to support this community we are building under NNA and when things don't fit NNA, support it under ARCSS. But there are probably things that should be under consideration in terms of a restructuring. He said he wants to keep ARCSS and AON and is quite open to the socio-environmental piece possibly outgrowing ARCSS and it would be its own thing. But are there other things we are missing in the programmatic restructuring? The point of saying we were rewording and clarifying areas in the solicitation now is because we can, and quickly. Restructuring a set of programs takes longer. He asked Dr. Nettles if there are things she thought should be looked at, triggered by the report itself or her understanding of what that background might be, that would be an opportunity to do something different now.

Dr. Nettles said her reading of the committee report was that the first two programs they suggested, the natural science and systems and the social science and systems, were not the same as what they saw to be existing already. She said she heard Mr. Stephenson saying those two first programs already exist and to have the third in ARCSS. She suggested the reason the report puts the language as natural science and systems was to highlight that a systems approach within natural sciences would fit within the natural sciences program, and the same for the social sciences. Pulling out the third bullet of the coupled human and natural systems was to highlight separately the human-environment interaction, which is another piece of the whole systems approach to the sciences. That's where she feels some of the confusion has come from in the past. Yes, there is an ARCSS program. But does that mean a systems approach within natural science or within social science, or does it only mean that coupled approach? Saying we already have these programs was not her read of the document. They were trying to pull something apart in a bigger way. Regarding the positioning, what Mr. Stephenson said makes sense, she said. You want to build on the fact that Arctic has long had a systems and Earth systems science perspective. But there has been all this confusion and sometimes changing the name of something helps say we're doing something new and restructuring a little and building the framework more explicitly for that long-term view. She added that she understood the challenge when you have NNA as a relatively new program and she understood the point about building towards that.

Mr. Stephenson said he did not spend as much time as he should have on the approaches construct for each of the three proposed programs. They all would have what they call deep dive investigations and they all would have an element of strategic support for experiments, strategic envisioning and a component of high-risk and exploratory research, and all have synthesis and integration and all have a long-term perspective. And there is a benefit to a set of POs seeing that portfolio as they make their decisions about what to fund and how to encourage different elements. One thing the POs noted was that, at least to begin with, there would be an imbalance

of the portfolios, but that is why you do a portfolio review. He said he'd try to break out what the current portfolio is and we can bin it in the proposed approach and in the current approach. He said the confusion will continue because if you are going to create programmatic boundaries there is always going to be research that is very close to the edge of a boundary. All the POs get together most every week to talk about what is coming in and what questions are out there and what one-pagers have they been receiving and people are asking what program should this go to. That little tool is helpful. That is to try and get over the confusion, so there is a program officer who will get back to the question and offer the best way forward.

He added that there wasn't the will for another review along the lines of the Arctic Horizons review of the social science program, which required a year of five workshops, but something less than that for all of the programs. That will come out through the strategic envisioning of the portfolio. There may be a need to be more strategic about strategic envisioning, so the AC has a better understanding.

He said he will further address the comments in writing.

At this point, Dr. Weingartner returned to Dr. Delgado's request for membership on the LTER review subcommittee. He said the ask was for a lot of work in a short period of time for an important program. His experience, he said, is that such subcommittees take much more time than he had initially bargained for. It involved going through a lot of material. For someone actively engaged in research and teaching, the next two months are spoken for already. He was concerned that anyone would have the time to participate, given the time frame. He asked if the period for the review could be prolonged.

Dr. Isern said she would provide a detailed time breakdown. Dr. Weingartner said he would provide that time breakdown to Dr. Loose, who expressed interest in participating, but would be at sea, probably without good communications.

#### Preparations for Meeting with NSF Chief Operating Officer

Dr. Weingartner; Dr. Falkner

Dr. Weingartner led the AC through the process of developing a list of questions to pose to the NSF Chief Operating Officer, Dr. Crim, during his appearance before the committee.

#### Meeting with NSF Chief Operating Officer

Dr. Crim

Dr. Falkner and Dr. Weingartner welcomed Dr. Crim and AC-OPP members introduced themselves.

Dr. Crim briefly described his background and said NSF Director Dr. France Córdova, who is on the West Coast, sent her regrets for not being able to attend. He said that last week Dr. Córdova was in Chile with Mr. Paul Dabbar, Under Secretary for Science at the Department of Energy (DOE), where she met with the president of Chile and visited the Large Synoptic Survey

Telescope. NSF has a partnership with DOE to fund the telescope. The week before Dr. Córdova attended the Arctic Circle Assembly in Iceland.

Dr. Crim said that next year is NSF's 70th anniversary and the 75th anniversary of the book, *Science, The Endless Frontier; A Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development*. Between 1945 and 1950 there was an intensive debate about how to support science. *Science, The Endless Frontier* was Dr. Bush's entry in that debate, which led to the founding of NSF in 1950, when President Harry Truman signed the legislation creating the Foundation on a train in Idaho.

Dr. Crim has written the introduction to a new edition of the book, which the Foundation is republishing. A history of NSF is also being written for the Foundation's anniversary. A symposium will be held to celebrate the anniversary. It will be held following the NSB meeting in February, when all the living former NSF directors are to be in attendance.

Turning to the budget, Dr. Crim said NSF had just finished spending out the FY19 budget (\$8.1 billion). The president's FY20 budget request was for \$7.1 billion. It reflects the administration's priorities for artificial intelligence (AI), quantum information science, and advanced manufacturing, areas that align well with the Foundation's Big Ideas. The House mark for the budget was \$8.6 billion and the Senate mark was \$8.3 billion. He said the Senate had just passed the minibus that has the Commerce, Justice, Science, and Related Agencies (CJS) bill in it that includes NSF. The House and Senate marks need to be reconciled, but the House mark of \$8.6 billion and the Senate mark of \$8.3 billion is a nice increase for NSF. The current continuing resolution runs until November 21.

In January there was a 35-day lapse when the government was shut down, so NSF knows what to do, he said. NSF came through it rather well, learned some lessons and tuned up procedures to be able to deal with a shut down more efficiently. Another 35-day lapse is not anticipated, but a short one may occur. The FY21 budget has been sent to OMB and we will see how that plays out in the president's budget in February.

Turning to personnel, Dr. Crim discussed changes among assistant directors. Dr. Jim Kurose, Assistant Director, CISE, has finished his term and Dr. Margaret Martonosi, from Princeton University, will be the new assistant director, starting February 1.

Dr. Crim also said that 43 new Convergence Accelerator awards have been announced (\$39 million). The foci were Harnessing the Data Revolution and The Future of Work at the Human-Technology Frontier (FW-HTF). NSF is also in the midst of its Mid-scale Research Infrastructure awards. He said there has been a gap between the top of the major research instrumentation program and the beginning of the MREFC line. This year, the Mid-scale Track 1 awards are \$6-\$20 million. Track 2 is for \$20-\$70 million and proposals are under review.

Dr. Crim said he has seen the AC-OPP report that synthesized a number of Academy and other studies. He said it will be particularly useful for the AC's work and informing people in a large range of areas about all the places Polar Programs connect around the Foundation, which is

something that needs to be understood at NSF and in the community. Polar Programs makes important connections with almost every piece of the Foundation.

He also discussed NSF responses to the Artic Portfolio Review Subcommittee and the Polar Research Vessel Requirements Subcommittee. That is the type of work that informs the Foundation.

When the Foundation gets to hear from the Advisory Committee, NSF gets the most value out of the AC. In addition to advice, NSF gets community connections, which are very important. He thanked the committee for its work and opened the session to questions.

### *Discussion*

Dr. Weingartner thanked NSF for moving forward with AIMS and noted the previous day's presentation from Dr. Easterling on the ESS initiative, which he said is a wonderful venue by which polar science is incorporated into global science. He also addressed the issue of promoting diversity among polar researchers and told Dr. Crim the AC had agreed to form a diversity subcommittee.

Dr. Crim said this is an example of how an AC can help by getting people together to look at what is going on at the Foundation and in the community, how they relate to each other, and what can be done to capitalize on the most effective practices.

Dr. Crowell asked about relations with Congress and issues of concern. Dr. Crim said it is important to look at the situation at NSF. A lot of things about NSF have put us in a good position. The director has done a wonderful job steering the Foundation through turbulent political times. She has had strong relationships with OSTP, the White House and the National Science and Technology Council (NSTC). In addition, NSF has been quite attentive to its relationship with Congress. OLPA works to be responsive and communicate. Some of the most vociferous critics are not in Congress now; nor are some of NSF's strong supporters. We do not feel we are a particular target or that our ability to pursue excellent science is particularly impeded, he said. NSF is in a different position than are regulatory agencies. NSF has a well-defined mission to support great research and when NSF attends to that mission and tells its story thoroughly and carefully, the Foundation is not suffering the way you might think.

Mr. Iselin asked about the challenges of making needed capital investments when pressed for dollars. Dr. Crim said that is something the Foundation worries about almost every day. It is not where the Foundation spends most of its money, but if it is not spent, NSF cannot move forward. We have to plan, execute and tell our story properly. He and Dr. Ulvestad have become better at dealing with this each year, Dr. Crim said. Congress wants NSF to look over the horizon and talk about things NSF is going to be doing. With the Mid-scale Research Infrastructure project and other things, NSF is trying to make sure a robust discussion is always going on.

Dr. Ulvestad added that there is a misimpression that there is a battle between facilities and research. He said facilities are an integral component of the research. Thinking is shifting in that direction but has further to go. He also mentioned that the Directorate for Mathematical and

Physical Sciences (MPS) has started showing an ambitious funding profile for the large construction projects going out to 2030. Currently, the construction line is about \$250 million per year and has been at that level for some time. AIMS had to be compromised to fit into that wedge. NSF is trying to look further across the horizon and ask whether the Foundation is going to get a \$600 to \$700 million a year MREFC line if the budget is \$7 billion. But NSF should be thinking that in 2030 the budget should be \$12 to \$14 billion, because the Foundation has important things to do for the country and the investment in the infrastructure needs to grow along with that to enable the science. AIMS, he said, is only the beginning, so NSF is very well aware of the need to invest to do the science. If NSF was not doing AIMS, it would not be possible to do the science to understand the change in the Antarctic. Dr. Easterling added that there is a misimpression in the community that NSF is where ideas for big new MREFC-level infrastructure and facilities are dreamed up and funded. The truth is that the ideas come from the community. NSF is dependent on a steady flow of recommendations and information on where the Foundation ought to be going next with those investments. NSF is always listening with open minds to big ideas. He urged the AC to not let budgetary considerations stop them from thinking big.

Dr. Weingartner asked if NSF sees itself as committed to the 10 Big Ideas over the next five years and what NSF perceives to be coming after that period ends. Dr. Crim said NSF will not spin up 10 big ideas every two years. The Big Ideas were created with substantial input from POs and the community and the leadership of each directorate and the senior leaders of the Foundation. There was a lot of back and forth at a retreat where ideas were pitched. One criterion was whether an idea was ripe for a push right then. The \$30 million budget for each Big Idea, is, together, a relatively small fraction of the budget. The point is to identify things where that push makes a real difference. The ideas turned out to be ones that are receiving a lot of attention and currency. Executing on the Big Ideas was a heavy lift because it required people to work across the Foundation for a relatively small amount of money. There have been about 25 to 30 awards in each of the areas. Think about the trajectory of any initiative. The Big Ideas rest on a base of fundamental research that has been going on around the Foundation. Quantum information science research has been funded for 30 years or more. Some of these ideas are going to have a natural lifetime. They are going to accomplish a lot and it is going to be time for something else to replace it. Others may go to a certain level and evolve into something quite different. NSF is going to look down the road toward that trajectory. What ideas are spawning other ideas, what ideas have made their contributions into another area. Over the next three to five years there will be an evolution of the Big Ideas. They can't be static, but they can't be changed every year.

Dr. Nettles asked about the NSF perspective on the tension between the need for and support at NSF for international scientific collaboration at the individual PI level and agency level and, on the other hand, the security concerns that are very much in the air. Dr. Crim said the AC is very important in this discussion. There are people from the intelligence or national security community who see issues with intellectual property (IP) and dual-use technologies. And there are researchers who say their work is born as a global activity and it has been vastly energized and enlivened by those connections. Both extremes are right. But if researchers say there is no issue or NSF says it needs to lock up IP and scientific research, there is a problem. The NSF is trying to find a place to operate where it has a reason to be operating that supports the international science that the Foundation believes is vitally important. The agency is working

hard at promoting the conversation. The Foundation believes that communicating as clearly as possible about what the Foundation expects and about the nature of this dialog is critically important. He said a new program guide is about to be released that will clarify language about disclosure. Since 1978, the Foundation has required disclosure of support, but it has been done in a casual way. Electronic tools are also being created to make it easier to do. A study has been commissioned with JASON, a group of distinguished scientists with high-level security clearances to advise the Foundation on this issue by issuing an unclassified report that the Foundation will share broadly. People have asked if they should worry about collaborating with someone from certain other countries. Dr. Crim said they should collaborate. Disclose the collaboration, though, so everything is in the open. There will be small areas where dual-use or IP will be troublesome. The goal is to minimize that.

Dr. Vieregg referred back to support for research facilities in the polar regions. Dr. Crim responded that he agreed with Dr. Ulvestad that there is no divide between research and infrastructure. NSF is funding research. Many fields require that research infrastructure. He referred to the South Pole Telescope, IceCube and cosmic microwave background. NSF has to put resources into those things to do them. Funding also has to go to individual investigators who are doing work in their laboratories and individual investigators who need to go to one of these facilities to do their work.

Dr. Steig commented that it was useful for the AC to hear the perspective from the director's office so members can relate the vision to their colleagues. Dr. Crim said the notion that AC members talk to their colleagues and either hear that what we're saying does not make sense to them or can explain what we say and help it make sense and help us say things that make sense is the vital thing that ACs do for NSF.

Dr. Hindle asked about changes in leadership at NSF. Dr. Crim said the NSF director is presidentially appointed and Senate confirmed. The director's six-year term is designed to get away from the presidential term cycle. The Office of Presidential Personnel and OSTP are a critical voice in how that process happens. He said he does not know what the cadence of the process will be. But in March the current term ends. NSF has a very strong leadership team and the NSF is not going to stop doing what it does when the current term ends. Plans are being made to charge ahead, continuing to support programs, grow programs, and carry the case to Congress and OMB. But we are not in charge and a lot of different things can happen, so his office is busy planning to deal with those things. But NSF is going to be strong, healthy and well-led when we get to March.

Dr. Weingartner thanked Dr. Crim for meeting with the committee and Dr. Crim said he looked forward to hearing from any committee members with any comments and thanked the AC for their input.

#### Final Wrap-up and Close Out of the Fall Meeting

Dr. Weingartner

Dr. Nettles asked if the spring AC agenda could include an update on the JASON report that Dr. Crim referenced. Dr. Falkner said that can be included on the agenda.

Dr. Weingartner recapped the action items agreed on earlier. A COV member is needed for the Antarctica subcommittee and the LTER. And the AC will begin working on the subcommittee to promote diversity, with a draft mission statement ready for the next meeting. And Mr. Stephenson will address the comments in writing, re: the NSF Response to the Arctic Portfolio Review and it will be taken up at the spring meeting. And there will be a further response to the ship subcommittee report on Antarctic vessels, if possible.

Dr. Heimbach asked about a joint meeting with the Office of Advanced Cyberinfrastructure (OAC). Dr. Falkner said timing has been an issue, but it is being worked on.

Dr. Steig said there should be an opportunity to suggest ideas for the spring meeting after the AC meeting concludes. He also asked if the diversity subcommittee will be comprised solely of AC members. Dr. Weingartner said it would include AC members, but not exclusively, working with NSF to identify other members. Dr. Steig said the people he knows who would be good picks are already over committed.

Dr. Crowell suggested having a follow-up in the spring on the issues of IP and security as they affect international scientific collaboration. He said he was not sure what an example would be. We all see science as open access in terms of peer review and publication and international sharing. Dr. Falkner said there have been recent articles in the magazine *Science* that include examples. She said that links to those articles could be provided. Dr. Falkner said she will take that into account for the spring meeting. Dr. Rebecca Keiser, who heads OISE, has been leading an effort to get our arms around this issue and has been involved in the JASON study. Depending on the timing of the study, Dr. Keiser may be able to speak to the AC.

Dr. Falkner added that is not acceptable to be paid by two entities for the same research. One of the issues is affiliations with a foreign country where you are being paid twice to do the same thing. Another issue is that financial arrangements with a foreign country may bind one to acknowledge them solely or first. There is also the issue of shadow labs in another country doing the same research in another country that NSF is sponsoring. There is also theft of ideas and IP. As an oceanographer, it has always been a concern for her how you transship various types of technologies. We don't just give away access to some of our sensitive technology.

Dr. Falkner said the AC meeting had been very productive and expressed her appreciation for everyone's participation.

Dr. Easterling returned to the impending NASEM study on ESS and said he had provided Dr. Heimbach with clarification on the study, which has a wide-open scope that welcomes community comment on the importance of doing novel modeling platforms that allow broadened scales and scopes beyond human activity.

Dr. Heimbach asked if there is a possibility for a joint effort or finding niches for each agency to play. Dr. Easterling said an aggressive effort will be made to involve the logical agencies. But it is a study funded by and exclusively for NSF. Some sensitive questions are being asked about

how the current organization maps onto what the community thinks is the best way to address ESS challenges. Those related agencies will be involved in a listening mode.

Dr. Weingartner thanked everyone and adjourned the meeting.