

Advisory Committee for Geosciences (AC/GEO)
October 17-18, 2019
Meeting Minutes

AC/GEO Attendees:

Dr. Kip Hodges (Chair)
Dr. Catherine Constable
Dr. Colette L. Heald
Dr. Chris Paola
Dr. Shirley A. Pomponi
Dr. Stephen C. Riser
Dr. Joshua Semeter
Dr. Kaatje Kraft

Joining by Teleconference:

Dr. Pamela Kempton
Dr. Jeffrey Welker
Dr. Lisa D. White

NSF Senior Staff:

Melissa Lane
Dr. Anjuli S. Bamzai
Dr. Scott Borg
Dr. Bill Easterling
Dr. Lina Patino
Dr. Terrence M. Quinn

Thursday, October 17, 2019

Welcome & Introductory Remarks

Dr. Hodges welcomed everyone to the meeting and asked those attending to introduce themselves.

Update on NSF GEO & Upcoming AC OPP Meeting

Dr. Easterling thanked the AC members for their work, saying much of their advice is put into action; he also thanked his National Science Foundation (NSF) colleagues who went through the last government shutdown.

He noted that the White House and the Office of Science and Technology Policy (OSTP) convey research priorities for NSF through the Office of Management and Budget (OMB) and that NSF has many programs addressing major White House science priorities, including:

American Security:

- Critical infrastructure resilience to changes in Polar regions —e.g., Navigating the New Arctic (NNA)
- Solar-terrestrial interactions that disrupt satellite communications and the power grid—e.g., Mapping Polar Ionospheric Conductivities
- Critical Minerals to U.S. national security and high-tech economy—e.g., Indium in magmatic-hydrothermal systems
- Nuclear Test Ban Treaty nuclear bomb monitoring network—e.g., National Geophysical Observatory for Geosciences (NGEO)
- Research that leads to societal benefits—e.g., weather forecast models, management of marine living resources.

American Energy and Environmental Leadership:

- Oceans, e.g., advanced autonomous sensors
- Earth System Predictability across multiple phenomena, time, and space scales—e.g., Community Earth System Model and a new U.S. National Academy of Sciences, Engineering and Medicine (NASSEM) study focusing on Earth systems.

Dr. Easterling said NSF aligns with high-priority crosscutting actions that span the research and development (R&D) priorities:

- Build and leverage a diverse, highly skilled American workforce
- Create and support research environments that reflect American values
- Support transformative research of high risk and potentially high reward
- Leverage the power of data
- Build, strengthen and expand strategic multisector partnerships.

Turning to budget issues, Dr. Easterling said NSF is operating under a continuing resolution (CR) that started at the beginning of October and will go at least to mid-November and he presented the following directorate spending details:

Directorate for Geosciences (Dollars in Millions)					
	FY 2018 Actual	FY 2019 Current Plan	FY 2020 Request	Change over FY 2018 Actual	
				Amount	Percent
Division of Atmospheric and Geospace Sciences (AGS)	\$276.10	\$272.12	\$221.97	-\$54.13	-19.6%
Division of Earth Sciences (EAR)	179.69	181.54	156.97	-22.72	-12.6%
Integrative and Collaborative Education and Research (ICER)	85.75	113.78	93.20	7.45	8.7%
Division of Ocean Sciences (OCE)	366.26	364.49	314.91	-51.35	-14.0%
Total (GEO without OPP)	\$907.80	\$931.93	\$787.05	-\$120.75	-13.3%
Office of Polar Programs (OPP)	\$501.72	\$469.16	\$403.39	-\$98.33	-19.60%

One-time funds for NCAR (arrow pointing to FY 2019 Current Plan for AGS)

Funds for NNA (arrow pointing to FY 2020 Request for AGS)

Funds for ALVIN (arrow pointing to FY 2018 Actual for OPP)

Funds for Palmer Pier and Completion of AIMS Design, plus MOSAIC (arrow pointing to FY 2018 Actual for OPP)

National Center for Atmospheric Research (NCAR); Antarctic Infrastructure Modernization for Science (AIMS); Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAIC)

The one-time funds for NCAR are for an overhaul of its aviation facility and infrastructure maintenance and updates. Funding for the ALVIN, a deep-ocean research submersible, will increase its depth limit. The Palmer Station pier is being updated in Antarctica, the AIMS design is being completed, and the MOSAiC experiment is currently underway in the Arctic where a German icebreaker is freezing in for the winter for a novel study of the Arctic Ocean over the next year. Integrative and Collaborative Education and Research (ICER) includes funding in the 2020 request to continue with NNA.

Turning to Regional Class Research Vessels (RCRV), Dr. Easterling said Congress had approved the construction of three RCRVs:

- Research Vessel (R/V) Taani construction is well underway with most of the hull erected.
- R/V Resolution is just beginning fabrication.
- The Gulf–Caribbean Oceanographic Consortium, led by University of Southern Mississippi (USM) and Louisiana Universities Marine Consortium (LUMCON), has been selected to operate the third ship. Construction to begin in early 2020.

Dr. Easterling also provided an AIMS update:

The primary contractor, Leidos, continues to advance designs of the different AIMS construction phases. It is currently in the first phase of construction, which involves procurement of long-lead items. The Research Aviation Facility refurbishment is scheduled for completion during FY21.

Coastlines and People (CoPe), is now a major GEO investment. Coastal zones are constantly changing, with increasing human population pressures and dependence on coastlines and an increasing vulnerability of coastal ecosystems and economies. The best way to understand this is through an interdisciplinary approach that brings a range of scientists together in research hubs. The first solicitation for these hubs will be this fiscal year.

Dr. Easterling discussed two of NSF’s 10 Big Ideas:

Growing Convergence Research:

- Blends scientific disciplines in a coordinated, reciprocal way.
- Accesses new methods enabled by high- performance computing
- Integration of disciplines that encourages convergence of theories.

NNA:

- 214 proposals were received for 105 unique projects
- \$180 million was requested, with \$30 million available
- 83 proposals were from Established Program to Stimulate Competitive Research (EPSCoR) states, totaling 37 unique projects
- There were international collaborators from 10 countries.

Turning to notable GEO-funded research, Dr. Easterling discussed mercury levels in fish, which have increased 10 percent in cod and 20 percent in spiny dogfish due to higher water temperatures, at a time when there has been a 20 percent decrease in mercury emissions.

In other research, data collected over two decades were used to analyze coral bleaching patterns in relation to thermal anomalies. The study suggests:

- Thermal tolerance increased by ~0.5 degrees C in the last decade
- Declines in temperature-sensitive corals has led to coral populations with higher bleaching thresholds
- Reefs near the equator were less affected by ocean warming than those at tropical mid-latitudes
- Rapid ecological and evolutionary responses to ongoing climate change occurring.

Turning to EarthScope, which is designed to track North America's geological evolution. EarthScope is the largest science project on the planet. This earth-sciences observatory records data over 3.8 million square miles. Since 2003, its more than 4,000 instruments have amassed 67 terabytes of data and adds another terabyte every six to eight weeks.

He also discussed Targeted Observation by Radars and Unmanned aircraft systems of Supercells (TORUS), in which teams of researchers and students participated to better understand conditions (humidity, air pressure, temperature, wind speed) that trigger some of the most devastating tornadoes in the U.S. and more accurately forecast which storm supercells will generate tornadoes.

The final research project he reviewed was the discovery of 2.7 million-year-old ice in Antarctica, which extends the global climate record by 1.7 million years and has the potential for new insights into the chemical composition of the atmosphere and Antarctic climate during times of comparable, or even greater warmth, than the present day.

Dr. Easterling turned next to the Advisory Committee for Polar Programs (AC-OPP), which will meet later in the month. The OPP Director, Dr. Kelly Falkner, is attending a symposium celebrating the 50th anniversary of the first all-woman research team in Antarctica. AC-OPP, chaired by Dr. Thomas Weingartner, recently issued a report summarizing OPP studies from 2012-2019 and consolidating community-developed recommendations in one document.

Dr. Easterling said NSF is on a fast track with the National Academies of Sciences (NAS) to start a study that asks the Academy to advise NSF how best to manage an emphasis on Earth system science. This fall, NASEM committee member nominations will be solicited. The committee will be given draft objectives later this year or in early 2020 to:

- Review the current state of the science of Earth Systems
- Describe investments needed to enable an Earth System research enterprise at NSF
- Identify Earth System science synergies between NSF and other Federal agencies

The final report is anticipated between September and October 2021.

Discussion

Dr. Hodges said the Earth system science graphic Dr. Easterling presented does not account for the effect the deep Earth has on the complex interrelated system, other than for volcanos. The

plate tectonics process has to be included and the committee membership should reflect that understanding. Dr. Easterling agreed.

Dr. Hodges added that the AC/GEO report being prepared will say everything in GEO should be looked at with an Earth system approach; therefore, NSF is already in the midst of the research enterprise Dr. Easterling listed among the NAS study objectives. Dr. Easterling responded that NSF has many facilities that contribute to different aspects of the Earth system and there needs to be a way to organize them to use their capabilities for system-level research science. Dr. Hodges said it might be problematic to create an Earth system research component separate from the rest of GEO. Dr. Easterling said he did not want to erect anything that challenged the work done to increase interdisciplinary Earth system research. But NSF is stove piped and Earth system science cannot be done absent the biological sciences or the social sciences. The task is to bring together these different pieces without harming well-developed disciplinary research. Dr. Hodges supported that effort but said most of what GEO should be doing is Earth system type research. He cautioned against crippling initiatives to make it more system orientated by carving out something and calling it Earth system science.

Dr. Pomponi offered that Dr. Easterling was looking for recommendations related to NSF-wide support for this type of program, not just geosciences, and the task should be made as specific as possible. Dr. Easterling said he has received support for this approach from NAS. At NSF, in addition to GEO, he expects there will be contributions from other directorates and that they are supportive. Asked if the sponsor can make recommendations about the types of committee members, he said he has suggested names for committee chair. The Academy did a report in the 1980s on Earth system science and two or three individuals who participated in its preparation are available and would be ideal for the new committee.

Dr. Semeter asked about connections to Harnessing the Data Revolution. Dr. Easterling said one of the biggest developments in Earth system science has been the emergence of data science and he hopes to have strong participation from Computer and Information Science and Engineering (CISE).

Update on Navigating the New Arctic

Dr. Gregory Anderson, Program Director (PD), Arctic System Sciences, and a co-chair of a working group that is managing NNA, presented an update. He discussed the 1°C average change in the Northern Hemisphere from November to April that occurred during his lifetime, 1969 to 2019. The Arctic is warming at significantly higher rate: almost 7°C. This is causing the permafrost to degrade and sea ice to retreat. Also, coastal erosion becomes a bigger factor because the wave action is stronger. Wildfires are more widespread, more intense and more frequent. These changes affect the people who live there and the distribution of animals and plants. Arctic ice melting causes the sea level to rise, with nuisance flooding on the U.S. East Coast. There are also new opportunities for taking shipments across the Arctic, with accompanying risks. Responding takes system-style thinking, which is where NNA comes in.

NNA is going after large, system-level questions to understand how to make informed decisions about responding to opportunities and challenges. NNA has three goals for FY19:

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

He said these components occur in the overlap of the natural environment, the built environment and social systems. NNA is different from other initiatives because it crosses geographic boundaries, NSF organizational boundaries, and intellectual boundaries. The idea of convergence is central to NNA, he added. A convergence project has to have different things coming together across intellectual spaces—different techniques, approaches, thought processes, knowledge structures and ways of answering questions—as a whole.

Many NNA projects involve the co-production of knowledge, when appropriate. It involves the integration of different knowledge systems and methodologies to systematically understand the phenomena, systems, and processes being studied in a research project. This can include research in which local and Indigenous people and organizations fully engage in the complete research process.

NNA began in FY17, with the first solicitation for research proposals and planning grants in FY19. The initiative is to last at least five years and will be refined based on the progress of projects and feedback from the scientific community. In FY18, 20 projects were funded with a total budget of \$22.7 million. He discussed a soundscape ecology project to assess environmental and anthropogenic controls on wildlife behavior.

He also discussed MOSAiC, the largest ever Arctic expedition, which is freezing the Polarstern icebreaker into an ice flow for a year to measure the biogeochemical and physical environment above the ice, in the ice and below the ice.

In FY19 there were 47 awards comprising 21 projects, with a budget of \$37.6 million. Thirteen are research project and eight are planning grants. There are 123 senior personnel involved and two awardees are new.

He and his co-chairs—Dr. Irina Dolinskaya, PD, Division of Civil, Mechanical & Manufacturing Innovation (CMMI) in the Directorate for Engineering (ENG) and Dr. Kendra McLauchlan, PD, Division of Environmental Biology (DEB) in the Directorate for Biological Sciences (BIO)—discussed three examples:

- Arctic impacts and reverberations of expanding global maritime trade routes (Principal Investigators (PI): Elise Miller-Hooks, George Mason University)
- Developing Arctic village resilience to changes in the water cycle, river systems, and coasts (PI: Julie Brigham-Grette, University of Massachusetts at Amherst)
- The Permafrost Discovery Gateway (PI: Anna Liljedahl, University of Alaska at Fairbanks).

Dr. Anderson also discussed what is coming next:

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

Discussion

Dr. Constable asked about the finances of multi-PI groups. Dr. Anderson said there is a proposal-per-PI limit. Dr. Dolinskaya added said the research awards are up to \$3 million, which is sizable and PIs and co-PIs have adequate commitment to their projects. Responding to a question about the difficulty of developing teams with sufficient social scientists to work with those from other disciplines, Dr. Anderson said it is not required to have a social scientist on a project. One purpose of the planning grants is to build those connections and it is possible to be on a research project and planning grant simultaneously. Also, the PI workshops will bring people together to form networks.

Dr. Hodges asked about areas with no built environment and no local social component and whether NNA would fund an interdisciplinary project (cryosphere, atmosphere and solid earth). Dr. Anderson that would be an Arctic system science proposal. NNA, he added, is an addition to other programs, which are not being supplanted. Dr. Borg suggested adding this to NNA's Frequently Asked Questions (FAQs). Dr. Anderson said he often has conversations with PIs about whether NNA is the best home for their proposed projects.

Discussion of 21st Century GEO Draft Report

Dr. Hodges said the 2014 report *Dynamic Earth: GEO Imperatives & Frontiers 2015-2020* presented a set of imperatives to fulfill the potential of geoscience to advance knowledge and address critical national needs, which he briefly reviewed. He also reviewed the four examples in the report of research frontiers that were of growing interest in the GEO research community.

Imperatives:

- Research
- Community resources and infrastructures
- Data and cyberinfrastructure
- Education and diversity.

Research Frontiers:

- Earth systems that cross land/ocean
- High latitude, ocean-atmosphere ice ecosystem interactions and processes
- Urban geosystem science
- Early earth.

Starting in 2017, AC/GEO was asked to reevaluate *Dynamic Earth* and think about how it needed to be updated. The AC especially supported the imperatives but believed the research frontiers were not representative of all the most exciting research directions of the geosciences. An American Geophysical Union (AGU) Town Hall was held and a Dear Colleague Letter (DCL) issued for feedback. Dr. Hodges said *Dynamic Earth* was not well known and had a

minimal impact. Many felt the report did not represent their interests, he said. Over the last couple years, the AC devised three components for a new report:

- Component 1. Interdisciplinary geoscience research, including twin foci on basic science and applied science to address societal impacts;
- Component 2. NSF must intensify its efforts to help the community diversify;
- Component 3. Current structures and procedures of GEO at the program level should be reviewed and modified to better support interdisciplinary science; minimize bias; simplify and accelerate the proposal writing process; and ease burdens on mail reviewers, panels, and PDs.

Substantial progress has been made on a first draft for Component 1. It is stronger on socially relevant science and weaker on basic science, which is too focused on early Earth and biogeochemistry. A subcommittee is needed to add to it without endorsing specific research priorities.

For Component 2, nothing has been written. The problem has to be articulated, suggesting how AC/GEO can lead by example and recommend concrete steps AC/GEO can take to encourage and support the building of a more inclusive geosciences community. Another subcommittee is needed to write this section.

For Component 3, Dr. Hodges provided a list of ideas for reevaluating structures and procedures from the point of view individuals submitting proposals:

- Too much time writing proposals, given the success rate
- Unintentional bias in the review process (mail and panel) based on age, the perceived quality of institution, gender, race, etc.
- Too few mail reviews
- Mail reviewers and panelists have no accountability due to anonymity
- One or two harsh mail reviewers can kill a proposal
- Harsh mail reviews overly influence panels
- Panel evaluations are highly variable and idiosyncratic
- Panels not representative of the breadth of the field
- Creative proposals are harder to get funded than “more of the same” proposals
- Opportunities for funding of collaborative efforts are too perspective in scope
- Research that cuts across disciplinary boundaries and does not fit in any single program
- Removal of deadlines works well but the evaluation process and how long the process should take are unclear
- Researchers should be able to provide rebuttals to factually incorrect panel or mail reviews before proposals are ranked and final funding decisions made
- Bias toward funding safe science over high-risk, high-reward science.

A third subcommittee is needed to lead the writing. Dr. Hodges proposed sending the products of the three subcommittees to the other members for a two-week comment period. Dr. Hodges

volunteered to write a first draft based on those comments and have it distributed to the committee. The document is to be essentially complete by the spring 2020 meeting.

Discussion

Dr. Pomponi said the Component 3 items are mostly all in the Council of Visitors (COV) report and the Program Officers have responded. Also, the AC/GEO report does not have the focus Dr. Easterling wanted. *Dynamic Earth* is focused on research prospectus and perspectives. She suggested centering the report on Component 1 with some recommendations regarding Components 2 and 3. Also, since Component 1 focuses on interdisciplinary research and since a statement of task is being drafted for a National Academies report, she asked if there is something the committee can do that will introduce that concept to the community and still affirm the importance of core research and interdisciplinary research, reaffirming the overall imperatives, make a statement about evolving research frontiers, but introduce the value of interdisciplinary research while still maintaining the value of the core programs, providing a preview of what NSF is asking the National Academies to do and GEO's interest in interdisciplinary and multi-disciplinary programs. Dr. Hodges responded that there was enthusiasm at the last meeting for the approach he outlined, with buy-in from Dr. Easterling.

Dr. Easterling said the three Components answer the charge. He added that the value of geoscience research is not well understood outside the discipline, particularly on the Hill. His intention was to identify the research questions that are just over the horizon that are not in today's research portfolio that could supplement *Dynamic Earth*, and this is honored in the three Components. There is not enough progress being made in diversity in the geosciences, he said, though it has been a priority for decades. Geosciences is increasing its financial commitment to Inclusion across the Nation of Communities of Learners that have been Underrepresented for Diversity in Engineering and Science (INCLUDES), hoping to make headway. Even so, the committee's thinking is needed to break out of the rut GEO is in. Component 3, he said, gets to the heart of what NSF is trying to address through interdisciplinary research to build research programs that deliver usable knowledge without harming curiosity-driven science.

Dr. Pomponi said she wanted to make sure the committee was not just doing a follow-up that had the same kind of content as *Dynamic Earth*. The committee is moving beyond that and the Components are important topics that AC/GEO can contribute to. She wanted to assure the committee was not thinking the report will be a follow-up to *Dynamic Earth*.

Dr. Easterling said the three Components represent a logical progression of the committee's thinking but cautioned against making it too broad so it loses its punch and cannot be operationalized.

Dr. Hodges said he wasn't advocating for the three Components. The first, he said, the committee agreed to; Component 2 is an emerging phenomenon and came out of committee brainstorming; Component 3 got its start four meetings prior with a discussion about why NSF isn't pushing more funding into things that are cutting edge. And the committee has heard from many people who are concerned about the structure and process. Many may be mis-informed, but GEO needs to address them, some at an NSF level and some not. Outside of GEO at NSF, proposals are handled in creative ways.

Dr. Riser said that as a member of the COV he had heard people make many of the same comments captured in Component 3. He also said the draft version of the report Dr. Hodges had circulated does not sufficiently address climate change. Dr. Hodges said he mostly just put together input from the committee and was also struck by the minimization of climate science. The document got its start when there was a different House of Representatives, when there was a perception there that geoscience only did climate change science.

Dr. Easterling said that in years past it had been advised to be circumspect in the use of “climate” and “climate change.” But there is now no reason why the word “climate” cannot be used. Still, the aspects of climate NSF is interested in are basic research questions, as opposed to what to do about climate.

Dr. Hodges said that society has started a major experiment on the planet and it’s an obvious thing for AC/GEO to understand the outcome. He added that the subcommittee working on this portion of the report should address this.

Dr. Borg said NSF has given mixed signals over the years. The emphasis on Broader Impacts (BI) and affecting society can easily be interpreted as advocacy. Congress has attempted directorate-level appropriations targeting lower investments in GEO and the Directorate for Social, Behavioral, and Economic (SBE) Sciences because of the perception that climate change equals advocacy.

Turning to the distinction made earlier between basic science and applied science, Dr. Borg asked if the intention was to refer to curiosity-driven science that does not have an obvious, immediate application vs. fundamental research. NSF cannot save the world; its niche is in fundamental research, though it might inform potential solutions down the line. He advised the committee to be cognizant of the claims and interpretations people make about terms like “applied research.”

Dr. Paola asked for more information on how the report could be most useful for NSF. Dr. Easterling said not to rewrite *Dynamic Earth* and to identify the next major research questions that will become imperatives and are not in *Dynamic Earth*. Dr. Paola said that seemed like an odd charge for the committee, which is a small subset of the community. Dr. Hodges said the committee had decided it was not worthy of that charge. The community did not embrace *Dynamic Earth*. Future imperatives have to be determined through decadal research papers and National Academies reports that have been vetted through a large part of the community.

Dr. Easterling said *Dynamic Earth* has a good roadmap of some of the major research challenges that lie ahead. It is a reasonable selection of research areas. But when you depart from being a research priority process, you get into the questions in the three Components. Developing a strong argument for why geosciences research is important needs to be made clear. It needs to make the case that the discipline can make strong contributions to understanding how the world works and suggest solutions to very important challenges to society in the Earth sciences. And the document can’t be silent on workforce diversity. GEO’s current structures and procedures need to be looked at, but he would not state it as strongly as it is in Component 3, which says

they need to be modified. NSF needs advice on how efficient the structures and procedures are in encouraging interdisciplinary science.

Dr. Constable said *Dynamic Earth* is missing much of what the community sees as their scientific objectives. This committee wants to avoid repeating that mistake. The new report has to be sufficiently general to allow for whatever kinds of science we do. Also, Components 2 and 3 are both about bias within the community about the kind of people we are willing to hire as faculty members who don't meet the criteria we thought of as being the 1960s faculty member. Despite efforts to diversify faculty, much more implicit bias training is needed. The new report should encourage GEO to take on board the idea of transforming the community. The people who write peer reviews can be very narrow minded in what they see as important. There is a particular problem with interdisciplinary programs at the core level. Dr. Pomponi went further and stated that all three Components are interrelated.

Dr. Easterling agreed that there is a logical relationship between all three Components. The charge for the first is: Why is interdisciplinary geosciences research important? The corollary is: Why is it important to maintain a balance of interdisciplinary research and curiosity-driven research? For the second Component, the question is: What is it about diversity in the geosciences that is important enough that we should pursue it aggressively? For the third Component, the question is: How can the current NSF structures be improved to facilitate interdisciplinary science while maintaining a balance of the core disciplinary, curiosity-driven research?

Working Lunch: Presentation on Status of RCRV Construction and Alvin Dive

Dr. Brian Midson, PD, Division of Ocean Sciences (GEO/OCE), began with the status of construction:

- Three RCRVs under construction at Gulf Island Shipyards in Houma, LA
- Full appropriation of the \$354 million Total Project Cost was completed in FY19
- Oregon State University manages the construction of all three and will operate the first vessel, R/V Taani
- The East Coast Oceanographic Consortium, led by the University of Rhode Island, will operate the second vessel, R/V Resolution
- The Gulf-Caribbean Oceanographic Consortium, led by the University of Southern Mississippi, will operate the third vessel, name to be determined.

He also presented the RCRV financial status:

- The total project cost, \$354 million, included \$56 million (16%) contingency at the time of award
- Initial contingency produced 90% confidence based on probabilistic (Monte Carlo) assessment of known risks
- The project is 19% complete, on budget and slightly behind schedule, which is very good for ship building projects
- Cost Performance Index = 1.01
- Schedule Performance Index = 0.92
- Remaining contingency for known risks produces greater than 90% confidence that funding is sufficient to complete

- The imperatives included research imperatives, core programs, hazards and disasters and the water cycle.

The construction program has the following remaining risks:

- Hull delivery delay: shipyard unable to meet the delivery date for each hull and impacts to project management costs
- Emergent technologies: new technologies preferable to those specified such as communications or science outfitting
- Requirements changes: design or scope changes initiated by stakeholders including NSF, Science Oversight Committee, and operating institutions
- Sonar performance: acoustic sensors do not perform to expectations; primary concern is bubble sweepdown coming from bulbous bow and bow thruster gratings.

Dr. Midson also presented a summary schedule that concludes with University-National Oceanographic Laboratory System (UNOLS) designation. Once designated, each RCRV becomes part of the Academic Research Fleet and begins science operations.

Hull 1:

- Keel laying: 11/7/18
- Launch: 11/17/20
- Delivery: 8/25/21
- UNOLS designation: 8/25/22

Hull 2:

- Keel laying: 5/7/19
- Launch: 5/13/21
- Delivery: 2/4/22
- UNOLS designation: 2/3/23

Hull 3:

- Keel laying: 11/5/19
- Launch: 10/20/21
- Delivery: 7/14/22
- UNOLS designation: 7/14/23

For the first ship, R/V Taani, he showed a graphic of the construction process. He also showed images of the ship's "bulbous bow," shell plate installation, the overboard handling system, the water sampling rosette, and said there's a public [webcam](#) for viewing construction.

Discussion

Dr. Quinn described his experience seeing the keel laying for the R/V Resolution. Dr. Kraft asked about the bow and fuel efficiency. Dr. Midson said it was hard to quantify. In response to a question from the audience, Dr. Midson said the R/V Sikuliaq, funded in 2009, had advanced

features and a process the new construction program is benefiting from. In response to the position of the sonar mounting, Dr. Midson said the center of the ship was the optimal location.

Alvin

Dr. Midson discussed modifications to the Alvin, a deep-ocean research submersible, so it can achieve a depth of 6500 meters with the capacity for a heavier payload:

- Replace foam
- Replace ballast spheres
- 4500-meter implodables (limited to vehicle primary/base functions)
- Main and variable ballast plumbing (valves, tubing, fittings)
- Main hydraulics
- System level engineering

He followed-up with images depicting the modifications and described how the changes, including replacing the foam:

- Existing 4500m syntactic foam (14 blocks) to be replaced with new 6500m foam shapes (mid body cluster, major tail block, beaver tail)
- 200 cubic feet of foam in hand and 100% testing completed
- Four new large blocks are in the process of being bonded and shaped
- Total quantity and complexity of foam mounting brackets is reduced from the existing configuration
- Foam attachment analysis will be updated and submitted for review
- Three battery boxes are built and ready for 6500-meter service

He also discussed:

Frame

- Modifications to the aft upper portions of the main vehicle frame in support of new foam and ballast sphere arrangement
- Frame analysis will be updated to reflect the new configuration and distribution of weights
- Frame analysis report will be based on existing analysis.

Ballast Spheres

- Reduces total ballast spheres on vehicle from eight to four
- MOP capable w/o pre-charge
- 26-inch ID (old spheres = 23.78")
- Increase VB capacity from 400 lb. to 500 lb.
- Design approved by Naval Sea Systems Command (NAVSEA).

Main and Variable Ballast

- Dual intensifier sea water pump fabricated and delivered to Woods Hole Oceanographic Institution (WHOI)

- Factory Acceptance Test was SAT
- Piping study completed, replacement parts selected, tested SAT
- Valve study completed, replacement parts selected, tested SAT.

Propulsion

- New 6500-meter rated motor controller housings designed, fabricated and pressure tested SAT
- Motor control housings can be configured as dual or quad units.
- New thruster design has been completed and prototyped
- Thruster components for production run of remaining 10 units have been ordered and expected to be assembled by the end of 2019.

Hydraulic

- Main hydraulic system design complete
- Pump, manifolds, valves procured and/or fabricated
- Hydraulic system testing underway at WHOI

Implodables

- Replacement 6500-meter fiber optic bulkhead for data, power and imaging bottles identified and qualified.
- Assessment of critical implodable volumes completed and remaining work defined.
- COTs replacement units procured or in hand
 - USBL beacons
 - Sonar
 - Flashers
 - RF beacons

To be completed

- Alvin Major overhaul (sub arrives at WHOI in March)
- Foam shaping coating
- Replacement skin design and fabrication
- Frame modifications
- Life support testing
- Component fit-up
- Upgrade optical fiber bulkhead on data, power and Imaging housings
- DVL testing and connector qualification
- WHOI designed housings
 - Design and fabricate pressure sensor and temperature probe housings
 - Modifications to magnetometer and laser housing endcap and connectors

Risks

- Ballast sphere-moderate (cost/schedule)
- Frame analysis and modifications-moderate (cost/schedule)
- Optical fiber replacement-low (cost)
- DVL connector replacement-low (cost)

Milestones

- Foam block complete December 2019
- Alvin demobilization mid-March 2020
- Forging delivery March 2020
- Vehicle disassembly May 2020
- Spheres complete/TRR July 2020
- Sphered hydro test August 2020
- Alvin Sea Trials to follow Atlantis return to service, July 2021

Discussion

Dr. Pomponi said 15 years ago NSF funded a study that recommended the 6500-meter capability and said she was pleased to see that happening. She asked what will happen to the scientists proposing deep submergence science using Alvin when it is not available. Dr. Midson responded that Jason, a remotely operated submersible vehicle, is supporting some projects and proposals being made now. He added that his deep submergence program is funding operations of non-National Deep Submergence Facility (NDSF) assets but are not available to substitute for Alvin when it is out of service. In response to a question from Dr. Easterling, Dr. Midson listed the upcoming cruises for the R/V Atlantis. In response to an audience question about the Pisces submersibles, Dr. Midson said the support ship is out of its useful service life; the submersibles could still be used, if there were funding.

Preparation for Meeting with NSF Chief Operating Officer (COO)

The committee developed a list of questions it would pose to the NSF COO.

Meeting with NSF Chief Operating Officer, Fleming Crim

Dr. Crim said NSF Director Dr. France Córdova, who is travelling, sent her regrets for not being able to attend. He noted that last week Dr. Córdova was at the Arctic Circle Assembly in Iceland.

Next year is NSF's 70th anniversary and the 75th anniversary of the book, *Science, The Endless Frontier; A Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development*. In those intervening five years there was a debate about how to fund science, which was influential in that discussion. Dr. Crim has written the introduction to a new edition of the book, which the foundation is republishing. A history of NSF also has been commissioned for the foundation's anniversary. A symposium will be held to celebrate the anniversary. It will be held following the National Science Board (NSB) meeting in February.

Turning to the budget, Dr. Crim said NSF had just finished spending out the FY19 budget (\$8.1 billion). The president's FY20 budget request was for \$7.1 billion. Even so, it reflects priorities for artificial intelligence (AI), quantum information science, and advanced manufacturing, where the foundation aligns with administration priorities. The House mark for the budget was \$8.6 billion and the Senate mark was \$8.3 billion. The two need to be reconciled. The CR runs until November 21.

In January there was a 35-day practice, when the government was shut down. Those responsible at NSF for recovering from that lapse did a great job, he said, adding that NSF is well prepared whatever comes along.

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

Dr. Crim also said that 43 new Convergence Accelerator awards have been announced (\$39 million). The foci were Harnessing the Data Revolution and The Future of Work at the Human-Technology Frontier (FW-HTF). NSF is also in the midst of its Mid-scale Research Infrastructure awards. He said there has been a gap between the top of the major research instrumentation program and the beginning of the Major Research Equipment and Facilities Construction (MREFC) line. This year, the Mid-scale Track 1 awards are \$6-\$20 million. Track 2 is for \$20-\$100 million and proposals are under review.

Dr. Crim described his visit to WHOI, which he said is an example of the foundation's effort to each month bring attention to an area of emphasis. He also discussed an NSB retreat in Boulder, Colorado, and a trip to NCAR.

Dr. Crim also thanked the committee members for their work and invited questions.

Discussion

Dr. Kraft raised the issue of diversity in the geosciences and asked Dr. Crim about best practices that translate across disciplines. Dr. Crim mentioned Bridge Programs that connect individuals from minority-serving institutions to major research institutions. Admitting a student into a first-rate program is not sufficient without the bridging, he said. Bridge Programs, he added, require intensive, heroic efforts. INCLUDES is trying to scale some of those heroic efforts by networking them together. He emphasized the communication and networking aspects of INCLUDES.

Dr. Paola asked about funding for interdisciplinary research across the foundation outside of the well-known, big named initiatives. Dr. Crim said the Big Ideas consume a relatively small amount of NSF resources but capitalize on a base of research that it was time to build on. Every Big Idea was to have connections across the foundation. Tying people across the foundation is tremendous work; Program Officers (PO) knock themselves out to make the Big Ideas happen. That is an example of the barrier, which is institutional. People are so busy and focused on what's before them, they need encouragement and incentives and rewards for connecting around the foundation. NSF has to recognize the effort involved and create situations where POs have time to do interdisciplinary work. The POs are key to getting beyond the big initiatives. He recommended finding ways to encourage people to find a reward — financial or intellectual fascination — in finding a connection.

Dr. Constable asked about the balance between core science and interdisciplinary research. Dr. Crim suggested finding a term other than "core." It means work at the heart of the discipline. Saying to member of Congress or OMB officials that advances in science can be made by

funding core research causes their eyes to glaze over. It is better, he said, to talk about things that resonate with your audience. Despite the Big Ideas, a lot of NSF's budget goes to individual investigators and small groups that are mostly working in a single discipline and that will continue. The foundation may be served well by emphasizing the issues on people's minds, such as AI and quantum information science. NSF has been funding quantum science research for decades. Now it is hot and NSF is a leader because it has been doing it for decades. That's the position NSF wants to be in for every discipline. Only slightly more than 20 percent of proposals received are funded, but the foundation is not backing away from that commitment. Emphasis on the Big Ideas or another multidisciplinary effort creates the impression that NSF is moving all its firepower to that area, but it's not the case.

Dr. Hodges said individuals are becoming more diversified. There is not a premium now for going to NSF with an individual investigative multidisciplinary proposal. But it is happening more as people are cross-trained. Dr. Crim said young people now were born with the capacity to do interdisciplinary work. The question is how to promote that at the foundation. We need to encourage POs to find co-funding.

Dr. Semeter asked about foundation-level strategic thinking around Earth system science. Dr. Crim said NSF needs to foster discussions with the National Academies and other places to get momentum behind that. More of the traditional directorates recognize that they need social, behavioral and economic sciences to be involved. We need to hear thoughtful people talk about Earth system science. This community needs to start driving the discussion. If something comes along that reaches across the foundation and starts to drive things forward, the foundation will respond. Dr. Semeter said talking about Earth system science does not generate interest. Dr. Crim suggested using images of undersea volcanoes and the like to create a story. Thinking of the Earth as a system fits in with much of what is going on these days. Dr. Semeter said we don't know all the correlations between the data sets that are used by the different directorates and it is difficult to write a write a proposal about it. Dr. Crim said the research community will be well served as we get people up to speed using AI not as a buzz term but as a way to do science.

Dr. Pomponi asked about NSF's role in the United Nations Decade of Ocean Science for Sustainable Development. Dr. Crim said he didn't know and will look into it. Dr. Quinn said the U.S. co-chairs are from Scripps Institution of Oceanography and the National Oceanic and Atmospheric Administration (NOAA) and there have been discussions at the Subcommittee on Ocean Science and Technology (SOST). Many of the eight research themes play into basic research applications at NSF. Dr. Pomponi asked about financial support. Dr. Crim said NSF will not be in the position of committing to a certain amount over 10 years but would be in the position of saying over the next 10 years we are going to begin funding at this rate and we expect to go forward, subject to availability of funds. Dr. Quinn said there are three new regional class research vessels coming on board and the ocean science community should be thinking about leveraging facilities and taking advantage of that.

Dr. Riser mentioned the AC's 21st Century GEO Draft Report and asked how much flexibility is allowed in the proposal review process. Dr. Crim responded that solicitations can have extra review criteria. In reviewing unsolicited proposals, or solicitations without extra conditions, there is a standard review process that can vary by discipline. The POs are building a portfolio. NSF

does not simply rank proposals and draw a pay line. The PO discretion responds to intellectual opportunities. There is a standard guide, but with room for flexibility. Dr. Riser asked if answering the proposal reviews before the decision is something GEO could do alone. Dr. Borg said it would not be something NSF would simply adopt or let GEO run separately but it could be a pilot program, as could giving PIs access to reviews with the ability to correct factual errors. Dr. Crim agreed.

Dr. Hodges raised the example of eliminating deadlines to say there has to be a pre-experiment plan for assessment with a fixed term. Dr. Crim said the data on that experiment is being examined. It is currently an opt-in decision for directorates, which represents a marketplace for the idea. NSF is also hearing from POs on how it is working. Early data show the complications are well worth more carefully considered proposals. It is still unknown if the proposals are better. Someday it might serve the foundation to eliminate deadlines but a better way to make change is for individuals to see an advantage to doing things differently.

Dr. Borg said there are different levels of policy and it will take a sea change to get the board to change the two basic review criteria and it is NSF policy that there has to be a minimum of three reviews. For no deadlines, there have been programs where deadlines have been an exception for many years. The deadline issue is a different scale of policy change. Dr. Crim agreed that there are a few fixed points of established policy, like review criteria, and other things that are about how they are executed.

Dr. Hodges asked where the boundary is between what can be handled at the GEO level and what has to go to NSF as a whole. Dr. Crim said GEO's suggestions do not have to be fully executable, but need only point to something NSF might do, perhaps with some modifications.

Dr. Constable asked if the impact has to be measurable. Dr. Crim answered that it is hard to do something without measuring the outcome. Dr. Constable asked how to measure if proposals are better. Dr. Crim said it is vexing. Dr. Borg said measuring quality recently came up with CISE considering going to no deadlines. Dr. Patino said there are samples from a range of directorates. Community input shows they feel the proposal is ready to be submitted, but the data to quantify that is not available. Dr. Crim said even if the proposals have not gotten better there is a gain for the community and science because the POs will have more time to work with the PIs and the community is not generating proposals just to meet the deadline.

Dr. Bamzai said her division has experience getting quality proposals with no deadlines and salvages the parts that are fundable. Sharing the reviews and rebuttals is something her division has done all along. Success rates were relatively high. Geography and Spatial Sciences was running an experiment in which they would have deadlines and a subset that did not review well. The reviews went back to the PIs and they would resubmit the proposals. This was called GSS Plus 1. The same panel would look at the subset of proposals and would apply the criteria of high risk/ high reward. Not all proposals, she added, can be in no-deadline mode, especially in OCE and the Division of Atmospheric and Geospace Sciences (AGS).

Dr. Hodges thanked Dr. Crim for coming and Dr. Crim thanked committee members for their remarks.

COV Report: Ocean Research

Dr. Riser summarized the recommendations of the 2019 Ocean Sciences COV report to provide external expert judgments in two areas: (1) assessments of the quality and integrity of program operations; and (2) program-level technical and managerial matters pertaining to proposal decisions.

On the quality and integrity of the merit review process, the COV found that overall, the review methods are appropriate and work well and the COV was impressed with the work of the program officers in the review process.

Summary of recommendations:

- (1) At least four reviews should be required before making a final decision on a proposal
- (2) Provide more structure for the panel summaries of each proposal (lots of variation) and ensure that the summaries are approved by all panelists and the Program Officer
- (3) Collect information on the expertise, geography, ethnicity, etc. of panel members
- (4) Consider the possibility of virtual or hybrid panels for groups not already doing so
- (5) Consider the possibility of eliminating proposal deadlines
- (6) Consider having a panelist contribute a review for each proposal prior to the panel
- (7) Consider having reviewers supply separate proposal scores for intellectual merit and BI.
- (8) Make sure the definition of BI is clear
- (9) Clarify the meaning of numerical scores for proposals (i.e., the meaning of scores 1-5)
- (10) Inherent bias training for panelists?

Regarding the selection of reviewers, the COV believes reviewer selection is effective and appropriate.

Summary of recommendations:

- (1) The program should track reviewer expertise and demographics
- (2) Program officers should ensure that external reviews are not dominated by international reviewers, who tend to have less familiarity with the NSF review process and might have conflicts of interest unknown to the program officers.

Regarding management of Ocean Sciences, the COV recognized that management of the program is complex and nuanced. Many of the OCE staff have long institutional histories and their dedication and professionalism provides much needed continuity. This is balanced well with rotators who bring community knowledge and immediacy to the program. The COV considered the balance of permanent and rotating staff and heard that most programs are satisfied with the current composition.

Summary of recommendations:

- (1) The program should provide data on the total amount of funding allocated to each program within Ocean Sciences, and the justification for this allocation

- (2) After an evaluation of present experiments with no-deadline submissions, consider establishing this as process throughout the program if appropriate
- (3) Important for the program to encourage mid-scale interdisciplinary research
- (4) Make institutional efforts to enhance diversity a high priority
- (5) Consider strategic use of more small grants to stimulate innovation (Early-concept Grants for Exploratory Research (EAGER), Rapid Response Research (RAPID))
- (6) Continue to provide a self-study report for future COVs, perhaps annually.

Regarding the portfolio of awards, the COV was asked whether the program has an “appropriate balance” of awards across all disciplines and sub-disciplines in the program. It was unclear to the committee what the meaning of appropriate and balance might be.

Summary of recommendations:

- (1) The program should provide data in the form of keywords (submitted by PIs) for each proposal as a way to better quantify “balance” (as in some other NSF directorates)
- (2) Continue to provide good opportunities for new investigators
- (3) Consider providing bias training to proposal reviewers
- (4) Provide increased support to historically black colleges and universities (HBCUs), etc. This was identified as a potential weakness from several examples in the review material supplied by NSF, with panels sometimes unprepared to assess such proposals
- (5) Increase the participation of HBCU scientists in the proposal review process.

Following Dr. Riser’s presentation AC/GEO voted to approve the report.

Response:

Dr. Candice Major, OCE Section Head, and Dr. Lisa Clough, OCE PD, presented the NSF response to the COV report.

Dr. Major said the COV’s input was appreciated. Based on the COV’s review, four action items have been developed, which reference the COV recommendations.

- Evaluate impact of no-deadlines in OCE (Marine Geology and Geophysics (MGG) Program) – III.1.2
- Annual progress broken out in COV reports – III.4.3
- Examples of large and interdisciplinary projects to next COV -- IV.4.1
- Continued attention to panel process, panelist guidance, and reviewer selection – (several points in Sections I.1, I.2, and I.4, plus III.2.3).

She said some of the recommendations will require working with the Office of Integrative Activities (OIA) because they deal with NSF policy and process above the division level. Her office is committed to reaching out to OIA to move the needle on these points:

- Demographics (PIs, ad hoc reviewers, and panelists) – I.1.4; II.1.1; OT.5a
- Single login for COV members – OT.5b
- Eliminate automatic proposal download for COV – OT.5c

- Separate scores for Intellectual Merit and Broader Impacts – I.2.2
- Assessment of BI – I.2.5, I.2.6

Dr. Major said some COV recommendations require further discussion and time to decide how to proceed:

Review Process:

- Use of virtual/hybrid panels in OCE – I.1.6, I.1.7, OT.3c, and OT.5a
- Reviewer video viewing pilot, including implicit bias training – I.2.1 and I.7.1
- Ratings refinements – I.3.1 and I.3.2
- Recognition for reviewers – II.3.b.

Portfolio Balance and Strategic Planning:

- Mid-scale and interdisciplinary research – III.1.4, IV.2.2, IV.4.1
- Cross-division – directorate partnerships – OT.1a, OT.1b, OT.3b
- Coding/keywords – III.1.5, IV.1.1, IV.1.2, OT.3a
- Program allocations and (sub-)disciplinary balance – III.1.1, IV.1.3
- Geographic distribution of awards – IV.5.1.
- RAPIDs/EAGERS/conferences – III.2.1, III.2.2, III.2.3

Other:

- Self-study (improvements and recurrence) – III.1.3, III.4.1, III.4.2, OT.2, OT.5d)
- Community engagement and communications (I.6.1).

Dr. Clough provided a road map for the OCE response, which will include coming back to AC/GEO with some of its priorities. Dr. Major then turned to another item for further discussion:

Diversity and Inclusion:

- Diversity information for reviewers (including panelists) – I.1.4, II.1., OT.5
- Engaging HBCUs (and other minority serving institutions) – III.1.6, IV.6.1, IV.9.1, IV.11.

Dr. Major said OCE needs to do a better job with diversity and inclusion, which she called a persistent problem in OCE and other parts of GEO, and said there is a commitment to addressing it, but there is not yet a plan. Dr. Clough said this is the right thing to do and said her office is fully committed. It should be put in the context of broadening participation writ large.

Dr. Major concluded with two recommendations where there is disagreement:

- Generic explanation for weighting of ad hoc and panel reviews -- I.1.8
- Expand requirement for panelists to contribute ad hoc reviews -- I.1.9.

What makes NSF unique, Dr. Major said, is PO discretion to take the input of the whole review process as advice and make a decision on that basis. The emphasis on ratings alone misses the point of the content of the reviews. The content of the panel summaries and ad hoc reviews is

what is most important and what makes OCE's decision. The peer review is only part of the broader merit review and the decisions made at the program level. The process is neither mathematical nor generic. But OCE is committed to providing an explanation for each proposal.

On the second point of disagreement, she said there are OCE programs that have panelists submit ad hoc reviews along with at least three additional external ad hoc reviews. There are numerous reasons why programs operate in different ways and OCE can provide more justifications for those differences to a future COV but OCE does not see any reason now to make that modification.

Discussion

Dr. Borg said the COV is an AC/GEO subcommittee. AC/GEO owns the report.

Regarding Dr. Major's statement about PO discretion, Dr. Hodges said NSF is not unique; the National Aeronautics and Space Administration (NASA) has a similar procedure.

In response to a question from Dr. Kempton about how jackets were chosen, Dr. Clough said COV members selected from among the 300 randomly provided. A self-study report was provided to the COV with information from all proposals submitted during the four-year period. Dr. Riser said panelists chose proposals in areas they were familiar with.

Dr. Kempton asked about lack of headway on BI. Dr. Hodges said NSF has changed the definition of BI so there isn't an articulation that works for everyone. Dr. Borg said BI should be in the context of a larger institutional investment, which questions the value of looking at a single project to extract the BI.

Dr. Kempton said as long as the community is confused, it will ignore BI. Dr. Hodges added that without clear guidance, everyone defines BI for themselves. Dr. Clough disagreed, saying guiding questions for reviewers are thoughtfully constructed, including those for BI and said there should not be one definition of BI, which has changed science for the better. Dr. Hodges said there is not enough information given to reviewers on weighting BI. Dr. Clough agreed and said there is a need to scale for different types of projects. Dr. Major said her office is making the NSF BI training video more visible. Dr. Kraft said partnerships with Minority Serving Institutions (MSI) should not put extra work on those who are already tasked with too much.

Update on Coastlines & People

Dr. Amanda Adams, of AGS, and the lead CoPe PD, began with an overview of the program:

- Interested in the intersection between natural processes and hazards with human dynamics and the built environment
- Broadening participation is an important component
- In FY18, NSF funded four concurrent scoping workshops on this topic.

FY19 activities included:

- DCL released April 24, 2019
 - One page inquires submitted by May 31, 2019

- Full proposals submitted by June 28, 2019
- Conversations with other agencies
- The University Corporation for Atmospheric Research (UCAR) convened a synthesis group to create a community synthesis of the September 2018 workshops and white papers

She described the goals of the CoPe DCL:

- Build capacity for CoPe
- Support the development of pilot projects
- Support activities that facilitate discussion and collaboration with new partners
- Fund proposals that would not easily be supported by core programs or other NSF opportunities
 - Expectation that both “coastal” and “people” were being addressed in some capacity

The DCL provided for conferences, EAGER and Research Coordination Networks (RCN). The conferences:

- Bring together a diverse group of scientists and practitioners to work together to explore new synergistic research topics related to coastlines and people;
- Discuss novel, new strategies to integrate broadening participation into CoPe activities; and/or
- Explore how academic and industry partnerships can advance CoPe related research.

EAGER provides for:

- Exploratory research in its early stages on untested, but potentially transformative, research ideas or approaches related to CoPe
- Especially "high risk-high payoff" by involving radically different approaches, applying new expertise, or engaging in novel disciplinary or interdisciplinary perspectives
- Within the context of CoPe, EAGER may pilot high-risk efforts such as incubators, mobile hubs, untested instrumentation technology, and community responsive science teams.

The RCNs:

- identify and prioritize research topics for innovative CoPe science with well-defined research questions that span spatial and temporal scales across disciplines and sub-disciplines
- establish mechanisms for new coordination with ongoing or planned coastal research activities, especially with local communities and stakeholders and
- connect with the NSF INCLUDES National Network, the Geosciences Opportunities for Leadership in Diversity (GOLD) program, or other broadening participation efforts to build relationships necessary to broaden participation in coastal research.

Dr. Adams said decisions are still being made on DCL awards. In FY19 there were 10 conference awards with 17 EAGER projects, which are distributed geographically. She highlighted a few awards:

- "CoPe Conference: International Symposium on Interdisciplinary Evacuation Modeling for Rapid Onset Disasters," Oregon State University
- "CoPe EAGER: Development of a Drone-Based Coastal Change Monitoring Program through Citizen Science Partnership and Capacity Building," Michigan State University
- "CoPe EAGER: Nearshore Extreme Events Reconnaissance (NEER) Association," WHOI
- "CoPe Conference: HuRaCon: Science at the Intersection of Hurricanes and the Populates Coast," East Carolina University
- "CoPe Conference: Symposium on Far Field Effects of Sea Level Rise 2020," University of Arkansas
- "CoPe EAGER: Pathways for Community College Students to Explore the "Tipping Point" in Vulnerable Coastal Communities Following a Natural Hazard," Austin Community College.

She concluded with visioning questions for AC/GEO:

- How much time is needed for DCL funded activities to occur in order for capacity to be grown? Is our PI community ready for a CoPe hubs solicitation?
- Is there a value in having opportunity for two different sizes of hubs?
- How do we manage community expectations on the life span of CoPe?

Discussion

In response to a question about hubs, Dr. Adams said they are interdisciplinary, working with multiple institutions, working on cutting edge CoPe research, and working with local communities; they can be virtual or not. The budget is several million per year over a couple years. She said the most successful hubs will involve multiple institutions. Dr. Hodges said the community is ready for these kinds of hubs and the solicitation, adding that the size of hubs could vary depending on the project.

Dr. Kraft suggested distinguishing topic-based and location-based hubs. Dr. Hodges agreed, adding that local hubs can have a more direct connection with the communities involved.

Dr. Paola said a hub can't be functional for a number of years that is less than the number of disciplines involved. Dr. Easterling said two years is just enough to get started; it needs to go at least five years.

Dr. Pomponi said CoPe seemed well suited to receive funding from NOAA. Dr. Adams said there are conversations with NOAA. She also mentioned the U.S. Global Change Research Program's (USGCRP) coastal group. Dr. Easterling said there is an opportunity to do collaborative science with NOAA on this and possibly the Department of Energy (DOE). Dr. Pomponi suggested working with NOAA and a cooperative institute. Dr. Easterling said the head of NOAA's Regional Integrated Sciences and Assessments (RISA) Programs is interested in interacting with NSF's Broader Impact efforts. He has had a hot and cold conversation with the Gulf Research Program at the National Academies.

Discussion of 21st Century GEO Draft Report, continued

Dr. Hodges introduced the committee to an online polling program that they began using individually to submit points for discussion later in the meeting.

Meeting Adjourns for the Day

Friday, October 18, 2019

Atmospheric & Geospace Sciences

Dr. Bamzai said AGS is one of the divisions within GEO. There are two offices, OIA and the Office of International Science & Engineering (OISE). AGS has about 20-plus staff. There are four programs in the Atmosphere Section (AS), three in the NCAR and Facilities Section (NFS) and five in the Geospace Section (GS).

Dr. Bamzai showed a word cloud for AGS awards. Some of the largest were climate change, climate models, boundary layer, space weather, magnetic field, electric field and gas phase. She also showed the geographic distribution of awards. About 300 per year are made. Awards for the last three years are spread across all states without undue concentration, she said. Another graphic showed the nationwide distribution of distinct PIs and co-PIs. About 2,500 are funded at any one time, including NCAR.

Turning to recent staffing changes, there have been about seven who left. There have also been seven arrivals in the last year. There are three searches in progress (Program Manager, Lower Atmosphere Observing Facilities (LAOF); Section Head, Atmosphere Section; Science Analyst). There is an open DCL for Intergovernmental Personnel Act (IPA) positions in AGS (Space Weather Research Program, Aeronomy Program).

Dr. Bamzai also reviewed the post-shutdown challenges in FY19:

Approach: Moved from in-person panels to virtual, or virtual to ad hoc while maintaining a robust merit review

- Paleo Perspectives on Climate Change (P2C2) relied on ad hoc reviews, no panels
- GS had less time for Distributed Array of Small Instruments (DASI), CubeSat, Faculty Development in the Space Sciences (FDSS) panels
- Ensuring “buffer” funding for facilities
- Ensuring funding for AGS Postdoctoral Research Fellowships (PRF)
- Ensuring funding of continuing grant increments (CGI)
- NFS COV postponed
- AGS PRF issued only in April 2019. No AGS PRFs were awarded in FY 19.

Dr. Bamzai provided AGS points of contact:

- NNA – Jielun Sun
- Innovations at the Nexus of Food, Energy and Water Systems (INFEWS) – Chungu Lu
- Prediction of and Resilience against Extreme Events (PREEVENTS) –Eric DeWeaver, Carrie Black
- Infrastructure (MRI, MsRI) – Nick Anderson
- Education (INCLUDES, Pathways into Geoscience (GEOPATHS)) – Manda Adams

- CoPe – Manda Adams (lead)
- Computation (Cyberinfrastructure for Sustained Scientific Innovation (CSSI), EarthCube, Harnessing the Data Revolution (HDR)) – Shree Mishra, Roman Makarevich
- Spectrum Working Group (WG) –Lisa Winter
- The Faculty Early Career Development (CAREER) Program - Chungu Lu
- P2C2- Soumaya Belmecheri, Dave Verardo
- Growing Convergence Research – Sarah Ruth.

The COV has been scheduled for March 30 to Apr 1, 2020:

- NFS COV postponed due to shutdown
- Date of last COV for each Section in AGS
 - Geospace May 2018
 - Atmosphere March 2016
 - NCAR and Facilities June 2015
- Divisional-wide COV requires synchronization
- NCAR excluded from review.

Dr. Michael Wiltberger, AGS Section Head, continued the presentation with a discussion of two awards:

Virtual Super-resolution Optics with Reconfigurable Swarms (VISORS), a high-risk, high-reward project that pushes technology boundaries of what can be done with a CubeSat:

- VISORS will test fundamental theories of solar coronal heating to answer a decades old question — how the outer layer of the Sun is heated to millions of degrees
- First very high-resolution imaging of nanofilaments in the solar corona
- Revolutionary, potentially transformative technology: three individual CubeSats acting as a single telescope (optics, sunshade, detector).

DASI Track 1: Development of a Distributed Multiple input, multiple output (MIMO) Meteor Radar Network for Space Weather Research:

- Meteor trails are used to characterize high altitude winds (120km-50km), which are important to understand, in part, for understanding the impacts of space weather events (externally or internally driven) on radio communications
- MIMO will capture vertical wind component and spatial variability of wind field that classical meteor radar systems (SISO) cannot capture
- This award is to develop and test the instrumentation and open source software. Testing and deployment will take place in CO with long term plans to deploy at two transmit array sites, one receive array site, and 10 single receiver sites over $\sim 90,000 \text{ km}^2$.

Dr. Wiltberger also presented the National Space Weather Strategy and Action Plan:

- NSF AGS was actively involved in the development of this new plan
- Objective II – Develop and Disseminate Accurate and Timely Space Weather Characterization and Forecasts
 - 2.3 – Support and coordinate opportunities for fundamental research in heliophysics and geospace sciences

- 2.4 – Identify, develop, and test innovative approaches to enable, enhanced, more informative, robust, and cost-effective measurements
- Supported the Next Step Benchmark activity required by Objective 1.1.

NASA Geospace Dynamics Constellation (GDC):

- The Science and Technology Definition Team (STDT) Report was released on Oct
- Federal Advisory Committee Act (FACA) guidelines prohibited discussions with NASA while the report was being developed
- Goals of GDC are well aligned with Coupling, Energetics and Dynamics of Atmospheric Regions (CEDAR) and Geospace Environment Modeling Summer Workshop (GEM) programs at NSF
 - Understand how the high latitude ionosphere-thermosphere system responds to variable solar wind/magnetosphere forcing
 - Understand how internal processes in the global ionosphere-thermosphere system redistribute mass, momentum, and energy
- NASA Research Opportunities in Space and Earth Science (ROSES) B.14 Heliophysics System Observatory Data Support is pathfinder for future collaboration between the agencies.

Discussion

Dr. Hodges asked about NASA's data archiving. Dr. Wiltberger said a discussion is starting on ways to create data infrastructure for the whole system. The Heliophysics Division wants to make the data as open as possible to scientists across the community.

Dr. Pomponi asked about the National Space Weather Strategy and Action Plan and the mission agencies. Dr. Wiltberger said there is a memorandum of understanding (MOU) between NOAA, NASA and NSF for supporting operations to research and research to operations. He didn't know if there was something similar for ocean sciences. Dr. Semeter said OSTP, by producing the space weather plan, drove something concrete to happen, giving NSF a seat at the table, and said this could be a model.

Dr. Sarah Ruth, AGS Section Head, provided recent NCAR Highlights:

- New Cooperative Agreement with UCAR began October 2018
- Everette Joseph started as NCAR Director in February 2019
- Research Aviation Facility renovation progressing well – design work completed (project ends late 2020)
- GEO-funded Early Career Innovator Program: kick-off May 2019
- Atmospheric Chemistry Observations and Modeling (ACOM) revitalization under way with additional AGS funding
- The NCAR-Wyoming Supercomputing Center (NWSC)-3 procurement started (for late 2022)
- System for Integrated Modeling of the Atmosphere (SIMA) Unified Modeling Framework: planning Ideas Lab community consultation
- NCAR- National Ecological Observatory Network (NEON) workshop spring 2019.

She turned next to current and upcoming LAOF field campaigns:

- Chequamegon Heterogeneous Ecosystem Energy-balance Study Enabled by a High-density Extensive Array of Detectors (CHEESEHEAD)
- Organization of Tropical East Pacific Convection (OTREC)
- MethaneAir
- Prediction of Rainfall Extremes Campaign in the Pacific (PRECIP)
- Sundowner Winds Experiment (SWEX)
- Secondary Production of Ice in Cumulus Experiment (SPICULE)
- The Asian Summer Monsoon Chemical and Climate Impact Project (ACCLIP).

She also discussed the University of Wyoming King Air airborne platform and the 2019 Operations & Maintenance (O&M) Cooperative Agreement and Mid-Scale Research Infrastructure 1 (MSRI-1) award for approximately \$16 million to modify and outfit a new research aircraft with cutting-edge instruments and capabilities not currently available on the three LAOF aircraft to provide synergistic measurement capabilities for atmospheric boundary layer studies, atmospheric chemistry, aerosol-cloud-precipitation interactions, and atmospheric dynamics.

Under education and Outreach, she discussed:

- NCAR Interactive Traveling Climate Exhibit
 - Currently being tested at Boulder Public Library
 - Will be available for broad PI community to request.
- New kiosk being built at NCAR Mesa Lab Visitor Center
 - Highlight recent field campaigns
 - Share AGS funded science beyond NCAR.

Dr. Bernard Grant, AGS Acting Section Head, continued the presentation with a discussion of the Unidata five-year award renewal. He said a lot of research would not be done without this contract. It supports classroom instruction as well as research. He discussed the large number of downloads that support the community and Unidata workshops for software training. There are also regional workshops, American Meteorological Society (AMS) short courses and online courses.

Dr. Grant also discussed Significant Opportunities in Atmospheric Research and Science (SOARS), which received the Diversity and Inclusion Program of the Year award. SOARS is a highlight for geosciences and atmospheric sciences to increase underrepresented minorities. There are 200 alumni, 80 percent of whom are still in Science, Technology, Engineering, and Mathematics (STEM). SOARS supports students for up to four years. Discussions are underway on how to duplicate components of SOARS where there are alumni of the program on the faculty.

Concluding his presentation, Dr. Grant discussed AGS patriation in initiatives across the foundation regarding Historically Black College/Universities, tribal colleges and Hispanic-serving institution. AGS, he said, has done particularly well in the Education and Human Resources (EHR)/ Historically Black College/Universities Undergraduate Program (HBCU-UP)

Excellence in Research (EiR). In the Atmosphere Section there is a concerted effort to better reach MSIs.

Discussion

Dr. Hodges said the SOARS chart does not show increasing participation after 2000, with a decrease in 2018. Dr. Grant said there is a concern that many participants are not going for their Ph.D. Dr. Borg added that the degrees earned may be only part of the story. Dr. Grant said there is a maximum of 20-24 enrolled. Dr. Easterling asked if there is a sine wave effect and Dr. Grant said there is.

Dr. Pomponi said the number of doctoral degrees earned is not the most important metric. Some jobs don't require a Ph.D. The goal is for an adequate and diverse workforce. AC/GEO's report should address workforce development.

In response to a question from Dr. Bamzai, Dr. Grant said students ask about the return on investment for a Ph.D. He asked the Program Director, who said they would not. It was also noted that Earth Sciences has a program similar to SOARS.

Earth Sciences

Dr. Patino discussed staffing updates, including two new Program Directors. She also introduced the subject of programmatic updates and turned to Dr. Richard Yuretich, Earth Sciences (EAR) Program Director, including:

Critical Zone Collaborative Networks:

- Thematic clusters
- 8-10 awards; \$7.5 million annually
- Coordinating Hub
- 1 award; \$1 million annually Proposal Deadline: Dec. 2, 2019
- Proposal Deadline: December 2, 2019.

He also discussed the funding of two Research Coordination Networks (RCN) to explore future research topics. One is exploring a dimension that has not been part of the critical zone observatories and the other takes information from existing critical zone observatories and synthesizes data to outline new research directions. Dr. Patino said the RCNs are examples of a systems approach looking at processes in the transition zone between the bedrock and the top of the canopy trees.

Dr. Steven Whitmeyer, EAR PD, discussed cyberinfrastructure for the geosciences, noting that there is information on the [NSF website](#) for PIs about where to target research proposals. He also discussed geoinformatics (GI) solicitations. The first deadline was in August and proposals are in review. The solicitation had three tracks: catalytic, facility and sustainability. The next solicitation will be in 2021. The program budget is \$4.8 million/year. He also reviewed current GI-supported projects.

Dr. Whitmeyer turned next to EarthCube, an established community to plan, build, and educate geoscientists about data stewardship through a discovery and use framework for geoscience data,

sensors, and data resources. The vision is to make it an interconnected, interoperable, high-functioning, ecosystem of data repositories with search and discovery capabilities and analysis/modelling/visualization applications for the geosciences to improve the time to science, enhance data discovery and knowledge creation, and enable cutting-edge research.

EarthCube success stories include:

- Council of Data Facilities
 - First data center interoperability effort
- Metadata standards for data search and discovery
 - Cloud implementation of data
 - Data resource registries built on industry standard search capabilities
- Large portfolio of applications
 - Geosciences Web services – disseminating simple Web services across a range of NSF data facilities
 - StraboSpot community and software for field-based geoscience research
 - Earth-Life Consortium – data integration across paleobiology, geology, bioinformatics
 - Pangeo – open-source data resource for climate and ocean science, coordination between scientists, software, computing infrastructure
 - Cloud-Hosted Real-Time Data Services for the Geosciences (CHORDS)
- Industry Engagement.

CSSI:

- Supports the development and deployment of robust, reliable, and sustainable data and software cyberinfrastructure
- Fosters innovative capabilities towards sustained scientific innovation and discovery
- Provides a cross-directorate opportunity to advance common approaches to sustain and innovate research cyberinfrastructures
- Supports larger-scale, cross-disciplinary projects via two types of awards: Elements (up to \$600K) and Frameworks (up to \$5M)
- Follows accepted data management and software development practices.

Dr. Whitmeyer also presented an outline for HDR, including Transdisciplinary Research In Principles Of Data Science (TRIPODS):

Components of HDR Vision
Foundations of Data Science
Education & Workforce Development
Data-Intensive Science & Engineering
 Algorithms and Systems for Data Science
 Data Cyberinfrastructure

HDR Programmatics
HDR TRIPODS (FY19)
Data Science Corps (FY19)
HDR Institutes (FY19)
Conceptualization (FY19)
 Idea Labs
 Frameworks
Coordination (FY20)
Convergence (FY21)

National AI Research Institutes

- Interagency effort: NSF, United States Department of Agriculture (USDA), National Institute of Food and Agriculture (NIFA), Department of Homeland Security (DHS) Science & Technology Directorate (S&T), Department of Transportation (DOT) Federal Highway Administration (FHWA), and Department of Veterans Affairs (VA)
- Seeks to enable such research through AI Research Institutes via two tracks
 - Planning Track: any areas of foundational and use-inspired research appropriate to NSF and its partner organizations. Deadline Jan. 30, 2020. NSF plans to make approximately eight awards.
 - Institute Track: must have principal focus in one or more themes. Deadline January 28, 2020. NSF plans to make one to six awards.
- Trustworthy AI
- Foundations of machine learning
- AI-driven innovation in agriculture and the food system ai-augmented learning
- AI for accelerating molecular synthesis and manufacturing
- AI for discovery in physics.

The anticipated funding amount is \$24 to \$124 million.

Discussion

In response to a question, Dr. Whitmeyer said it is currently a one-time solicitation; it is to be rewritten for the next round. The next solicitation could be in one or two years. In response to a question from Dr. Borg, Dr. Whitmeyer confirmed that the planning track would be appropriate for geosciences. GEO is supporting planning grant proposals in the current round with the expectation of the community identifying institute tracks to pursue in the next solicitation.

Regarding geoinformatics, Dr. Constable asked if it is sustainable. Dr. Whitmeyer discussed the financial difficulty in supporting new initiatives with fixed budgets and encouraged consideration of models for keeping important facilities available to the community while recognizing that not everything can be supported down the road. He hoped that with the sustainability track PIs will have funding to explore novel ways to move toward a more sustainable future for a lot of these facilities.

Dr. Patino added that 10 years are provided for the current activity and you can reinvent yourself after that. Dr. Constable compared the geoinformatics and cyberinfrastructure advancement to replacing libraries, which takes away access to previous research. Dr. Patino said data is a tool, like a seismograph.

Earth Sciences, Continued.

Dr. Margaret Benoit, EAR Program Director, continued the Earth Sciences presentation regarding future support of earthquake system science and geophysical facilities support. A competition will support one or more research centers. NSF has supported the Southern California Earthquake Center (SCEC) for almost 30 years. Competition will be opened for support of an earthquake research science center to align with NSB advice to openly compete expiring awards. A DCL will be released this fall with a solicitation in 2020.

There will also be a competition to support a single, unified geophysical facility to succeed the Seismological Facilities for the Advancement of Geoscience and Earthscope (SAGE) and the Geodesy Advancing Geosciences and Earthscope (GAGE). The new facility will have a more streamlined management structure. A DCL is being prepared with a solicitation in 2021. NSF is working with the community and the facilities to identify the benefits and risks of centralization. The DCL will announce community workshops to identify science priorities for the next facility.

Dr. Jonathan Wynn, EAR Acting Section Head, continued the presentation with a discussion of the decadal survey initiated in response to the 2017 AC/GEO COV. The study has three objectives:

- Concise set of high-priority scientific questions to advance EAR science over the coming decade
- Analysis of EAR portfolio of infrastructure and capability gaps to align investments with priority research questions
- Analysis of how EAR can leverage and complement capabilities, expertise and strategic plans of its partners and maximize shared use of assets and data.

The committee is chaired by Dr. Jim Yoder, Dean Emeritus, WHOI, with 20 [members](#) chosen from an open call for nominations. The committee is finishing a series of seven meetings with a report to be released in mid-2020.

Discussion

Dr. Hodges emphasized the importance of the first bullet point, high-priority scientific questions, which ties to the report AC/GEO is preparing. EAR's scientific questions cannot be a laundry list of things that would be good to do.

Earth Sciences, Continued.

Dr. Patino resumed the presentation, turning to the impact of removing deadlines. She described the rationale and goals:

Rationale:

- Rationale and Goals
- Number of proposals to Division of Earth Sciences has increased
- Greater workload on reviewers, panelists and staff
- Provide community with greater flexibility
- Potential improvements to merit-review process.

Goals:

- Do no harm
- Reduce workloads on reviewer community
- Reduce and level program workloads
- Increase quality of submissions
- Increase success rate.

She presented the annual project submission timeline for Geobiology and Low-Temperature Geochemistry (GG), Geomorphology and Land-use Dynamics (GLD), Hydrologic Sciences (HS) and The Sedimentary Geology and Paleobiology Program (SGP) showing the number of submissions. Between 2012 and 2014 there were close to 150 projects per submission date. A year after deadlines were removed, submissions averaged out through the year. A similar pattern emerged for Petrology and Geochemistry (CH), Geophysics (PH) and the Teacher Enhancement (TE) Program after deadlines were removed. This resulted in reduced workload for panelists, ad hoc reviewers and NSF staff. Panels can now take their time to discuss projects.

Turning to other parameters being tracked, she said there were no significant changes in PI and co-PI demographics for GG, GLD, HS and SGP.

Institution type:

- 3.1% decrease in Ph.D. and equivalent degree
- 2.1% increase in Master's degree
- 0.2 % increase in Bachelor's degree.

Race:

- less than 1.3% change in race.

Ethnicity:

- less than 0.7% change in all reported ethnicities.

Gender:

- 4.8% decrease in males
- 4.1% increase in females
- 0.6% increase in not reported.

She said project collaboration is also tracked and there are no statistical differences with the removal of deadlines. Anecdotally, it is harder to make decisions in panels because all submissions are high quality. And regarding response rate, or dwell time, she said responses are not significantly later.

Summarizing what has been learned, she listed:

- Opportunities:
 - Reduced workload on community and NSF staff
 - Decrease in number of ad hoc reviews
 - Program directors have more time for sustained community interactions
 - Improves quality of merit review processreview format
- Panel only, ad hoc only, ad hoc and internal panel, virtual vs. in person
- review timing
- Could have more panels throughout the year
- Limited by budget appropriations and FY timing
- Challenges:
 - Conflict of Interest (COI) issues – in some panels/programs/divisions
 - Panel logistics.

Discussion

Dr. Pomponi asked about negative community feedback. Dr. Patino said some people need a deadline for motivation to submit proposals. An audience member said the panel dates are in the Federal Register. Dr. Borg said those dates would not work to drive submissions.

On virtual vs. in-person panels, Dr. Patino said the quality is the same. For virtual panels, social interaction is missing but a greater diversity of panelists is available. Dr. Heald asked about the success rate. Dr. Patino said it has gone from under 20 percent to 20 percent or higher. Program Directors are also choosing to fund larger projects and more career awards are being made.

Dr. Hodges said dwell time results should be publicized. Also, he asked about reconsidering limits on the number a proposer could submit at one time and the time limits on resubmission. Dr. Patino said thought is being given to easing the PI limit.

Dr. Bamzai said another benefit to no deadlines is the workload for the Division of Grants and Agreements is evened out. Also, from the PI perspective, there is an advantage to submitting before February because of the FY. Also, the timing of faculty hiring for graduate students is a factor.

Dr. Hodges also said the carbon footprint is an important reason to favor virtual meetings and he criticized NSF's lack of recycling bins. Dr. Constable and Dr. Kempton said video is a critical component of virtual meetings. Dr. Borg said the issue is under discussion. It is a budget issue, specifically a line item in Agency Operations and Award Management (AOAM). The AC can advise the foundation about the value of including video in all teleconferencing; a letter can be written to the director.

Addressing the shutdown, Dr. Patino noted that in addition to the 35 days lost, it was followed by a two-week continuing resolution and uncertainty about whether there would be another shutdown. The impact, which was traumatic, has not been acknowledged and is still being felt. Dr. Hodges said that on behalf of the community, NSF's hard work during that period is appreciated. An audience member commented that the shutdown brought people together and complemented the director's office performance during this period.

Ocean Sciences

Dr. Quinn began his presentation with Division of Ocean Sciences (OCE) activities of Oceans Month, including the Frontiers of Science Symposium and the Capitol Hill Oceans Week Congressional event booth.

Turning to the budget, he displayed a graphic representing the funding levels for physical oceanography, marine geology and geophysics, biological oceanography, chemical oceanography, The Oceanographic Technology and Interdisciplinary Coordination (OTIC) Program and Ocean Education. Adjusting for inflations, funding has been flat and declining. The numbers are in accord with the *Sea Change* recommendations for a roughly 50 percent balance between infrastructure costs and core science programs.

Under staffing, he noted four new OCE staff, a new Section Head, and one retirement. There is a search on for open positions, including an ocean policy expert.

He also provided a facilities update on the Joides Resolution Ship Operator, Texas A&M University (TAMU). The NSB approved a five-year renewal for TAMU.

For his Ocean Observatories Initiative (OOI) update, he said OOI 1.0 was closed out and 2.0, run by Woods Hole, completed one year of operations by completing all planning turn-cruises of the Global/ Coastal/ Regional Cabled Arrays. The Year 2 annual work plan is in progress.

He said there was an extensive review of OOI data delivery and cyberinfrastructure (DDCI). Currently there is an internal OOI 2.0 self-evaluation and analysis of alternatives going on. There is a standing Ocean Observatories Initiative Facility Board (OOIFB) subcommittee on DDCI, with a report to be delivered in 2019. A formal panel review is scheduled for next week.

Dr. Quinn highlighted the Alaska Amphibious Community Seismic Experiment (AACSE). He noted that:

- North America's largest earthquakes and most powerful volcanic eruptions occur along the Alaska Peninsula subduction zone
- In a major shoreline-crossing experiment, 75 broadband ocean bottom seismometers (OBSs) and 30 onshore broadband seismometers were deployed for 15 months with the promise of recording many thousands of earthquakes
- AACSE inspired complementary projects: deployments of seafloor GPS-acoustic stations, absolute pressure gauges, seafloor temperature observations linking to the water column above, and subseafloor electromagnetic imaging. There is also close collaboration with the USGS Alaska Volcano Observatory
- OBS were recovered in August/September 2019; data will be released immediately once initial quality control is complete.

He also highlighted long-term observations that reveal the impact of extreme events:

- Since 1978, the Ocean Flux Program has sampled sinking particle flux on a biweekly to monthly basis throughout the water column in the Sargasso Sea
- Following the passage of Hurricane Nicole in 2016, sinking organic material increased by up to 800 percent at over 3000-meter depth, revealing unanticipated impacts of surface storms on the deepest parts of the ocean.

From physical oceanography he highlighted Overturning in the Subpolar North Atlantic Program (OSNAP), which has delivered results from the first two years of observations:

- Highly variable overturning circulation responsible for the majority of the heat and freshwater fluxes
- Contrary to expectations, much of the Atlantic Meridional Overturning Circulation (AMOC) variability in this timeframe stems from water mass transformations east of Greenland, rather than deep water formation in the Labrador Sea
- Two more years of data were recovered and instruments are now deployed for an additional two years.

From the biological oceanography program, Dr. Quinn showcased a project examining fish otoliths for evidence of climate change effects:

- Shallow marine and freshwater systems have experienced dramatic increases to the intensity and duration of hypoxic and anoxic areas, often referred to as dead zones
- Chemical analyses of fish otoliths, the calcareous formations in the inner ear of teleost fish, are being used to directly assess lifetime hypoxia exposure in Eastern Baltic cod populations (*Gadus morhua*). Baltic cod exposed to hypoxia were 39 percent smaller in length by age 3 and weighed 64 percent less compared to cod with little or no hypoxia exposure
- Investigating the consequence of systematic hypoxia on fish health is valuable and necessary for understanding the ecology, management, and conservation of commercial fish populations.

Another research project he discussed comes under Understand Rules of Life: Epigenetics, one of NSF's 10 Big Ideas. The team will conduct experiments on the coral reefs of Mo'orea, where there is a long-term ecological research (LTER) site, to develop and expand new theoretical modeling approaches to piece together the complex interactions that result in organism function, ecological performance, and evolution.

Another project was originally submitted to Mid-Scale Infrastructure 1, another of the 10 Big Ideas. It is for the acquisition and testing of new instruments to enable measurement of seafloor movement, which is analogous to a land-based GPS. It supports research in subduction zone and mid-ocean ridge processes, earthquake hazards, transform faulting and volcanic deformation. It is being funded by Ocean Sciences and the director's office.

Dr. Quinn also discussed the LTER fourth decadal review, a study of ecological phenomena since 1980 that focuses on primary production; population dynamics and trophic structure; organic matter accumulation and decomposition; nutrient flux; and patterns and frequency of disturbance. The fourth decadal review is charged with evaluating:

- The significance of the long-term scientific findings and approach to research of the LTER Network over the last decade
- Network's readiness to support the research of future decades.

Evaluation will culminate in a report to NSF assessing:

- The significance of the long-term ecological and environmental science produced by the LTER network
- The strengths and weaknesses of the LTER network model of support
- The review will begin in late 2019 and take place in early 2020.

A representative from AC/GEO is needed to participate in the review.

In closing, he raised issues for discussion:

- Mid-term review of *Sea Change* Report?
 - Budgets
 - Balance infrastructure-science
 - Science
 - Eight priority science questions
 - Facilities
 - Recommendation 6: Program reviews for OOI, Integrated Ocean Drilling Program (IODP), the academic research fleet, and NDSF should occur periodically (nominally every 3-5 years)
 - Proposal success rate.

Discussion

Dr. Borg asked if there had been a request that an AC/OPP member serve on the decadal review. There needs to be coordination with that committee, he said. Dr. Quinn said he will look into it.

Dr. Constable asked how junior PIs do in terms of success in proposals and if some PIs are taking a significant fraction of the budget. Dr. Pomponi said there are community concerns about whether that data are captured and analyzed. Dr. Quinn said POs have leeway to balance portfolios. Certain PIs may have a substantial funding portfolio that is taken into account with regard to whether they can dedicate the amount of time needed. In Ocean Sciences there is also the issue of soft money support, where some are asked to raise a significant amount of their annual salary, and productivity. Dr. Patino agreed that part of the portfolio balance for PDs is looking at the commitment of PIs to projects and whether they have overcommitted.

Dr. Hodges recommended being open and clear with the community about how portfolios are balanced, providing the percentage of young investigators, senior proposals and underrepresented minorities that are funded. Otherwise, there is speculation to the contrary. He suggested GEO investigate the possibility for this type of communication with the community.

Dr. Easterling focused on the low application rate in the geosciences for early career awards. GEO has one of the lowest numbers among the directorates. He and Dr. Borg have been unable to find a reason, but it has to start with the community needing a push to pursue these awards. Dr. Patino added that in GEO most early career PIs receive regular research grants before they receive a career award, unlike ENG.

Dr. Bamzai said that when the career program was started, ENG needed it as a platform for their investment in early career development, whereas AGS has the PRF and two- and three-year awards. Also, some programs include informal guidance for PIs approving of soft money with the caveat that one program cannot be counted on to provide a nine-month salary.

Dr. Borg said it had been common to distinguish between the success rate for early career, defined as up to six years post-Ph.D., vs. those not within six years. Dr. Riser said for the OCE COV, there were four career awards among the 300 jackets. Dr. Borg said those are five years long and asked if that was enough for a research cruise: Is four years of analytical work on data from the cruise justified, or are people being driven to propose two or three research cruises within a five-year period. The latter might be perceived as biting off too much. These dynamics

play into decisions about parsing research proposals when dealing with facilities. Separate from the class of career proposals, it is possible to call out a success rate for people who are within six years of earning their Ph.D.

Dr. Henrietta Edmonds, OCE Program Director, said there is a self-study document that includes a section on early success rate by early career stage and a section on the management of career proposals and the number of career submissions and awards by program. The early career success rate was statistically indistinguishable from the broader proposing community. Dr. Major said the self-study was not provided to AC/GEO but can be made available. Dr. Hodges asked that it be provided. Multiple post-docs are becoming more common so a definition of years after post-doc should be changed to years after first appointment. There could be 35- and 40-year-old scientists who are less than six years from their first appointment.

Dr. Bamzai said that after the 2008 economic downturn there were few jobs, which caused individuals to receive three post-docs. Dr. Major said the career awards are very specific and do not include collaborative awards. Also, those not interested in innovating on the education side are often successful through the regular proposal process. And the success rate there for early career people is very comparable. Dr. Hodges said it is unfortunate so many universities push for more research proposals and grants and not as much on education.

Dr. Constable asked if there is an upper limit on the amount requested through an early career award. Dr. Bamzai said there is a minimum and no stated maximum; some in EAR are close to \$1 million. Dr. Borg said the prohibition on collaborators is a real issue for GEO. Dr. Constable, said some junior faculty have told her the early career awards are not worth pursuing. Dr. Bamzai said the success rate for the career PIs in her division is slightly lower than the regular success rate. Dr. Borg said it is underutilized by GEO. Dr. Heald said she was discouraged by her PO early in her career to apply for an early career award because the success rates are lower. Also, in practice, the amount per year for research is less than for a three-year proposal. And there is a discrepancy between what the career is and how universities are valuing it. For tenure, universities are thinking about the career as a top indicator of research productivity, which is not correct. Education and research operate on separate paths. Dr. Hodges said at his institution a career award is counted like a research award, but if you take the educational component seriously, it retards the total amount of research.

Dr. Pomponi asked about the barriers to analyzing data and making it available to the community. Dr. Bamzai said there are some privacy restrictions on what can be shared but at the division level it can be shared with the appropriate approvals. Dr. Hodges said he did not understand why saying, for example, that a certain percentage of the portfolio is going to young female scientists, is a privacy issue. Dr. Midson distinguished between success rate, which is protected, and success.

Dr. Pomponi commended Ocean Sciences on keeping the balance between infrastructure and science. Dr. Midson said the intention has always been to operate the entire fleet within the operating budget of the existing fleet. Three new ships are being built but five are being retired. Dr. Pomponi suggested being more proactive in convincing the other agencies they don't need new ships because we have ships available that are sometimes undersubscribed. Dr. Bauke

Houtman, OCE Section Head, responded that NOAA has mission requirements for fisheries type vessels which are different from the academic research fleet's capabilities. But NOAA uses the academic research fleet ships as it fits their requirements and there is an ongoing discussion.

Dr. Pomponi asked how to request the periodic reviews of the infrastructure programs that the *Sea Change* report recommended. Dr. Borg said it is best done by NSF because of how it relates to the regular competition. Dr. Houtman added that as part of the large facilities requirements there is an annual program review of each facility.

Discussion of 21st Century GEO Draft Report, continued

After committee members entered additional comments into the online polling program used earlier, Dr. Kraft volunteered as one of the point persons for the report.

Different types of pilot programs for the review process were discussed, including a pilot where there is an opportunity for a PI to identify factual errors in a review. Dr. Hodges said some NASA reviews employ this procedure, but such challenges are rare and handled expeditiously. If it is included in the report, it should be framed as something to look into; NASA contacts can be provided, if needed. Dr. Constable said Natural Environment Research Council (NERC) has a similar process, which should also be investigated. Dr. Bamzai suggested using graduate students to take notes during reviews to familiarize them with the system; currently this is not permitted.

The committee also discussed BI. Dr. Constable suggested splitting BI into categories. The range is so broad, some who have a restricted view of BI may downgrade proposals because they do not match their view of BI. Dr. Easterling supported the suggestion. Dr. Hodges also agreed these divisions would be helpful, making it clearer where a proposal has come up short. There was also discussion about various scoring options for the different categories. But providing too many categories can make it seem the questions are not relevant and do not need to be answered, Dr. Constable said. Dr. Patino said the review criteria are set by the NSB. An EAR BI analysis found proposals with an array of activities did not do as well those with a single activity. This is counter to what the community perceives, Dr. Hodges said.

A suggestion was made to list the BI criteria next to the checkboxes. There was also a suggestion to allow more self-direction for PIs than checkboxes permit. Dr. Hodges said the boxes should be for reviewers, not PIs. Also, NSB left BI up to the community, which never defined it, so people's definitions differ.

Volunteers were chosen to spearhead each report section:

- Dr. Constable volunteered for Component 1
- Dr. Kraft previously volunteered for Component 2
- Dr. Paola volunteered for Component 3, with assistance from Dr. Pomponi.

Dr. Hodges said that after the meeting he would divide the committee into groups corresponding to the three report sections. The volunteers, above, will be responsible for keeping in contact with those assigned to their sections. These working groups will produce drafts that will be reviewed by the whole committee.

Dr. Pomponi suggested a follow-up letter to Dr. Easterling with some of the questions and recommendations that have been discussed. Dr. Easterling and Dr. Hodges agreed, and both supported more communication between meetings, among members and with NSF.

Dr. Heald suggested an online Webex-type meeting. Dr. Hodges agreed, but Dr. Borg said certain procedures have to be followed if it is a full meeting.

Dr. Hodges said first drafts should be completed by the end of November.

Dr. Easterling thanked the committee for its work and Dr. Hodges adjourned the meeting.