Advisory Committee for Geosciences (AC/GEO)
November 3-4, 2022
Meeting Held Online and in Person
Meeting Minutes

AC/GEO Attendees:
Dr. Kaatje Kraft (Chair)
Dr. Lihini Aluwihare
Dr. Carol Arnosti
Dr. J. Ramón Arrowsmith
Dr. Kerry Cook
Dr. Robyn Mieko Dahl
Dr. Kusali Gamage
Dr. Luis Alberto González
Dr. Kristin Wilson Grimes
Dr. Vernon Morris
Dr. Francisca Oboh-Ikuenobe
Dr. David B. Parsons
Dr. Tammi Richardson
Dr. Alan Robock
Dr. Barbara Romanowicz
Dr. Sharon Stammerjohn
Dr. Cathy Whitlock

AC/GEO Members Not Attending:
Dr. Robyn M. Millan
Dr. Gary Mitchum
Dr. Daniel Wildcat

NSF Senior Staff Participants:
Melissa Lane

Other Meeting Participants:
Dr. Amanda Adams, Program Director, the Division of Atmospheric and Geospace Sciences (AGS)
Dr. Gail Christeson, Program Director, OCE
Dr. Lisa Clough, Section Head, OCE
Dr. Henrietta Edmonds, Program Director, OCE
Dr. Bauke Houtman, Section Head, OCE
Dr. Alexandra Isern, Deputy Assistant Director, GEO
Dr. Anne Johansen, Section Head, AGS
Dr. Brandon Jones, Program Director, GEO
Dr. Karen Marrongelle, NSF Chief Operating Officer (COO)
Dr. James McManus, Division Director, OCE
Dr. Brian Midson, Program Director, OCE

Dr. Aisha Morris EAR Program Director
Dr. Lina Patino, Senior Program Director, GEO
Dr. Timothy Patten, Deputy Assistant Director, GEO
Dr. Jessica Robin, Acting Division Director, EAR
Dr. Elizabeth Rom, Program Director, OPP
Dr. Dena Michelle Smith-Nufio, Program Director, EAR
Mr. Brian Stone, Chief of Staff, Office of the Director (OD)
Dr. Arnoldo Valle-Levinson, Program Director, OCE
Dr. Jennifer Wade, Program Director, EAR

Thursday, November 3, 2022

Opening Remarks and Introductions
Dr. Kraft welcomed everyone to the AC/GEO's first hybrid meeting asked AC members and others to introduce themselves. She said the meeting format provides the potential for greater access and inclusion for those not able to attend in person. There will be a conversation later about the format. There will also be a conversation later in the meeting about getting feedback into the agenda sooner. The challenge is addressing topics that are timely and the required material the AC needs to cover. Dr. Kraft briefly discussed some of the topics on the agenda that fall into each category.

GEO Updates
Dr. Isern began with two staff updates. Dr. Anne Johansen, of Central Washington University, is the new AGS Division Director and Dr. Jim McManus, of Bigelow Laboratory for Ocean Sciences, is the new OCE Division Director. She also said Dr. Brandon Jones is the new incoming president-elect for American Geophysical Union (AGU).

Turning to the NSF Strategic Plan for 2022-2026, Dr. Isern discussed:

- Vision: A nation that leads the world in science and engineering research and innovation, to the benefit of all, without barriers to participation.
- Mission: To promote the progress of science, to advance the national health, prosperity and welfare, to secure the national defense.
- Core Values: Scientific leadership – Diversity and inclusion – Integrity and excellence – Public service – Innovation and collaboration

She also discussed the plan's four strategic goals:

1. Empower Science, Technology, Engineering, and Mathematics (STEM) talent to fully participate in science & engineering
2. Create new knowledge about our universe, our world & ourselves
3. Benefit society by translating knowledge into solutions
4. Excel at NSF operations and management

Turning to the Advisory Committee for Polar Programs (AC-OPP), Dr. Isern provided updates from the committee's last meeting:

- Polar Sub-committee on Diversity and Inclusion
    - Multi-year Polar diversity, equity and inclusion (DEI) Report Complete

- Antarctic Research Vessel (ARV)
    - Sub-committee Design Review #2 Accepted
- South Pole Planning Sub-Committee
    - New Strategic Planning Initiative
- Polar Research Board / the U.S. National Academy of Sciences, Engineering and Medicine (NASEM)
    - Activity Report
- Policy and International Engagement Status of Polar
    - Activity Report

She also highlighted AC-OPP's discussion of the Sexual Assault/Harassment Prevention and Response (SAHPR) Program:

- Commissioned needs assessment to provide a safe community for U.S. Antarctic Program participants
- Reviewed results of assessment, recommendations and implementation plan
- Launching NSF Director-led changes to augment the plan

Expanding on the last point, Dr. Isern said the Office of the Director and the director himself mobilized his staff, led by the NSF Office of Equity and Civil Rights (OECR), and moved oversight of this activity into the office of the Director. OECR is leading the SAHPR support office.

She also highlighted other actions being taken:

- Single point of contact to help ensure access to resource materials
- Help prevent miscommunication regarding reporting lines
- Build trust for all leadership and management structures
- Coordinate with internal NSF offices including OPP, Office of General Counsel (OGC) and Office of Inspector General (OIG).

Re the Action Plan, she said initially the goal is to build a unified message that if you're doing research at an NSF facility, funded by an NSF grant, no matter where it takes you, there is zero tolerance policy on harassment and sexual assault. She discussed six elements of the Action Plan:

- Resources for victims
- Antarctica presence and site visits
- Increased vetting
- Accountability
- Improved training
- Enhanced security measures on the ice

She said the big challenge in the Antarctic is multiple groups, the military, multiple contractors and different research institutions, creating significant jurisdictional complexity. NSF wanted there to be a place where someone who experiences harassment can go to get advice on possible next steps.

She also listed other near-term and immediate actions:

- Policy and procedure review
- Director's United States Antarctic Program (USAP) Task Force
- Listening session
- Interagency contact plan

Continuing her presentation, Dr. Isern provided an update NSF's FY '23 budget request:

- Request to increase budget to $10.492 billion
- Climate and Clean Energy emphasis
- NSF-wide goal to support 10,000 Fellowships
- Facilities and infrastructure funding to increase substantially

The vision for this budget request is expressed in three pillars:

- Strengthening established NSF
- Inspiring the Missing Millions
- Accelerating partnerships

These pillars support cross-NSF themes:

- Climate and clean energy research
- Equity for underserved communities
- Discovery Engine: NSF's research portfolio
- Emerging industries
- Research infrastructure
- Organizational Excellence: Agency Operations and Award Management (AOAM)

She also listed major GEO and NSF investments for FY '23:

- GEO Climate Incubator: $80 M
- GEO Cyberinfrastructure Incubator: $20 M
- GEO Education, Diversity and Equity Incubator: $7.5 M
- NSF-Wide Climate Hubs
- National Discovery Cloud

Dr. Isern turned next to climate change and climate equity, asking: What are the characteristics of NSF's portfolio on climate change, and to what extent might this portfolio advance NSF's goals of equity, discovery, and impact?

She said Evaluation and Assessment Capability (EAC) has engaged a contractor to use machine learning (ML) to examine project descriptions for the proposals received and help NSF determine the ecosystem of climate-related proposals. By early next year, NSF hopes to have results from that analysis and have the subcommittee in place to work with the data. By summer of 2023, the subcommittee will have recommended ways to address gaps where there is not a lot of investment or proposals submitted. By this time next year, a report is expected from that subcommittee.

Turning to NSF and GEO large-scale investments, she discussed:

- Science and Technology Centers
- Harnessing the Data Revolution
- Navigating the New Arctic (NNA)
- Coastlines and People (CoPe)
- Mid-Scale Research Infrastructure
- AI Institutes
- Networked Blue Economy

Focusing on CoPe, she discussed:

- FY22 CoPe Solicitation
- Interdisciplinary projects to synthesize coastal research results into actionable solutions
- Stakeholder involvement
- Foster inclusive diversity and to broaden participation in STEM

She also discussed CoPe Large-scale Hubs:

- Coastal Hazards, Equity, Economic prosperity, and Resilience (CHEER)
    - R. Davidson, University of Delaware
        - Regions of Study: Gulf, Southeast
    - Hurricane hazards, computational framework, equity, economic prosperity and climate change, disaster policy design.

- Reducing Climate Risks with Equitable Nature-based Solutions: Emerging Communities on Reef-Lined Coasts
    - M. Trotz, University of South Florida
        - Regions of Study: Florida, Caribbean Islands, Belize
    - Nature Based Solutions, coral reefs and mangroves, social and economic ecosystem co-benefits, participatory adaptation.

In addition, there are three Focused Hubs:

- Heat waves in the Southern California coastal zone: their oceanic and atmospheric drivers, human health impacts, and sustainable adaptation
    - M. Merrifield, University of California San Diego
        - Region of Study: West
    - Extreme heat, coastal cloud processes, climate, hydrology & vegetation physiology, urban greening, environmental justice

- Strengthening Resilience of Manoomin, the Sentinel Species of the Great Lakes, with Data-Science Supported Seventh Generation Stewardship
    - J. Hester, Northwestern University
        - Region of Study: Great Lakes
    - Coastal wetlands processes, climate hazards, ecologically & culturally important species, local sovereignty, Native nations partnerships

- Enhancing Resilience and Equity in Urban Coastal Communities through the Co-Generation of Community Capitals

    - J. Goodall, University of Virginia
        - Region of Study: Northeast
    - Co-designed green stormwater interventions, modeling urban stormwater systems, natural and social-human capital, mental health

Dr. Isern also discussed the:
Convergence Accelerator: Networked Blue Economy

- Smart, integrated, connected and open ecosystem for ocean innovation, exploration, and sustainable utilization
- Interconnect the blue economy and accelerate convergence across ocean sectors
- Six new Phase 2 awards

She also provided an update on GEO facilities, discussing the National Center for Atmospheric Research (NCAR), deep ocean submergence, research vessels, polar facilities, seismic and geodetic facilities and Arecibo. For the Arecibo Education Center, she listed the following goals:

- Promote STEM education, learning, and teaching
- Support fundamental and applied STEM and STEM education research
- Broaden participation in STEM
- Build and leverage existing and new collaborations and partnerships

Next, Dr. Isern discussed a division called Research, Innovation, Synergies, and Education (RISE). This is where the incubators mentioned previously will be housed.

- Innovation Incubator:
    - Climate
    - Cyberinfrastructure
    - Education
    - Diversity, Equity and Inclusion
    - Partnerships
    - Cross-foundation programs

Focusing next on DEI, she said the initial focus was on increasing numbers and making investments to increase numbers in the geosciences. One example is Opportunities for Enhancing Diversity in the Geosciences (OEDG). It was realized there needs to be a commitment to leadership and mentoring. That's where the Geosciences Opportunities for Leadership in Diversity (GOLD) Geoscience Opportunities for Leadership in Diversity - Expanding the Network (GOLD-EN) comes in. Awards for the new program, Cultural Transformation in the Geoscience Community (CTGC) should be made soon. This focuses on a whole science ecosystem approach, looking at where research is conducted and how it's done. It involves planning grants that build capacity and implementation projects that build cohorts at specific career stages to build and design inclusive programs.

Dr. Isern discussed the Treatment Improvement Protocol (TIP), noting that the pace of discovery is being accelerated by data and emerging technologies. The upcoming generation of early career researchers and students want to do research and engineering that has societal impact, that impacts the economy and is focused on equity and justice. There is also a drive to do research with some end use that isn't just research. These elements led to the formation of TIP.

Discussing TIP programs, she said NSF has traditionally done foundational research and use-inspired research. But the core of NSF's investments has not been in support of proof of concepts. The market needs investments in prototypes and product development, but for the primary research needed to get something to market, funds have been hard to find. TIP is there to bridge what's been termed but the valley of death but could be called the ramp of opportunity.

TIP will:

- Accelerate research results to impact
- Establish translation pathways
- Foster innovation and technology ecosystems
- Partner to engage the nation's diverse talent

One of the activities currently underway is a regional innovation engines program, which includes:

- Use-inspired research and development
- Translation of innovation results to society
- Workforce development to grow and sustain regional innovation

She showed a map of where concept outline submissions originated. They were made public to build broader teams. On the website it is possible to explore submissions from each state and download the data. Every state and territory had a submission. She said $160 million will be invested over 10 years and will allow awardees to lay the groundwork for establishing their engines. There will be three phases to get to the ability to move to market. TIP received 700 proposals. About 20 to 25 percent of the concept papers submitted included climate and environment.

TIP will be investing in entrepreneurial fellowships:

- Multi-year cooperative agreement with Activate.org
- Translate research breakthroughs to new products and services
- 2-year fellowships, training, $350,000 in direct support, and access to research facilities and equipment
- 3 Pathways

In October TIPS released Experiential Learning for Emerging and Novel Technologies (ExLENT):

- Goals:
    - Expand access to experiential learning for diverse populations
    - Promote cross-sector partnership
    - Develop a workforce aligned with regional economies

There has been a lot of discussion about the possibilities for GEO in the innovation space, including:

- Use-inspired research
    - Precipitation extremes and agriculture

    - Non-traditional sources of critical elements and minerals
    - CO2 capture and transformation
    - Ocean currents, marine life redistribution
- Translational research
    - Smart water trading
    - Sensor for accurate solar forecasting
    - Subsea wireless communication
    - Apps for Earthquake early alert and lead-based paint hazards
- Workforce Development
    - Marine fisheries and the blue economy
    - Natural hazard-resilient infrastructure
    - Green energy technology
    - Sensor innovation and miniaturization

Dr. Isern concluded with a discussion of interagency partnerships, beginning with an update on what had been known as the NSF the National Oceanic and Atmospheric Administration (NOAA) Summit. It is now called the NSF-NOAA Leadership Roundtable and was held in September:

- Session 1: Weather and Climate
- Session 2: Earth System Modeling and Prediction
- Session 3: Social Science, Education, and Equity
- Session 4: Ocean Innovation for the New Blue Economy

Roundtable Outcomes:

- Major Themes:
    - Research to Application (R2X) Cycle
    - Workforce Development
    - Interdisciplinary Approaches
- Work Plan:
    - Developed by Partnership Teams
    - Living guidance document for collaboration
- Year-Long Engagement:
    - Implement work plan
    - 89% of survey participants would be interested in a 2023 Roundtable (n=47)

<u>Discussion</u>
In response to a question from Dr. Kraft during her presentation on SAHPR, Dr. Isern said harassment is defined as including bullying.

In response to a question from Dr. Arnosti, Dr. Isern said a timeline will be used to help NSF share what it is learning, particularly after listening to people on the ice. Part of the work is looking at vessel safety and she predicted more coordination. Dr. Clough added that under The Proposal & Award Policies & Procedures Guide (PAPPG) published two weeks ago, when each institution signs off, they certify there is a plan. It is no longer part of the merit review process. There will be a new checkbox as of January 30 on the cover page where institutions will be saying if offsite or off-campus research is included. That's a trigger to acknowledge they are

certifying there is a plan required for offsite and off-campus research. The PAPPG also includes suggestions for what should be in the plan, including training, both on the inclusion side and on bystander intervention and other things along those lines. A second piece involves what will be done. while in the field to promote an inclusive environment and what one will do if there is an event.

Dr. Marinelli added that the focus on the implementation plan is important. It has best practices, including a critical focus on culture and climate and setting the tone from the top and innovative training aligned with the recommendations in the 2018 National Academy report, Sexual Harassment of Women; Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine. Also, regarding the initial requirement to have a plan, the earlier vision was that that the plan would be reviewed by NSF. While that's not on the table now, OPP is prepared to help people if they want to develop a plan. OPP has the expertise through someone who hired who was part of the initial consulting team who can assist with revealing whether a plan is going to be helpful, including appropriate points of contact and gaps that need to be filled and creating an environment in which people feel free to articulate when they do not feel safe.

Dr. Parsons said a lot of universities have research vessels and field facilities, so something specific on lessons learned and how things are implemented and what to do would be helpful to the broader community.

In response to another question from Dr. Robock about how the climate hub would differ from NCAR, Dr. Isern said NCAR is a Federally funded research and development center (FFRDC) but does not have Federal employees, so NSF can't direct NCAR, which does different kinds of work, whereas the climate hubs would focus on regional-scale problems in the climate arena and be community driven and outcome oriented, with a focus on building the next generation workforce in climate. With an investment of a sufficient size, real outcomes can be derived. Asked again how a climate hub would differ, Dr. Isern said it would give the research community the resources needed to focus, including paying more salary, and they would be all in for looking at the decadal outcome. Asked by Dr. Romanowicz about the timespan, Dr. Isern said it originally was felt the decadal scale was appropriate and everyone is trying to get on the same page.

During the discussion of RISE, Dr. Kraft asked about the previous division it is replacing, which was not staffed, and asked if RISE would be staffed. Dr. Isern said the answer has not been determined.

Dr. Kraft also asked about Arecibo and what happens to instruments at the site. Dr. Isern said principal investigators (PI) can still propose to use them. Dr. Johansen added that NSF is interested in performing science on the instruments still there. Dr. Kraft asked about the decision behind making Arecibo an education center and not supporting the continued research operation. Dr. Isern said it is about research priorities.

Dr. Arnosti asked about winding down NNA and CoPe and said they are unique programs in the extent to which stakeholders, including people usually not integrated into proposals at the earliest stage and not integrated into projects, were involved. One of the problems with developing

relationships is it goes badly if you show great interest in somebody for three years and are no longer interested when the money is gone. She asked how the relationships developed through the programs can be sustained and how the diversity initiatives can be worked in with that.

Dr. Isern said sustainment is a significant concern. The CoPe and NNA groups are talking amongst themselves because CoPe has been going on for almost five years, the time when staff look at what's been successful and how to be more impactful. Dr. Isern said she hadn't thought of the connection to some of the activities. Dr. Patino agreed with Dr. Arnosti's concern. That's why in the CTGC the implementation projects are five years with the possibility of another five-year term. It is built as a center-like activity. And there is a planning grant to help with initial steps. She said there has been coordination between CTGC and CoPe and NNA with the program directors; with the PI community some of the awards build on efforts that were supported by other programs. Those potential connections are examined. Some of the CoPe and NNA awards may have been too new to take advantage of this. The hope is to continue the program. There will hopefully be a home for those types of programs, because that community engaged science aligns with the principles of CoPe and NNA but is broader than those.

After Dr. Isern's presentation, Dr. Whitlock asked if NSF has any international partnerships in climate change. Dr. Isern said she had a meeting the day before with someone in the Office of International Science & Engineering (OISE). She said the UK has been a strong partner. There have also been discussions with the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) about critical minerals. Dr. Patino said the NSF Director is keen on strengthening international collaborations, so there are active collaborations with the UK and there have been recent memoranda of agreement or understanding (MOA/MOU) with Canada and Switzerland. Dr. Isern said another area of active partnerships are in the polar regions, particularly in the Arctic but also the Antarctic.

Dr. Bamzai added that at the US government level, there was a joint committee meeting with France last December; climate was on the agenda. More recently, there was a symposium at the French Embassy. The French President had made several Make Our Planet Great Again awards about five years ago. The recipients were at the symposium along with NSF representatives.

Dr. Parsons praised the NSF - NOAA collaboration and the international efforts. Speaking for the weather and weather climate interface, he said it has gone downhill since he has been in the field. Every month, program managers from NSF, NOAA, NASA, the Department of Energy (DOE) and the Office of Naval Research (ONR) got together and invited leading scientists to give talks. He said it's good to see it moving in that direction. Dr. Isern said one element of the discussion was whether to bring in agency partners more broadly. Suggestions on how to strengthen those interactions would be helpful. With the Subcommittee on Ocean Science and Technology, there's a tremendous amount of activity. So, in some areas there's a tremendous amount and other areas need more work.

Dr. Richardson asked about including NASA and its Ocean Biology and Biogeochemistry (OBB) program. Dr. Isern said she would like to focus on building back some of those interactions lost during COVID.

Program Officer Panel on Broader Impacts

Dr. Patten began with a review of merit review principles:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These broader impacts may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

He said these principles are distilled into the merit review criteria:

- When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:
- Intellectual Merit: The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- Broader Impacts: The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

Based on these criteria, the PAPPG elaborates on a few elements to consider. He said the following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to:
    - Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
    - Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Dr. Clough introduced the four program directors who would present next. Dr. Adams began, saying that when she thinks about broader impacts (BI), she thinks about why taxpayers care that

we have chosen to fund that project and how it is contributing to the progress of science and the health, prosperity and welfare of the nation or securing the national defense. Non-scientists want to know why it matters. And that's what the BI are.

Dr. Aisha Morris said she has a similar definition of BI. It is why taxpayer dollars should be invested and why it's worth investing in the type of research and questions we ask and what benefit we can give to those who are contributing to the work we're doing. So, broader participation can be part of BI; sometimes they are conflated. Broader BI is the benefit to everybody other than those who are determined to understand the scientific details.

Dr. Rom added that she would like to see something beyond the norm. The most common BI is working with students. That's great, but she wants to see an extra special good job with your students where they're getting special training, special mentoring, or getting involved in policy questions.

Dr. Jones said that when thinking of the research and development enterprise, he sees BI on the development side. It's the human part of the research enterprise; the science doesn't conduct itself. How are we supporting that side of the enterprise through BI so people are supported and the outcomes and outputs and products from the sciences is communicated. Oftentimes scientists seek the necessary expertise in the intellectual merit activities of their proposals. The biological oceanographer may need to know where the water goes. So, they then partner with a physical oceanographer. But we don't always see that when it comes to the BI criteria, because natural and physical scientists think they know how to engage in the BI realm. We would like to see more collaboration and connection with experts and the BI arena for physical and natural scientists to have substantial BI activities in their proposals.

Dr. Clough paused to ask for questions and Dr. McManus asked Dr. Jones how to demonstrate that the resources are available to do aspirational things. How do we message that that's a responsibility you have to take seriously when you submit your proposal?

Dr. Jones said through the proposal and review process; in negotiations with PIs after a positive review there needs to be a budget to support these activities. And the budget needs to be commensurate with the activity level.

Dr. Adams said that in addition to having an adequate budget for BI, a proposal must include the expertise to do what you're saying you're going to do for the BI. It is NSF's responsibility to get appropriate people who can assess and review the BI. One might need to get a reviewer specifically to look at that to make sure you have the expertise to determine they put the appropriate financial resources towards it and have the appropriate expertise. Also, in addition to the intellectual merit and broader impacts, solicitation criteria can include questions on specific areas of broader impacts, if that's part of the program's goals.

Dr. Rom said NSF recently began trying to assess annual reports relative to BI, starting with career awards because those are supposed to have education components. Dr. Clough added that they looked at the first annual report and asked how many include a BI goal in the first section of the annual report. For career awardees, it was on the order of maybe 50 percent. Pulling

randomly from other projects funded with OCE had less than 25 percent. What you're telling us about what you're doing is super important, she said.

Dr. Rom said a letter was drafted to career PI's recently, asking then to pay attention when submitting their first annual report to include BI.

Dr. Kraft conveyed a question from the audience about reviewers sometimes criticizing the PIs for outsourcing the work and not doing it themselves that asked about right balance. Dr. Adams said it has to come across as integrated in a genuine relationship. Reviewers get good at telling if you're just going to pay someone to do it for you. If collaborating on BI, involve them during the development of the proposal for it to resonate and be integrated.

Dr. Arnosti asked about institutions without the resources to have someone evaluate a program, where faculty don't have the bandwidth to dig up people who can help them. How can we not disadvantage them further in an effort to improve our BI? Dr. Jones responded that many emerging institutions might be involved in BI activities outside of what would traditionally count as BI. They may have connections to the community or decision makers beyond outreach and education. There could be an opportunity to learn from smaller institutions about what they're doing to meet the BI criteria, though the lack of support and resources could hinder them in other areas. There are opportunities for established institutions and emerging institutions to learn from one another to build up BI in this space.

Dr. Aisha Morris said emerging institutions can explore BI in a new way. There are activities in those places that are unique. This provides an opportunity for large institutions to partner with emerging institutions and for emerging institutions to provide leadership in this space. Faculty at smaller institutions and organizations may have connections to places like the Science Education Resource Center, where you can connect with people who have expertise in different areas and with networks you may not necessarily have been exposed to.

Dr. Adams said there are a lot of facilities in GEO that work with different kinds of institutions and often have educational and professional development activities within them that are looking to partner and support the broader community. There are many opportunities with the facilities GAO funds to partner with them on BI.

Dr. Grimes said some projects have greater impacts than others and asked how NSF tracks the impact of the BI sections from a portfolio perspective. She said she had to report on prior support, which is directed at the research part. Would it be possible to report out on the BI section separately?

Dr. Clough said that within 120 days after the date of the enactment of the Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act, the director must enter into an agreement with a qualified independent organization to assess how the BI review criteria are applied across the foundation and make recommendations for improving the effectiveness of meeting the goals. We have answers on how we're doing it already within the programs we want to share.

Dr. Grimes asked about training given to reviewers to assess the quality of the impacts, particularly if they fall outside the STEM discipline of the target Request for Proposals (RFP). She said she could imagine an innovative BI that has to do with partnering with local artists. But she was not sure there are artists available when a panel is evaluating that. She asked if there is training given to reviewers to assess the quality of BI impacts, particularly if they're innovative.

Dr. Rom said for a proposal like that, there are often ad hoc reviewers who are experts in whatever is proposed, so we can assess the broader impact for that piece of the proposal. The review process is flexible when it comes to making sure we have the right assessment for every proposal.

Dr. Grimes mentioned bias trainings and said it could be an opportunity for training reviewers broadly about how to think about BI in a new way.

Dr. Adams said sometimes for specific programs, in advance of panels, there is a pre-panel meeting for panelists to find the sweet spot time, not too far in advance that they haven't thought about them yet but not too late to incorporate what they learn. Especially if there's solicitation-specific criteria to make sure they understand the intention and can provide a review that is useful to us regarding what they would be assessed on.

Dr. Jones said the reviewer pool with BI expertise is developed indirectly from programs NSF has administered over the years, like ADVANCE: Organizational Change for Gender Equity in STEM Academic Professions or GOLD, where alumni now are reviewer eligible. They are involved in activities where they're looking at or engaged in big activities holistically.

Dr. Robock said education of proposal writers and reviewers is necessary. He asked about impacts after the next big volcanic eruption on food availability or water resources. His work allowing society to deal with climate change better doesn't have specific BI activities but will benefit society and asked if that is an acceptable BI.

Dr. Aisha Morris said it was a great idea. The key is drawing the connection and figuring out how to take that next step. Going beyond the scientific information you're contributing is key, she said.

Dr. Adams said society is not trolling the science journals. Those working with communities need somebody who understands their needs and can communicate that information.

Dr. Clough discussed the convergence accelerator presentation and said policy people don't care what you're publishing. It's about getting to the impact stage.

Dr. Oboh-Ikuenobe said there are many institutions already thinking about BI and asked about communicating the resources that are going to be shared with research offices across the universities, because that's where the PI's go for help with their proposals. Dr. Rom responded that the resource she will share is an attempt at that. It tries to build a community of practice around supporting BI at institutions.

Dr. Jones said the FY '23 NSF budget includes a request to support the Growing Research Access for Nationally Transformative Equity and Diversity (GRANTED) program to look at institutional infrastructure to assist faculty at emerging institutions holistically, all things pre- and post-award management. Providing BI or resources at the institutional level would be a great idea to engage with those who are involved in GRANTED now.

Dr. Richardson said the Integrative Programs Section (IPS) Committee of Visitors (COV) identified the need for training for reviewers and proposal writers because those proposals are so different. Inherently they are BI.

Dr. Romanowicz said serious BI will have financial implications and she asked where the money will come from.

Dr. Rom said where you're proposing, and the review criteria, impact your BI. It affects what you're proposing and what your level of effort is for the various components required by the solicitation.

Dr. Adams added that intellectual merit and broader impacts are so integrated you can't parse the budget out into one part or another. When people are going to go recruit at historically black colleges and universities (HBCUs) to get students and there's absolutely no money anywhere in the budget, how are they going to do it? Dr. Jones asked if that is a question asked about intellectual merit to NSF. We still have a divide in our minds; for intellectual merit there's not a discussion really of the budget. It comes back to treating BI as you would treat your collaborators on the intellectual merit side: What is their salary? If they're an expert, what are you paying them? If they're a subcontractor, what are you paying them? He said they are equal in his mind.

Dr. Adams continued the presentation with a review of NSF BI resources:

- The NSF website
- A blog post by POs
- The NSF Proposal and Award Guide
- A three-minute video on merit review basics: BI

Dr. Rom discussed Advancing Research Impacts in Society (ARIS), an effort to create a community practice around BI. The site contains a BI toolkit, which includes a checklist for proposers to make sure they've covered everything important; a wizard, which is a set of resources that helps one write a BI statement; and a rubric. There are also toolkits that address certain audiences. She also mentioned the Center for Advancement of Informal Science Education (CAISE), a database from NSF's Informal Science Program.

Dr. Aisha Morris discussed the Science Education Resource Center (SERC) at Carleton College, which focuses on education and curriculum development pedagogy, with workshops and experts who can help develop BI in education.

Dr. Jones talked about GOLD and broadening participation under the broader umbrella of BI. It's about professional development, or individuals already in the research enterprise and the

resources available so we can be better mentors, advisors and educators for early career scholars being socialized into the research enterprise. The website has a lot of material about broadening participation and what people who are in the positions need to help those coming in.

Discussion

Dr. Wade said the policy office runs the grants conference twice a year aimed at institutions. There are presentations about merit review, including BI. The conferences are recorded. Dr. Kraft also mentioned the National Alliance of Broader Impacts, which Dr. Jones said developed materials for ARIS.

Dr. Jones also discussed Global Learning and Observations to Benefit the Environment (GLOBE), which includes citizen science, technology, education, teacher training, and international collaboration and is about Earth System Science.

Dr. Rom described an effort by a group of senior marine geologists to train the next generation of chief scientists to go on cruises to do coring that he said was an example of specific training for scientists that makes the use of the facilities more efficient and makes research more effective and impactful and broadens the diversity of leaders knowledgeable about how to use these facilities. He also described the Ocean Observing Initiative, a major research facility with instrumentation in the water sending data back. The data are being used for research and education. There are data labs that can be used anywhere, including by community colleges and organizations that do not otherwise have access to the facility. He also described a relationship between the University of Maine and Upward Bound that included a field experience focused on polar science. The material developed could be used in the classroom to introduce students to polar science. He advised PIs to partner and not reinvent the wheel and to get help for their BI.

Dr. Aisha Morris said some of the strongest BI have a clear plan for the activities, including a budget, expertise, the people to engage and a mechanism to assess success. You do what you need for the research; the same applies to BI. They must be created for each idea and hypothesis. The BI are unique to the project and tie to the work and provide a contribution to the true investors.

Dr. Smith-Nufio described a project looking at climate change in marine ecosystems in the Gulf that collaborated with communities in Louisiana and the Gulf and worked with students. It incorporated art projects and dating shells. There were undergraduates from groups previously excluded due to race or ethnicity at the core of the team. There are exciting results coming out of that core project in the BI. Dr. Aisha Morris said those students created postcards they sent to the communities, which were learning about what was happening locally from the students. Dr. Smith-Nufio said it is a community that had a direct hit from the hurricane that went through Louisiana. The project has been important for the development of activities and helping reunite people and returning to things they were doing in the classroom previously.

Dr. Adams talked about research experiences for undergrads. She said NSF doesn't fund things in perpetuity; there needs to be something new. She pushes for something that's new and exciting, which is where some of the exciting BI happen, because she forced students to think bigger than their site. They realized they could offer their training to other REU sites on specific

topics and work together, or have an opportunity to try a new professional development that wasn't part of the program before, because they have to come up with something new that's going to show a BI.

She also discussed the coastlines and people hub led by Haskell Indian Nations working with universities and tribal communities to decide the important coastal questions for indigenous communities in the coastlines and integrating indigenous knowledge with climate models at NCAR and integrate indigenous knowledge in training undergraduate students and postdocs. They're figuring out training for everybody that's part of the hub in how to work with indigenous communities. They're building a framework that can start to train future researchers that aren't part of the project in how to work in meaningful ways with indigenous communities on science.

Dr. Wade said at the end of the core program every panel was asked for favorite projects out of the whole panel and chose projects because they had fantastic BIs. They said, the science is great, but this is going to have an impact. There has been an effort in GEO to make sure reviewers, panelists and PIs are focused on that and it's showing up in the panels. Dr. Christeson recalled a panel where the science was average, but the panelists said if there's any proposal that should be upped because of the BI, this should be it and it informed the conversation. We take those BI into account when building the portfolio.

Dr. Whitlock asked how much space a 15-page proposal usually gives to BI. Dr. Adams said if you can't understand how it's going to have a BI, it's going to die on that. You've got to balance them. Science done in isolation isn't going to be as meaningful. Dr. Whitlock said that with the best proposals, they would be so tightly linked you wouldn't be able to separate them. But reviewers are asked to comment on them separately. The right balance is a challenge. Dr. Adams said people have been trained to focus on one. With more conversations like this and better training, it becomes easier; stop the thought that it's an add on or a separate thing.

Dr. Robock said to think of all the good science done in isolation that later had huge impacts that nobody realized at the time. Dr. Clough said we're not leaving NSF's bread and butter behind. But there's room to think about the good science *and* how it's going to save the planet right now.

In response to a questioner who said there has to be a place where basic research gets funded, Dr. Clough said, we hear you. We're not leaving behind our merit review criteria. But with TIP coming online and NSF getting into the solution space, there's room for both, especially in a growing budget. NSF-A is not getting left behind, but NSF-B is here.

Dr. Richardson said there is a lot of intellectual merit coming out of the activities planned for broader impacts and they're merging. She asked if there's been discussion of changing the language, so it's less confusing. Dr. Adams said the National Science Board sets those criteria. Dr. Jones added that it doesn't have to be a zero-sum game. He challenged scientists to engage their imaginations about humans and how the science can be helpful. It's not about the pie being in two dimensions — there could be other dimensions to BI and intellectual merit other than the traditional ways we've been trained to think.

Dr. Adams said it's a luxury to be curious. There are people with real problems who are relying on science to help. Going back to the history of science, the people who were doing it had a privileged life and were funded by the church. That's not the society we're in now. Not everybody has the privilege to be curious, because they've got real problems that they're dealing with.

Dr. Parsons said the private sector is growing rapidly in the weather and climate sphere, so impacting private sector companies is not something he would have put in a decade ago and he asked if that is a viable BI. Dr. Clough said that's absolutely a BI for somebody who's thinking in the climate world.

Dr. Romanowicz said it is important to remind society that sometimes it's curiosity that 50 years later comes to some very important, practical, applications; for example, with a vaccine against COVID.

Dr. Kraft thanked everyone for the discussion.

NSF Response to GEO in the 21st Century Report (September 2021)
Dr. Isern provided brief background information on the report and thanked those involved. She said the report was forward-looking and timely. Also, it:

- Shaped thinking for budget requests
- Framed internal discussions for near- and long-term planning

She summarized the report's major themes:

- Resilience
- Outcome-oriented research contributing to national goals
- Natural hazards research

She also listed the key enabling strategies:

- Embracing a systems approach
- Changing the research "reward structure" and geoscience education
- Promoting excellence in disciplinary and transdisciplinary work
- Tackling the challenge of diversity in the geosciences

The theme of resilience has a strong thread through the current budget request. She cited four examples of imperative science informing GEO activities:

- Regional Climate Hubs
- Subduction Zones in Four Dimensions
- Diversity, Inclusion, and Education activities
- FY23 and beyond planning

She noted that Regional Climate Hubs were an important part of the report:

- As large-scale activities, hubs would focus on resilience issues in regions through a systems approach
- Envisioned as being organically interdisciplinary, hubs would foster excellence in disciplinary and transdisciplinary research

- Built around the needs of stakeholder partners, Hubs would focus on research with societal relevance
- As multi-institution partnerships, reaching groups that are underrepresented or underserved is an explicit goal

She also highlighted cultural transformations in the GEO community (NSF 22-562):

- Framework
    - Geosciences research
    - Learning ecosystems
    - Community partnerships
- Aims
    - Inclusive geoscience research community
    - Talent Development for innovations to sustain society
- Approach
    - Support fully inclusive environments for research activities
    - Invest in authentic and equitable partnerships
    - Emphasize systems approaches
- Project Tracks
    - Planning Grants
    - Implementation Grants

She concluded by reiterating that it was the right report at the right time:

- Imperatives – the right report at the right time
- GEO is poised to move forward with important and exciting new activities. Looking forward into 2023, 2024, and beyond some topics come up frequently:
    - Climate Intervention
    - Critical Minerals
    - New Technologies
    - Research Facilities
    - Hazards and Extreme Events
    - Economics of the Earth System
    - Cyberinfrastructure
- Are there particularly impactful elements in the topics above?
- Who are the key partners we should engage with?

Discussion

Dr. Arnosti said the report authors wrestled with diversity in geosciences. She asked if there has been discussion about figuring out at all levels from PIs and up the food chain how we can more effectively identify, promulgate support, and push forward a variety of initiatives. There are many experts and practitioners far outside of science who have learned things that would be useful if we knew them. She asked about getting reports from a broader framework that's soliciting people with expertise and success in this area and transitioning that at all levels through the scientific enterprise.

Dr. Isern said that with climate intervention, maybe the best avenue is a National Resource Center (NRC) roundtable. But we must navigate the political framework because it is hugely

charged. Economics of the Earth system is one GEO is thinking about as a community where we can bring stakeholders to the table. She mentioned Knowinnovation for getting people together to have breakthrough concepts. She also asked for the committee's help and ideas. She also discussed having more focused solicitations.

Dr. Richardson suggested having more focused and less focused solicitations. Although she works on developing new water sensing technologies, she doesn't know how to get from the lab to market. Some universities are well equipped to do that, such as the University of Georgia, with its Office of Biotech Transfer. She asked if NSF could help.

Dr. Isern said such an office sets the emerging institutions apart. TIP is looking at mechanisms to have this innovation space not become yet another win for the major institutions. TIP is focusing on regional centers of excellence that the emerging institutions can draw on.

Dr. Robin suggested looking at Innovation Corps (I-Corps™), Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (STTR) Program. Dr. Richardson asked if that assumes there is a company to work with in the first place. Dr. Robin said they do outreach and matchmaking.

Dr. Patten said the convergence accelerators do some of this and there are fellowships to educate about entrepreneurship. If you've got an idea and need to build a prototype, there's funding available. TIP will help folks think about how to do a startup. There will be more programs rolling out as they get more funding.

Dr. Patino said Grant Opportunities for Academic Liaison with Industry (GOALI) is a type of proposal or supplement submitted to a research program and evaluated within the research program. There are also supplements for graduate students to do internships in industry or another Federal agency.

Dr. McManus said he is involved in a new solicitation on underwater technologies that is bringing folks from engineering, biology and the Marine community together in an ideas lab setting and is a vehicle to bring the community together who may not normally be working together under a common goal.

Dr. Kraft mentioned the audience for the report. When the report was being written the committee talked about the idea of it being a resource for internal use and having conversations with legislatures about the importance of funding for the geosciences. She asked if that's been an aspect of the conversation.

Dr. Isern said AC reports have great power. When NSF briefs the Hill around budget time, it carries much more weight to say it came from the AC and the report has been used that way. It is also valuable inside the building in budget discussions.

Dr. Oboh-Ikuenobe asked if it has been shared with The Geological Society of America (GSA) and AGU. Dr. Isern said the incoming AGU president has it. She also suggested the American

Institute for physics newsletter. In addition to reports, the AC meeting discussions are important for what GEO does moving forward and to justify that the committee has had input.

Dr. Whitlock said stakeholders in her area are confused about these climate hubs. There's a United States Department of Agriculture (USDA) climate hub and U.S. Geological Survey (USGS) Climate Science adaptation centers and NOAA Regional Integrated Sciences and Assessments (RISA) Program sites. She asked if it is smart to develop a new climate hub rather than work with other agencies that have these hubs. Dr. Isern talked about whether NSF could supercharge some activities the sister agencies are doing for the more particular mission or goals NSF has, which are more on the basic research side. She said the NSF hubs could be decadal. The other agencies have that connection to local community. What CoPe and NNA have done building community was in some cases from the start. We should take advantage of where that footprint exists and enhance it rather than replicate it, because any of the CoPe and NNA program officers will say you can't do that overnight.

Dr. Arnosti said some of the local communities have tense relationships with Federal agencies. It may be better to come in as new people who are going to be here for 10 years, without the baggage. Dr. Isern said she hopes that successful proposals will take that into account and know the on-the-ground situation. Dr. Parsons noted his experience with the South Central Climate Science Center, which he said wasn't about science but has connections between the universities and the community. Dr. Isern said that even with a decadal footprint in an area, potentially we'd want to hand over some infrastructure put in play for the research that was relevant for operational forecasting to an operational agency. Having that partnership from the start could make that transition easier. Dr. Parsons said the world's changing with artificial intelligence and weather climate extremes increasing dramatically, favoring centers that are dealing with the new world.

Dr. Isern said the climate grand challenges are well known and asked if there is a need to have workshops to define those again, or if it is okay to say this is going to frame the solicitation. If yes, do we shorten the list and focus on these three or four themes? There was disagreement across the agency on how prescriptive or how open to be.

Dr. Grimes said she was glad to hear conversations are happening around about equity in how resources are allocated and whether that will exacerbate differences between emerging universities and established universities. Dr. Isern said there's been a lot of discussion with GRANTED and TIP, making sure there are synergies. In addition to avoiding the haves having more, it is about emerging institutions having access. Dr. Grimes asked if the Established Program to Stimulate Competitive Research (EPSCoR) programs have been part of those discussions and Dr. Isern said they had.

Dr. Kraft said it is a different time now than when the report was written and asked whether the AC should think about another report or focus on smaller documents that are more in the moment. Dr. Isern said the latter would be more helpful for GEO. She discussed the AC's connection to the community and the BI discussion and how to develop mechanisms to better inform and get the community ready. GEO is thinking about a Dear Colleague Letter (DCL) before AGU on topics to guide the community for the coming years. Dr. Richardson commented

on how much information is coming out from so many different directions and said a DCL would be helpful.

Dr. McManus said he has looked at the Sea Change decadal survey multiple times and such feedback from the AC matters to NSF. It informs hallway conversations and directorate-wide and division-wide conversations. Dr. Isern also asked AC members to consider suggestions for the upcoming AGU Town Hall.

Friday, November 4, 2022

Briefing and Vote on NSF/OCE Integrative Program Section COV Report/Response
Dr. Richardson summarized the June OCE COV:

- Reviewed 66 awards, 44 declinations, 21 Other, 1 withdrawn of 816 total proposals
- COV made 13 recommendations, to which IPS responded in a document dated 30 October 22
- Note that with the exception of The Oceanographic Technology and Interdisciplinary Coordination (OTIC) Program submissions, the proposals are different than in other sections (for ship ops, etc.)

She also provided highlights of the recommendations:

- Process itself – IPS Self-study was very useful, recommended going through this with the COV first, and only introduce e-jackets later (less confusion); include one former COV member on subsequent COVs to help facilitate the process
- Broader Impacts – tricky for facilities or ship support, PIs and reviewers are unsure of how to handle these; suggested IPS provide clearer guidance and reach out to other facilities-based programs to see how they handle BIs.
- IPS self-study – expand to include managerial changes due to disruptions like COVID, supply chain issues, etc. (IPS will document community planning and mitigation activities for these externalities in future self-studies)
- DEI efforts were lauded; IPS encouraged to track demographics more closely from NSF database; NSF encouraged to continue funding these critical efforts
- Recommended that NSF provide training for IPS POs in risk analysis, large effort project management, and systems engineering trade space analysis; consult/exchange ideas with colleagues across NSF and in other agencies
- Similarly, COV recommended that the NSF enlist other ocean science agencies (ONR, NOAA) and organizations (UNOLS, Consortium for Ocean Leadership (COL)) to assist with a method for ensuring appropriately well-trained ship operators, engineers, and other seagoing technicians; (response was that funds are being used for training cruises for techs, etc.; tech pool organized by UNOLS)
- We encourage IPS to continue ensuring that activities using federal funds follow appropriate laws. This is especially relevant to cooperative agreements, where NSF has more jurisdiction over the activities. We are concerned about misconduct at sea, as many open positions are being filled by mariners with limited or no experience on board research vessels, working with scientists, etc. (Response – NSF is working on this)

Dr. Houtman said OCE accepted the recommendations and there are areas it will continue to put more expertise on within the IPS team and OCE and across the divisions and in the GEO directorate. Dr. Midson added that previously each program presented what they thought was most important for their program. This was a focused effort to get to what we were asking the COV to do. He said he liked how it turned out and appreciated having that kind of guide to how to address the COV charge up front would have been would have been helpful. It's hard to step back and know what is most important for the COV to have first to improve that understanding.

Discussion

Dr. Kraft said the general practice at NSF has been to start looking at COVs more at the division level as opposed to the individual programmatic level and asked why this programmatic level one was done as a COV rather than part of the full OCE.

Dr. Houtman said there have been separate science and facility COVs over the years. The facilities at that program level are different than the science proposals. There is somewhat of a difference between the science and the facility COV. The facilities half of the Ocean Sciences Division budget is about half the division budget and the other half is science proposals. He asked if there would be value to thinking about an overall division COV. Dr. McManus added that this is the direction being considered. Dr. Kraft noted the point made during the presentation that there was not sufficient information to address the issue and that it is more appropriate for larger sections. She wondered at what point does the smaller number, because it's a subsection, limit the analysis, but she appreciated the granularity aspect. Dr. Richardson said somewhere there's a happy medium. Dr. McManus said there's a lot of components inside IPS that bridge over into the science enterprise. But by separating them, you're breaking up the workflow in ways we may not want. For example, the postdoc program is under IPS, but it's very much a science. Dr. Midson said there are additional challenges and opportunities with the approach, one of which is logistics. There are rules governing participation in such an activity. The roster of participants includes retired and other Federal types for a reason. You can't have any actions before the body under review and perform the review. Ocean Sciences is a smaller community and active on many proposals with a lot of soft money. So, increasing the scope of the review will constrain participation in that review. That said, the new tool that is performing self-study breaks down the barrier between how proposal driven programs work, versus those in the integrative programs section. Even though the facilities type programs are quite different, our evolving approach would support that kind of division-wide integration of evaluation.

Dr. Kraft called for a vote and the AC approved the OCE IPS COV report.

Report on Special AC GEO Sessions on Economic Impacts

Dr. Richardson and Dr. Kraft provided a recap of the two panels:

- Panel 1: External Scientists and Managers
    - Moderator: Kaatje Kraft, AC GEO
    - Panelists: Ivona Cetinic, NASA; Susan Lang, Woods Hole Oceanographic Institution (WHOI); Mark Walker, National Solar Observatory
        - How has the post-COVID economic climate impacted existing research projects and field campaigns? What specifically has been impacted most - schedules, deliverables, resource acquisition?

        - In your experience, who has been impacted the hardest? E.g., students, postdocs, administrative staff, research staff, construction staff.
        - Has the post-COVID economic climate affected your decisions on what research projects to undertake?
        - For facility maintenance and/or infrastructure buildup, what are the main challenges that have resulted from the post-COVID economic climate?
        - What evidence do you see of disproportionate effects on underserved minority scientists and students resulting from the effects of inflation?
        - What do you foresee as greatest long-term impacts of the post-COVID economic climate?
- Panel 2: NSF Program Directors & Staff
    - Moderator: Tammi Richardson, AC GEO
    - Panelists: Brian Midson, Lindsay Martin, OCE; Subhashree Mishra, AGS; Audrey Huerta, EAR; David Sutherland, OPP
        - Has the post-COVID economic climate resulted in increased communication of financial concern from your community?
        - From your oversight perspective, how has the post-COVID economic climate most impacted existing research projects and field campaigns? For example, what have been the impacts on schedules, deliverables, resource acquisition?
        - For facility maintenance and/or infrastructure buildup, what are the main challenges that have resulted from the post-COVID economic climate?
        - In your experience, who has been impacted the hardest? E.g., students, postdocs, administrative staff, research staff, construction staff.
        - Are concerns from the PI community coming from specific groups within the community or more generally?
        - What do you foresee as greatest long-term impacts of the post-COVID economic climate?

Dr. Richardson and Dr. Kraft continued with summary points from the Webinar:

- Post-COVID impacts
    - schedule delays
    - increased costs, e.g., transportation, fuel, lodging, supplies
    - huge staff turnover as people look for better options
    - delays in parts and materials
    - Huge Backlog in Field Campaigns
    - Domino effect, e.g., subcontractor experiencing supply issues impacts the schedule for the entire project
- Everyone impacted: graduate and undergraduate students, postdocs, administrative and blue-collar workers, project staff
    - Graduate students losing networking opportunities
    - Postdocs having trouble finding jobs in research
    - Uncertainty in the job market for Administrative and Blue-Collar workers on research projects and field campaigns
    - Loss of talent as researchers and technical staff find jobs outside academia
- "Brain Drain" as students and faculty seek out higher paying and more flexible jobs

- Impact on the scale of research rather than decisions on research project
- Higher impact on those with less resources and fewer safety nets; often minoritized scientists or students are most heavily impacted
- Post-COVID environment is changing the way science is done, e.g., remote work, less in person interaction, less travel
    - Federal programs will need to adapt to a changing model, e.g., Build in more flexibility
- Post-COVID environment is changing the way teaching science is done
    - More remote learning
    - More opportunities for virtual learning experiences

Discussion

Dr. Parsons said his takeaway was that one of the largest impacts is on early career faculty who have a field project planned or they're a participant, and suddenly they can't get the research done before the tenure decision. Dr. Richardson added that graduate students are in a similar situation. Dr. Parsons said having worked with the World Bank and the NSF, having people jump to the private sector is an opportunity to recruit grad students. We have to build that partnership, he said.

Dr. Oboh-Ikuenobe noted a spike in faculty requesting for tenure clock extension. Dr. Richardson said the University of South Carolina gave all pre-tenured faculty a one-year automatic extension. Dr. Kraft said that varies from institution to institution in terms of what that means and looks like.

Dr. Arnosti said several junior faculty told her that when extension was automatic, the only way to get a substantive raise was to get an outside offer to get promoted, which has a lot of follow-on effects economically. She added that the fiscal pressures at least at public universities are resulting in changes in priorities. Faculty, postdocs and graduate students are being asked to teach more, with universities increasing class size with more students on Zoom so the numbers look good, or to squeeze out more revenue. Only some of the controls put in place as a response to COVID have been removed. At her university, undergraduate students may not go abroad, except in the context of study abroad programs and faculty must get special permission to go abroad. Dr. Oboh-Ikuenobe said her institution no longer has snow days because you can teach by Zoom.

Dr. Aluwihare said there is a disparity: some faculty, such as those who do modeling, are being accelerated because they were able to be extremely productive during this time, as opposed to those with labs, especially early career faculty. Also, administrative staff are leaving for higher paying jobs and being able to work remotely, which has been a large burden. Dr. Kraft said she had one week with no support capacity at her college.

Dr. Whitlock said at her university and others, where people have moved because they're attractive places to work remotely, housing and other costs have gone up and it's impossible for graduate students to find housing and faculty aren't attracted to the positions.

Dr. Dahl said it isn't a post-COVID world yet. There are still teaching and research impacts. But institutions and people individually are acting as if we're over it. Many students are missing class, as she did, from illness this quarter. Dr. Kraft added that we're in a new phase of COVID.

Dr. Aluwihare said that in graduate recruitment, private universities were told to increase their stipend by about $10,000 to $15,000 and it's not possible for state universities to move that quickly. She and her fellow faculty were just told that they must build into their grants potentially a $10,000 to $15,000 increase in graduate student salaries. This will impact the relationship with funding agencies.

Dr. Gamage said at her community college, one of the existing NSF programs had to be split into multiple years. The proposal did not budget for that. So, they are working without salaries. They continued the program because they still have funds for student stipends and tuition. And the faculty are all adjuncts. They reached out to NSF, which did not fund them. Her colleagues will not come back. She said she was worried about how to get these people to write proposals and do this work in the future.

Dr. Romanowicz said NSF has been very good at allowing no cost extensions for grants, but she asked about flexibility in the near future.

Dr. Henrietta Edmonds responded that there's a hard limit on no-cost extensions and it would take an act of Congress to change it. But programs are continuing to make supplements to deal with impacts of COVID, which are going to continue to be felt. She and her colleagues are committed to continuing to support researchers through the ongoing impacts of COVID. That includes funding for new proposals. Dr. Isern said it is not only the costs of salary and students. It is a zero-sum game; funds spent on one thing can't be spent on another. Dr. Midson said not everything was a zero-sum game in the Federal response to COVID, or in response to Hurricane Ida. Additional resources were provided for specific facility construction. It is important to retain capability on the science side and focus on the most adversely affected and making sure not to lose facility projects, because you can't turn them on and off.

Off-Agenda Topics

Dr. Kraft noted the extra time remaining in the session and switched topics to acknowledge those rotating off the AC at the end of the year and those who have agreed to serve for another year. She also addressed the meeting's hybrid format, with some attendees on Zoom and others in person at NSF.

Dr. Isern raised the idea of convening the next AC meeting at NCAR, or another facility. Dr. Kraft said that would permit a better sense of what science is being done, adding a balance to the agenda.

Dr. Richardson spoke in favor of the hybrid format, which allows her to commit to attending, and she supported meeting at a facility. Dr. Dahl said the hybrid format worked well and meeting at a centrally located facility would make appearing in person easier for those on the West Coast. Dr. Robock said he appreciated not having to travel due to teaching responsibilities but noted some in-person attendees had their cameras off when talking, making it difficult to know who is

talking. He said he feels second class attending by Zoom. He asked if NSF could save money by having everyone attend by Zoom. Dr. Isern said no; the money came from different accounts. Dr. Robock supported meeting at NCAR, but questioned the time and money required for travel. Dr. Kraft suggested that those not visible on Zoom were from the audience. Dr. Oboh-Ikuenobe also supported the hybrid format and visiting facilities. Dr. Romanowicz also supported hybrid meetings and a facility visit. Dr. Isern raised the idea of meeting at a location where it is possible to visit two or three different institution types nearby to hear from a broader sector of the community.

Dr. Kraft raised the issue of AC members having earlier input into the agenda. Agenda planning starts almost immediately after the meeting and includes feedback from the meeting. Planning continues throughout the year. Some agenda items are needed because of NSF's need to communicate with the AC. There is also the issue of having enough time to do a topic justice. She discussed having wider participation in planning; those interested in contributing to the agenda could potentially meet to discuss upcoming AC sessions. She also raised the possibility of starting the meeting earlier to expand the meeting time.

Dr. Robock said he's been on the committee for three years and won't participate in another one. He's never had the chance for input to the agenda. He felt what he can contribute is not being taken advantage of. Rather than advise NSF, he listens to reports. Dr. Kraft said he can still be a part of the conversation as a Zoom attendee.

Dr. Parsons said this was the best advisory meeting he's attended. He proposed earlier updates and getting talks and reports ahead of time.

Dr. Isern said that over the next six months she would like to have more interactions with the AC through updates, which may help members think about what they'd like to hear more about.

Dr. Arnosti said the special sessions on economic impact, where there was short notice, was a nice way to extend the possibilities for members. That is a way for more interaction and information without extending the length of the regular meeting.

Dr. Kraft said a lot of work goes into those special sessions. But it was an important and timely issue and allowed for a deeper examination.

Dr. Gamage said the last meeting's breakout sessions were productive. Those would work well with a hybrid model.

Dr. Kraft asked if there is interest in providing input into the agenda. She also asked about any legal restrictions. Ms. Lane said there can be discussions between meetings. Planning can be done by email.

Dr. Oboh-Ikuenobe said Dr. Parsons had raised an issue that did not make the agenda and asked how it was handled.

Dr. Kraft said it is an important topic and she did bring it to the discussion. She got the email right before she was headed into a planning meeting. They talked about the topic and said it is important and they wanted to give it enough time. But the agenda was already tight. So, particularly because of not knowing how the hybrid format would work, they did not want to do too much. Shifting it to spring will allow a more thoughtful discussion. Dr. Isern added that there is a limitation on changing things at the last minute because it must go in the Federal Register. That's why subcommittees have more flexibility.

Dr. Parsons said he brought the topic forward because Sharon Mosher of NSF graduate education, brought it up at a workshop and there was a vote to bring it to the committee. Dr. Kraft said it will be on the spring agenda. If the meeting is at a facility, the AC could invite Dr. Mosher. She asked about the appropriate timeframe for getting an item on the agenda.

Ms. Lane said The Federal Register announcement must be submitted three weeks before the meeting. If the meeting is in April, she'd need to be in receipt by March 1.

Dr. Isern said that if the next meeting is at a facility, they can start framing plans around that early, which stimulates ideas for discussions.

Dr. Kraft said more input to the agenda makes the AC stronger. And part of the desire for input to the agenda is a reflection of the AC's leadership, and wanting greater input from the AC.

Areas of Mutual Interest with AC-ERE

Dr. Valle-Levinson reported on possible collaboration between the AC for Environmental Research and Education and AC/GEO in three areas:

1. Workshop on Environmental Equity – Focus: Integration of Equity in scientific research
    a. AC-ERE subcommittee working on this
2. Interest group on minimizing impacts of research on the environment
    a. Target: White paper to share with other advisory committees
    b. Outcome: Guidelines for the research community and recommendations for NSF program officers
3. Interest group on Broadening Participation – Initial stages

He concluded by noting that possible collaboration may include other directorates.

<u>Discussion</u>

Dr. Kraft asked about the first category and his data showing a six-fold increase over the last two years of the use of environmental equity and environmental justice. She asked if it was across NSF or within his directorate. Dr. Valle-Levinson said it was across NSF, with the Directorate for Social, Behavioral, and Economic (SBE) Sciences having a larger percent of awards with those keywords. Dr. Kraft also asked about the second topic and overlap with the idea of GEO ethics and minimizing the footprint of research. Dr. Valle-Levinson said the topic is so broad there's room for overlap. He said there is a possibility for convergence between environmental equity and climate equity.

Dr. Whitlock asked about how the items were picked, who's asking for the information, how useful that information is and how the information is going to be used. Dr. Valle-Levinson said his AC, like AC/GEO, advises NSF on potential directions. The topic of minimizing the impact of research on the environment was suggested by a member of the Environmental Research and Education working group and the AC is running with it. For environmental equity and broadening participation, the AC-ERE chair is a champion of both and wants to see NSF being more supportive.

Dr. Arnosti said regarding the impact of research on the environment, it is very difficult because the research necessarily generates paper and plastic waste. She said it would be difficult to quantify, because even just for our lab, which is relatively small, trying to get a handle on all the different impacts with all the different things we do, is hard. Dr. Valle-Levinson said that is a challenge, but a dent can be made.

Dr. Richardson said it might be an easier problem for Antarctic facilities. She asked about the carbon footprint of a season on the ice. Dr. Arnosti worried that focusing just on the activities on the ice might result in recommendations that disproportionately affect one group or another.

Dr. Clough said the US has just changed its position on plastic pollution and has agreed to sign on to the United Nations Environmental Assessment, so there may be opportunities on the international front.

Dr. Kraft said this is a nuanced and complex conversation and maybe a representative from AC-OPP on the subcommittee would be appropriate. Dr. Valle-Levinson said the one on minimizing the environmental impact is an interest group. A subcommittee cannot be formed until the spring meeting. But they are working on a white paper, which can be shared with all the directorates to get feedback. Dr. Kraft asked about the process of what the AC-ERP is considering in terms of what AC-OPP's role would be relative to each of the identified items. Dr. Valle-Levinson said the three general topics straddle geosciences and the other directorates.

Dr. Whitlock asked about the difference between a special interest paper and a subcommittee. Dr. Valle-Levinson said subcommittees must be authorized by the entire AC and can develop a report or recommendation to NSF. An interest group, for practical purposes, is a subcommittee but it doesn't have a formal shape yet. Dr. Bamzai said an interest group can bypass the rule for subcommittees that limit the number of members to less than 50 percent of the AC.

Dr. Meacham said that for AC-ERE, members explore what would be involved in pursuing a topic and decide whether to have a subcommittee and figure out what a subcommittee should be looking at. A subcommittee has several people from the AC interested in the idea, but you can bring on people with appropriate expertise to help the discussions. If the AC-ERE goes forward, the product might be a white paper for other communities to think about this topic. He said there is not an expectation that AC-ERE is going to recommend to NSF a set of guidelines for research.

Dr. Kraft said these topics clearly overlap with conversations AC/GEO has been having and she asked what that means in terms of next steps. Dr. Valle-Levinson said the AC-ERE liaison will keep AC/GEO updated on how to move forward together.

COVID at McMurdo
Before continuing to the next item on the agenda, Dr. Isern told the AC about a news item concerning an increase in COVID at McMurdo. There will be a meeting with the director to determine next steps.

Preparation for Meeting with the Chief Operating Officer (COO)
The committee developed a list of question to pose to the COO.

Wrap-Up and Action Items
Dr. Kraft took the opportunity of extra time in the schedule to advance the meeting's wrap-up and action item discussion. She brought up the 21st Century Report and asked if the AC should do more than post it on the website, such as sharing it with AGI, and how to boost interest. She volunteered to draft an email. Dr. Parsons suggested sharing it with AGU and possibly the American Meteorological Society (AMS). Dr. Isern suggested an Eos article, which would provide context. Dr. Kraft asked if Dr. Parsons could help with the wording to make appeals to the atmospheric community.

Dr. Kraft also brought up the discussion at the end of the economic impacts session that what was coming from the Webinars should be shared to a broader community.

Meeting with Chief Operating Officer
Dr. Kraft thanked Dr. Marrongelle and Mr. Stone for meeting with the AC and committee members introduced themselves.

Dr. Arnosti recapped the committee's earlier session concerning a report on sexual assault and harassment in Antarctica and the action plan that's been developed to deal with the problem. She was disturbed to hear that the requirement many in the community had expected, that they would be developing supplemental documents for how to ensure a safe and inclusive environment for fieldwork projects, has been changed to a checkbox on the front of proposals. Her university certifies it has flood insurance and other things she does not concern herself with, as opposed to postdoc mentoring plans and data management plans. She must think how her project is responsive to those requirements. Changing the safe and inclusive fieldwork theme to something the university is going to wave a wand at sends the wrong message to the community and there will be a failure to engage many of the people who need to put thought into this and how requirements for safety and inclusion are applied to their project.

Dr. Marrongelle said what NSF is rolling out this year is not what it expects to be doing in future years. NSF needed a more time. For the first year, it's not what the community expected. But it's where NSF felt more comfortable. It is going to expect more and wants time to hear from others and learn from sister agencies about how to roll this out effectively, knowing there's good models out there. She said she hoped the AC is engaged in helping NSF understand the resources

needed for staff at NSF and to ensure it is educating PIs throughout the community, so they're well equipped to respond to this call, in concert with their institutions.

Dr. Arnosti added that the community is going to have to lead on this. She said she comes from a large public institution, which is lawyer led and defensive. To get out in front of this issue, NSF can't wait for them to do the right thing.

Dr. Kraft summarized the AC's discussion of broader impacts and asked whether there's any discussion around merit criteria changing or if there's anything under review.

Dr. Marrongelle said NSF has been talking with the National Science Board (NSB) about the merit review criteria. They have expressed interest in BI over the last couple years and NSF works closely with NSB on merit review criteria. NSB has strong oversight of the process for NSF. NSF has done deeper dives with them around BI. NSF has also talked with the Office of Science and Technology Policy (OSTP) and it is interested in understanding if there are things NSF can be doing differently in the review criteria. NSB has taken an interest in looking at whether it is time to think through NSF's merit review criteria. Also, the CHIPS and Science Act has requirements NSF is still unpacking.

Mr. Stone said it's something NSF will have to coordinate with the NSB, because the merit review criteria is in their wheelhouse. But NSF is required to engage with the academies and will work with the NSB.

Dr. Kraft said it was interesting to hear there was a small study looking at fellows and how much follow through there was in some of reports on what they said they would do in their proposals, and it is good that they are starting to look at those data.

Dr. Richardson said the question of whether wording in the merit criteria should or could change came up when discussing the COV report for the Integrative Program section, where proposers and reviewers don't know how to deal with BI for those types of proposals. Another discussion was with respect to cases where the intellectual merit and the broader impacts nicely join. It seems it's time for rewording those two formerly disparate pieces of. She asked if it was possible to communicate better the resources for PIs who are writing proposals. Having resources compiled in one place would help, rather than pieces coming one at a time, in a million emails a week.

Dr. Marrongelle said everyone struggles sometimes to figure out where to find out the right information. NSF is in the process of developing a new website to help streamline communication and address part of that. Communication is something we need to continually work on. Public affairs has been doing focus groups and collecting information from website users with an eye toward improving the user experience on the website.

Dr. Dahl talked about the AC using the hybrid meeting model and said the general feeling was that it worked well. Those who had high teaching loads, or other reasons why it's difficult to travel to NSF, were able to commit to attending the meeting. Another benefit was the smaller carbon footprint.

Dr. Marrongelle said she and her colleagues have been pleased with how hybrid meetings have been working, even with larger meetings. There are a few glitches, but they have figured out how to make changes to ensure an inclusive meeting space.

Dr. Kraft said the AC is looking to assure broader participation from different types of institutions on the AC and hybrid meetings are a good way to think about that.

Dr. Whitlock said the AC came away realizing we're all long haulers when it comes to COVID. We're still suffering the consequences of COVID at our institutions regarding retention efforts, changes in the job market and people's aspirations for how they want to spend their time, changes in productivity and morale. There are large cost of living increases in university communities where it's impossible to hire people or provide stipends that allow graduate students to live in the community. She said the committee hopes NSF is aware of this problem and that it's going to affect institutions and the academic enterprise for years to come.

Dr. Marrongelle agreed that the effects are not going away anytime soon. The impacts on universities in terms of enrollment, additional stressors on students, faculty, and staff, will be with us for a while. She said NSF has known for many years that stipend rates for graduate students have not kept up with expenses. This is a critical piece of thinking about potential challenges to further developing the pipeline of STEM talent. NSF has ways to help; many were deployed during COVID. These are issues NSF needs to keep thinking about, asking if there are additional programs and supplements and ways to continue to partner with universities and individuals to ensure people aren't being priced out of a STEM career because of external factors likely to be there for many years. It's been a long two years and there's been a lot of science delayed. NSF is in the precarious situation of balancing health and safety and the need to continue doing critical science.

Dr. Robock returned to BI, stating that some were concerned NSF doesn't lose its focus on curiosity driven research that might not have practical applications now, but in the future will be very valuable.

Dr. Marrongelle said that as a mathematician, she understands the importance of curiosity driven research. When the director talks about translation research, he is the first to emphasize we don't have translation if we don't have curiosity driven research; the two need to feed into each other. Dr. Robock added that reviewers and people writing proposals need more training on what BI are and there are many different categories or BIs you could propose. It's not just female graduate students, for example, or talking to the community. It is hard to review proposals when you're not sure what is sufficient, what they've done, or even how to write them. The materials the AC was exposed to today need to be visible when you get a proposal to review or when submitting one. Dr. Marrongelle said she can think about how to make those resources more visible in one place and more widely available for PIs, reviewers, and the whole community.

Dr. Isern said a page is being added to the GEO broadening participation website, including the resources discussed during the AC meeting.

Dr. Kraft thanked Dr. Marrongelle, who thanked the AC for the advice it gives GEO and NSF and expressed her gratitude to the GEO leadership.

Closing
The next meeting will likely be mid-April, with the format to be determined. The dates are to be set before year's end.

Dr. Kraft thanked everyone for their participation and adjourned the meeting.