

## NATIONAL SCIENCE FOUNDATION (NSF)

Advisory Committee for Polar Programs (AC-OPP)  
Fall Meeting, November 1-2, 2018  
National Science Foundation Headquarters  
2415 Eisenhower Avenue  
Alexandria VA 22314

## MINUTES

### Action Items Arising out of the Fall 2018 AC-OPP Meeting

1. A subcommittee will be created to communicate with, and gather concerns from, the community about AIMS and other station modernization. Dr. Isern, Dr. Weingartner, and Dr. Stammerjohn will develop a subcommittee charter they will present to the spring AC-OPP meeting.
2. AC-OPP members will receive information at the spring meeting on the percentage of international involvement in the polar portfolio.
3. The spring AC-OPP meeting schedule will include additional time for breaks between agenda items.
4. The next version of the Polar Document will be completed by early December. It will be distributed to the community for comments, which will be due by February 1, 2019. The final document will be presented at the spring AC-OPP meeting. Meanwhile, Dr. Lynch, Dr. Fuentes, Dr. Heimbach, Mr. Arnaudo, and Dr. Mack will make contributions.
5. A draft polar research vessel report will be submitted to AC-OPP in final form at its spring meeting.
6. The Arctic Portfolio Review Subcommittee plans to present its report to the spring AC-OPP meeting.
7. The spring AC-OPP meeting agenda will include the IARPC principles document for Arctic research, with Dr. Nettles, Dr. Lynch, Ms. Renée Crain, Dr. Loose, and Dr. Fleener involved in the planning.
8. The spring AC-OPP meeting will include a discussion of astrophysics, including how the decadal process is unfolding with regard to OPP.

### 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

Mr. Raymond V. Arnaudo, Department of State (Ret), member, Advisory Committee, Environmental Research & Education

Dr. Aron L. Crowell, Arctic Studies Center, Alaska Regional Program, Department of Anthropology, National Museum of Natural History, Smithsonian Institution

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  
Mr. Craig Fleener, Senior Advisor for Arctic Policy, Alaska's Governor's Cabinet  
Dr. Jose D. Fuentes, Department of Meteorology and Atmospheric Science, Pennsylvania State University  
Dr. Patrick Heimbach, Institute for Computational Engineering and Sciences, The University of Texas at Austin  
Mr. Alex Kosseff, American Mountain Guides Association, Boulder, CO  
Dr. Brice Loose, Graduate School of Oceanography, University of Rhode Island  
Dr. Amanda Lynch, Institute at Brown for Environment and Society, Brown University  
Dr. Michelle Mack, Center for Ecosystem Science and Society and the Department of Biological Sciences, Northern Arizona University (telephone)  
Dr. Adam Marsh, School of Marine Science, University of Delaware (telephone)  
Mr. Christopher Mossey, Fermi National Accelerator Laboratory, Batavia, IL  
Dr. Meredith Nettles, Lamont-Doherty Earth Observatory, Columbia University  
Dr. Patricia Quinn, Pacific Marine Environmental Laboratory, National Oceanic and Atmospheric Administration (NOAA)  
Mr. Wilson W. Sauthoff, Science Assistant, OPP  
Dr. Sharon Stammerjohn, Institute of Arctic and Alpine Research, University of Colorado  
Dr. Eric Steig, Earth and Space Sciences, College of the Environment, University of Washington  
Dr. Abigail Viereg, Kavli Institute of Cosmological Physics, Eckhardt Research Centers, University of Chicago (telephone)

AC-OPP Members absent:

Dr. Douglas Bartlett, Marine Biology Research Division, Scripps Institution of Oceanography, University of California at San Diego

Office of Polar Programs (OPP) and other NSF staff present:

Dr. Kelly Falkner, Director, OPP  
Ms. Gwendolyn M. Adams, Safety and Occupational Health Manager, OPP  
Dr. Scott Arnold, Senior Advisor, OPP  
Dr. Andrew Backe, Management and Program Analyst, OPP  
Dr. Scott Borg, Deputy Assistant Director, Geosciences (GEO)  
Ms. Kimiko S. Bowens-Knox, Program Analyst, OPP  
Dr. Jennifer Burns, Program Director, Antarctic Integrated System Science, OPP  
Ms. Jessie Crain, Antarctic Research Support Manager, Antarctic Infrastructure and Logistics Section (AIL), OPP  
Ms. Renée Crain, Research Support & Logistics Manager, OPP  
Dr. Paul Cutler, Program Director, Antarctic Glaciology, OPP  
Ms. Terri A. Edillon, Communications Specialist, OPP  
Dr. Roberto Delgado, Program Director, Arctic Observing Network, OPP  
Mr. Jon M. Fentress, Safety & Health Officer, OPP

Dr. Patrick Haggerty, Research Support & Logistics Program Manager, OPP  
Dr. Alexandra Isern, Program Director, Research & Logistics Integration, Antarctic Sciences, OPP  
Dr. Rebecca Keiser, Office Head, Office of International Science and Engineering (OISE)  
Ms. Pawnee C. Maiden, Administrative Officer, OPP  
Dr. Nature McGinn, Environmental Policy Specialist, Section for Polar Environment, Safety and Health, OPP  
Mr. Timothy McGovern, Ocean Projects Manager, OPP  
Dr. Jennifer Mercer, Arctic Research Support and Logistics Manager, OPP  
Dr. Frank R. Rack, Arctic Research Support and Logistics Manager, OPP  
Dr. Jessica H. Robin, Cluster Lead, OISE  
Mr. Ben Roth, Facilities Engineering Project -Manager, AIL, OPP  
Ms. Stephanie Short, Section Head, AIL, OPP  
Mr. Simon Stephenson, Section Head, Arctic Sciences Section (ARC), OPP  
Dr. Coleen Strawhacker, Associate Program Director, Arctic System Science, OPP  
Dr. James Swift, Chair, AC-OPP Ad Hoc Subcommittee on the U.S. Antarctic Program's Research Vessel Procurement (telephone)  
Ms. Beverly J. Walker, Science Assistant, OPP

## **Thursday, November 1**

### New Member Orientation

Dr. Weingartner; Dr. Falkner; Dr. Isern

Dr. Falkner welcomed everyone and asked all those attending, in person and virtually, to introduce themselves and Dr. Backe provided the committee with logistical information for the meeting.

Dr. Isern briefed the committee on AC-specific conflict of interest (COI) rules. She said the AC is governed by the Federal Advisory Committee Act (FACA) of 1972 (Public Law 92-463), enacted to ensure that advice given to Federal government agencies by groups of individuals that include non-Federal employees is objective and accessible to the public.

The AC's role, she said, is to discuss policy regarding polar programs. Therefore, conflicts involve major activities the AC is likely to discuss. For example, a Principal Investigator (PI) on IceCube would be asked to recuse himself or herself from partaking in discussions regarding IceCube.

Dr. Isern said notice of FACA committee meetings must be provided to the public, the public must be allowed to have reasonable access to the meeting unless the meeting, or a portion of the meeting, is closed. Generally, NSF closes portions of FACA committee meetings where the information discussed is proprietary, would constitute an invasion of privacy, and/or frustrate proposed agency actions. Also, committee members must electronically sign in at the beginning of the meeting, meeting minutes must be created and maintained by NSF (available on the NSF website, along with other AC information).

Members are asked to recuse themselves if they:

- Hold a position or have an affiliation with the entity involved (e.g., employee, board member, consultant)
- Have a financial interest in the entity involved (e.g., stock holdings)
- Have any other circumstance that could raise a question about impartiality (e.g., best friend could be affected by a program change)

Dr. Falkner said that although meetings can be closed to the public when necessary, she has not done that with AC-OPP and believes the committee's business should be open to the broader community. Indeed, AC-OPP members represent the broader community and should feel free to reach out to the community to advance the committee's objectives. This contrasts with serving on a proposal review panel, when one is not to share proposal ideas discussed during a panel.

Dr. Falkner also briefly reviewed the committee's objective and scope of activities, which the AC charter says is "To provide advice and recommendations to the National Science Foundation concerning support for polar research, education, infrastructure and logistics, and related activities."

Dr. Falkner added that AC-OPP interfaces with other ACs. AC-OPP has met jointly with the Directorate for Engineering (ENG) Advisory Committee regarding possible collaboration on Arctic research. AC-OPP wants to make sure the polar community is aware of opportunities available through collaboration. In that regard, members briefly described their work and liaison positions with other committees.

#### Opening Remarks and Introductions

Dr. Weingartner; Dr. Falkner

Dr. Falkner reviewed OPP staff changes since the last meeting, including seven new hires, two section head acting appointments, and four departures.

Dr. Arnold provided a budget overview. The FY 2017 NSF budget was almost flat with FY 2016. There was an increase for FY 2018 of about \$300 million. The FY 2019 request is flat with FY 2017, though the House and Senate markups would be a substantial increase over FY 2018. OPP's FY 2017 budget was almost flat with FY 2016 with an increase for FY 2018, which saw OPP capture about 10 percent of the overall agency increase. The FY 2019 request is an increase due to first-year funding for Antarctic Infrastructure Modernization for Science (AIMS). Comparing FY 2018 and 2019, while science funding appears to be somewhat reduced, it appears as if science funding is down; in FY 2019 money was put toward the 10 Big Ideas, which the Polar community is poised to take advantage of, including Navigating the New Arctic (NNA), Windows on the Universe, and Mid-scale Research Infrastructure.

In response to a question from Dr. Mossey about the AIMS budget, Dr. Arnold said that although the House and Senate are divided on characterizing AIMS as research or Major Research Equipment and Facilities Construction (MREFC), there are no implications for execution because any project over a threshold amount must be conducted and subject to oversight as if it were in the MREFC account.

Dr. Nettles asked if the allocation to OPP is determined by NSF or Congress. Dr. Falkner said that generally the distribution is determined as part of the process of developing the President's request. She added that the House and Senate budget marks for the budget are publicly available and that NSF is operating under a continuing resolution (CR) until December 7, which maintains the previous year's budget. Meanwhile, the FY 2020 budget is under development.

In response to a question from Dr. Loose about the decrease in the FY 2019 request from FY 2017, Dr. Falkner noted that for FY 2018 about \$300 million more came to the agency than was requested. Currently, the Congressional budget marks are for about another \$300 million above last year.

Dr. Fuentes asked if the request included new funding for NNA. Dr. Falkner said it did, as did each of the Big Ideas. Dr. Loose asked if the Big Ideas are for one cycle. Dr. Falkner said they are anticipated to last at least 5 years. And another effort is underway to generate more big ideas. Dr. Mack asked about funding for Arctic research support and logistics. Dr. Falkner said there is flexibility to spend as needed to support the priority science. Regarding NNA, it is likely that the Foundation will have to make use of the logistics capabilities the Arctic has. A successful pitch was made to get some of the new money to support logistics costs for U.S. participation in Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC), helping to offset expenses and so devote substantial logistics support funding to NNA.

Mr. Arnaudo asked about funding for icebreaker construction. Dr. Falkner said the icebreakers that the Coast Guard owns are in that agency's budget; NSF no longer has responsibility for that budget. But there are discussions underway about replacing the research ships in Antarctica and the Division of Ocean Sciences (OCE) recently brought on a new Arctic vessel.

Dr. Falkner said the NNA solicitation is open, with a deadline of February 14, 2019, adding that she was hopeful and excited about receiving responsive proposals. She encouraged members to let the community know about the opportunity. A website has been set up to provide information (<https://www.nsf.gov/geo/opp/arctic/nna/index.jsp>). Many of the other Big Ideas are also relevant to the polar community, she said.

#### Safety Discussion

Mr. Kosseff; Dr. Mercer; Ms. Jessie Crain; Mr. Fentress

Dr. Mercer discussed a situation with a polar bear at Summit Station in Greenland in June. It was the first time a polar bear had been seen at Summit Station, though one had been seen in 2016 350km to the north at the East Greenland Ice core Project (EGRIP) and two weeks prior to the Summit Station event. These sightings had prompted safety discussions at Summit Station prior to the June event. After the bear was spotted in June, station personnel were evacuated within a couple minutes to hard-sided buildings. One person was not able to evacuate his tent. A tractor was used to repel the bear and allow this person to evacuate. Thirty-one contractors and no grantees were at the station. They remained sequestered for about 36 hours as the contractor coordinated a response with NSF and Greenland authorities. A Twin Otter with two hunters was

deployed to the station. They fired warning shots and eventually dispatched the bear, which was buried on the ice sheet away from the station, after samples were taken.

Bear safety measures taken at summit station:

- Immediate Term
  - A night watch person was hired to keep an eye on station overnight for remainder of summer while tents were occupied
  - Polar bear awareness and safety training for all personnel across the program
  - Bear deterrents made available at Summit (bear spray, air horns, flares, bangers)
  - Bear defense (rifles) on site at Summit (all personnel received classroom firearm safety training, and designated personnel received hands-on training)
- Long Term
  - Discussion/info sought from other Arctic operators and governments (e.g. through the Forum of Arctic Research Operators (FARO))
  - Bear detection (radar, lidar, IR, remote sensing, etc.)
  - Hard-sided berthing for summer occupants
  - Continuation of training, deterrents, defense, and a nighttime watch person when tents are occupied

Dr. Steig asked if EGRIP had a professional hunter always on-site. Dr. Mercer said she did not think they had hired a hunter but that the station manager had hunting experience.

Ms. Crain continued the presentation with an overview of management of Arctic and Antarctic programs. Both have many field teams across a large area. The Arctic work is decentralized, aside from some operational hubs. Teams can go into the field on their own, independently of NSF contracted logistics. Risk management oversight is expected at the field team level or the university level. In the Antarctic, participants flow through U.S. Antarctic Program (USAP) hubs with centralized training and emergency management functions, with direct NSF oversight of all field teams.

Both programs have common field risk management goals:

- Capture field incidents and share lessons learned
- Encourage and facilitate the connection between university risk management offices and research teams
- Increase research community involvement in field risk management processes and decisions

Discussing incident reporting and lessons learned, Ms. Crain said OPP has a Safety and Occupational Health policy that covers researcher safety, responsibilities, and reporting. The field team PIs, team leads, and the individuals who are part of the team are responsible for ensuring their safety, reporting incidents, and calling out unsafe conditions. The Arctic has a reporting process that accounts for the distributed work and publishes incidents and lessons learned on a website. In the Antarctic, incident reporting has been primarily carried out by the contractors and treated as a workplace safety process, with responsibility assigned to employers. However, scientists did not necessarily report to their home institutions. In the last 1-2 years,

NSF has clarified requirements for injured researchers to file a streamlined report. The Antarctic Support Contract health and safety office analyses the incident reports for trends.

Dr. Fentress said the Antarctic program was primarily focused on operations and construction and is now also engaged in research safety. Researchers are the customer and it is important to assure they are safe. The researchers have been largely supportive and cooperative. The Antarctic program amended the research support plan (RSP) so investigators know up front about reporting and safety requirements. This also helps to keep contractors safe. Dr. Fentress said some university risk management offices are not always aware of researchers' activities in the field.

Ms. Crain said that information being collected could provide insight into whether there are problems, due to the conduct of snowmobile training, for example, that occur across field teams.

She continued with a discussion of university risk management offices (RMOs) and how NSF can encourage RMOs to work with their field researchers. NSF's goals are to broaden institutional awareness of teams at field locations and link researchers with RMO resources, including risk management planning, emergency communications, insurance and evacuation. RMOs differ markedly: some are familiar with field work; others act more in a campus security role. Individual researchers work independently, and departments are independent from one another and it isn't structured so someone in the hierarchy knows exactly where each researcher is working. She was not confident universities are aware they have people in environments like the Arctic or Antarctica. There is a benefit, she added, to linking researchers with their risk management offices, which have their own resources, for example to get a researcher back to the U.S. She asked for input from the AC about working with RMOs.

Dr. Lynch said her RMO had more of a focus on export controls and legal risk. Dr. Crowell said CH2M HILL Polar Services (CPS) camp managers have been good about safety management. The universities are more concerned about the safety of students at field schools or assisting research than about researchers.

Dr. Steig said the University of Washington has addressed this issue because researchers are going to politically dangerous locations, with faculty informing the RMO where they are going. His RMO would embrace contact with NSF, he said.

Ms. Crain said there has been consideration of presenting at university risk management conferences and finding a group of universities interested in engaging more deeply to spread best practices through the community.

Dr. Crowell mentioned a 2014 OPP safety workshop and said its final report could be useful. If NSF presented that report to a university RMO, providing the range of problems and explained the risk, it would be taken seriously. Dr. Nettles also participated in the workshop and said it was very useful. It is frightening how little PIs think through the risk, she said. She supported NSF having a follow-on workshop to help create a community of practice that can exist independently. Her school's RMO is concerned about legal risk and knowing where researchers are in case of a disease outbreak or in the event of violence, but it provides a set list of air

carriers that does not include the Air National Guard and does not account for those not staying in hotels. The university does not appreciate the range of situations researchers are working in, even though students are involved.

Dr. Mack asked about sexual harassment and how much assessing risk related to Title IX is the job of CPS. Ms. Renée Crain responded that CPS has an opportunity to help educate research teams. NSF views harassment as a risk issue. The Project Manager (PM) is many times the first person contacted, so it is important for them to know about proper reporting.

Ms. Jessie Crain said that for the Antarctic there was a similar setup. The contractor will provide harassment training to all participants deploying through the U.S. Antarctic Program and staff are trained in how to direct someone to resources and contact NSF or their universities. She also discussed reporting from McMurdo Station and the reporting up through Polar Programs to be sure NSF is receiving the right information. There is a process at McMurdo run by the NSF science representative to give researchers information about Title IX and making them aware they should know who their Title IX coordinators are at their schools.

Mr. Kosseff said he has worked with many RMOs and they vary vastly in their capacity to deal with the issues under discussion and tend to be under-resourced. When they are focused on off-campus issues, it is around staff and students in conflict zones. NSF presence at the University Risk Management Conference could raise awareness of NSF's programs and the risks students and researchers face with off-campus research.

Dr. Fuentes said there is a need for a uniform approach that NSF could foster by providing national leadership and that workshops would help promote this.

Dr. Falkner asked Dr. Quinn for her perspective, since she has gone into the field for NOAA. Dr. Quinn said if out on a NOAA or University-National Oceanographic Laboratory System (UNOLS) ship, there are talks about harassment or what to do if someone is hurt. She has never had risk management training from someone at NOAA, she said.

Ms. Adams said she reviews funded proposals for safety and health risk. She may call an institution's risk management office to ask if they know where their researchers are and what they are doing. Some only handle financial issues and others are fully engaged and aware of the research being done and where their scientists are located. She also said there is a need to balance approaches to the Arctic and Antarctica.

Ms. Jessie Crain returned to her presentation to propose that the U.S. Antarctic Program (USAP) have a Field Risk Management Board made up of field researchers, NSF staff, and support contractors to:

- develop processes for evaluating field sites and field team technical skills;
- advise on best practices for field work; and
- review field plans and field guides

She said more robust processes are needed for deciding, e.g., which routes need to use Ground Penetrating Radar (GPR) and for evaluating field teams. She asked the AC for guidance on best



practices for how field teams should evaluate risk and create a safe work environment. She also discussed reviewing field plans and field guides, working with NSF and the Antarctic Support Contract (ASC) to provide peer review of field plans and technical personnel for a more well-rounded review process.

### *Discussion*

Dr. Nettles asked if the board would be permanent. Ms. Jessie Crain said she envisioned it would persist but with a rotating membership. She added that a group of field guides who have been working for decades are reaching retirement age, presenting a possible risk in Antarctica. With the Thwaites Glacier, there are one or two field guides who have been contacted by every field team. A more robust process is needed to match guides and teams.

Dr. Loose asked if a review of logistics plans would be needed for every proposal. Ms. Jessie Crain said the percentage of projects that need this type of review is small and would only require a couple meetings a year.

Dr. Stammerjohn supported the proposal because it would address risk management but also improve efficiency in the field. Continuity between contractors and documenting the knowledge gained over time and to share it with field projects is a great idea, she said. Having a venue to come together before field season or a research cruise would be very helpful.

In response to a question from Dr. Nettles, Ms. Jessie Crain said it would be chartered under NSF, but she was not sure of the format. The Diving Control Board would be a good model, which reviews all the dive plans for McMurdo and Palmer Station. Dr. Fentress said it concentrates on high-risk or unique dives. Dr. Steig suggested two names for volunteers. Ms. Jessie Crain said some younger investigators have been enthusiastic about helping with a board. She did a trial over the summer with a traverse route where it was not clear if GPR was needed. After sending a white paper the PIs had written to a group of glaciologists, she received a range of thoughtful input and feedback on process, showing people were willing to participate.

Dr. Crowell said the National Park Service (NPS) in Alaska has a strong safety culture. NPS provides significant training to anyone doing research in the parks. It is thought out and consistent across different parks.

Dr. Nettles asked about the legal protection for the board. Dr. Fentress discussed the distinction between accepting a plan and approving a plan.

Dr. Loose said he wanted to assure there would not be a change in the relationship with the contractors. Ms. Jessie Crain said it would not. Rather, it would round out the process, so the burden of the support isn't totally on a couple people working for the contractor to review plans and make recommendations. She said McMurdo has implemented a field risk review meeting with the field supervisor and field safety search and rescue lead and they talk about the daily work plan, camp setup, etc. Her proposal is to have some of that review happen as part of a pre-season planning phase, but it would not change anything onsite.

Arctic Portfolio Review; Subcommittee Update  
Dr. Lynch; Mr. Stephenson

Dr. Lynch said the subcommittee's charge was to ensure the investments in Arctic Sciences Section programs and supporting logistics align with today's needs and are capable of meeting future needs. The subcommittee considered recommend critical programmatic capabilities and a balance of investments. The committee was well balanced, including by gender.

The subcommittee surveyed OPP scientists, receiving about 250 respondents. The three primary sets of viewpoints extracted were:

1. The importance of social science and interdisciplinary research. They strongly suggested the Arctic Science Section should fund research in primarily in the U.S. Arctic, which Dr. Lynch found surprising.
2. The pivotal role of NSF in supporting Pan-Arctic natural science, with emphasis on blue sky and theoretical research. Dr. Lynch said surprisingly there was strong support among some for only funding natural science projects.
3. Support for logistics-intensive interdisciplinary research in the far north.

Most participants agreed with these principles:

- Additional investment in permanent Arctic facilities should not be pursued.
- More support for graduate students.
- NNA has the potential to increase research activity and quality in the Arctic overall.

The survey was used to take the temperature of the community. The subcommittee will appropriately weight what it considers the survey's extreme views to guide its recommendations. A draft report is almost complete.

One of the other survey findings was that many researchers were not completely clear about where their research sat in the Arctic Section's programs. Some of those programs have evolved over time, causing confusion and concern.

Accordingly, the structure for the report will include three programs:

1. Natural Sciences and Systems
2. Social Sciences and Systems
3. Coupled Human Natural Systems

To help people proposing to the program to determine what kinds of research would be accepted in those three programs, the subcommittee is articulating categories of support associated with different sizes of programs. Under these categories, proposers will be able to select one or two categories, but not every category. The categories are:

- Deep diving site
- Strategic envisioning process
- High-risk exploratory research
- System science research
- Synthesis and Integration, including policy-relevant research
- Long-term perspectives, including, e.g., long-term observations and cyber infrastructure

The subcommittee plans to discuss a draft report on November 14 and possibly present it to AC-OPP in the spring.

Mr. Stephenson said the subcommittee in September did not have time to also discuss education, diversity and inclusion, and the role of cyberinfrastructure.

Dr. Lynch said some members of the committee attempted to write about graduate students, post-docs, education, diversity and inclusion, and safety and this is included in a rough draft that needs discussion by the committee.

### *Discussion*

Dr. Steig asked the presenters to interpret the survey's showing of strong resistance to permanent stations. Mr. Stephenson said it was about building new things, not a comment on Summit Station, but the survey comments are still being analyzed. Preliminary survey returns showed support for keeping the program agile to go where people were proposing, versus investing in something more capable but static. Also, some recognized other countries had new capabilities that should be used. Dr. Lynch said there was a sense that long-term observations were very important and field work is expensive and needed but there were also people advocating more breakthrough science.

Dr. Weingartner asked about possible conflict between the subcommittee and tomorrow's AC-OPP discussion of the polar document. Dr. Falkner said she did not see a conflict, as they are along different lines. The AC-OPP effort has been collecting existing advisory documents at a high level to provide a summary that makes it more apparent what is driving investments whereas Dr. Lynch has been discussing the best way to manage the science, given where it is headed.

Mr. Stephenson said there was something to be said for two pictures of the same thing, one is a strategic set of recommendations and the other a portfolio view. He said looking at the same object but from different perspectives is valuable.

Dr. Crowell commended Dr. Lynch for quelling alarm in the social science community. Dr. Lynch said she wanted to communicate that it did not reflect the view of the committee as a whole and it was about finding out what people thought.

In response to a question from Dr. Mack about the focus on the U.S. Arctic, Dr. Lynch said the survey generates representative perspectives that are orthogonal to each other. Those who pushed hard on the importance of social science and interdisciplinary research also strongly agreed that the Arctic program should primarily fund research in the U.S. Arctic. That was one viewpoint and is not necessarily representative of the community. Dr. Lynch said she will be pulling out the individual comments that explain where their views come from.

### MOSAIC Update

Dr. Heimbach; Dr. Rack

Dr. Heimbach briefly introduced MOSAiC and Dr. Rack continued with a description of the project as the largest ever Arctic research expedition:

- >€100 million budget (\$115 million)
- 5 icebreakers
- Polar 5 & 6 research aircraft
  - + support helicopters
  - + support aircraft
- More than 60 institutions
- 16 nations
- >200 scientists in the central Arctic

Dr. Rack showed a slide illustrating the nested scales of multi-disciplinary observations, with a focus of activity within 1-2 kilometers of the Polarstern icebreaker. A network of four to five supersites that will be atmosphere, ice, and ocean observing stations will be revisited regularly by helicopter. Another 10-12 medium atmosphere, ice, and ocean observing sites with buoys on the ice that will be revisited as conditions allow. A distributed network of global positioning system stations will provide the coordinate framework for the other observations and demonstrate how the ice deforms and how the network of instruments change over the year. Different disciplinary teams will be focused on the atmosphere, sea ice, ocean, chemical cycles, ecosystems, with crosscutting teams for modeling, remote sensing, and aircraft operations.

Dr. Rack next described the goal of achieving nested multiscale observations:

Local: Central Observatory (<5 km)

- Ship based
- Sea ice stations
  - Process scale observations

Regional: Distributed Network (<50 km)

- Sea ice stations visited by helicopter
- Unmanned aircrafts
- Process & regional model
  - Model grid cell

Arctic-wide linkages (>1000 km)

- Collaborating research vessels
- Aircraft (Polar 5,6)
- Arctic buoys, satellites
- Data assimilation studies
  - Regional & global climate models

Dr. Rack said modeling is a strong component of MOSAiC, incorporating data simulation from observations and from other programs, such as the Year of Polar Prediction (YOPP) and the Sea Ice Drift Forecast Experiment (SIDFEX).

The MOSAiC project governance structure includes working groups based on discipline, overseen by a Project Board with representatives from the eight topics, with input from an Advisory Board and the Alfred-Wegener Institute (AWI). The Board reports to a Project Coordination Committee, which includes the lead PIs for MOSAiC. An Executive Committee is also organized through AWI and a Steering Committee that has not yet been formed. A Science Plan and an Implementation Plan are available online with this and other information.

Dr. Rack next discussed the logistics timeline, which includes a setup phase and six legs, with logistics, support for personnel, and exchange and resupply between legs. He noted that to get to the ship once the drift starts will require three weeks on an icebreaker to reach the location. After spending two months on the Polarstern, it could take as long as three weeks to return. Funding, however, is for the two months on the Polarstern.

NSF is working on the contract to support participation in the expedition:

- AWI is in the process of developing draft contract(s) for MOSAiC participation tied to financial contributions to the logistical costs of the expedition (user days).
- NSF is reviewing the terms and conditions and suggesting modifications.
- Department of Energy (DOE)/The Atmospheric Radiation Measurement (ARM), or other agencies, will need their own contract with AWI.
- The MOSAiC Expedition will consist of six (6) legs:
  - Leg 1: 19 September 2019 to 15 December 2019, 88 days
  - Leg 2: 15 December 2019 to 15 February 2020, 63 days
  - Leg 3: 15 February 2020 to 15 April 2020, 61 days
  - Leg 4: 15 April 2020 to 15 June 2020, 62 days
  - Leg 5: 15 June 2020 to 15 August 2020, 62 days
  - Leg 6: 15 August 2020 to 30 September 2020, 47 days
- What AWI will provide for each MOSAiC expedition participant (e.g., accommodation, meals, access to equipment, use of helicopters, etc.).
- Defined transfer start/end point for each MOSAiC expedition Leg (e.g., Tromsø, Norway (for start of Leg 1 and end of Leg 6) or an International Air Transport Association (IATA) airport for other Legs of the MOSAiC expedition).
- Details of individual transfers (e.g., accommodation, meals, mode of transfer options (vessel, fixed-wing aircraft, helicopter, refueling stops), time required – several weeks).
- Access to data and regulations for data use will be specified in the MOSAiC data policy, which each participant will be required to sign to get access to the central database.
- Governance and representation on MOSAiC Steering Committee.
- Financial contribution to logistical costs (1500 Euros per day per person).
- Other responsibilities (e.g., travel, transfers through Russia (medivac), visas and permissions, MOSAiC code of conduct, safety regulations, safety training, and understanding of potential risks).

Dr. Rack continued with a discussion of the nine projects that have been funded, which range across the disciplines:

- (1) Collaborative Research: Thermodynamic and dynamic drivers of the Arctic sea ice mass budget at MOSAiC.
- (2) Collaborative Research: Improving the Prediction of Sea Ice through Targeted Study of Poorly Parameterized Sea Ice Processes at MOSAiC and Responsive Model Development.
- (3) Chemical, Physical and Biological processes linking snow and sea ice to the Arctic Ocean mixed layer: Improving models through the MOSAiC platform.
- (4) Collaborative Research: Defining the atmospheric deposition of trace elements into the Arctic ocean-ice ecosystem during the year-long MOSAiC ice drift.
- (5) Collaborative Research: Surface Exchange of Climate-Active Trace Gases in a Sea Ice Environment During MOSAiC.
- (6) Collaborative Research: Quantifying microbial controls on the annual cycle of methane and oxygen within the ultra-oligotrophic Central Arctic during MOSAiC.
- (7) Analysis to evaluate and improve model performance in the Central Arctic: Unique perspectives from autonomous platforms during MOSAiC.
- (8) Parameterizing sub-grid Arctic snow-on-sea-ice processes in Earth System Models using MOSAiC field observations and realistic-resolution process models.
- (9) Collaborative Research: The Role of Planktonic Lower Trophic Levels in Carbon and Nitrogen Transformations in the Central Arctic, a MOSAiC proposal.

He went on to provide information about funding for the projects. In total, the NSF-funded U.S. project estimates are:

- Science Funding           \$15,497,964
- Logistics Estimate       \$ 7,501,923 [3,886 days]
- Support Vessel Est.     \$    64,000 [ ~160 days]
- Total NSF PAX =         72 berths (all legs)

The non-NSF-funded U.S. project estimates are:

- Non-NSF Funding           TBD
- Logistics Estimate       \$ 3,088,800 [1,600 days]
- Support Vessel Est.     \$    80,000 [ ~200 days]
- Total Non-NSF PAX     35 berths (all legs)
  
- TOTAL U.S. PAX Est. = 107 berths [5,486 + 360 days]

Discussing the transfers between legs 3 and 4, he said these would be done by air, with Khatanga, Russia, as the jumping off point. He followed this with a review of the Polarstern's complete 2019 schedule and the ship's capabilities.

Dr. Rack presented a schematic depicting the MOSAiC Ice Camp, including power cable deployment. Included is a meteorological area, Met City, with a tower and balloons; and Ocean City, where there will be holes through the ice and a winch. He also mentioned a remotely operated vehicle and a hovercraft.

He also showed a diagram of the MOSAiC distributed network, including GPS sites and supersites and medium stations and discussed the changing ice conditions expected.

Turning to training, he discussed:

- Arctic Field Safety Training
- Polar Bear Awareness Training
- Weapons Training
  - To get access to weapons: Mandatory participation in a two-day AWI weapon training is required (no exceptions).
  - A series of weapon training courses will be held in Bremerhaven during Spring 2019.
  - Substantial training will be required to carry a weapon under night conditions.
  - This night training will be limited to dedicated safety personnel.
- Sea Ice Field Techniques Training (including other discipline teams)
- Other Training (as required)

For polar bear safety there is a scanning infrared system on the ship's bridge and bear guards on the ship. There will be a trip wire at 700 meters and there will be bear guards on the ice. At night, every science group will have a bear guard.

The data flow framework goes from observation to analysis, including sensors, data acquisition, near-time storage, analysis, data transfer to shore, data archiving, and post-cruise use of the data. There will be a data storage environment on the ship and there may be CubeSats in orbit for small bandwidth data transfer. Bulk transfer would be sent with rendezvousing ships going back to shore. There will be a data archive at an onshore world data center.

In conclusion he discussed related projects, including YOPP, Terrestrial MOSAiC, and others, that will provide opportunities for expansion of the collected data.

### *Discussion*

Asked about data sharing expectations, Dr. Rack said DOE data will be released in close to real time, as permitted. The MOSAiC draft data policy was presented in May and a working group is expanding that policy. It is made more difficult by the different legs throughout MOSAiC. There is a wish for a MOSAiC data package, with data not being released until after a year of the drift. There will probably be some moratorium, but with data release as soon as possible, with it being as open as possible.

In response to a question from Mr. Arnaudo about other nations, including their financial contributions, Dr. Rack said it is evolving. There are ships and participants from China, Sweden, and Russia, which is also contributing aircraft. Most of the Western European countries are also involved. There are also Korean and Japanese participants. He also discussed the participation of Greenland and Canada. He said the U.S. contribution will be about \$11.5 to \$15.0 million, depending on the exchange rate and the contributions from the other countries will be better known closer to the departure. Mr. Arnaudo also asked about the connection with Russia, White House awareness of that involvement, and whether Russia and other countries were contributing enough financially. Dr. Rack said there has been a lot of discussion internationally for over a decade about the program. The Russian contribution is largely logistical currently. The U.S. has

balanced its investment with the scientific return and is about 20 percent of the total. Dr. Falkner added that the U.S. has been at the table for over a decade and is an intellectual leader for MOSAiC. It is a World Meteorological Organization (WMO) endorsed project. During difficult times with Russia in other endeavors, collaboration and coordination on science continues, she said. Dr. Rack said the scale of observational activity is because the models focused on the Arctic are very scattered and the hope is MOSAiC will assimilate that data into the models and greatly improve their capacity for a better predictive capability.

#### Polar Research Vessel Requirements Subcommittee Update

Dr. Swift; Mr. McGovern

The subcommittee report is not complete but weekly telecons are being held and the committee is working diligently, Dr. Swift said.

Dr. Swift discussed the U.S Antarctic Program's two ships, ARSV Laurence M. Gould (LMG) and RVIB Nathaniel B. Palmer (NBP). They are not owned by NSF but operated by a contractor and work in the Southern Ocean.

LMG, built in 1997, is not an icebreaker, though it breaks a foot of ice. It has lab space and accommodates 26. Its mission is split between science and logistics support of Palmer Station. The ship averages 235 days per year at sea. With flat budgets and ship costs increasing faster than inflation, he asked if there are realistic alternatives to support the LMG's most critical activities. The Antarctic Program could charter a commercial vessel for logistics and Palmer resupply.

The NBP is the premier Polar research ship in the U.S. It is well maintained and operated but does not meet some regulations and codes. It is capable of breaking 1 meter of ice. It has been averaging 196 days at sea per year, mostly for marine science support and open ocean, non-U.S. Antarctic program science missions. The scientific community believes the NBP has operational shortfalls and wants stronger ice performance and has issues with winches and cranes. OPP has pointed out that the NBP could work in heavier ice by being paired by an escort icebreaker of greater capability.

The Service Life Extension Program (SLIP) is a major refit for ships after 20 to 30 years. Preliminary estimates for upgrades to improve its science performance would be about \$30 million. Dr. Swift said refits cost more or accomplish less than planned. He said \$30 million is a small amount in the shipbuilding industry for polar ships.

Turning to Ship Access to Antarctic Waters, Dr. Swift said marine support—presently from the LMG and NBP—is crucial for USAP science, past, present, and future. But the NBP was not constructed to support missions in areas of multiyear ice. He showed a map indicating areas where the NBP cannot operate well in support of science and logistics missions.

He asked if a new ship should be capable of working further into the ice and support year-round science operations in most of the Southern Ocean. An increase in icebreaking capacity over the



NBP would require a larger, heavier vessel, and it would be more expensive to operate. The icebreaking capacity of Palmer can't be increased.

The committee is not exploring the basic science drivers for the ships but there is a community of scientists interested in doing big science in the Antarctic. Innovative, transformative research requires ship access to polar seas over much of the year. In the opinion of some science oversight committees, the U.S. does not have “an ice-capable research vessel with which scientists can penetrate the ice-covered polar seas during most months of the year in Antarctica,” he said, quoting a 2012 report.

Presenting his individual view, he made these points:

- The Palmer is nearing end of contract and is being considered for replacement (or SLEP). Antarctic Peninsula research support issues are also at hand. There are many uncertainties. NSF is engaging the science and technical communities for input to make decisions on the path ahead.
- NSF/OPP is faced with many of the same future ship issues now facing the UNOLS academic fleet, such as increasing ship construction and operating costs in an era of flat federal science and infrastructure support budgets. (The UNOLS fleet is shrinking.)
- The NSF/OPP Advisory Committee formed the subcommittee to examine, update as needed, and prioritize science mission requirements for U.S. polar marine science ships, and to also consider issues attending to some operational options (and possible future hard choices).

He added that there is useful overlap with the present UNOLS Fleet Improvement Committee exercise to examine Science Mission Requirements for future US Global-class research ships.

NSF, he said, is looking for the possibility of a new vessel that supports the science. NSF language refers to state of the art seagoing facilities. Some in the science community read that as meaning an advanced icebreaking polar research ship significantly more capable than the NBP. The subcommittee was asked to review and assess those science mission requirements and state whether it feels the vessel will support seagoing science.

The subcommittee was also asked to review specific documents regarding science mission requirements for polar ships. It is now drafting recommendations for each of those. It was also tasked with prioritizing capabilities and operational requirements. Some priority decisions may be unintentionally controversial.

The subcommittee is also making progress on its task to look at the two-ship model and evaluate moving to a one-ship model.

Dr. Swift also discussed the subcommittee's charge to survey the broader scientific community. He said this has been completed. Most of the 91 responses were from senior and mid-career scientists. The subcommittee is trying to determine what new science drivers are coming into prominence. More work is being done with autonomous and semi-autonomous devices. A ship and its crew need to be able to handle this new science. They also asked how the ships could be better.

For science mission requirements, the subcommittee is looking at a long list of systems on a ship used to support science.

He also discussed conundrums faced by the subcommittee, including ship discharges of non-sewage water wastes. For a Palmer-like ship to work in a non-discharge area for 4 days requires a 10,000-gallon tank. A ship with more berths (50 versus 39) requires a bigger tank, and 20 days would require an even bigger tank, requiring a bigger ship that costs more to build and operate. Also, a stronger, heavier hull, and more powerful engines imply higher cost to build and operate. Improved support of permanent and temporary science stations requires increased bulk cargo and 20-foot container capacity requires a larger ship, which also increases costs. He added that new polar ships being built by other nations are large research and supply ships. Some increases in size, power and cost seem inevitable for a new ship.

He presented examples of enhanced capability and features of a new generation ice breaking polar research ship that would result in construction costs of \$600 million, with significant costs for operation.

The subcommittee plans to use existing studies of future Antarctic science forecasting, rather than redo those studies. A draft report is anticipated by the end of 2018 and will be submitted for review and comments. It will be submitted to AC-OPP in final form at the spring meeting.

Dr. Swift said it is clear the scientific community has science to do that would best be supported with an icebreaking research ship that is more capable than the NBP. But should the USAP fix up the NBP and use partnerships with more capable polar ships, or should the U.S. find a way to join the big ship club? Ultimately, it is a decision for NSF, the community, and the executive branch to make that decision. In conclusion, he said the subcommittee plans to make specific recommendations.

Mr. McGovern added the support contractors are developing action plans for various scenarios and paths forward. Vessel contracts expire in the next 2 and a half years, so a decision needs to be made soon.

### *Discussion*

Dr. Falkner noted that funding has been appropriated for the Palmer Station pier. Mr. McGovern added that currently only the Gould can tie up at Palmer Station pier. The plan is to rebuild the pier and extend it to deeper water, which would allow more ships to tie up, including NBP. But the timing is not right because the Gould contract ends before the pier will be rebuilt. The contractor is examining this issue.

Dr. Swift said he is interested in hearing input for the report from the AC. Dr. Steig asked about the implication of the two-ship option and having a significantly more capable ship, the \$600 million cost of a big ship, and the \$40 million cost of retrofitting NBP. Dr. Swift responded that the \$600 million figure is based on hearsay. The Norwegians are building a very capable polar research and supply ship for \$167 million. The cost would be at least twice as much in the U.S.

An issue with one ship is how that would tie the other ship to the Palmer peninsula or limit the science being done in the waters of the Antarctic peninsula. The NBP is a far-ranging global vessel, he said. Reducing the geographic scope of USAP marine science is a serious issue.

Mr. Arnaudo asked if any consideration was being given to getting rid of the Jones Act so foreign hulls can be purchased. Mr. McGovern said not that he was aware of. The act applies to vessels with start and end points in U.S. waters, so the Jones Act should not apply. However, whenever NSF has discussed building ships or buying from other countries, Congress has prohibited that.

Dr. Loose asked about nuclear-powered icebreakers. Dr. Swift said the U.S. Navy has control over all ship reactors, as far as he knew. Also, nuclear is very expensive. He noted that the Coast Guard's new national security icebreaker will not be nuclear-powered.

Dr. Falkner suggested the need to be clever about autonomous equipment and pairing with other nations for their more capable icebreaking and less capable science vessel. Dr. Swift said that in the Arctic there is a consortium of operators of icebreakers. If that became a working model, the same model could be used in the Antarctic. The problem is when something has to be done on a specific day. Cooperation works well for science but not as much for resupply, he said. Mr. McGovern noted that in the peninsula there are many foreign stations to collaborate with. Dr. Swift added that everyone wants the ship in the same narrow time window.

Returning to alternate fuel sources, Mr. McGovern mentioned Liquid Natural Gas (LNG), which has its own complications for refueling, and he called nuclear a nonstarter. Dr. Flanner added that there was a scientific perspective re atmospheric chemistry measurements with MOSAiC's consumption of 20,000 liters of fuel per day. Mr. McGovern mentioned ships that can operate for 20 days on LNG or electricity. Dr. Weingartner said it was hard to compare vessels across missions because of different berthing capacity, for example, which provides the capacity to stay in the ice longer. He added that he was curious about how the research icebreaker consortium will operate. Dr. Falkner said it was nascent with a limited commitment for ship time to the consortium. Mr. Stephenson said NSF was in the consortium business, but only for one science project at a time.

## **Friday, November 2**

### Antarctic Infrastructure Modernization for Science

Mr. Mossey; Ms. Short; Mr. Roth

Mr. Mossey said AIMS had reached an important milestone with the final design review that was completed within the last couple days and Ms. Short introduced Erin Heard the, newly hired Winter Site Manager for McMurdo Station.

Mr. Roth continued the presentation with an overview of major milestones:

- Aug 2014: Director's Approval to Proceed
- Nov 2014: Info Item to NSB
- Mar 2015: Concept Design Review

- Aug 2015: Info Item to NSB
- Oct 2015: Director's Approval to Preliminary Design Review (PDR)
- Dec 2016: Preliminary Design Review
- Jul 2017: Director's Designee Approval to Final Design Review (FDR)
- 2017-2018: Design Development
- 29-31 Oct '18: Final Design Review

He also listed major milestones ahead (2018-2019) to AIMS contract modification:

- 31 Oct: Independent Cost Estimate
- 2 Nov: Advisory Committee Meeting
- 14 Nov: FDR Panel Report Due
- 16 Nov: Info Item to NSB
- 27 Nov: Deliver Report to the Facilities Readiness Panel (FRP) and Director's Review Board (DRB)
- 11 Dec: Facilities Readiness Panel
- 12-13 Feb: Action Item to NSB
- 4 Mar: Contract Modification

Timely Contract Modification Enables:

- Onloading of Materials to Supply Vessel
- Procurement of Construction Equipment and Materials
- Consolidation of Materials at PT. Hueneme, CA
- Offloading of Materials at McMurdo
- Materials Staging and Construction

Mr. Roth presented site plans depicting how the AIMS project will transform a large part of the McMurdo footprint and significantly streamline science support activities, including improved transit pathways.

AIMS construction activities are planned to begin in March 2019 and last for 8-10 years. Mr. Roth highlighted the following points:

- The project is in the proposal phase
- Construction funding was requested in NSF's Fiscal 2019 budget
- In March 2019, we hope to gain approval to move into construction
- Material and equipment procurements will target the January 2020 re-supply vessel
- Construction is forecasted to last between 8-10 years and will be completed in phases

He stressed that the McMurdo Station will continue operating throughout the station modernization activities, with the station continuing to serve as a logistical hub to near and deep field science and to the South Pole Station. Utilities, connectivity, and emergency capabilities will be maintained, and environment, safety, health, and other requirements will be met.

Infrastructure transition activities are underway to adapt the utility infrastructure over the life of AIMS and rebuild physical telecommunications and utility connections as buildings are razed

and new ones constructed. Construction is ongoing and will continue throughout most of the AIMS project.

Mr. Roth listed the ramifications for individuals on station:

- Additional personnel on-site
- Site access will shift due to dynamic construction sites; routes will vary
- Scheduled utility outages will be planned and communicated
- Additional offloading/onloading of material will be required
- Coordination of move-in will be planned as beneficial occupancy of each facility is achieved

He also described the ramifications for science:

- Intermittent lodging surges from construction personnel will be accommodated
- Science support activities will continue throughout construction
- Transportation to near and deep field and South Pole Station will not be affected
- Science at South Pole unaffected
- Results in an enhanced platform from which great science can be launched

Turning to messaging, he said it would be emphasized that AIMS:

- Replaces and modernizes aging facilities and infrastructure to support continued science
- Contains increasing operations and maintenance requirements
- Consolidates multiple facilities into fewer buildings and streamlines transit among work centers
- Provides greater flexibility and resilience for future research
- Enhances safety and improve operational and energy efficiency

Mr. Roth clarified that the second messaging point means that increasing operations and maintenance requirements will be minimized.

Ms. Short continued the presentation with a discussion of an updated AIMS/station modernization communications plan. The USAP communications plan will serve as a guide to coordinate, incorporate, and synchronize mission-related communication efforts within the Office of Polar Programs and with the Antarctic Support Contract. This plan is also intended to create a framework for integrating messaging in a timely, accurate, and useful outreach approach in support of USAP and the goals of the plan. Ms. Short highlighted three goals for the USAP communications plan:

- Increase the visibility and understanding of the U.S. Antarctic Program.
- Promote USAP supported science.
- Inform USAP stakeholders how NSF plans to increase scientific capability and reliability through an ongoing recapitalization program.

Discussing how the action plan is already being used, she showed graphics that will be posted around the station and reviewed what has been done to date:

- Information shared via slides at various staff meetings around McMurdo Station.
- Emails sent to all grantees, notifying them of construction.

- Bulletin board in common area to be used for routine updates.

At the December American Geophysical Union (AGU) meeting, Ms. Short and Mr. Roth will staff the NSF booth to provide information about AIMS and station modernization. She also discussed graphics that show year by year the changes that will be coming at McMurdo. The closed-circuit television on station will also be used to push out information, as will ops notices and support plans to provide specific information for grantees and PIs on particular projects.

She said they would like to use the AC as a conduit to the community, including getting feedback. There is a frequently asked questions (FAQ) page on the [future.usap.gov](http://future.usap.gov) website, but it is not getting a lot of use.

Dr. Falkner added that there used to be area-based user groups that the contractor organized and oversaw. Since the contractor is also supposed to make the customer happy, some representatives from the science community on those groups had more personal agendas and it was therefore difficult to use those groups effectively. However, it is important to hear from the science community. Going forward, it is important to collect the community concerns on at least an annual basis and have a place where they can be heard. One possibility is to work with AC-OPP and set up an AIMS user group with the AC filtering personal agendas from the larger issues.

#### *Discussion*

Dr. Weingartner asked about providing information at the fall AGU meeting. Ms. Short said an update is being prepared for some of the materials that will be at the booth, including renderings and schedule and scope information, and there will be an opportunity there for direct feedback.

Dr. Roth said lectures on AIMS are also being provided at McMurdo.

In response to a question from Dr. Steig about examples of useful feedback, Dr. Falkner said that when the South Pole Station was reconstructed, the IceCube facility and the telescope were also constructed, with competed for support from C-130 aircraft, which created schedule issues. They learned from that experience the importance of having in place a system through which the community concerns could be registered. Although the same sort of resource conflicts with transport are not anticipated, issues will arise. Ms. Short said the most frequent question is about impact on particular activities, so it is important to get feedback on those impacts, if they are occurring. Also, as designs continue to mature, it would be useful if AC-OPP could convey the interests of the community.

Dr. Roth said many people are concerned about the impact on lodging. He said studies confirm that everyone who comes to Antarctica to conduct and support science can be accommodated.

Mr. Arnaudo asked about briefings for other countries in Antarctica. Ms. Short said there has been close collaboration with Antarctic New Zealand, which is undergoing nearby construction. The Ross Sea Working Group has been used to share information with neighbors in the region and the comprehensive environmental evaluation will be formally submitted to the next meeting.

Dr. Falkner said there have been communications via the Council of Managers of Antarctic Programs (COMNAP).

Mr. Massey followed up on an earlier point Dr. Falkner made, noting that there will be outreach to AGU with specific information at the station level. He stressed reaching out to the community to communicate what is happening, including the impact on individuals over time.

Dr. Nettles returned to the notion of a subcommittee to facilitate two-way communication. She complemented how OPP has been proactive in communicating what is happening within the programs and said setting up the subcommittee would be a good place for receiving feedback.

Dr. Weingartner asked as an AC-OPP action item that a chair for the subcommittee be named.

Dr. Falkner initially asked Dr. Isern and Ms. Short to work with the committee to determine how the subcommittee would work. Dr. Isern asked for a volunteer and said the charge to the subcommittee will be critical to set the rules of engagement and make the expected outcomes and expectations clear.

Dr. Stammerjohn asked for elaboration on the type of feedback desired, as compared with other construction items. Ms. Short elaborated on the construction of Palmer Pier, which is not as advanced as AIMS, and said it would be beneficial to have a conduit to the community to discuss other station modernization work. She suggested making the scope of the subcommittee's charge broader than just AIMS.

Dr. Falkner said FACA rules allow the subcommittee to have members who are not on the AC-OPP. She proposed as an action item to have a small group from AC-OPP to start thinking about that charge and later vet it with the larger committee. She said those without experience in Antarctica would still be able to contribute to that effort. She suggested that the proposed charter be presented at the AC-OPP's spring meeting.

Dr. Stammerjohn asked if the subcommittee would include representatives from the grantee science community as well as USAP and OPP. Dr. Isern said there is consideration being given other projects to having discussions with the user community through workshop activities. It is therefore timely, she said, to have the subcommittee set up to provide additional feedback from the community, which would also help populate a FAQ.

The subcommittee makeup would be most helpful if it provided a conduit to grantees and the user community, Ms. Short said, adding that the contractor and others could be brought in on an ad hoc basis as needed.

Dr. Heimback suggested using a webinar as a conduit to the community. Ms. Short said that is being considered.

Dr. Weingartner said he anticipated that NSF would be helpful in reaching the community, so the burden of running a survey, for example, is not on the subcommittee. Ms. Short that would fit with the communications framework.

Dr. Weingartner asked for volunteers by the end of the day. Dr. Falkner asked for volunteers to work on the charter, which would clarify the subcommittee duties for those prospective volunteers. Dr. Weingartner volunteered to help with the charter.

Dr. DeGrandpre asked for more specificity as to volunteers' responsibilities. Dr. Falkner responded that it would involve deliberating on, and providing in writing, the purpose of the ad hoc committee, its responsibilities, and the interface with the community, with presentation to the AC-OPP at its spring meeting. In response to a question from Mr. Mossey about the skills needed for subcommittee membership, Dr. Falkner said the AC could consider the areas of expertise the membership should cover. Dr. Isern said she could provide a white paper she produced that includes the history of user groups.

Dr. Stammerjohn asked about the responsibility all AC members have to communicate to their greater communities. Dr. Falkner said all AC members were chosen to be conduits to a larger community and should feel free to communicate useful information with their communities or to bring back to the AC information the committee would benefit from. AC meetings are open and public. Although an ad hoc committee does not need to have every element public, that is not to suggest doing things in secret. Such committees interface extensively with the community.

Dr. Weingartner said discussion could resume on this topic later in the meeting.

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

Dr. Weingartner; Dr. Falkner

The committee developed a list of questions to pose to the NSF Director, Dr. Córdova, during her appearance before the AC-OPP. The committee also further discussed two related topics.

Dr. Stammerjohn raised the issue of official collaboration with international partners, particularly with regard to the U.K. Natural Environment Research Council (NERC), asking if similar international joint funded projects are the way of the future and what this portends in light of the difficulty she finds in having international partnerships, unless the international partners are self-funded.

Dr. Falkner responded that the 2<sup>nd</sup> Arctic Science Ministerial brought together countries to enhance their ability to coordinate to do research at the scale and the pace needed. She traced this to the International Polar Year, which provided encouragement to coordinate internationally. NSF can share with the AC at its next meeting the percentage of international involvement in current OPP programs. Polar programs without international involvement are the exception.

Dr. Stammerjohn distinguished polar programs with international collaborators from the NSF-NERC arrangements, which she said are a formal commitment to review and fund joint projects.

Ms. Jessie Crian said the Thwaites collaboration was developed jointly between NSF and NERC, with specific criteria and each proposal must have at least one PI each from the U.S. and U.K. The review process included panelists and POs from both countries, with all proposals submitted



through NSF. NERC POs and NSF POs made decisions based on advice from the joint panel. U.S. PIs were funded through NSF's regular mechanism and U.K. PIs had to submit a secondary proposal to NERC.

She said there are other collaborative proposals with international scientists, with submissions to their own countries' funding organizations, which make their decisions independently. Dr. Falkner said this process for non-NERC international collaboration was not fully independent: When NSF decides to support a project that needs an international component to be successful, it involves a conversation between NSF program officers and those from the other country and funding decisions include in writing the arrangements with international partners.

On another topic, Dr. Fleener raised issues Dr. Weingartner said were relevant to the polar review document. Dr. Fleener talked about funding a track for indigenous researchers who bring the ability to participate in science and by doing so solving the problem of how to weave indigenous knowledge with scientific methods. A clear track is needed for indigenous researchers that helps them through college and in finding positions where they can be contributors. Almost none are going for wildlife management degrees or degrees related to polar science, he said. He also stressed the importance of developing a better understanding of whether the science that polar researchers do is useful from the policy-maker perspective.

#### Overview of the Office of International Science & Engineering's Recent Efforts/NSF International Strategic Visioning Document

Dr. Robin (Dr. Keiser was unable to attend); Dr. Falkner

Dr. Robin introduced OISE, where she is the Cluster Lead for Countries and Regions. OISE's three pillars are:

- Promoting the development of a globally engaged workforce
- Facilitating and supporting international partnership
- Providing opportunities for U.S. leadership to shape the global science and engineering agenda

OISE has three clusters:

- Administration
- Countries and regions
- Program and analysis

OISE manages three funding programs:

- Accelerating Research through International Network-to-Network Collaboration (AccelNet)
- International Research Experience for Students (IRES)
- Partnerships for International Research and Education (PIRE)

AccelNet accelerates research through international network-to-network collaborations:

- NSF 19-501
- Aims to foster networks of networks, creating links between multiple networks that cross international boundaries

- Leverage expertise, data, facilities, and/or other resources to stimulate critical research advances.
- Supports catalytic and full-scale implementation projects
- Topic areas focus on NSF Big Ideas and community-identified scientific research challenges

Dr. Robin also reviewed OISE's role in international policy coordination. She said the office coordinates, disseminates, and provides guidance to the foundation in navigating the changing landscape of international engagements. She also discussed collaboration with sister agencies on international policy and global engagement, listing the Department of Energy, Department of Defense, the Federal Bureau of Investigation, the National Institutes of Health, the Department of State, and the Office of the President.

NSF, she said, has five criteria for international engagement:

- Intellectual merit, broader impacts strengthened
- Mutual benefit for all partners
- True intellectual collaboration among all collaborators
- Leverage of complementary skills, facilities, sites, resources
- Active engagement of students and early career researchers

Discussing strategic visioning for global engagement, she listed charge, approach, and process:

- Charge: Formulate an NSF strategic visioning plan for global engagement with corresponding action items
- Approach: Visioning document aligns with the NSF Strategic Plan for 2018 – 2022: *Building the Future Investing in Discovery and Innovation*
- Process: Small working group to formulate document with International Collaborations in Chemistry (ICC), International Science and Engineering (ISE) Advisory Committee, and Assistant Directors (ADs) providing feedback for final document presented to the Office of the Director (OD) then the National Science Board (NSB).

OISE is working on a new approach to international collaboration to assure awareness of and access to the best minds and facilities, which is called Multiplying Impact Leveraging International Expertise (MULTIPLIER). This approach includes:

- Strategic factfinding missions to visit international sites
- Teams of subject matter experts explore content-specific collaborations
- A project approach with clear goals and follow-up toolkit
- Evidence-based outcomes inform next steps

OISE's first MULTIPLIER was in synthetic biology, which is a major component of the Rules of Life. The working group indicated that the U.K. and Germany are world leaders in synthetic biology research. Five NSF subject matter experts travelled to Scotland and Germany and identified synergistic benefits that will increase cooperation with partner funding agencies.

The second MULTIPLIER was to China, which is making substantial investments in large facilities. The objectives were to:

- Advance China engagement in Group of Senior Officials good practice framework - Open Data and Access (“Reciprocity”)
- Explore international expansion of distributed infrastructures (National Ecological Observatory Network (NEON), Ocean Observatories Initiative (OOI))

The third MULTIPLIER involved quantum specialists in information science, optics, electronic engineering, chemistry, material science, and physics in Japan, which has funded a 5-year quantum initiative.

Dr. Robin concluded with a review of science diplomacy engagements. She provided highlights from the 2<sup>nd</sup> Arctic Science Ministerial in Germany, the Next Einstein Forum in Rwanda, the Global Research Council in Russia, the Science Ministerial in Israel, and the Carnegie Meeting in Canada.

### *Discussion*

Dr. Nettles asked about the United States Geological Survey (USGS). Dr. Robin said her office works with USGS on many activities. Dr. Nettles mentioned data sharing restrictions when working with Russia and China. Dr. Robin agreed that this requires high-level State Department agreements and described coordination that includes GEO.

Dr. Heimbach asked if there are mechanisms for the science community to suggest MULTIPLIERS. He said Denmark is very active in the area of sea level rise. Dr. Robin said her office is studying how to engage across NSF for ideas and the community at large in an inclusive, transparent way to get the best ideas. She recommended speaking with Program Directors in OPP, who her office will be contacting.

Dr. Steig asked about timing for the pilot program, which Dr. Robin says runs every other year. After two competitions it runs on a 2.5-year basis. Dr. Steig suggested including more information on the website about when the competition is open. Dr. Steig asked if AccelNet is funding research; Dr. Robin said the intent is to do network connections and the products that might be developed to help the overall connections.

Dr. Nettles asked about the next step for MULTIPLIER. Dr. Robin said the teams produce internal reports, some of which may become publicly available. The teams assess ripeness for a workshop or, at the other extreme, a joint call on a particular topic and the reports are used for future planning and assessment.

### *Discussion (Additional Topics)*

AC-OPP returned to an earlier question, raised by Mr. Arnaudo, about MOSAiC, which Dr. Rack said involves a bilateral agreement with Germany, which is making other bilateral agreements with Russia and the other participating countries. Mr. Arnaudo said the contacts with the Russians might cause trouble if there is not a clear description of the relationships and the funding.

Dr. Heimbach referred to the dynamic environment and asked about being responsive to events that give opportunities for doing measurements at times and places that cannot be predicted. He also asked about the greatest concern for the program. Dr. Rack said the focus is on teams identifying requirements and thinking through their observational programs and assuring open and widespread communication. They are looking at plans for what are called “events” and prioritizing resources and measurements. And if there were a breakup of the camp infrastructure, how would resilience and recovery be assured. This would include making sure instruments can float and be recovered and do it safely and efficiently.

Dr. Heimbach asked about data sharing and if NSF is heavily involved. Dr. Rack said there is an evolving data policy framework and a data working group. Also, the Arctic Data Center, which is the NSF Arctic sciences repository, is working on a process for metadata harvesting and pointing to where data resides and discussion of mirroring data. The Steering Committee will be the opportunity for NSF to voice concerns or directives regarding any aspect of the program.

Turning to a discussion of the 10 Big Ideas, Dr. Falkner noted that almost all of the Big Ideas have an obvious entry point for the Polar research community to participate in and benefit from. These include NNA, Harnessing the Data Revolution, Convergent Science, Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES), and Mid-scale Research Infrastructure.

Dr. Loose asked about the review process for the Big Ideas. Dr. Falkner said each has a different approach. For NNA, there is an all-of-foundation Program Officer group overseeing the review process. How it plays out will depend on the number and nature of the proposals. Broader impacts and intellectual merit will be the main criteria. The cross-agency Program Officer group last year expended more than \$20 million of funding toward the NNA objectives.

#### Meeting with NSF Director and Chief Operating Officer

Dr. Córdova; Dr. F. Fleming Crim, Chief Operating Officer; Mr. Brian Stone, Chief of Staff

Dr. Falkner welcomed Dr. Córdova, Dr. Crim, and Mr. Stone. Dr. Weingartner thanked the director for her leadership regarding Title IX and briefly reviewed the committee’s work preparing an advisory overview for OPP. After AC-OPP members introduced themselves, Dr. Córdova told the committee of her recent trip to Berlin, where she led the U.S. delegation to the Second Arctic Science Ministerial. She also expressed her excitement at the science being done in the Arctic and in Antarctica, including as it has addressed the riddle of the origins of high-energy cosmic rays.

Dr. Lynch asked about the interaction between the budget process and the implementation of the 10 Big Ideas and how that process is expected to play out over what time scale and how it might affect implementation of the Big Ideas projects. Dr. Córdova said all the Big Ideas made it into the 2018 budget and are in the 2019 budget. The House and Senate marks were higher than that budget, which would give NSF more resources. She mentioned the recent solicitation on NNA and said she hopes people are thinking big and that projects can be leveraged with other countries. She expressed optimism about the budget and said that if it is near the House and Senate marks it will be the first to be over \$8 billion. She advised plowing ahead with plans and

not worrying too much. She stressed the importance of telling the public and elected representatives how important the science is that NSF does, its benefits, and the hope for the future.

Dr. Heimbach asked the Director to elaborate on the ministerial meeting's significance to Arctic science. Dr. Córdova said the other countries were grateful the U.S. was represented at the ministerial and was sustaining its commitment to the Arctic. The U.S., she said, took a big role in the Arctic science forum that preceded the ministerial. There was significant contribution from the indigenous nations, which are facing real changes in their existence, and discussion about the importance of co-production of knowledge. Representatives of the Arctic indigenous peoples spoke eloquently about how they look at the world. The Joint Statement of Ministers agreed to at the meeting speaks to enhancing and developing collaborative activities under three themes: 1) strengthening, integrating and sustaining Arctic observations, facilitating access to Arctic data, and ensuring Arctic research infrastructure; 2) understanding regional and global dynamics of Arctic changes and; 3) assessing vulnerability in building resilience of Arctic environments and societies. The document concludes with a recommendation for exploring the possible call of a forum of Arctic science funders, which includes the U.S., to discuss strategies for supporting the research necessary to achieve the goals agreed at the meeting. She also mentioned that the upcoming Interagency Arctic Research Policy Committee (IARPC) meeting will follow up the ministerial statement.

Asked about international data sharing policies and partnerships for improvement, Dr. Córdova said there was a lot of discussion about facilitating access to Arctic data and the need for interoperable databases. At NSF there are many efforts around making databases interoperable and accessible, including extending that to other agencies and countries. Dr. Falkner said there has been work with the Europeans to take practical next steps and there are plans to work on this jointly and join systems in the next 1 to 2 years. Dr. Córdova said the money is available and one of the Big Ideas has a focus on this objective.

Dr. Steig asked about the tension between the need for long-term monitoring versus the usual 3 to 5-year grant period. He said the Long-Term Ecological Research (LTER) is unique in having a long-term plan. Dr. Córdova said these were very important and encouraged collaboration with NEON to share data. For small grants in the longer-term programs, it is important the directorates have long-term visions of how to systematically do observations over a long time. She supported funding for LTERs, adding that sites need to be well managed, return value, and continue to be competitive. Many grants, she added, are actually very long term.

Dr. Fleener asked how the science community can do a better job of addressing policy makers' needs. Dr. Córdova said she has been impressed at how many Arctic policy groups there are and asked the AC about opportunities for engaging more to find out what policy makers need to know. Many of the ministers at the Berlin conference were not scientists, she noted, but they know the issues and are well informed. Dr. Fleener said better communication is important. He also advocated allowing more people involved in policy to participate in groups like AC-OPP. There needs to be more scientists coming to the governor's office to present their work and listen to what is important to the State. The same applies on the Federal level, he said. Dr. Córdova agreed, adding that when visiting a member of Congress, it is important to ask what is needed in

the area the member represents. She encouraged a larger perspective in which a researcher's skill set can be of service to society in a broader way.

Mr. Arnaudo asked for the Director's views about the White House's attitude toward science and NSF. She said the foundation has a very good relationship with the White House and the Office of Science and Technology Policy (OSTP) that includes interaction at least weekly. She said Kelvin Droegemeier, who has been nominated to lead OSTP, will be dynamite in that position and the office has excellent staff. She discussed working with them on the new 5-year Science, Technology, Engineering and Mathematics (STEM) education plan, a recent White House summit on quantum science, and a White House Summit on artificial intelligence. NSF has had unusually good collaborative contact with the other agencies, with frequent meetings and collaborative statements. She co-chairs three National Science and Technology Council committees and is on the president's National Council for the American Worker. She said NSF is very highly regarded by the administration's science arm.

Mr. Stone said NSF has regular communication with the Office of Management and Budget (OMB) and OSTP. He added that NSF is always at the table when there is a major science issue. Dr. Crim added that NSF spans such a large range that for most of the science issues that come up, the foundation has a program and expertise. Dr. Córdova also mentioned work between Computer & Information Science & Engineering (CISE) and OSTP. She is very bullish, she said, on the foundation's interagency collaboration and its relationship with OSTP.

Dr. Fleener requested that the report from the Second Arctic Science Ministerial include indigenous experiences and their priorities for research. Dr. Córdova said it would be included in the documents from the science forum. The only output from the ministerial is the joint statement of the Arctic nations, but indigenous peoples should keep working toward their goals, in order that it might ultimately be achieved, she said.

Dr. Weingartner asked about solar wind and how NSF harnesses the resources that industries can provide to help address these research questions without a conflict of interest. He explained that solar wind research has ramifications for the power grid, which involves private industry. Is there a way to encourage participation in that research from private industry? Dr. Crim responded that NSF has long had programs to make connections with small business and the Industry-University Cooperative Research Centers Program (IUCRC) involves large industries. The question is how to bridge the pre-competitive space where NSF can work with a collection of industries before they want to take their piece off and work by themselves. If you're thinking of a profit-making industry with proprietary information, NSF needs to find a way to work in the pre-competitive space. Convergence accelerators may be useful for doing that. With a big regulated industry, life can become more complicated and there are places for those conversations. Dr. Córdova said there are rules and legislation governing how utilities can work with NSF. She mentioned a Berkeley, CA, policy institute that is legislatively permitted to do research. Dr. Borg said members of the AC and their university colleagues can create partnerships with corporations and incorporate them in proposals. Also, NSF is exploring ways to reinvent the foundation, including how to deal with partnerships. He encouraged members to talk to POs and inform them of their ideas. Mr. Stone said the issue of industry partnerships and changing the regulatory

environment comes up often in high-level policy discussions. He added that there are many ways to partner, some of which do not include funding.

Mr. Kosseff briefly recapped his AC-OPP safety presentation from the day before for the Director, who said the Council on Governmental Relations (COGR) is a forum NSF uses for discussing these types of issues related to research. Dr. Crim said that at the last COGR meeting the focus was on risks related to security and sexual harassment. But he said the organization looks broadly at the research enterprise with universities. Dr. Córdova said the domain of responsible conduct of research is relatively new. NSF has learned through the sexual harassment policy making that university Diversity and Title IX Offices are not conferring with their Offices of Research. She said this needs to change. Universities need to have the right infrastructure to capture all the different aspects that surround the conduct of research. There are things every organization can do. She said many people at NSF were responsible for the foundation's new sexual harassment policy, adding that it was an eye opener to NSF that there was something as a Federal agency that it was allowed to do that could make a difference. That lesson is leading the foundation to look at its whole portfolio and have discussions about what else NSF can do. There will be discussions with the NSB in late November on the responsible conduct of research and administrative burden. The bottom line is that there's something each person and organization can do.

#### Polar Document Review

Dr. Weingartner; Dr. Falkner

Dr. Weingartner presented the AC overview to Polar Programs, noting that his characterization of it as the strategic plan is a misnomer that will subsequently be corrected. He thanked Ms. Walker for her help, along with predecessor AC members who started the process, and AC staff.

#### The "Advisory Overview": Outline

- Purpose:
  - OPP-AC: advises/recommends to NSF (and, via NSF, to Congress and other Federal agencies) on issues concerning support for polar research, education, infrastructure and logistics, and related activities.
  - A synthesis of The National Academies of Sciences, Engineering, and Medicine (NASEM), agency, and international reports and science planning documents (e.g., "10 Big Ideas").
- Introductory material:
  - NSF's mission & OPP's mission within NSF: fund great science, support infrastructure, logistics, health, safety, and environmental stewardship.
  - OPP structure.
- Research Drivers (9 – lots of filtering; focus on the forest and not the trees)
  - Better (more accurate) phrasing on several of the drivers (done, maybe)
- Infrastructure and Logistics
  - No comments
- Data and Cyberinfrastructure
  - No comments
- Education and Diversity

- Addition: Support undergraduate, grad, and post-docs to develop next generation of polar scientists. (DONE)
- Additional modifications perhaps: awaiting further advice from NSF- Education and Human Resources (EHR) program office.
- Synergistic Partnerships & Collaborations
  - Suggestion to include a more comprehensive list of recent and/or existing collaborations. (Perhaps)
- Conclusion

Dr. Weingartner reviewed the outline, noting that the report builds on what the community has provided over the last 5-10 years in reports and documents. Regarding the introductory material he said he had not previously been aware of the breadth of OPP's portfolio. He said the report focuses on key ideas and incorporated members' comments on the nine identified research drivers; another driver was subsequently added. A comment was received on infrastructure and logistics that has been incorporated. Noting that Data and Cyberinfrastructure had no comments, Dr. Heimbach offered that he had not yet been able to provide his input. Under education and diversity, advice has since been received from EHR.

Dr. Weingartner turned next to questions associated with the document:

- Are social science topics sufficiently addressed? Dr. Crowell had suggested that a 10<sup>th</sup> driver was needed to deal with social science issues; this was sent to members the previous evening. Dr. Weingartner said he was happy with it, but asked committee members to send in their comments.
- Is there a balance between the Arctic and Antarctic content? Dr. Weingartner said he thought there was but encouraged discussion on the topic.
- Are there modifications needed for advisory content and tone?
- What have we missed that OPP needs to know; have we over- or understated anything?
- What other recommendations do we have? These could be outside the box.
- Is the conclusion too bland? Dr. Weingartner said it could possibly be spicier.

Other suggestions were offered late in the process:

- Should explicitly mention NNA in the introduction. Dr. Weingartner said that on the advice of Dr. Falkner that will not be done. NSF is looking to break down barriers between its components; by singling out NNA, it might inadvertently signal that this is OPP's territory and by inference that other Big Ideas are not.
- Ordering footnotes sequentially. That is being addressed.
- Grant duration? Dr. Weingartner said it does not belong in its current location and whether it should remain can be discussed.
- Include a table to show interagency collaboration. Dr. Weingartner suggested a table would be useful but it needs to be balanced.

Dr. Weingartner said he attempted to incorporate suggestions from Dr. Mack. Also, ocean acidification was omitted, but will be addressed.

The document, which will go to NSF, Congress, the State Department, and others, should avoid jargon and be accessible to a general audience. Part of NSF's mission is to provide education,



information, and knowledge for enhancing national security; this is not included in the document and should be added, Dr. Weingartner said.

Mention of the Antarctic Artists and Writers Program should be included in the education and diversity section. The report should also address the relationship with GEO. Dr. Weingartner said he would include that wording.

Turning to the timeframe for the document, Dr. Weingartner said the penultimate version should be done by early December for the fall AGU meeting. Ms. Walker will put out a version with photos and members were encouraged to submit pictures, along with explicit permission for their use. The document will be distributed to the community for comments, which will be due by February 1, 2019. The document will be finalized by the next AC-OPP meeting.

Dr. Falkner noted that the 10 Big Ideas are cross-agency activities but suggested adding explanatory language that speaks to the table in the report that maps 10 themes with the 10 Big Ideas.

Dr. Lynch mentioned a potential conflict in the data and cyberinfrastructure area with the portfolio review. The draft's language about software and analytical and visualization tools being available and continuously upgraded conflicts with the NSF Arctic Data Center's finding that there is a lack of progress in data handling to make better use of developing online tools using artificial intelligence (AI) and machine learning to enhance access to data and the step backwards in usability of data in the Arctic. Dr. Lynch said she would provide Dr. Weingartner with wording to address the conflict.

Dr. Heimbach said he intended to also provide comments on data and cyberinfrastructure, focusing on analysis as a science and the ability for people to do their analysis in the cloud.

Dr. Heimbach also addressed the document's main introduction and purpose section. At the last meeting there was a distinction made between polar science and science at the poles and note made of OPP's broad portfolio. The second paragraph touches on the broad portfolio but the first paragraph makes a very specific point. He suggested switching their order, so it starts with generic language.

Mr. Arnaudo said he would add to the paragraph on international cooperation and possibly language on the National Security Council (NSC).

Dr. Fuentes said the document does not give climate sufficient attention. He said one category of drivers for climate change is anthropogenic activity, which should be highlighted. Dr. Weingartner said if the report is too specific and narrow, some readers will not understand. He asked for language that does not include too much detail, with direction on placement. Dr. Fuentes said he had text for the table that Dr. Falkner mentioned. He asked if the synergistic activities with other units was omitted intentionally. He mentioned other NSF units that are invested in the Arctic and Antarctica and said they are not in the report. Dr. Weingartner said that had been in an earlier version but he wanted to keep the document to about 10 pages and he expressed his concern about losing the audience with too much detail, adding he was not

concerned about satisfying the scientific community. Dr. Fuentes said not including programs that have been mentioned to Congress previously will cause concern. NEON should be mentioned in the section on national partnerships.

Dr. Steig said the audience for the report is unclear because of its structure. He said the report does not clearly distinguish between what NSF should be doing, what NSF is doing, and what it will be doing and suggested making that clear for each section with consistent language between sections.

Dr. Falkner said the AC had settled on trying to coalesce the advice from numerous reports to provide an appreciation of what is driving current investments. She said it is tricky to synthesize at a high level the science drivers and asked Dr. Steig to determine if it hits the right tone. She added that if the committee finds there is something other reports fail to capture, that can be added. Dr. Steig said some language could be excised; for example, wording on the length of grants. He also suggested combining research drivers five and six. Dr. Weingartner said they were split to make it easier to understand.

Dr. Stammerjohn asked about the language on research drivers that emerged from previous reports. Dr. Falkner said some AC members had reviewed past reports in their areas of expertise and tried to find a framework, but it was difficult to do the synthesis. She credited Dr. Weingartner with taking all the studies into account but noted members' input is needed.

Dr. Stammerjohn said the report is more Arctic than Antarctic. Dr. Weingartner said he did not disagree, adding that there is some prioritization, which comes from prior reports and their emphasis on the ice sheets and how changes in the Arctic Ocean will affect the weather over Nebraska. Dr. Stammerjohn agreed that earlier documents have this emphasis. She asked about including a table of national and international synergistic partnerships. Dr. Weingartner said the table would be extremely long, though it would be good to show OPP has these partnerships.

Ms. Walker suggested that additions to the document be evaluated according to the value added for someone unfamiliar with the names on such a list.

Dr. Nettles said it is important to know the report's expected impact. If the goal is to provide an understanding of why the research is being done and some grasp of how it is being carried out, it has to remain brief. Dr. Falkner said the target audience will have mostly not read the more extensive reports. She said NSF frequently brings Congressional members or staff to the Arctic and Antarctic and it is desirable to have something that concisely expresses what the science community has decided is important. It would also be useful to the State Department. There are also internal NSF audiences that would benefit from the committee's report. Dr. Falkner described AC-GEO's efforts to prepare a similar report. AC-OPP's report will help AC-GEO with those efforts.

Dr. Weingartner raised the question of how AC-OPP's report should be linked to policy making. Dr. Crowell suggested stating the report's intended audience in introduction. The report's conclusion could include policy implications, he said.

Dr. Heimbach suggested using infographics, but acknowledged the effort involved.

Dr. Loose said the report reads like a summary for stakeholders. It succeeds, he added, in distilling the larger reports into something that can be easily read by either someone in the community or further removed.

A member of the audience who works at the State Department said the report would be helpful for himself and others at the department. As it is reported up the chain, it will be condensed. He suggested including references to in-depth reports and using information that is highly summarized into a paragraph.

Dr. Mack suggested including something on LTER. She plans to provide further feedback on drivers one and six to move from classic evolutionary biology to some of the more exciting integration of rules of life up to understanding the ecosystem services that are changing. She also proposed including a sentence on wildfires into driver 6. Dr. Weingartner encouraged her to provide that wording.

Dr. Steig said the document mentions climate too often to accurately represent the breadth of OPP activities and said he would provide suggestions. Dr. Weingartner said he would give the point some thought.

Dr. Falkner said meeting the proposed February 1 completion date depends on when members return comments; time will then be required for responding to community input.

#### Wrap-Up & Other Actions

Dr. Weingartner; Dr. Falkner

The committee discussed member availability for the next meeting. Dr. Backe will follow-up with an email to members. Dr. Falkner discussed coordinating with other ACs.

Dr. Weingartner listed action items for the next meeting as:

- Ship report
- Polar portfolio analysis
- Polar document
- Subcommittee formation
  - Dr. Isern, Dr. Weingartner, Dr. Stammerjohn

Dr. Falkner encouraged members to submit ideas to Dr. Backe for future discussion.

Dr. Loose asked about addressing the issue of coproduction of knowledge and information flows from indigenous peoples to understand and communicate to the science community what it is, what it means, how to make use of it, and how to fit it with the scientific method.

Dr. Weingartner said the polar document mentions the challenge of incorporating traditional knowledge into databases.

Dr. Lynch said the coproduction of knowledge is not the same as traditional knowledge. Elements of the coproduction of knowledge may include traditional knowledge, local knowledge not associated with indigenous peoples, and practitioner knowledge.

Dr. Falkner said Ms. Renée Crain has been working on updating the principles document, which might be added to the agenda for the next meeting. Ms. Renée Crain said IARPC established a set of principles in 1990 for conducting Arctic research. About a year ago a process was begun to update that document to make it more relevant and to engage with indigenous peoples on what the principles ought to be and to reengage with Federal agencies, so they are aware of the principles and use them. Comments were taken on the existing document; a revised document was circulated for comments and the last comments are now being incorporated for submission to the IARPC's principals. The document is succinct and covers accountability, communication, respect, and being good stewards of the environment to apply to all research in the Arctic. The final version will be widely distributed and will include a 5-year review process. Working on the report has been an opportunity to engage with Alaska native peoples, with a lot of feedback and comments.

Action item: Dr. Falkner said this should be put on the agenda and said Dr. Lynch, Ms. Renée Crain, Dr. Loose, and Dr. Fleener should work together to figure how an event can be structured for the next meeting. Dr. Nettles asked to participate to include the interplay with Greenland.

Action item: Dr. Falkner suggested including a discussion of astrophysics on next agenda. Dr. Vieregg said that by the next meeting it will be clearer how the decadal process is unfolding, especially with regard to OPP.

The meeting was adjourned.