

Advisory Committee for Geosciences (AC/GEO)
October 13-14, 2021
Meeting Held Online
Meeting Minutes

AC/GEO Attendees:

Dr. Kaatje Kraft (Chair)
Dr. Lihini Aluwihare
Dr. Carol Arnosti
Dr. J. Ramón Arrowsmith
Dr. Kerry Cook
Dr. Luis Alberto González
Dr. Colette L. Heald
Dr. Amanda Lynch
Dr. Robyn M. Millan
Dr. Gary Mitchum
Dr. Vernon Morris
Dr. David B. Parsons
Dr. Tammi Richardson
Dr. Alan Robock
Dr. Barbara Romanowicz
Dr. Sharon Stammerjohn
Dr. Cathy Whitlock

NSF Senior Staff:

Melissa Lane

Other Meeting Participants:

Dr. Nicholas Anderson, Program Director, the Division of Atmospheric and Geospace Sciences (AGS)
Dr. Clemencia Cosentino, Office of Integrative Activities (OIA)
Ms. Renée Crain, Research Support & Logistics Manager, OPP
Dr. Ruth S. DeFries, Columbia University
Dr. Jacqueline Dixon, University of South Florida, College of Marine Science
Ms. Lauren Everett, Senior Program Officer, The National Academies of Sciences
Dr. Erwin Gianchandani, Deputy Assistant Director, Computer and Information Science and Engineering (CISE)
Dr. Steven Goldstein, Division Director, EAR
Dr. George Hornberger, Vanderbilt University
Dr. Alexandra Isern, Deputy Assistant Director, GEO
Dr. Anne Johansen, Section Head, AGS
Dr. Brandon Jones, Program Director, GEO
Dr. Douglas E. Kowalewski, Section Head, Antarctic Sciences, OPP
Dr. Zhuangren (Alan) Liu, Program Director, Aeronomy/ Coupling, Energetics and Dynamics of Atmospheric Regions (CEDAR)

Dr. Candice Major, Section Head, OCE
Dr. Madeline Midyette, Program Analyst, GEO
Dr. Aisha Morris EAR Program Director
Dr. Sethuraman “Panch” Panchanathan, NSF Director
Dr. Lina Patino, Senior Program Director, GEO
Dr. Terrence Quinn, Division Director, GEO/OCE
Dr. Jessica Robin, Section Head, EAR
Mr. Brian Stone, Chief of Staff, Office of the Director (OD)
Dr. Vashan Wright, Scripps Institute of Oceanography

Wednesday, October 13, 2021

Welcome

Dr. Kraft thanked the staff and recognized the leadership of Dr. Kip Hodges, her predecessor as AC/GEO Chair and reviewed the committee’s charge, emphasizing its opportunity to provide advice, especially regarding conversations at NSF on climate change and equity and justice.

Update on NSF GEO & Meeting Goals

Dr. Isern reviewed the National Science Board (NSB) 2030 pillars from its 2020 report:

- NSB Vision 2030:
 - Research benefits
 - Science, Technology, Engineering, and Mathematics (STEM) talent
 - Geography of innovation
 - Global science and engineering (S&E) community
- NSF Vision
 - Advancing research
 - Accessibility and inclusivity
 - Global leadership
 - Translation, Innovation, Partnerships (TIP)
- Administration Pillars
 - Pandemic response
 - Economic recovery
 - Racial equity
 - Climate change

She said the visions align in terms of advancing the research enterprise, ensuring equity and broad participation in STEM, assisting the U.S. economy and global competitiveness, while acknowledging grand challenges, such as climate change and recovering from the global pandemic. She added that TIP is not necessarily referring to the new directorate, but the importance of translating knowledge to innovation and building partnerships.

Dr. Isern also reviewed the administration’s FY ‘22 budget request, focusing on the agency’s overall proposed 19.8% increase, which will provide an opportunity to advance research objectives. The proposed geoscience budget is \$1.94 billion, about a 19% increase. There are about \$364 million in existing programs that will move into the proposed Directorate for Technology, Innovation, and Partnerships (TIP) from some directorates. An additional \$500

million is proposed to be added to that, for a total \$864 million. The proposed Office of Polar Programs (OPP) increase is 4.7%, in part because research dollars went up but logistics dollars stayed relatively the same. Overall, the agency budget is proposed at \$10.16 billion.

Dr. Isern said climate change was a driver for the budget increases across the foundation and she discussed an internal working group, the Climate Change Coordinating Committee (C4), to bring together the scientific disciplines and programs to start having discussions about partnering across the foundation. NSF has the ability to bring all the disciplinary areas to the table. C4 has a holistic Earth system view:

- Foundational Research on Climate Change
- Mitigation and Adaptation
- Impact, Risk and Resilience
- Observations and Modeling
- Cultural Transmission of Climate Change Beliefs

She also reviewed GEO's FY '22 budget themes:

- Addressing national priorities:
 - Climate Change
 - Racial Equity
 - Recovery from the pandemic

GEO will continue to work collaboratively inside the foundation and with external partners on the grand challenge of climate change, she said, and reviewed the directorate's climate vision.

- Directorate-wide group "GEO Climate Challenge"
 - Decadal-scale
 - Outcome-oriented to address the climate imperative
 - Leverage investments in core climate research
 - Convergent approach
 - Impact, risk, resilience
 - Regional/local scales
 - Community-centric approach
 - Justice, equity, diversity, and inclusion central to investments
 - Developing the next generation climate workforce

Much of the FY '22 increases are around the U.S. global change research program investment themes:

- Ocean's Role in Climate Change and Climate Solutions
- Terrestrial-Climate Interactions and Water Sustainability
- Cryosphere and Climate Change
- Forcings and Feedbacks
- Earth System Predictability and Resilience

Another major budget theme is racial equity, with GEO as one of the agency leaders. She discussed removal of barriers to participation in the geosciences:

- Geoscience Opportunities for Leadership in Diversity (GOLD)

- Improving Undergraduate STEM Education: Pathways into the Earth, Ocean, Polar and Atmospheric & Geospace Sciences (GEOPATHs)

She also discussed new activity on climate change and social justice to build diverse and inclusive research ecosystems that focus on institutional transformation and inclusivity.

GEO, she said, will continue to be as flexible as possible within the policies that dictate boundary conditions with the aim of helping the academic community recover. The focus is on:

- Research and facilities support
- Resumption of field campaigns
- Outreach via webinars/office hours

Turning to NSF and GEO large-scale investments, she discussed the Networked Blue Economy, under the NSF convergence accelerator program. Sixteen new ocean related projects were recently funded under this program, with the goal of interconnecting the blue economy and accelerating convergence across ocean sectors and creating a smart, integrated, connected and open ecosystem for ocean innovation, exploration and sustainable utilization. NSF is also making big investments in artificial intelligence (AI) and GEO recently received funding for the Artificial Intelligence for Environmental Sciences Research Institute, a multidisciplinary multi-sector project to address societal problems using AI. NSF has also invested \$75 million to establish five Harnessing the Data Revolution institutes, including the NSF Institute for Harnessing Data and Model Revolution in the Polar Regions. Another is the NSF Institute for Geospatial Understanding through an Integrative Discovery Environment (I-GUIDE). One target area is generating a set of analytic tools that address data and interdependencies to better anticipate impacts from disasters or climate change. The goal is to bring impacted stakeholders together with the geosciences, social scientists, biologists and engineers to work on complex coastal problems.

NSF has also committed to filling the gap in midscale infrastructure. Ten awards totaling \$127 million were made, with 10 of the projects from the GEO communities. NSF is also continuing its investments in critical research on the rapidly warming Arctic through the Navigating the New Arctic (NNA) program. Also, three of the six new science and technology centers just awarded are all GEO related: The Center for Oldest Ice Exploration (COLDEX), The Center for Learning the Earth with Artificial Intelligence and Physics (LEAP) and The Center for Chemical Currencies of a Microbial Planet (C-CoMP).

Dr. Isern also discussed the U.S. National Academy of Sciences, Engineering and Medicine (NASEM) study:

- Vision
 - A next generation Earth Systems Science that explores interactions among natural and social processes that affect Earth's capacity for sustaining life, now and in the future.
- NSF Role
 - To innovate, advance, and nurture systems approaches to discover how our planet functions and to inform how society can function as part of Earth's systems for the well-being of communities, regions, the nation, and world.

The other study she discussed was the AC's report, Imperative Science for the 21st Century; Why a Vibrant Geoscience Research and Educational Enterprise is Essential to American Society and How NSF Can Ensure Its Vitality, which emphasizes:

- The Importance of Geoscience Research in the U.S.
- Acknowledging the Limited Diversity of Geoscientists
- Optimizing NSF Support for Geoscience Research

NSF recently released [NSF by the Numbers](#):

- Statistical and funding information for awards, NSF-funded institutions, funding rate, proposals evaluated and obligations by fiscal year.
- Graphs and visuals:
 - 10-year view for all measures
 - Map view and bar graph view of States, Congressional Districts, Institutions
 - Metrics at the Directorate level
 - Detailed reports for Awards
 - Trendline comparisons for all metrics

Dr. Isern said the goal is transparency into NSF funding trends over a number of years and it will be a tool for the research community to understand the agency and agency trends.

In closing, she discussed the AC's next agenda item regarding NSF's learning agenda, a pilot to allow the AC another avenue for providing impactful advice to NSF and report direct stakeholder input to the Office of Management and Budget (OMB).

Discussion:

In response to a question for an audience member regarding partnerships with the National Oceanic and Atmospheric Administration (NOAA) Dr. Isern said there have been discussions with NOAA across a number of areas, including AI for observing systems and racial equity.

Dr. Robock asked about NSF by the Numbers and success rates and said more detailed information is needed to increase diversity. Dr. Isern said it is a new tool and there's still discussion about what information can be released. She said to treat it as a beta site.

Dr. Parsons asked about any enhancement in international collaboration. Dr. Isern said she is working with the Office of International Science and Engineering, which has a lot planned that overlap with GEO. OPP has strong international ties, as does GEO. Those will be seeing an enhancement and there's going to be solicitations coming out with interesting avenues opening.

Dr. Kraft said the interdisciplinary piece is important to successfully address the science of climate change around a lens of equity and justice. The goal for the discussion is thinking about deeper and important issues with the potential for increases in funding to make change. These discussions allow the AC to be more engaged whereas a lot of times the AC passively receives information. Today and tomorrow the AC will start engaging more actively. AC/GEO is the first to engage at this level with NSF. It provides an opportunity to think about whether this is something other ACs should be engaging in.

NSF Learning Agenda & Breakout Exercise

Dr. Cosentino introduced herself as the chief evaluation officer at NSF. She said the learning agenda is new for NSF, which hopes to determine from AC/GEO whether this is a good way to engage with NSF.

She began with a discussion of the Evidence Act, or The Foundations for Evidence Based Policymaking Act of 2018, enacted in January of 2019, which focuses on building and using evidence to help agencies achieve their mission more effectively and more efficiently.

The Evidence Act has three titles that include interconnected requirements regarding evidence and data:

- Title I
 - [Evaluation Policy](#)
 - Learning agenda
 - [Evaluation plan](#)
- Title II
 - Agency data inventory
 - NSF data available on open data platform (data.gov)
 - Data access and use by NSF and others
- Title III
 - Regulations for Federal agencies to access NSF data
 - Data quality standards for statistical products
 - Expanded availability of Confidential Information Protection and Statistical Efficiency Act (CIPSEA) data sets

She said the Evidence Act is trying to revolutionize the Federal government by making sure to produce useful evidence for decision making, which requires a robust data infrastructure and a specialized workforce.

Dr. Cosentino said her focus is the learning agenda, with questions that will generate useful evidence for decision making. The learning agenda includes the background information needed to understand why the questions are being asked and for participants to come up with a mini research plan. NSF's strategic plan provides the foundation for the learning agenda. The strategic plan and the agency's goals generate high-level guiding questions (Level 1). These lead to specific questions (Level 2).

Dr. Cosentino showed three strategic goals:

- Workforce
 - Foster the growth of a more capable and diverse research workforce
- Discoveries
 - Expand knowledge in science, engineering and learning
- Impact
 - Advance the capability of the nation to meet current and future challenges

For each goal, she provided guiding questions:

- Workforce:
 - How can NSF grow STEM talent and opportunities for all Americans most equitably?
- Discoveries:
 - How can NSF fuel transformative discoveries most effectively?
- Impact
 - How can NSF mobilize knowledge most effectively to impact society?

Answering these guiding questions informs the next strategic plan in four years. Using as an example the workforce strategic goal, she said the accompanying guiding question could lead to specific questions such as:

- Describe characteristics, outputs, and outcomes: What are the characteristics and, among individuals, educational and workforce outcomes of beneficiaries of NSF workforce development programs?
- Assess impacts: What is the impact of program X on the diversity of the STEM workforce?
- Consider improvements: What changes to program X might further catalyze improvements in the participation of under-represented minorities in the STEM enterprise?

Dr. Cosentino said this is a new exercise for NSF. It was developed from questions from NSF staff, leadership and external stakeholders; by reviewing reports and congressional testimony, mining everything to get a sense of the questions being asked of the NSF portfolio.

One of the topics NSF is prioritizing for the future is climate change, a topic where the stars aligned, she said. It has been an NSF priority for a long time and it is now an administration priority and it meets selection criteria included in the NSF Annual Evaluation Plan, an offspring of the learning agenda.

The starting point was the question:

- How can NSF fuel transformative discoveries most effectively?

She said a landscaping study would help NSF understand where the foundation is operating in this space, with investments across the portfolio. She said it is important to understand who is studying the processes that govern climate change and the impacts changes are having to ecosystems and societies. Some of the solutions are available or are being developed to help adapt to climate change or mitigate its impacts. The agency wants to know who's being included in its portfolio. That will help NSF refine its strategy for the future and think about where to make investments. A descriptive analysis is needed, she said, to understand the portfolio and how choices are being made.

She said the AC will break out into groups that individually focus on climate processes, impacts and solutions. They will focus on two questions:

1. What does "equity" mean in [group's topic area]?
2. How do equity issues reveal themselves in [group's topic area]?

A cross cutting theme is equity: What does equity mean across the portfolio? This includes equity in access, participation, reviews and outcomes. Equity is a principle to be mindful of throughout.

Discussion:

In response to a question about expectations for the breakout groups, Dr. Cosentino explained the task is to think about, for example, what equity means when we think about solutions to climate change.

Dr. Robock said he is a climate scientist, not an expert in equity. Dr. Cosentino asked who gets to participate when we study climate change processes. The goal is to start thinking about your area of science with an equity lens, though it may feel divorced from your work. She suggested thinking about who gets to be on your teams, and what kinds of topics are studied and why and who gets engaged in the research. Dr. Robock said this is quite different from curiosity-driven research that does not look at impacts, which NSF has publicly supported. He said he was confused about what NSF wants.

Dr. Cosentino said NSF wants to hear his perspective and that of others. She said it is possible to ask about the outcomes associated with curiosity-driven research and its impact in society and whether those outcomes and impacts are equitable. It is possible from NSF's perspective to think of two different strategies, to advance knowledge and impact society, and ask which is most effective. She said Dr. Robock's comment may imply a need for more space for curiosity-driven research, if it can be demonstrated it not only leads to great advances but does so equitably. Dr. Robock said one can't predict where curiosity-based research will take you and a lot of it is not useful. It's hard to figure out ahead of time what's going to be equitable and focus just on that.

Dr. Kraft asked who gets to be able to do curiosity-driven research and what is the system that's preventing some people from being able to participate. There is a need to expand our thinking beyond just our one lens of what we know to say, with an equity lens, who is participating and who's not participating. How do we broaden that opportunity for all the different things that help science advance?

Dr. Cosentino added that regarding not being able to predict research outcomes, it is possible to study processes and use past data to see what those outcomes were. We can look retrospectively about what got a person to the point they are today winning the Nobel Prize. She said Dr. Robock's point is more of a methodological problem than a conceptual one.

Dr. González said the task is to think about equity in terms of who can do the research and who is not present in the group that's doing curiosity-driven research and what the factors are limiting participation of a particular group of people in the curiosity-driven enterprise. There is a fraction of the population who may have wonderful ideas but are not able to participate for whatever reason and that limits our curiosity-driven research. By limiting the number of participants, we limit the number of questions that can be asked.

Dr. Mitchum questioned the emphasis on transformative research when most research is incremental. Dr. Cosentino said transformative research is an ultimate goal, but you get there

through different strategies. Regarding equity, she said it is not just the people who get to be at the table, but also why we study certain things and not others. In addition to curiosity-driven research, are there other motivations for pursuing research? Some argue that research sometimes follows the money. And there may be other reasons.

Dr. Kraft said one breakout group is looking at the processes that govern climate on Earth at different spatial and temporal scales. The second is looking at the impact changes in climate have on ecosystems and societies. The third looking at the most sustainable solutions and technologies that will enable adaptation to and mitigation of climate change through a lens of what equity means and how equity issues reveal themselves.

Briefing on the Establishment of the new Technology, Innovation and Partnerships (TIP)

Dr. Gianchandani said there are a number of versions of TIP but he will focus on the version in the President's budget request. He said the nation is at a pivotal moment for climate change, equitable access to education and health care and critical and resilient infrastructure. There is also an opportunity to think about the science and engineering community as having an ability to meet many of those and other challenges with science and engineering, he said, highlighting:

- Pace of discovery accelerated by data, emerging technologies
- Demand for societal impact
- Opportunity to leverage partnerships

Noting that NSF has long supported fundamental research, he presented a spectrum from pure basic curiosity-driven research to use-inspired, solution-oriented and nearer-term basic research activities. NSF differentiates itself from some other agencies with an emphasis on applied research. He described a third dimension around translation and innovation that cuts across and emanates from basic research that's curiosity driven to one more solution-oriented research. There is an opportunity to spotlight use-inspired and translational research, which has long been a part of NSF but is something that can be strengthened and scaled.

NSF's existing directorates and offices are doing their fair share of use-inspired and translational research. Each is supporting part of the spectrum from curiosity-driven to more use-inspired. There is an opportunity to think of a new directorate to lift up all the activity across the foundation and enhance use-inspired and translational research across all science and engineering disciplines NSF supports. To be effective, TIP must work in partnership with all existing directorates.

He presented the four units within the Directorate and the FY '22 request for each (\$M):

- Innovation Ecosystems (IE) - \$335.00
 - Partnerships Office (PO) - \$50.00
 - Technology Frontiers (TF) - \$150.00
 - Translational Impact (TI) – \$329.87
- Total - \$864.87

Dr. Gianchandani said for this to be successful, NSF must think about partnerships between NSF and the private sector and State and local governments and nonprofits and foundations. It must also think about accelerating and catalyzing partnerships. The PO represents an emphasis on

building up expertise on how to do partnerships and work collaboratively with directorates to foster partnerships with stakeholders in alignment with NSF research areas.

One level above partnerships is an emphasis on the technology and innovation ecosystem (\$485M). This includes:

- Convergence Accelerator
- NSF Innovation Corps (I-Corps)
- Regional Innovation
- Industries of Tomorrow co-investment
- Entrepreneurial Fellows

These investment areas would be realigned at the request level into the new directorate.

One layer above that is technology translation (\$329.87M) to cultivate the translation of those research results into practice, which includes:

- Partnerships for Innovation (PFI) Program
- Small Business Innovation Research (SBIR)/ Small Business Technology Transfer (STTR) Program
- Innovative Pathways

Together, there will be a mix of existing programs realigned at the budget request and new investments that might be ramped up.

These functional levels are aligned with NSF's FY '22 priorities:

- Enhance Fundamental Research and Development
 - Support research across the spectrum of science, engineering, technology, and education
- Strengthen U.S. Leadership in Emerging Technologies
 - Includes the establishment of a new directorate for technology, innovation, and partnerships within NSF to advance science and engineering research and innovation
- Advance Equity in Science and Engineering
 - Increase participation in science and engineering of individuals from racial and ethnic groups underrepresented in these fields
- Advance Climate Science and Sustainability Research
 - Advance use-inspired, solution-oriented research and innovation in climate and clean energy-related research
- Continue construction of forefront infrastructure
 - Continue construction of major NSF research facilities

Dr. Gianchandani discussed enhancing the lab-to-market platform, improving access to SBIR/STTR funding earlier on for researchers to more smoothly facilitate transition from phase one to phase two, which he said is an example of an existing program where there is opportunity with respect to repositioning it within a technology directorate and working closely with all directorates and an example of a new investment.

He also discussed the regional innovation accelerators concept, which aligns with the university technology centers. The regional innovation accelerators are about trying to cultivate new-innovation ecosystems throughout the country at the scale of individual communities or regions that allow NSF to address the challenges of climate change, equity and critical and resilient infrastructure, as well as challenges and opportunities from a technology context in terms of AI, manufacturing, wireless and so forth.

He said the Regional Innovation Accelerators will:

- Cultivate new-innovation ecosystems at the scale of individual communities and/or regions throughout the U.S.
- Address major scientific and technological goals while ensuring broad societal benefits
- Balance technical and geographic innovation; incentivize partnerships; serve as hubs for NSF's broader portfolio

Some challenges today are different depending upon location. So, with regional innovation accelerators, it's about trying to be able to foster engagement of the broadest set of stakeholders earlier on to help shape the research, foster iterative co-design and co-creation, and take research results and pilot and prototype them and ultimately put them on a pathway toward maturation and utility by the market and society. This is a fundamental phase shift from a technology push to a market pull dynamic.

Looking across the country there are examples of innovation ecosystems and there are opportunities to do this all across the country. A significant infusion of NSF funding may serve as an attractor for co-funding and for other stakeholders to congregate around that community to potentially help cultivate these innovation ecosystems and allow anyone, anywhere who's interested in participating in innovation and use-inspired research and translation to engage. This is about trying to speak to different types of institutions, different sectors and individuals with different backgrounds and perspectives.

Turning to the workforce side, Dr. Gianchandani discussed NSF Entrepreneurial Fellows, focusing on:

- Pathways for Ph.D.-trained scientists and engineers
- Forging connections between academic research and government, industry, and investors
- Training to become leaders capable of maturing promising ideas and technologies from lab to market

He said this is another example of a potential new investment, where NSF hopes to draw in students and expertise from different backgrounds and perspectives to be engaging in entrepreneurship and innovation activities.

Discussion

Dr. Kraft said TIP looks like a large, higher-category categorization. It's being called a directorate, but it sounds like two different things. Dr. Gianchandani said the foundation has directorates and offices and the notion is to establish a directorate, but NSF sees it as one where those in the directorate work collaboratively with existing directorates. It would be a misnomer to suggest there isn't collaboration already happening between directorates. But there is a

concentration of alignment between the GEO and the broad and diverse geosciences community. By contrast, TIP doesn't have a community. It has the innovation and entrepreneurial community it will engage with, but not a community by itself that it will engage with exclusively. There's an opportunity for TIP, through engagement with the other directorates, to help all the scientific enterprise emphasize use-inspired and translational research. The goal is not to only do use-inspired research in TIP. TIP is a little bit a directorate, but it's also about trying to have the perspective of thinking about use-inspired research and translational activity across the agency.

Dr. Kraft asked on behalf of an attendee about review panels and the mechanics of proposing an innovation with multiple directorate-level people involved. Dr. Gianchandani said to imagine a call for proposals for regional innovation accelerators that's concentrated around climate change and potentially seeing diverse proposals in terms of who's participating, the sectors, backgrounds and perspectives. It's about thinking through how to ensure the right expertise in terms of use-inspired research, translation and the innovation ecosystem and how to have that expertise at the table. That might mean making sure to have academic researchers in terms of the scientific questions. But NSF also wants to have entrepreneurs and industry at the table. There needs to be different aspects of the research and innovation ecosystem together on the review panel. The perspectives on the review panel have to be multi-disciplinary and multi-sector.

Dr. Stammerjohn asked when the directorate would be formed. Dr. Gianchandani said it's wait and see at the moment, given the legislative environment. Dr. Stammerjohn also asked, from the proposer's perspective, how a project will come together across the directorate. Dr. Gianchandani said with respect to the regional innovation accelerators, NSF might specify thematic areas of interest to the foundation. Those areas might emerge from workshops and conversations with program officers across the agency. He said NSF does not anticipate TIP replicating the expertise of GEO or BIO but rather partnering with colleagues in those directorates. TIP will be dependent upon their expertise to help shape a theme in a particular topic space. Once a funding opportunity goes out, there are going to be teams ready to go on day one to submit a vibrant proposal and other teams may need more time. NSF is trying to design with that flexibility in mind to meet folks where they are with respect to preparedness and interest level.

Briefing on the Newly Released NASEM Report, Advancing a Systems Approach for Studying the Earth: A Strategy for the National Science Foundation

Dr. Hornberger thanked the committee members that worked on the report:

- Ruth S. Defries (Nas) (Co-Chair), Columbia University
- George M. Hornberger (Nae) (Co-Chair), Vanderbilt University
- Claudia Benitez-Nelson, University of South Carolina
- Asmeret Asefaw Berhe, University of California, Merced
- Melissa A. Burt, Colorado State University
- James J. Elser (Nas), University of Montana
- Courtney G. Flint, Utah State University
- Royce A. Francis, George Washington University
- Inez Y. Fung (Nas), University of California, Berkeley
- William D. Gropp (Nae), University of Illinois At Urbana-Champaign
- Melissa A. Kenney, University of Minnesota

- Jerry X. Mitrovica, Harvard University
- Constantine Samaras, Carnegie Mellon University
- Kristen St. John, James Madison University
- Fiamma Straneo, Scripps Institution of Oceanography, University of California, San Diego
- Duane E. Waliser, Jet Propulsion Laboratory

Dr. DeFries continued with the meaning of Earth system science:

- Essential elements of an integrated approach for understanding the Earth's systems emphasize research on complex interconnections and feedback between natural (e.g., physical, chemical, biological) and social (e.g., cultural, socioeconomic, and geopolitical) processes.

She said NSF played a key role in the advancing the understanding of system science and has been pivotal to advancing that understanding. Also, the time is ripe for an integrated approach to help address many of this century's most urgent challenges. NSF is uniquely positioned to strengthen the scientific foundation necessary to explore these issues.

Turning to Earth systems science across directorates, she stressed:

- Next generation Earth Systems Science is aligned with NSF's dual mission
 - To "promote the progress of science"
 - To "advance the national health, prosperity, and welfare"
- Research within and across NSF directorates is key for advancing understanding of the Earth's systems.
- Given the breadth and scope of the subject, the report and recommendations take a high-level approach that provides NSF with several options and the leeway to develop a feasible implementation plan.

The committee's task statement included five key elements:

1. Describe key characteristics for studying the Earth system
2. Discuss emerging opportunities and barriers to progress for achieving this vision
3. Identify potential synergistic opportunities within current facilities, infrastructure, and coordinating mechanisms
4. Discuss computational, data, and analytic support for Earth systems research
5. Discuss workforce development to support the personnel needed to advance Earth systems research, including undergraduate and graduate education, and increasing diversity in the future workforce.

The committee built on previous Academy reports that address Earth system science. Its process involved:

- All virtual meetings
- Online questionnaire
- Newsletter outreach
- Cross-cutting workshops
- Extensive committee deliberations
- Rigorous peer review

She also listed the community engagement workshops and roundtables:

- November 13, 2020: Education and Workforce for Earth Systems Science Framing Session
- November 20, 2020: Integrating Earth Systems Science and Engineering
- January 12 & 19, 2021: Accelerating Integration of the Social Sciences in the Study of Earth System Interactions
- February 4 & 12, 2021: Computing, Data, and Cyberinfrastructure for a Systems Approach to Studying the Earth
- April 16, 2021: Education and Workforce for Earth Systems Science Follow-up Discussion
- May 14, 2021: Roundtable Discussion on Example NSF Facilities
- May 28, 2021: Roundtable Discussion on Example Coordinating Mechanisms

The committee's vision was for:

- A next generation Earth Systems Science that explores interactions among natural and social processes that affect Earth's capacity for sustaining life, now and in the future.

And NSF's critical and unique role in next generation Earth Systems Science is:

- To innovate, advance, and nurture systems approaches to discover how our planet functions and to inform how society can function as part of the Earth's systems for the well-being of communities, regions, the nation, and the world.

Dr. Hornberger continued with what he listed as the key characteristics of an integrated approach:

1. Advance both curiosity-driven and use-inspired basic research on the Earth's systems across spatial, temporal, and social organization scales.
 - a. Both curiosity-driven research and use-inspired basic research are key to unraveling the complex drivers, interactions, and feedbacks within and across the Earth's systems.
 - b. A broad interdisciplinary approach is important
 - c. Use-inspired basic research is also crucial to guide management of societal challenges related to the Earth's systems
2. Facilitate convergence of social, natural, computational, and engineering sciences to advance science and inform solutions to Earth systems-related problems.
 - a. Natural-social relationships are at the heart of many complex problems
 - b. Identifying and understanding these multi-directional relationships involves a robust integrated science
 - c. Convergent research provides a means to develop that integrated science
3. Ensure diverse, inclusive, equitable, and just approaches to Earth Systems Science.
 - a. Who participates in defining and studying the Earth's systems influences how well we understand these systems.

- b. Incorporating broad perspectives, values, and experiences into all stages of research will result in more relevant research questions, more new ideas, more creativity, and more capacity.
 - c. It will also help ensure that scientific advances yield benefits to all sectors of society.
- 4. Prioritize engagement and partnerships with diverse stakeholders to benefit society and address Earth systems–related problems at community, state, national, and international scales.
 - a. Engaging stakeholders in shaping research questions is essential for developing knowledge that can be put into practice
 - b. Stakeholders may also co-produce knowledge with scientists
 - c. Partnerships among government agencies and private companies expand the pool of knowledge, observations, and computational resources
- 5. Use observational, computational, and modeling capabilities synergistically to accelerate discovery and convergence.
 - a. The observational, computational, and modeling infrastructure must work collectively
 - b. Observational, computational, and modeling capabilities have undergone dramatic and transformational advances in the past decades
- 6. Educate and support a workforce with the skills and knowledge to effectively identify, conduct, and communicate Earth Systems Science.
 - a. The Earth Systems Science workforce must maintain strong disciplinary knowledge and skills, while developing interdisciplinary and transdisciplinary science skills and practices, including:
 - (1) systems thinking,
 - (2) integration and application of human dimensions,
 - (3) complex problem solving,
 - (4) computational and analytical skills,
 - (5) spatial and temporal reasoning,
 - (6) communicating to diverse audiences, and
 - (7) the ability to work ethically in diverse teams.

Dr. DeFries and Dr. Hornberger continued with a presentation of the report’s six recommendations:

- Recommendation 1. NSF should create a sustained next generation Earth Systems Science initiative that both furthers scientific understanding of the Earth’s systems and supports solutions to Earth systems–related problems.
 - An integrated initiative that incorporates the six key characteristics requires sustaining and expanding NSF’s current practices.
 - Place increased emphasis on use-inspired and convergence research while maintaining strengths in curiosity-driven Earth Systems Science
 - Strengthen efforts to include diverse perspectives in the research and engage with stakeholders

Dr. DeFries said implementation presents challenges and opportunities:

- Integration will involve overcoming different vocabularies, cultures, methodological and data mismatches, professional incentives, and power differentials across diverse scientific fields and stakeholder groups
- It is critical to fund both the early stages and ongoing hidden labor of relationship building and collective ideation necessary for successful collaborative research
- Meeting contemporary and future challenges will involve expanding the discipline-specific research and theoretical conceptualizations that are the core of NSF and embracing a convergence research agenda.

The presentation continued with the remaining recommendations:

- Recommendation 2. NSF should remove barriers to convergence research, including facilitating engagement with stakeholders and building transdisciplinary teams.
 - Convergence research for Earth Systems Science requires new modes of interaction
 - Transdisciplinary teams and relationships with stakeholders develop over longer time frames
 - These realities are key to convergence research, team building, and productive and sustained engagement with stakeholders.
- Recommendation 3. NSF should integrate diversity, equity, inclusion, and justice in all aspects of next generation Earth Systems Science, including the determination of research priorities, evaluation of research activities, and development of the workforce.
 - Participatory knowledge creation is as ^[11]_[5EP]important as programs that increase DEI through education and workforce development
 - NSF can incentivize scientists to consider diversity of research teams and address the implications of their research on different segments of society
- Recommendation 4. NSF should promote and support collaboration, instrumentation, cyberinfrastructure, and data-sharing activities among facilities for the production of convergence research for next generation Earth Systems Science.
 - This includes
 - leveraging synergies between cyberinfrastructure and observing facilities,
 - collaborating across science divisions, and
 - working to increase adaptive flexibility as use-inspired research needs evolve
- Recommendation 5. NSF should provide leadership in the computational revolution by expanding resources (e.g., hardware, software, data analytics, and skilled workforce) and ensuring equal access to them.
 - Earth Systems Science will need to advance with the fast pace of changes in computation and observations
 - Proactive planning requires engaging computational and data scientists as critical members of the Earth systems scientific community and ensuring the provision of sufficient computing resources
- Recommendation 6. NSF should promote and support the development of the workforce for next generation Earth Systems Science, including undergraduate and graduate students, scientists, and engineers looking to engage in convergence research.

- Sponsoring established and emerging programs that promote the development and evaluation of the necessary skills and competencies
- Exposure to convergence research, transdisciplinary teams, and a diversity of perspectives in undergraduate and graduate training
- Including research software engineers and system engineers as a part of the Earth Systems Science workforce

Dr. DeFries concluded by saying that the ability to deepen understanding of how the planet and societies function and enable help humanity to sustainably manage and adapt to future changes rests on knowledge found within and beyond science. The next generation of system science is an expansion of the tent, including data scientists, social scientists, ecologists and people coming from different areas who might not describe themselves as system scientists.

Discussion

Dr. Kraft asked who is represented in the study and the people who did the peer review, observing that it is pretty much all the same type of institutions. She asked how to make sure these conversations involve from the beginning a wide range of different kinds of institutions and populations. Dr. DeFries said it takes all different perspectives to define the research questions. She said committee members were from different communities. Dr. Hornberger said the committee size had to be kept reasonable. Through workshops and making connections outside the committee, there was an effort to be more expensive and recognize there were other perspectives to incorporate. Ms. Everett added that the committee tried to reach out to as many different types of communities as it could throughout the study process. There are many different considerations to be balanced in putting together any study committee, including consulting with National Academies members. The committee recognized the importance of including different institutions beyond the traditional types that have been included in Academy studies. The Academies' Chief Diversity Officer is looking at better ways to bring in new voices.

Dr. Robock noted an emphasis on users and practical work and asked if the committee wasn't also considering basic research or curiosity-based research. Dr. Hornberger said there was a strong emphasis on inspired basic research but the committee didn't mean to give short shrift to fundamental curiosity-driven research.

Dr. Morris said he appreciated the recognition that environmental justice work and community engaged work occurs on radically different timescales than funding considerations or evaluation. He asked if there were related recommendations that can provide guidance. He said it was exciting to think about a different epistemology of climate research. Thinking about climate research through an equity lens is potentially transformative. Dr. DeFries said the committee didn't see its role to recommend to NSF to get to that level of specificity.

Dr. Millan said the statement of task is important to how the report is framed, and the committee is constrained and asked if that's an area where those diverse perspectives could be interjected, at the very beginning of the process. Ms. Everett agreed, adding that there have been conversations at the Academies about bringing that in earlier in the process and how it develops the statement of task. That defines how the study is composed and how it's run.

Dr. Isern responded to a question about how NSF views the high-level recommendations and whether it wanted more immediately actionable recommendations. She said there is a shocking alignment with what her office was independently thinking. Also, the level at which the recommendations were given is very appropriate. They're at a level that makes them actionable. There are discussions on how to address what was recommended.

Dr. Morris asked why community colleges weren't included in recommendation six. Dr. DeFries and Dr. Hornberger said there was no intention to exclude community colleges.

Dr. Morris said one challenge is that the public does not trust scientists. The ability for the public to discern and use and incorporate the knowledge system sciences is generating is a huge challenge that wasn't included. He asked how to address some of these challenges and gauge communities. He asked if that was part of the discussion. Dr. Hornberger said the statement of task was understood to be related to the NSF's role in the Earth system science workforce. But the committee recognized the need to engage people typically not in the scientific community and build communication skills amongst Earth system scientists. It was not meant to be an omission.

Briefing on NSF-supported program, URGE, Unlearning Racism in Geoscience

Beginning his presentation on Unlearning Racism in Geoscience (URGE), Dr. Wright said he titled his presentation We are Scientists. He said he had wanted to be a scientist since high school. In addition to being geophysicist, he tells stories, he said.

In March 2020 he was at Berkeley, when his advisor sent him an email saying that maybe today's the day to leave. San Francisco was going into lockdown, because of COVID-19. Other events occurred, including those involving Ahmaud Arbery, Breonna Taylor and George Floyd. After the protests, there was a call to action, particularly in the geosciences and particularly in STEM fields. He said it seemed like the geosciences were ready for change and in June, he tweeted:

- Geoscience Academic twitter? Could we commit to reading a book together? A book about how to be anti-racist? One chapter per week? Discuss with your group? Then, we have summaries from your discussions posted to a website, so people can read? Doesn't need to start exactly now.

Of those responding to his Twitter poll 95.5% said yes. Dr. Wright said he thought we were going to go away, read books, come back and do nothing. And he thought, we are scientists. People already know some of the solutions to some of the problems. We are creative. We are scientists. Thus, the science should be used to guide decisions and what is implemented. That is how URGE started, he said.

After the tweet, he gathered a team from those who had contacted him, including geoscientists, educators, people with business experience and a student in between undergraduate and graduate school. He said URGE is a community-wide journal-reading and policy-design curriculum to help diversify the geosciences. He added that URGE has four objectives:

- URGE's primary objectives are to (1) deepen the community's knowledge of the effects of racism on the participation and retention of Black, Brown, and Indigenous people in

Geoscience; (2) draw on existing literature, expert opinions, and personal experiences to develop anti-racist policies and strategies; (3) share, discuss, and modify anti-racist policies and strategies within a dynamic community network and on a national stage; (4) implement or help facilitate the implementation of those policies.

He said URGE has been guided by four theories of change:

- More people will participate in initiatives that seek to increase belonging, accessibility, justice, equity, diversity and inclusion, when they believe they're part of something that is significantly larger than themselves and it recognizes them and realizes who they are.
- People will participate if the activities appear well run, are cohesive, there's a story with a beginning and an end, where they expect trustworthy sources of knowledge, particularly ones that mimic the ways in which they've come to know but expand upon the ways of knowing that exist.
- People will participate when they're publicly and clearly recognized for their efforts.
- Initiatives that are more action oriented, will draw more people because action is where the community is now, because we large realize and recognize that racism exists and lack historical inclusion exists.

URGE is trying to answer the question, What inspires people to act in diversity initiatives?

URGE aims to achieve its objectives in six main stages:

- Development
 - Draft anti-racist policies and resources
- Refinement
 - Improve anti-racist policies and resources
- Peer review
 - Experts provide feedback
- Dissemination
 - Share policies and resources with colleagues
- Implementation
 - Implement and assess policies and resources
- Broadening
 - Market to other disciplines

URGE has six main tenets:

- Focus on geoscientists of color
- Honor social science expert opinions, lived experiences, the research
- Build community
- Recognize and compensate people for work
- Be reliable
- Tell stories

Dr. Wright said that alongside these six tenets, the following must also be accomplished:

- Niche marketing
- Value innovation
- Less can be more

- Practice accountability
- Consistent branding
- Research everything

Dr. Wright discussed an example from the last [URGE](#) session called racism and accountability. Resources were placed on the URGE website. There were one to two journal articles per session, including one from the journal article, Improving Underrepresented Minority Student Persistence in STEM. There is also a live interview with an expert who, in this case, had knowledge and experience with change at an institution and liaising. For each session, there was an inclusivity tip, which was a quick way to change behaviors now to become more inclusive. Sometimes it was about pronouns, etc. Dr. Brandon Jones talked about creating institutional change.

There were about 4,600 participants from about 300 groups, known as pods. These pods were made up of people from the same workplaces and the same departments. It was mostly White women (63%) doing the work. He asked about how to design programs to inspire more men to participate. There were people from diverse career positions, including administrators, professors, graduate students, undergraduates, people in education, postdocs, scientific researchers and others. He added that a survey is being done of participants.

In the next stage there may be more Black, Indigenous, People of Color (BIPOC) sessions, more guidance on discussing racism, more guidance on ways to connect with people and more resources. The survey found people wanted more time to work on this. The three upcoming BIPOC sessions during the period of refinement will amplify the voices of BIPOC geoscientists ask what we want in the policies and resources and share that with the community because a lot of parts do not have BIPOC members. It's mostly White members designing the policies and resources, despite the resources they are using coming primarily from BIPOC scientists and individuals who've done a lot of the research.

An aim is to build community. People are offered a chance to have URGE merchandise. There will be a session on December 15 and people who are attending will wear URGE t-shirts. There'll be a lot of people wearing the same t-shirts on the same day, and people are going to ask questions about URGE. That is a good opportunity to network, build community and bring more people into the fold, communicate to them what we're hoping to do. It is an opportunity for not only building off the networks between URGE participants, but when people go back to their departments and said they went to URGE, leaders will have a harder time ignoring that. That is what the market research says.

Included in this refinement period are three live meetings with leaders from workplaces that participated in URGE to advocate for policy changes:

- Build Community
 - Conference Sessions
- Advocate for Changes
 - Three Live Meetings with Meetings With Leaders
- Facilitate Improvement of Policies and Resources
 - Additional Resources, More Ways to Connect

Dr. Wright also discussed the future of URGE and an [article](#) he co-wrote. He said many diversity programs in geoscience have waned with time, either due to changes in priorities, lack of funding, or changes in leadership or the sense of urgency to fix the issues being dealt with. The future of URGE is peer review after refinement, dissemination implementation. Broadly, the future of URGE depends on whether or not we consult URGE. The plan is to apply to the institution and community transformation program for peer reviewed dissemination and implementation, and then transition to potential nonprofit status.

He said the last thing on his outline is the first thing, because it's the story he began with. He asked if the pandemic, the deaths he referred to earlier and subsequent related events are needed for change. He said his life and death should not be the thing that spurs people to action and he does not want the world to be reflected this way in the geosciences. He said we should use the science, and our personal experiences, and be meticulous in the use our creativity. To solve these problems, we're not just scientists, we're human scientists. We are humans. And we are humans first, not scientists first. He said, I can cross out the science thing and say, we are humans. And this work is about taking care of humans and being human together and being in relationship together. And that is fundamental to why we do science. And we should keep remembering that.

Discussion

Dr. Kraft asked about going from the idea to funding and then expansion of the program and whether expansion was part of the original proposal. Dr. Morris said Dr. Wright inquired about receiving funding and received a small amount of funding initially. And the program got bigger more quickly than he imagined. He came back about four months later and put in another proposal for additional funding. Dr. Kraft said it as a model of thinking creatively about how to do something and run with it.

Dr. Aluwihare said from the other side of seeing students and faculty participate in this was, it was well designed in terms of having papers to read and having a strict requirement of deliverables and engaging with university leadership. The design is something we should be thinking about modeling. Dr. Wright said the survey information is important, because he does not want to be subject to heuristic representative errors.

Dr. Morris said he had questions on going through the various stages and seeing differential participation. Dr. Wright said he wanted to see the literature on what inspires White men to participate more. But we probably don't need the research to know what the answer is because we have lived experiences. If a system supports you and holds you and gives you power, you don't always want to participate in dismantling that system. He said he is interested in how to infuse this type of work in the everyday lives of people who don't participate in networks. In dissemination, how do we get institutions to say, "We already do talks"? Do we get URGE participants to give seminar series talks before everybody votes? And eventually you have to make it a part of your assessment and be true and honest with your words. Don't give people awards, if they don't do this work. Don't promote them in the same way if they don't do this work. It's a multifaceted way of infusing it into the everyday routines, academic culture or research and government culture. And communicate to people that you're going to be left in the dust if you are not actively involved in this type of work. And look at the research on effective communication and outreach strategies to the groups that are not participating. It's frankly, kind

of BS, because I shouldn't have to beg for someone to improve my life. Because we are human scientists. And we're human. And this is about dignity and respect. And I shouldn't have to reach out to someone to not historically exclude me, but unfortunately, I don't have all the power, he said.

Dr. Morris said it's a multi-layered issue and an important effort and must be paired with other efforts for the academy to transform. He hopes it is sustained and that there's momentum in other areas that change policy, because if there's no policy change there's no change to the power differential and no equity.

Dr. Wright said just because it will increase inclusivity or diversity doesn't mean URGE should do it. If we remain narrowly focused on our contribution others will learn from how we do it and add their piece of the pie and their contributions. And we build together in that way.

General Discussion on Approaches to Addressing Climate Equity - 1

Dr. Kraft asked for brief reports on the earlier breakout groups.

Dr. Aluwihare said her group's question was about processes that govern climate on Earth and different spatial and temporal scales. The first question was: What does equity mean? From an analytical perspective, it means engaging diverse voices and designing the science. Talking to non-scientists is important, as is engaging them in identifying questions and producing and communicating science relevant to vulnerable populations.

Regarding how equity issues reveal themselves in the topic area, there were examples focusing on climate science over the ocean without thinking about the populations that live on land, or where there is a lot of money available to look at tropical climate or climate change in the African continent versus in North America. So, where science takes place, how and where data are collected, and who hears about and understands the science.

The group talked about how important it is to communicate outwardly and ensuring that vulnerable populations have a chance to determine how research is designed. This is perhaps done better in an international forum, but within our country too, we need to be more careful about that. In the context of communicating scientific findings, it's important that our public is prepared based on the education they receive and the ability to distill information and figure out how that affects their own populations. This could be as simple as which language is used to communicate your science and as complex as the education system for vulnerable populations. So, this requires broad access to STEM education.

There was also a discussion about data collection. With urban heat island research, areas that were vegetated did not get as hot. And poor communities don't have lots of green spaces. The group also talked about which citizens are engaged in citizen science. For remote data collection, there was a discussion about having humans less connected to the platforms by which data are collected.

Dr. Romanowicz said her group considered the impact of climate change on ecosystems and societies from the point of view of equity and had three themes: 1) the disproportionate impacts

in different communities and different regions; 2) who has access to the information and what information is listened to and trusted; 3) the international perspective.

Very often, the coastal communities that suffer impacts of floods are economically disadvantaged, but some coastal communities are among the richest ones and other lower lying parts in the interior are less advantaged. People that can move away from threatened places may displace other people. Migration can be considered as leading to adaptation, but people get priced out of neighborhoods. So, the impact is often economic as much as anything else, in particular, along racial lines. The same amount of dollars doesn't get you as far depending on where you live.

Regarding access to the information and communicating the science, there's a limited amount that can be done. How do we engage individuals that have the capacity and the ability to communicate what the scientists say in words understood by local communities? Who do they trust? How do we build on that? How do we communicate to skeptics? Examples were given about Puerto Rico after the earthquake two years ago, on designing exercises locally, tailored to specific communities that had a great effect. Often scientists are too removed and it's not enough to create a website and documents, you have to go out and talk at community centers and invoke student organizations to reach out to the community. She also stressed listening to what communities need and letting them ask the questions so scientists can understand better how to get messages across. Dr. Romanowicz's group also briefly talked about collaborating internationally to build capacity.

Dr. Kraft said discussed a point made about pressure at research institutions to focus on research and teaching, because that's where the revenue comes from, and so service is being de-emphasized. She said it is important to leverage the language so what might be deemed as service in one place can be re-couched as research.

Dr. Whitlock said her group on climate solutions included many options, global and local. They talked about who's impacted, who benefits, who has access to these solutions and who is consulted in their implementation and what equity-inspired solutions mean to different populations and sectors. The effects of de-carbonization will vary across countries, regions, communities and sectors. She discussed determining the winners and losers. In agriculture, transformation to more sustainable farming and ranching practices has differential costs to large and small farmers and different impacts to farm communities and farm workers in their health. The group also discussed how decisions are made, who pays and the real costs and benefits and whether these are determined on a per capita basis or by geography. This should be a fundamental area of research. The group also discussed political decision making behind solutions. Equitable solutions are an opportunity for greater participation of diverse stakeholders. For example, the transitioning of coal communities requires bringing in communities that are involved, including indigenous knowledge and traditional knowledge to prioritize ecosystem and water resource solutions in the region.

Her group also talked about how to know if a solution is equitable and decided it was difficult to answer. The impact of a climate solution improves when the impacted community or group is actively engaged. The group agreed that equitable solutions involve building a diverse workforce

to tackle solutions in a team-driven environment and learning how to communicate solutions. And NSF should continue to examine investigators, projects and research questions to evaluate diversity, especially in engineering programs, innovation, investments and solutions-focused areas. Statistics should be collected at the low end of NSF funding to help determine funding rates, attrition rates and BI successes. NSF should continue to examine what elements hinder participation. For example, the use of mandatory grade points is a problem in trying to recruit underrepresented groups. She also raised the narrow time window for graduate research fellowships, which often disadvantages people starting to get prepared for the graduate program.

Dr. Cosentino said there was a clear theme running through the groups that ties back to the session just ended and the point that until you change the power differential, there will be no equity. That theme appeared in all three groups. Any solution has to address that. She will take this information back and there will be internal conversations about how this conversation can influence the research NSF is doing, beginning with understanding the characteristics of the portfolio, what science is being done, by whom, whose voices are being included and if there are convergent approaches. Another session is needed to talk about next steps.

Dr. Isern referred to the original question of wanting to keep the momentum going and the discussion leveraging off what was put forward. There are pros and cons of doing it as a whole AC versus a subcommittee. The best thing is to start an exchange through an out of meeting exchange.

Dr. Kraft said today's session was a surface level conversation. Top dig deeper, she asked if the AC should work as a whole or akin to a COV that gets access to data the AC can't necessarily discuss in a public meeting format. She also referenced the AC meeting with the director and not having a traditional didactic format where he talks about what's happening and the AC asks standard questions, but rather having a conversational format, sharing what the AC has been doing in its work with Dr. Cosentino and engaging him in that conversation of what might make sense for us serving in the capacity to support NSF.

Dr. Isern said the director would be interested. The National Science Board is engaged in the diversity equity inclusion area. These are discussions he is seeing all over the place. It would be interesting to get his thoughts on where to take this. If we want to keep this going, that gives a mandate to plan how to move next. An advantage of a subcommittee is that more work can happen in between, so more progress can be made on the learning agenda concept. If NSF is doing most of the work, the power of the AC's input is lost.

Dr. Arnosti added that something from the AC can be brought in at the university level to get the attention of people in power positions who aren't engaged for the most part in in these sorts of programs.

Dr. Isern said that if the decision is to go with a subcommittee, there would be representatives from the AC, but it could put other people on as well.

Dr. Cosentino said, in response to a question from Dr. Isern about how to best pitch the discussion to the director, to think big about what kind of change we want to make in this space

and think about how to measure that work, because he is focused on trying to measure progress, which is crucial for NSF to get support outside the building.

Dr. Isern said pushing the needle on diversity and inclusion is the key and mapping out concrete steps would be useful. Dr. Cosentino said NSF alone is not going to fix the problem but can make a contribution through programming and influence or partnerships. She recommended thinking big about how NSF can be influential in this space to go beyond its budget alone.

Dr. Richardson asked about demographics-specific goals for grantees or participants. Dr. Cosentino said that would make a national contribution.

Dr. González said he was not surprised by the comment that not all the institutions are pushing hard for more research and less service. A commonality on the committee of visitors revolves around broader impacts. It's perhaps the weakest part of the proposals and the review process. There's nothing that can make institutions respond to this. When promotion comes around, this falls by the wayside and is cast in terms of how much money was brought in. And the great percentage of women getting involved with outreach suffer the consequences. He suggested asking the director about plans to put some teeth behind this, so it's not just beautiful words on a document. Dr. Isern said the director likes to hear proposed solutions. If Dr. González feels there's a policy direction NSF can implement, that'd be a powerful thing to raise. Dr. González said comments in the report and the COV for EAR and equity and diversity can be transforming to policy.

Dr. Parsons said he would like the breakdowns on gender and race below the level of GEO to understand in the different disciplines why there is such a large difference and why in the disciplines where minorities arise marginalized.

Dr. Arrowsmith asked about working at a high level between NSF and university administration to say these are things we value beyond the classical research metrics of dollars and papers. Many of these activities produce dollars and papers, so writing a great proposal that broadens participation in some of these activities may in the end be a well-funded activity. Related is encouraging scholarship on these topics. He encouraged younger colleagues to write papers on some of these broader activities that help them get promoted.

Dr. González said he would like to see outreach to the community be part of the indirect cost return calculations for institutions.

Dr. Richardson spoke about control over the unit criteria for tenure and promotion and said that may be the only control many faculty have in terms of changing the general culture. Also, her institution gets less than 10% of its total operating budget from the State. Dr. Kraft added that suggestions to the director should be couched through the lens of how NSF can serve as a leader in the community towards this larger global problem.

Dr. Whitlock said the National Institutes of Health (NIH) does a better job at this kind of translational equity and reaching out to the community and asked at what level NSF and NIH are

trying to align in looking at things like climate change and human health. Dr. Isern said that would be a good question for the director.

Discussion and Vote on Division of Earth Sciences Committee of Visitors Report

Dr. Dixon reviewed the committee's charge and membership. She said the bottom line of the review was a completely positive assessment of how the EAR program is running and how it's being managed. The COV reviewed roughly 5% of the proposal jackets with attention to eliminating conflicts of interest with committee members. She also listed the disciplinary programs reviewed and the integrated activities sections reviewed.

She discussed proposal handling, concluding:

- The review process continues to be the gold standard. The system of ad hoc, panel, and program officer (PO) reviews provides the opportunity for multiple perspectives on proposals and facilitates development of a strong and balanced portfolio.

She also provided a summary of related recommendations:

- Enhance the quality of evaluating the BI component, educate the community on high quality and effective BIs
- Enhance overall quality of reviews (e.g., through feedback) and reviewer selection/solicitation (e.g., recognize exceptional reviewers; reviewers with BI expertise)
- Increase transparency of funding decisions, incl. communicating decisions related to portfolio balance; potential value in discussing decline decisions with principal investigators (PI).
- Continue efforts to streamline workflow and standardize training and reporting templates across the division to lessen high workload of POs and PDs.

Regarding program management:

- The COV found that EAR programs are very well-managed and would like to highlight EAR leadership's successful management of the many challenges that occurred during the review period. These include the transition to the No Deadlines policy, the government shutdown, and the global pandemic.
- We also commend the strong culture of collaboration that has been nurtured within EAR. This culture, combined with distribution of program officers among the programs, serves EAR well as POs negotiate proposal funding and develop new and revise existing solicitations.

She also provided a summary of the COV's program management recommendations:

Summary of recommendations:

- No Deadlines appear to be effective, however, we recommend continue paying close attention to increases in staff workload that have arisen due to changes in workflow
- Archiving and public availability of data. EAR should:
 - facilitate a community working group to develop mechanisms for archiving and curating currently existing and future physical samples, and for funding such efforts.

- develop and implement a strategy to support long term, compliant FAIR (Findable, Accessible, Interoperable, Reusable) practices within community-based data efforts.
- develop synergy and communication with national programs already established to deal with preservation of geoscience datasets at the national level, such as the data preservation program managed by the U.S. Geological Survey (USGS) (National Geological and Geophysical Data Preservation Program (NGGDPP))
- NEW Data and Sample Working Group will address many of these recommendations.
- Community engagement (both in terms of getting information out and bringing ideas in) is robust and deliberate within EAR. We recommend continuation of these activities. Additional activities for seeking community input may be restricted by NSF rules and regulations and we recommend seeking clarification on those issues. Awareness of NSF funding opportunities appear to be variable, and we recommend EAR review and enhance strategies for disseminating information especially to smaller and underserved research universities.
- “Spread the perspectives” when handling emerging science opportunities that lead to programs in Integrative Activities (IA) by engaging researchers in the review process (for example) who were not the originators of these programs.
- When sunsetting IA programs, continue to find ways to communicate “opportunities to continue” to keep PIs engaged. Lots of specialized expertise may be developed through these programs with “nowhere to go” when programs end.

She turned next to a summary of recommendations re infrastructure and facilities:

- Summary of recommendations: (need for GEO-wide participation)
 - GEO should facilitate partnerships between EAR and other divisions to augment, develop and manage initiatives that fall under the EAR IF program. Sunsetting facilities has been challenging. Recommend an external (midterm?) review process of facilities (either every three years or prior to renewal submission).
 - Similarly, establishing new facilities, especially if lead by PIs at institutions where the need is great (research and teaching) but institutional support is sparse. Continued effort to engage and educate these communities of opportunities and facilitating partnerships (e.g., research 1 (R1)- Minority Serving Institution (MSI) partnerships) is recommended.
 - Smaller facilities are paramount to the educational mission and often understaffed due to difficulties securing technician support. We recommend exploring mechanisms, including specific competitions to provide support for these smaller scale facilities.
 - EAR- Instrumentation and Facilities (IF) Working groups already charged with some of this

She also covered responsiveness to the previous COV:

- Ad hoc, panels and PO is the trifecta. Virtual meetings appear to be effective
- Reduced workload for identifying reviewers. The transition to no deadlines resulted in increased reviewer response rates to >50% in 2020 (fewer requests and longer timeframe over which requests were made).

- Continues to maintain 30% of its budget for infrastructure.
- Earth in Time report from NASEM gave EAR some marching orders which they are addressing in multiple ways.
- Utilized expertise to improve communication strategy.

Summarizing the portfolio of awards (I):

- EAR has continued to manage a broad mix of grants focused on deep Earth and surface processes, as well as a balance of research- and education-oriented projects. In addition to scientific merit, attention is paid to creating and sustaining balance among program subdisciplines; geographic distribution of awards; institution type, career status, gender, and ethnicity of PIs; and availability of co-funding. Program Officers are crucial to the success of the system and facilitate a more nuanced balancing of portfolios within individual programs over multiple years than could otherwise be achieved.
- Success rate of disciplinary programs matches proposal pressure but IA has variable success rates across programs.

Portfolio of awards (II):

- The Division has an acceptable balance between small-scale and large-scale funding initiatives. The data provided to the COV suggest that median annual award size ranges from ~\$120,000/yr. to \$535,000/yr. with the largest annual budgets going to the large Integrated Activities of Integrated Earth Systems (IES) IES/ Frontier Research in Earth Sciences (FRES), Critical Zone Observatories (CZO), and Geoinformatics (GI).
- We commend individual programs for seeking novel ways to increase funding by partnering with other NSF units. Co-funding of proposals is another measure of the effectiveness of EAR in engaging outside the division.

Portfolio of awards – Broadening Participation (I):

- Although racial and ethnic diversity has not improved markedly in the grant applicant or awardee pool across EAR, the geological sciences lead both ocean sciences and atmospheric sciences in terms of the number of doctorates awarded in 2019 to Hispanic or Latino, American Indian or Alaska Native, and Black or African Americans (National Center for Science and Engineering Statistics). This puts EAR in an excellent position within the Directorate to move the needle for racial and ethnic diversity. And the directorate should support EAR efforts.

Portfolio – Broadening participation (II)

- Summary of recommendations (EAR WG in Belonging Access Justice Equity Diversity Inclusion (BAJEDI) are tackling some of these recommendations):
 - PIs within 5 years of their PhD seem to be receiving fewer awards and outreach to these communities is warranted particularly after proposals are declined. Opportunity for GEO wide policy.
 - EAR is building on several previously successful BAJEDI activities (URGE). We applaud EAR's ability to support new ideas that emerge from the community—a strategy, which in this case, resulted in a substantial national impact—and we hope that the division and GEO, overall, can continue to be supportive of these grassroots efforts while also implementing their own strategies.

- Continue to coordinate with programs inside and outside the agency that have been successful at broadening access.
- NSF GEO and NSF overall, need to maintain long-term support for programs that proven effective in broadening access and participation and attracting undergrads from traditional science fields into GEO
- EAR's Data Intensive Scientific Computing (DISCO) or PODS?
- Avoiding parachute science.
 - Include language that encourages ethical research conduct and train and educate PIs on cultural sensitivity and how to build meaningful partnerships with local communities.
 - Encourage the utilization of planning grants to build partnership with local communities and leaders to design research approaches (examples of best practices exists)
- Continue to increase diversity of EAR leadership.
- Race- gender- non-reporting categories. Needs attention at NSF-wide level
- Develop a procedure for reporting of actions taken on grievances

NSF-wide:

- The COV committee feels that modifying the questions for the BI criterion would likely lead to more substantial and critical reviews by both ad hoc reviewers and panelists, would better enable POs to adhere fully to the principle that all funded proposals should include strong BI components, and would facilitate stronger discussions and revisions to declined proposals. Examples of revised questions that would help reviewers assess the long-term impacts and efficacy of the broader impacts might be:
 - What is the potential for the proposed activity to benefit society or advance desired societal outcomes?
 - To what extent are the proposed activities grounded in the evidence base and likely to have an impact?
 - Is an appropriate evaluation plan included that assesses the impact of the proposed activities?
 - Is the expertise to carry out the proposed activities and evaluation plan present in the project team?
 - Does the budget support the broader impacts activities?
 - How well does the BI component leverage existing NSF and other Federal agency BI investments at their institution (Louis Stokes Alliances for Minority Participation (LSAMP), Research Experiences for Undergraduates (REU), Sea Grant College Programs).

Bottom Line:

- The COV is impressed with the professional and productive performance of POs and mission/program support personnel in response not only to the normal workload, but also to the many challenges the past four years introduced (i.e., government shutdown, moving to Alexandria, and global pandemic). The highlights of accomplishments and other metrics show that these programs are impacting scientific discovery, workforce training, outreach, and all other essential activities of the programs.

Dr. Goldstein provided the EAR response. Focusing on the issues brought up by the COV, he began with proposal handling:

- EAR will continue to run workshops, webinars, virtual office hours, other outreach to educate the community on high quality broader impacts.
- EAR will explore the bounds of what NSF policy and confidentiality regulations allow for recognizing service.
- PDs spend significant time talking to PIs about their proposals and reviews, and will continue.
- EAR wants to lessen the high workload of PDs, will review templates.
- “Funding decision transparency, portfolio balance”: EAR agrees, it is important that PIs know why their proposal is declined. Portfolio balance considerations go into every decision. EAR will consider how to better convey these considerations.

Turning to program management, Dr. Goldstein said:

- EAR is committed to supporting efforts to:
 - preserve and share research products in accordance with NSF and EAR data policies,
 - enable their findability and accessibility for research transparency and future reuse.
- Data and Sample Working Group will address many of these recommendations.
- EAR is in contact with the USGS.
- EAR has been reaching out to small and underserved universities, and will enhance its efforts.
- EAR agrees that it is important to engage researchers in the review process who were not originators of IA programs.
- EAR will work closely with Directorate leadership to explore ways to ensure continuity for the research community when programs are sunsetted.

The response to the infrastructure and facilities recommendations was as follows:

- Individual IF awards often receive co-funding from other divisions and directorates, EAR would welcome facilitation by GEO.
- EAR has begun discussions with other GEO divisions and BIO on co-utilizing and co-developing facilities.
- EAR IF has developed new reporting requirements for facilities to standardize program and reporting of metrics.
- Mid-term reviews are required for large facilities, extending to the smaller community facilities will be considered.
- EAR/IF has supported equipment acquisition at hundreds of labs, many of them serve research and student training needs beyond the PI team and institution
 - Nevertheless, for new facilities, the new IF solicitation will emphasize
 - broadening participation,
 - workforce development,
 - partnerships,
 - providing opportunities,

- exploring new models and mechanisms to support under-resourced institutions.

Dr. Goldstein also provided the EAR response to the COV's Broadening Participation recommendations:

- We agree. These are good ideas!
- EAR is particularly aware of our role in nurturing early career researchers. We will check the statistics on ECR success rates.
- We will consider doing something like DISCO and PODS.
- EAR is aware of the need to avoid “parachute science”, as well as “colonial science”, and will pursue many suggestions in the report.
- EAR values a diverse workforce:
 - current scientific staff: gender balance of leadership is 2F/1M; PDs are 14F/11M; EAR includes members of under-represented groups in STEM, individuals at all career stages.
 - EAR realizes the need to be vigilant about maintaining and enhancing diversity of the team.
- The NSF Office of Equity and Civil Rights (OECR) is charged with addressing grievances, we forward grievances we receive to them. OECR establishes policies for disclosure, taking into account confidentiality issues.
 - We will forward the CoV recommendation.

Dr. Goldstein also agreed with the COV that EAR is in an excellent position within the directorate to move the needle for racial and ethnic diversity and that the directorate should support EAR efforts.

The AC voted to accept the COV report.

Discussion and Vote on GEO Education & Diversity Programs Committee of Visitors Report

Dr. González said there were 497 packets submitted and 196 awards. The COV reviewed 90 of the awards. It also went back to older declinations to see continuity and the fate of those rejected more than once. It reviewed 62 awards, about 30%, 28 declinations, or around 10%, and an average of 30% of the proposals were reviewed.

The report was very positive, Dr. González said. The review process was appropriate for the most part. There were questions regarding the Early-concept Grants for Exploratory Research (EAGER) process or the review by the program director (PD) and whether it was appropriate for all programs, but the COV found no fault in the process as it's been implemented.

The COV also made a comment regarding the diversity of expertise. The committee encourages the PD to rely on other sources for individual decisions. In terms of the review criteria, the merit review in panels were okay. The BI are lacking and highly variable in many aspects. Although the program manager summaries are fairly explicit and well balanced there was variability on individual responses, in particular the BI but also merit review feedback to the proposers and in particular the declination is highly variable and often lacking substantive information for those

who have been declined to take proper actions. The COV encourages the program as well as the institution to streamline the way the feedback is given by the reviewers and diversify the review diversity and expertise. The summaries produced by the panel or by the director are comprehensive and adequate. The information for decisions is often there.

In terms of award declines, usually the summary statements are informative. Individual reviewers are highly variable, and some are not informative. In some programs, in particular GEOPATHs, there are multiple declinations. The COV suggest there be a mechanism to educate PIs, in particular from MSI or historically black colleges and universities (HBCUs) where there seem to be a higher proportion of repeat declinations. The COV asked if NSF can improve the feedback and the quality of proposals by PIs, particularly in small institutions.

In terms of the selection of reviewers, in general expertise of reviewers is appropriate. But the COV found there's not adequate representation of the demographics of the country as well as the area where the proposals are coming from. The pool of reviewers that is available is limited, but the COV encourages continued attempts to enhance the diversity of the reviewer pool.

In terms of conflict of interest, there's no data available to make an assessment. In terms of reviewer selection, diversity is lacking in certain areas. The COV encourages the review pool be broadened. It recommended ways to provide training to the reviewers in terms of how to give proper feedback.

In terms of management of the program under review, the COV found the program is well managed. The PD and staff do an outstanding job, given the limited resources and small staff that supports that program. The program is responsive to emerging trends and opportunities.

In comments and recommendations, the COV suggests that, for example, GEOPATHs be used as a model program for equity within MSIs and HDCUs and try to recruit more reviewers from those institutions. It also recommends a better dissemination of programs like Non-Academic Research Internships for Graduate Students (INTERN) and for the recipients to be more aggressive in sharing their research and expertise to the communities at large.

In terms of external evaluation, the evaluation plan was in the process of being constructed. The program has been responsive to prior COV reports and suggestions.

In terms of other topics, budget is a limiting factor. Given that the program seems to be a three-person operation, they are doing an outstanding job. The COV wonders what it would be able to do with larger staff and a much larger budget.

The COV encourages the program to do more partnering with agencies outside NSF, both government and private institutions.

Regarding NSF at large, the COV recommended increasing resources to the program, either by direct funding or enhancing interactions with professional societies or other institutions, in particular MSIs.

BI are set by policies of NSF and the COV urges NSF to review those and provide better guidance. It urges NSF to increase efforts to reach out through programs like Global Learning and Observations to Benefit the Environment (GLOBE) to HSUs and MSIs, which train a K-12 teachers from underrepresented groups or undersized groups.

The balance of the presentation and the vote were deferred until the next day.

Thursday, October 14, 2021

Preparation for Meeting with NSF Director and Chief Operating Officer

The committee developed the list of question it would pose to the NSF Director.

Meeting with NSF Director and Chief Operating Officer

Dr. Isern introduced Dr. Panchanathan to Dr. Kraft who thanked the director for meeting with the AC and provided a summary of the AC's agenda.

Dr. Panchanathan talked about the excitement working with the current administration, which prioritizes climate equity, climate change, adaptation and mitigation and his discussions with agency heads, including the NOAA administrator. Dr. Panchanathan said that together they plan to work on climate equity. The director also said he chaired The Interagency Arctic Research Policy Committee (IARPC) Council and recently talked with the head of USGS about working with the IARPC framework and promoting climate equity. NSF is working with native tribes and making sure they feel included. Dr. Panchanathan also discussed a talk he gave about climate equity and climate in which he talked about Federal research priorities for equitable climate solutions. He also talked about the 10 I's:

- The immediacy of the problem.
- Investments that help shape the agenda
- Implementation strategies
- Creating impact
- A mindset of innovation
- A strong infrastructure
- An integrated approach
- An international approach
- Inclusion and equity
- Inspiring people to participate

He said NSF is going full steam ahead on all of this, thanks to the President's FY 2020 budget. There is a tremendous focus on climate equity and climate change mitigation and adaptation.

Dr. González asked if something can be done at the director's level to strengthen the importance of innovating in how BI are approached and the integration of BI with science, without adding more work for the program managers and divisions. He said the committee would like to see better guidance or better policies that can help guide the PIs to come up with better BI more integrated with their science and deliver the message to institutional administrators that BI are extremely important. When it comes to promotion, tenure and salary increases, quite often BI are

not considered as important. And yet, with the current administration this is seen as extremely important.

Dr. Panchanathan said he advocated that institutions have a BI office that chooses five or 10 BI challenges and all the proposals they write give the faculty an opportunity to channel their ideas of BI through those lenses as one option. If the institution has a BI office at the institutional level, that will affect tenure promotion policies, because you only get what you reward and recognize.

Dr. Morris discussed thinking differently about the epistemology of climate science. The community is stuck at a binary, there's pure science and a lot of times that purity is very exclusive. And then there's this other stuff, service and BI and the fear of talking about racism explicitly and how that determines trajectories and excludes people. And that's not this pure stuff. The real opportunity for innovation is to ask questions that are our equity center. That equity is part of the scientific question. It's part of the scientific endeavor. And in addition, there are BI, because that's a translational thing that we should be engaged in. There are no climate solutions that don't affect people. And right now, there are no climate solutions that don't affect people differentially. And it's more than class. Dr. Morris also discussed making equity cross cutting. He said it's very difficult and may cause many to think about how it might affect people who have perspectives different than our own experiences. But if we can do science that way, we'll come up with equitable solutions that don't have to backtrack 10 years later and say why aren't these people in the room, which is what we've been doing for several decades. We need greater inspiration and a lot of different levels and trying to figure that out across the spectrum of schools. He said he liked the idea of an Office of Innovation, but few HBCUs could afford that and it would put them at a disadvantage. Dr. Arrowsmith added the idea of taking intellectual merit and BI as pillars and gluing them together with the equity lens as a third criterion for proposal evaluation.

Dr. Panchanathan said if intellectual merit is a vertical, BI is horizontal and the intersection of the vertical and the horizontal has to happen. When people say it can't be done, they are not innovative enough. This is something we need to keep challenging the system to think about. Regarding affordability, he said there is a need for a virtual Sponsored Research Office (SRO) created by NSF that people can tap into at their office. He said NSF is already starting to design that kind of thinking.

Dr. Marrongelle added that NSF has been thinking about a variety of ways it can help level the playing field for both faculty and students at a variety of institutions. There are many programs that aim to do that, but NSF can be doing more and thinking more creatively about leveling the playing field, understanding the barriers of access to entry to NSF, and the downstream impacts on faculty and students.

Dr. Richardson said Canada does a better job integrating issues of diversity, equity and inclusion into proposals. They have a separate section for a diversity, equity and inclusion (DEI) plan and part of the score comes from how well that's articulated. Part of the problem is the structure of the NSF proposal. The two pillars have been barriers in terms of integrating those concepts, because we've focused on the science and we focused on the BI but the idea of weaving them

together would be helped if we were expected to do that in the proposal, as opposed to thinking about it in two different sections. The Canadian structure also does better at thinking about what they call highly qualified personnel and you're expected to say how are you integrating underserved populations into your research.

Dr. Panchanathan described his personal experience in Canada and said he would look into Dr. Richardson's idea.

Dr. Arnosti said the disciplinary structure often leads to a focus on one aspect of the environment or outcome without adequately considering others. The importance of the oceans in climate change affects ocean generated processes. Ocean generated processes have effects in places where people have long forgotten that the ocean is behind them. More integrated thinking is needed across scientific disciplines, weaving in issues of landscapes where people live and who is having to deal with the effects of these processes being accelerated by climate change.

Dr. Panchanathan said he looks forward to the synthesis of those and will see what can be done better. The problem is important and it's something that should receive more attention. The Coastlines and People (CoPe) program already focuses on this restructuring, but we are going to get more densification of that.

Dr. Isern said NSF plans to invest more in CoPe and NSF has a big footprint in the interagency space in oceans and climate and in discussions of future strategic planning in climate and the oceans. NSF just made a big investment to complement The Southern Ocean Carbon and Climate Observations and Modeling (SOCCOM) project to better understand the carbon cycle of the ocean.

Discussion and Vote on GEO Education & Diversity Programs Committee of Visitors Report (Continued)

Dr. Jones addressed the main COV recommendations:

- Quality and Effectiveness of Merit Review Process
 - Response: GEO ED will actively seek expertise from across the Foundation when internal reviews are necessary for certain proposals.
 - Response: GEO ED will continue to work with NSF & NSB regarding BI elements as well as include guidance on broader impacts at outreach events.
- Selection of Reviewers
 - Response: In instances where GEO ED and EHR formally co-review proposals, reviewers are shared. In other cases, GEO ED will continue working with colleagues from EHR and other relevant directorates in expanding the reviewer pool.
 - Response: GEO is committed to ensuring that review panels are representative of the U.S.A. demographics.
 - Response: The information regarding conflict of interests is expected to be recorded in a diary note in the electronic jacket. GEO ED will make sure that the guidance for the next COV makes the location of COI information clear.

- Response: The quality of the review process would be enhanced through targeted training of reviewers. GEO ED will work to provide more explicit guidance to reviewers during pre-panel webinars.
- Management of the Program under Review
 - Response: GEO ED plans to include information about the INTERN program in future communication efforts and will also consider working across the GEO divisions to encourage recipients of INTERN support to highlight the program whenever possible.
 - Response: Because the action plan is an internal document, the community will be informed of related activities via solicitations or dear colleague letters that announce opportunities that will support the goals of the program.
- Other Topics
 - Response: Engaging with NSF's Office of International Science & Engineering (OISE) regarding how to scale NSF's contribution to the GLOBE program could pave the way for significant impact at the K12 level and with MSIs. GEO ED will emphasize the possibility of connecting with the GLOBE program in future GEOPATHs solicitations. GEO will also be sure to include the GLOBE program during the targeted outreach to MSIs and other education/teaching focused institutions.

The AC approved the COV report.

General Discussion on Approaches to Addressing Climate Equity - 2

Dr. Kraft referenced an earlier point about who's doing reviews and noted that a division in the National Association of Geoscience Teachers (NAGT) has a text entry box for potential newsletter items. It might be interesting for someone to write about their experience serving as a panel reviewer. College faculty often don't see themselves as being considered to serve on a review panel. It would demystify that process somewhat and allow them to see themselves in that role and be a potential way of addressing the shortage of people who bring an important perspective to review panels.

Dr. González suggested that when the Society for Advancement of Chicanos/Hispanics & Native Americans in Science (SACNAS), which runs professional sessions, calls for session proposals, that AC members present on the review process and how important it is to be a participant.

Dr. Patino said it is important to invite people to participate. She called on AC members to invite colleagues, including junior faculty, to engage with NSF in different ways. She offered to help set up a webinar to engage people not traditionally engaged.

Dr. Kraft said the AC does not necessarily have a broad cross section of types of institutions represented. She asked about how to expand that pool to have those representatives to reach out to their respective communities.

Dr. Kraft returned to idea of where to go with the conversation about the learning agenda and asked what would be helpful for NSF. Dr. Isern responded that it would require work from the committee to collect information, if the committee wants to take it on. If so, it should discuss whether to form a subcommittee or keep it in the full AC. A subcommittee has more flexibility to see data and information that isn't public. On the other hand, a subcommittee will subset the AC. A subcommittee allows adding other people with expertise or representation the AC does not have. If the AC wants to proceed, NSF staff and Dr. Kraft can plan out how it would work.

Dr. Whitlock said it is frustrating to keep producing reports saying the same thing over and over, and then trying to see how it's going to go to the next step. She asked if a subcommittee creates a report, if it goes to the AC for a vote and then goes forward. Ms. Lane said it gets posted on the AC and OIA public websites. Dr. Isern said the advantage to the learning agenda activity is that it is almost like a research project where you'll hopefully recommend concrete actions.

Dr. Kraft added that the discussion of what's happening with the learning agendas is an opportunity to provide input at an earlier stage rather than reacting and responding to what the policies are now. Dr. Patino agreed and said the learning agenda for climate change and climate equity is being developed, so input now will be valuable.

Dr. Aluwihare said there's been a lot of environmental justice and climate GEO-linked job searches for faculty. The question for institutions is how to value these contributions and ensure the promotion and tenure process understands this focus on equity. It is hard for the traditional science community to have the tools to evaluate the impacts and contributions of this work. It is important that NSF takes this on. If NSF shows the community how important this is to the way we do traditional science, it makes it easier for folks trying to change the institutions from the inside. Many are young and aren't tenured. We want these individuals to succeed, and we need to keep them engaged in the process.

Dr. Stammerjohn agreed with the idea to form a subcommittee to bring in outside expertise. She said there are two pillars in the proposal process, the project process and awarding process. But where is the equity part, she asked. She said there is a convergence on the same kind of ideas and the time is ripe, especially given the enthusiasm and the inspiration from yesterday, to form a subcommittee to come up with new and innovative approaches. There's an opportunity to do something completely new.

Dr. González suggested a subcommittee from across all of NSF to come up with action plans or recommendations that impact all directorates, so it is better integrated within the system and not a patchwork.

Dr. Kraft said she understands there have been cross disciplinary conversations happening with other stakeholders. The idea is that we're modeling what this might look like at the AC level because other conversations like this have already been happening. This would be a more focused conversation specific to issues within the geosciences as applied across the directorate. We would be looking at it through a different lens than some of those broader groups have already been looking at it.

Dr. Isern responded that the learning agenda briefed yesterday is part of NSF's internal strategic planning process that gets reported to OMB, which asks how stakeholders are feeling in this space. Well, we have a body of stakeholders in our ACs so why couldn't we use them as a proxy for the broader community? We're proposing using AC-GEO as a leader in this space. It is true that a lot of these issues are agency wide. But to start from zero to a full agency level would be difficult. We could have members from the other ACs on a subcommittee. If the AC wants to do this, it will help set the methodology. What we're offering is an opportunity to lead in this space. It will get the attention it deserves in the end.

Dr. Parsons said he agrees with the frustration that you have these committees and NSF often responds quite nicely, but it's a big challenge to change the whole field. So, it sounds like a wonderful action for GEO.

Dr. Kraft asked about keeping the conversation going at the committee level and discussing possibly doing a subcommittee.

Dr. Parsons said a lot of data from grants and reports gets dismissed; one of the first steps is to be looking at the data that are out there on what people think the problem is. Dr. Kraft said there's plenty that's publicly available that doesn't require a subcommittee that can still extract a fair amount of information. Dr. Isern said gathering some of that data is a good place for NSF to support the AC's analysis and Dr. Kraft suggested that as part of the next step and then determining testable hypotheses. Dr. Aluwihare suggested getting the perspective of the committee for equity in science and engineering that Dr. Morris is a member of. Dr. Morris said there'd be good reception from that committee and suggested synergizing its efforts with the AC's.

Dr. Kraft said some of the common things that came up in the first round of discussions are:

- building trust with different communities
- more effectively communicating with different communities
- addressing issues of disproportionate impact
- the different communities that are not interacting and the systems preventing that from happening.

From that list, she said, the committee can determine potential hypotheses and the data the committee would want to gather. Dr. Whitlock asked if the goal of the subcommittee is to make recommendations based on the answers that that come from looking at these data. Dr. Kraft said depending on what questions are asked and what data are needed, does it need to be at the subcommittee level.

Dr. Stammerjohn asked if in addition to collecting the needed data whether the AC could make the subcommittee equitable and inclusive and make one of the objectives brainstorming on what would a proposal look like that embraced the ideas of climate equity. She asked if there is a vehicle at NSF where that kind of group could come together and formulate a proposal that embraces those ideas. She said it might be helpful to come up with concrete examples of tractable problems that embraced these concepts and put it into action. Dr. Kraft agreed and said that's what the afternoon's session could be.

Dr. Isern said climate equities are connected but it's a subset within the broader be a Justice, Equity, Diversity and Inclusion (JEDI) set of challenges. She said the focus here is on climate equity. It would be biting off too much if you look at the subset as being part of the whole instead of being that subset.

Dr. Kraft, following up on remarks by Dr. Patino, recapped that there is interest in forming a subcommittee to bring in people outside the AC to come up with questions to pose to NSF and specific hypotheses that may need to be tested based on data NSF can assemble that would be put together in a report with some of the questions that need to be answered and some of the data that support the hypotheses to be tested and having the AC try and better define some of the questions and directions for the subcommittee.

Update on Office of Polar Programs

Dr. Stammerjohn provided highlights from the recent AC-OPP meeting, beginning with leadership changes:

- New OPP Director:
 - Dr. Roberta Marinelli
- New AC OPP Chair:
 - Dr. Meredith Nettles

She also reviewed the joint session with AC Cyberinfrastructure (CI):

- Discussed data principles involving findability, equitable access, reuse, & sensitive (indigenous) data
- Lively discussion on CI challenges in polar sciences and how CI solutions could help: 'if we can make it work there, we can make it work anywhere'; form working group to further explore polar 'use cases'
-

She also discussed the Subcommittee on Diversity and Inclusion (DI) in Polar Science:

- Reminder of Charge Objectives: (1) current state of DI, (2) current efforts by NSF/others to enhance DI, (3) final recommendations to enhance DI over both short and long term
- Recommendations drafted (Spring 2022); Final Report (Fall 2022)

And she reviewed the update on the Antarctic Research Vessel (ARV)

- Just completed the Conceptual Design Review (Sept 20-23); panel report was delivered Oct 8, 2021
- Facilities Readiness Review Panel (Nov 17), then Preliminary Design Phase (2022-2023), Final Design Phase (2023-2025) and Construction Phase (2026-2031)

Mr. Sheppard introduced the other senior leaders in OPP and handed the presentation to Dr. Kowalewski who presented some Antarctic science highlights for the field season:

- Over 50 science and technical activities are scheduled: approximately 30 on the Continental side & 20 to the Peninsula side.
- Research Vessel / Icebreaker (RVIB) Nathaniel B. Palmer and the RV Laurence M. Gould will operate out of Punta Arenas, Chile.

He said the pandemic resulted in reduced deployments and prioritization for all activities on a tiered system with the highest priority for science where there was field work that involved international collaborations, expected loss of continuous time series data or a high risk of instrumentation loss. While the granting numbers were low in the 2021 field season, over 70 science support staff dedicated their time in Antarctica to projects where breaking a critical data set would jeopardize the science. This season, the projected number of grantees deployed will triple that from last year.

Dr. Kowalewski presented a snapshot of some of the major Antarctic science being conducted this year in the field and the non-field work successes of the past year, including:

- NSF Antarctic Cable Workshop
- Diversify science portfolio: increased non-field work and data reuse projects
- Integrated approach to challenges between Antarctic Infrastructure and Logistics (AIL) & Antarctic Sciences (ANT)

Ms. Short continued the presentation with some challenges the logistics team overcame. She discussed deployers traveling through New Zealand, where they were held in isolation and received additional COVID tests, following which there was a wait for favorable weather, which extended some deployers' time and isolation to more than 40 days. She discussed daily planning and coordination across governments and among medical professionals. Ms. Short also reviewed logistics challenges with testing machines, test kits and protective equipment and an emergency isolation unit at McMurdo Station. She also reviewed delivery of COVID vaccine doses using small aircraft operating amid evolving international entry requirements or border closures. There was also the failure of the ice pier last year and an unprecedented air bridge resupply. There were no cases of infection reaching the stations. Rigorous protocols continue for this season, which will be far short of normal operations.

Next, she mentioned recent accomplishments in improving science support. Last year a team of subject matter experts helped establish a sexual assault and harassment prevention and response program. And an extensive outreach effort to hear directly from that community on the tools and resources that would have the most impact was recently launched. There are negotiations with the Defense Department to update a memorandum of understanding re science support partnership, particularly regarding airlift capabilities. In addition, the Palmer pier replacement is being constructed this year.

Ms. Crain continued with a discussion of the goals-based approach used to protect the health of researchers and prevent the spread of COVID-19 in the Arctic. She referenced two research stations that continue to operate year-round throughout the pandemic, Toolik Field Station and Summit Station in Greenland, where technicians maintain instrumentation and data streams. She discussed a building buried up to the roofline by snow accumulation and drifting.

Ms. Crain reviewed the impacts of COVID-19 on field-based research and the recovery since 2020. For 2019, there were 139 projects in the field and 811 researchers deployed. In 2020, only 48 projects conducted their own fieldwork, with 186 people deployed, 83 projects were postponed and 42 projects used remote support. She said 2021 was closer to normal with 120

projects in the field 20 postponed and 19 with remote support. Roughly 450 researchers deployed in 2021.

She said the Greenland ice sheet is estimated to contribute 7.4 meters to sea level rise and current models appear to underestimate melt in response to warming and the contribution to sea level rise. In 2017 the Arctic Natural Sciences program sponsored a workshop to explore how stable the Greenland Ice Sheet is. Since that workshop a group of researchers has been funded through several awards to work on the priorities identified. Funding was received from the Office of Advanced Cyber Infrastructure to pursue a community driven data model framework for ice sheet science through the Cyberinfrastructure for Sustained Scientific Innovation Program and the Arctic System Science program funded an award to constrain ice sheet dynamics.

Dr. Kowalewski returned to discuss how the Antarctic and Arctic sections want to highlight some of their partnerships and said program officers from the Arctic and the Antarctic sections have led the development of the OPP Postdoctoral Research Fellowship program. The Antarctic and Arctic have arranged joint panels to evaluate glaciology proposals across both poles. And the polar geospatial center contract has been renewed and investing in the Polar Geospatial Center was critical.

Discussion

Dr. Arnosti asked for data on the relative impacts of non-deployment and of the impact of having others gather data. Dr. Kowalewski responded that the data are being explored and some of the questions involve where proposals are coming from and if they are coming from certain demographics. Ms. Crain said some of the supplements were given out to support postdocs or graduate students so they could stay on a little longer. Also, in the Arctic, where researchers were able to work with local community members to collect their data, this resulted in collaborations that may be ongoing and that engaged local people in a way that doesn't normally happen.

Dr. Kraft asked about construction at McMurdo and the impact on next season. Ms. Short said Access Increases in Mental Health and Substance Abuse Services (AIMS) is delayed another season. She is hoping for next season to make up some ground.

OCE Division Subcommittee Meeting Report

Dr. Quinn began with Marine Geoscience Section staffing updates:

- Maurice Tivey joined as Section Head (IPA), June 2021
- CHEMICAL OCEANOGRAPHY (CO) PROGRAM
 - Simone Metz retired in February
 - A permanent PO and new IPA will join CO in early October
 - Emily Benayoun (Science Asst) left for a position at EPA in September
- MARINE GEOLOGY & GEOPHYSICS (MGG) PROGRAM
 - A permanent PO hire (Geophysics) imminent
 - Steve Hovan (IPA) left in July
 - IPA (paleoclimate) hire now in progress

- Current staffing level: 2 (soon 4) POs in CO and 3 POs in MGG, 1 SA in MGG. Summer interns (Hispanic Association of Colleges and Universities HACU). Ana Bruton (MGG), Duvan Aaron Lopez (CO)

Dr. Quinn next presented a staffing update for the Ocean Science Section:

- Biological Oceanography (BO)
 - Allison Lewis, Science Assistant (SA) departed this summer
 - Goal is to have a new SA to start this fall
 - Petra Lenz, Program Officer, completing IPA rotation in November 2021
 - Dear Colleague Letter forthcoming
- Physical Oceanography (PO)
 - Arnoldo Valle-Levinson, Program Officer, IPA rotator started in early 2021
 - Hana Busse, Science Assistant, also started in early 2021

Next, he discussed the Integrative Programs Section:

- Active Recruitment, OOI Program Officer
- Active Recruitment, Science Analyst

Dr. Quinn moved next to division activities, with a focus on Be-A-JEDI:

- Restarted OCE Post-Doc Program; (\$8M for 26 Early-Career Scientists)
 - Ocean Education Portfolio
- BAJEDI cohort efforts: Belonging Accessibility Justice Equity Diversity Inclusion
 - 2123549: LANDInG-PRFP: A Postdoctoral Research Fellows Program with the Leadership Academy and Network for Diversity and Inclusion in the Geosciences
- Workshop Activities to build MSI/R1 partnerships
 - 2109970: Building a diverse ocean science community through collaboration: Reframing the R1-MSI research partnership model.

Turning to Marine Geoscience Section activities:

- COVID-19 related supplements:
 - 18 supplements in MGG (~ > \$1M)
 - 19 supplements in CO (~\$1M)
- Career Life Balance (CLB) awards: 1 MGG and 1 CO
- DCL Critical Aspects of Sustainability (CAS): Innovative Solutions to Climate Change – posted Sept 30. NSF-wide Directorate participation
- Core Repository Virtual Townhall Sept 8, 2021 (The current 4 repositories (LDEO, WHOI, URI, OSU) are funded for 2 more years)

Regarding Ocean Science Section activities, he noted:

- Biological Oceanography Removed Target Dates (Jan 2021)
 - So far, so good

Integrative Program Section activities:

- The Mid-scale Research Infrastructure-2
 - Global Ocean Biogeochemistry (GO-BGC) Array (www.go-bgc.org)

- Infrastructure and O&M proposals were awarded. There have been 13 of the proposed 500 floats deployed and another 18 floats will be deployed soon.
- The National Ocean Sciences Accelerator Mass Spectrometry (NOSAMS) facility at WHOI was awarded Major Research Infrastructure funding for a new Accelerator Mass Spectrometer

Turning to award highlights for the Marine Geoscience Section:

- CO
 - 46 awards were made in FY21 (more are expected in FY22) for science projects as part of two upcoming linked GEOTRACES expeditions in the South Pacific and Southern Oceans (tentatively scheduled for Austral summer 2022 and 2023)
 - Total science investment so far in the two expeditions is \$22.5M, of which \$3.2M is from OPP/ANT
 - OCE will support one leg on a UNOLS ship, while OPP will support the other on the N.B. Palmer
- MGG
 - MSRI award to Ocean Bottom Seismometer Instrument Center (OBSIC) for new OBS instruments (\$6.5M)

Award highlights for Ocean Science Section:

- New Awards
 - BO-McMahon (2049307) & Record (2049308)
- Collaborative Research: Sources and transformations of export production: A novel 50-year record of pelagic-benthic coupling from coral and plankton bioarchives.
- Annually resolved time series (50-yr) using molecular geochemical analyses of deep-sea coral & copepod specimen archives serves as input to multi-faceted model to identify bottom-up drivers that link decadal-scale oceanographic change w/sources of organic matter coupling pelagic and benthic ecosystems.
- PO-Tyler (2048788) & Trossman (2048789)
 - Collaborative Research: Exploiting Geomagnetic Records to Describe Past and Present Ocean Variability
- The ocean generates electric currents and associated magnetic fields as it flows through the Earth's magnetic field. The work will extract past ocean variability from long, land geomagnetic observatory records, develop forward models for predicting the oceanic magnetic fields, and ultimately develop data assimilation strategies for both land and satellite observations.

Ocean Science Section award highlights:

- New Results
 - BO-Hagedorn et al (2021) Assisted gene flow using cryopreserved sperm in critically endangered coral. PNAS 118(38), <https://doi.org/10.1073/pnas.2110559118>
 - Summary: This publication describes a cryopreservation technique for coral sperm that can be used to enhance genetic diversity across coral communities. The study provides a roadmap for the application of assisted gene flow to preserve genetic diversity across corals.

- PO-Perez et al (2021) Understanding physical drivers of the 2015/16 marine heatwaves in the Northwest Atlantic. Nature Sci Reports 11, <https://doi.org/10.1038/541598-021-97012-0>
- Summary: The Northwest Atlantic, which has exhibited evidence of accelerated warming compared to the global ocean, also experienced several notable marine heatwaves (MHWs) over the last decade. We find that a combination of jet stream latitudinal position and ocean advection, mainly due to warm core rings shed by the Gulf Stream, plays a role in MHW development.

Dr. Richardson said the OCE subcommittee met last week with program officers and section heads to discuss hiring and the continuing effects of the COVID-19 pandemic on the OCE community. She said there was little mention of the word oceans and encouraged its use in future correspondence. Another topic of concern was long-term effects of COVID on scientific productivity, particularly by women, caregivers and underserved populations. She encouraged the continued collection of demographic information. But there's already a lot of evidence that women and underserved populations are being disproportionately affected. She encouraged program managers to continue to make supplemental awards to help mitigate effects of COVID on science. She said the newest Long-Term Ecological Research (LTER) project sites will struggle with this issue. There is also concern about a backlog of delayed cruises and limitations on the size of the scientific parties. There is particular concern about the impacts on junior faculty, graduate students, postdocs and pre-tenure faculty. There is also concern about NSF being relatively short staffed and some feeling isolated due to COVID.

She also mentioned the recent award for the Chemical Currencies for Microbial Planet center. Also, the Alvin upgrade is completed and sea trials will soon begin. New positions are being created that include a unique blend of skills, ship inspection and cyber security.

Many youth programs were cancelled or held virtually last summer but appear to be ramping back up to close to normal. She discussed spreading the word that the ocean and processes happening in the ocean are central to climate change. If there is a large plus budget, a few cross-cutting priorities need to be identified and communicated.

She also said a focus on environmental and climate justice by the current administration provides opportunities for cross agency collaborations. Many aspects of the ocean response to climate change have direct impacts on human populations.

Discussion

Dr. Aluwihare said the concern about staffing is that all the new funding opportunities will add to the workload of existing staff. She referred to how staffing might be increased and having positions that can jump between the different programs and help as needed.

Dr. Goldstein said that in addition to CoPe it is important to talk about the carbon system. There's a broad range of climate problems that are not just along the coastlines.

Dr. Quinn said in reference to program officers who can go from one thing to another, it's not simply hiring one person to do this new thing because your people have been there for a long

time, and they also get a bite of the apple. Cross training is one of the key things they've been trying to do because climate does not necessarily understand stovepipes so it's especially important to get people able to flex across the system.

AGS Division Subcommittee Meeting Report

Dr. Major provided updates for the Division of Atmospheric and Geospace Sciences.

- Staffing
 - Dr. Anne Johansen is now Head of the Atmosphere Section
 - Dr. Alan Liu is acting Head of the Geospace Section, following on a term by Dr. Lisa Winter
 - Dr. Yu Gu has joined NSF as a new rotator program director in the PDM program.
 - Dr. Jielun Sun has departed NSF after serving as a rotator in the PDM program.
 - Dr. Ilia Roussev (program director for Solar Terrestrial program) has departed from NSF
- Recruitment
 - Geospace Section Head Position – Currently accepting applications, closing on October 20th, 2021.
 - 3 active IPA searches (2 in Geospace, 1 in Atmospheric Chemistry)
- Community Engagement
 - General Office Hours August 18 2021
 - Facilities-focused Office Hours October 12 2021
- COVID and American Rescue Plan (ARP) investments
- Major Awards of Importance to Atmospheric Science Community
 - Mid-scale Research Infrastructure-1 Implementation Project:
 - Atmospheric Science and Chemistry mEasurement NeTwork (ASCENT)
 - to support a new network of 12 US sites, outfitted with state-of-the-art instruments for characterizing aerosols
- Science and Technology Center (STC) Projects:
 - Center for Learning the Earth with Artificial Intelligence and Physics (LEAP)
 - to converge climate science and data science to narrow uncertainty in climate modeling and provide more precise and actionable climate projections
- Center for OLDest Ice Exploration (COLDEX)
 - goal of extending the ice-core record of past climates to at least 1.5 million years

Dr. Major also discussed new geospace facilities:

- Expanded Owens Valley Solar Array
- The Simpson Neutron Monitor Network
- High-frequency Active Auroral Research Program (HAARP)

She concluded with new opportunities:

- Facility and Instrumentation Request Process (FIRP)
- Community Instruments & Facilities (CIF)

- Next Generation Software for Data-driven Models of Space Weather with Quantified Uncertainties (SWQU)
- Grand Challenges in Integrative Geospace Sciences: Advancing National Space Weather Expertise and Research toward Societal Resilience (ANSWERS)

Dr. Heald continued the presentation, covering the discussion with the AGS staff and conversations with Dr. Major. In discussions with staff there was interest in understanding the inter-agency relationships, and how that's working with AGS. It seems there's more interagency collaboration on climate. It was important to hear that the fraction of awards to women continued to increase despite COVID. In terms of proposal submissions that were female, lead and minority leads have increased in AGS.

The subcommittee feels it's important to see programmatic funding data. She said it is important to have programmatic level data, at whatever level of disaggregation is needed so anonymity is preserved. There was also discussion about the need to better explain BI. The subcommittee was also interested in the Earth System Science National Academy report. Programmatic data were also raised. There's interest in the subcommittee seeing more data on the impact of dropping deadlines and what that means for funding across the programs. The final topic was the need to have more guidance on reviewing interdisciplinary proposals. Dr. Major added that there is a specific learning agenda item on looking at impacts of dropping deadlines.

Dr. Liu added that the geospace science community would like a close coordination with NASA, for example, and yesterday was the first meeting with the NASA program director to talk about the proposal review process and topics for future meetings including coordinating proposals submitted to both agencies.

Discussion

Dr. Romanowicz asked for specific numbers regarding minority and female grantees. Dr. Heald said that in tracking work going on during COVID, 100% of the new projects for High-Performance Computing (HPC) were funded, which is three awards. We're not coding huge successes here, she said, but going in a positive direction.

Dr. Johansen presented the following AGS proposal statistics for diversity measures:

	2017	2018	2019	2020	2021
% of Proposals from an MSI	8%	10%	11%	12%	11%
% of Proposals from an EPSCoR jurisdiction	16%	18%	15%	17%	18%
% of Proposals from a PhD-granting Institution	73%	71%	75%	75%	72%
% of Proposals with a Female Lead PI	23%	22%	23%	23%	28%
% of Proposals with a Minority Lead PI	4%	5%	7%	5%	7%

*Female funding rate +7% over male

*URM funding rate 2% higher than overall

Dr. Anderson said there's an increasing number of proposals, especially from '20 to '21. In some categories female-lead PI goes from 23 to 28% of proposals and minority goes from five to seven. He ran the numbers knowing the funding rates irrelevant of how many were proposed. That resulted in females being funded at a higher rate as are underrepresented minorities (URM) than the overall population. The definition of minority is NSF's and is self-selected by the PIs. It is female versus male, not female versus male and no response. The non-responders are messing with the data.

Dr. Whitlock said the Biological and Behavioral, Computational and Critical (B2C2) Data Initiative was undergoing a reimagining and asked where things stand with that. Dr. Major said things are still under review and there is another competition this year. The programs are deciding how the B2C2 themes might evolve to address more current priorities.

EAR Division Subcommittee Meeting Report

Dr. González said at the meeting last week discussions centered on many of the things already discussed at this AC/GEO meeting with equity and inclusion being a part. There was excitement about some of the new solicitations and programs. There was satisfaction with progress being made on all the Earth in Time recommendations. Also, there's excitement about the potential increase in the budget.

Dr. Goldstein continued with staffing updates since the last AC-GEO meeting:

- GEO-AD: Alexandra Isern appointed after Bill Easterling rotated off.
- GEO- Acting Deputy AD – Lina Patino
- Acting Section Head: Robin Reichlin appointed Acting Section Head for Disciplinary Programs after Eva Zanzerkia rotated off
- New rotator Program Director:
 - Hendratta Ali (Fort Hays State, KS): Hydrological Sciences
- Section Head for Disciplinary Programs – job is posted for permanent or rotator
- Five Program Director rotator searches in progress (2 arriving in October, 1 in January, 2 being interviewed)
 - Sedimentary Geology and Paleobiology (SGP)
 - Geobiology and Low-T Geochemistry (GG)
 - Geophysics (PH)
 - Geomorphology and Land Use Dynamics (GLD)
 - SGP–Paleo Perspectives on Climate Change (P2C2)
- With these hires, all of EAR's permanent and temporary positions are filled or in process.

He also discussed priorities and COVID-19 challenges:

EAR FY2021 support to the EAR community:

- Feb. 25 DD letter - guidelines for supplemental funding requests, focus on relief for vulnerable EAR cohorts - students, postdocs, technical staff.
- Mar. 4 – Guidelines emailed to every PI and co-PI of active awards
- Results:
 - >\$7M dollars in supplemental funds awarded
 - ARP: \$600M to NSF - allowed for many additional EAR awards
 - e.g. 34 EAR Postdoc awards, twice as many as expected

Next he discussed the EAR budget over time:

- FY21 breakdown: 70% Research and Education, 30% Infrastructure
- FY22 Administration request: \$240M (19% increase), focus of new funds on climate, green energy

Dr. Goldstein turned next to new solicitations since the last AC-GEO meeting:

- “Beamlines” - Community Facility Support: Synchrotron-based analytical capabilities advancing Earth and Environmental Sciences research and training (NSF 21-592) (Addresses virtually all Earth in Time “Science Priority Questions”)
- “Geohazards” - Centers for Innovation and Community Engagement in Solid Earth Geohazards (NSF 21-628) (Addresses several EiT Science Priority Questions)

He also discussed the 14 recommendations from Earth in Time and the status of each:

Recommendation / Status

Evaluate the IF portfolio, monitor Facilities / EAR WG; new Facility reporting requirements
National Consortium for Geochronology / Discussions - community & internally within EAR
Very Large Multi-Anvil Press Facility / Fulfilled - funded (!) by NSF-wide MSRI-1 Program
Near-Surface Geophysics Center / EAR WG
SZ4D/CONVERSE / SZ4D WG - EAR & OCE; RCN
Continental Critical Zone / CZCN WG; 9 clusters & HUB awards
Continental Scientific Drilling / EAR-BIO WG; discussions with community
Archiving/Curating Physical Samples / Discussions within EAR and w/BIO
Cyberinfrastructure standing committee / EAR WG
Support + Implement FAIR / EAR WG
Leadership to improve DEI in Earth Sciences / EAR WG; discussions w/EHR/HRD
Sustain technical staff capacity / Focus area of EAR-IF WG
Partnerships - that cross boundaries to advance "novel societally relevant research" / Discussions across NSF, interagency, international

Dr. Goldstein also mentioned a grant to Arizona State University (ASU) to build the Facility for Open Research in a Compressed Environment (FORCE) and mentioned presentations made on BAJEDI WG, Climate WG, Geohazards Solicitation, SZ4D (Subduction Zones in 4 Dimensions) and geoinformatics.

He also reviewed BA-JEDI activities in EAR. He noted that URGE started as a supplement to an EAR award and will continue as an EHR award, an example of how engaged the division is and how much it cares about dealing with under representation and lack of diversity in the geosciences.

He said there are two phases to The EAR BAJEDI Working Group:

- Phase 1 - providing solicitation language that relates to:
 - broadening participation
 - working on native/tribal lands
 - student mentoring plans

- including BI in annual reports
- Phase 2 - Analysis of strengths and needs in EAR, including:
 - Internal work
 - Opportunities for collaborations (e.g., HRD, OECR)
 - Work with external community

He also touched on the EAR climate change working group, presenting the group activities:

- Engage the division to collect information and discuss programs' climate portfolios
- Lead discussion of climate research at EAR science meetings
- Describe EAR climate change research and identify emerging areas for investment and potential partnerships within GEO, NSF, and with other agencies
- Recommend to EAR management potential funding activities and programs that represent the breadth of EAR.
- Prepare a short document to expose a wide range of audiences to EAR climate research
Based on the U.S. Global Change Research Program (USGCRP). 2017. National Global Change Research Plan 2012-2021: A Triennial Update. Washington, DC.

Next he reviewed the Centers for Innovation and Community Engagement in Solid Earth Geohazards:

- Two tracks:
 - Track 1: Center Catalyst: will address topics that focus on the fundamental processes that create solid Earth geohazards, including earthquakes, volcanoes, landslides, and other solid earth or tectonic processes.
 - Track 2: Center Operations: For FY22, consider only those proposals built around a compelling research challenge or theme related to fundamental earthquake processes
- The Earth in Time "science priority questions" focus areas:
 - What is an earthquake?
 - What drives volcanism?
 - What are the causes and consequences of topographic change?
 - How can Earth science research reduce the risk and toll of geohazards?

Centers for Innovation and Community Engagement in Solid Earth Geohazards:

- Community engagement is central to the program:
 - Centers -
 - Must have a vision and integrated set of activities for community engagement that places a major emphasis on supporting activities that educate the next generation of researchers.
 - Will prioritize broadening participation of underrepresented groups in all facets of activities; proposals should demonstrate how this will be accomplished.
 - Will be expected to take explicit steps to develop a culture of equity and inclusion at all levels of operation and in all research endeavors

Dr. Goldstein provided additional SZ4D highlights:

- 2016: Boise SZO workshop

- 2018: Research Coordination Network (RCN) funded
- 2020: Highlighted in Earth in Time Report
- 2021: Convergence on implementation plans
- 2022: What comes next?

He said SZ4D is a community group with a vision for understanding subduction zones and their implications for advancing basic science. He noted that subduction zones are locations of major geohazards related to geomorphology magmatism earthquakes and climate. The group has objectives to build computational models that will integrate observations and be predictive and transform this into meaningful results that can be immediately utilized by the affected communities.

Next, he provided an update from the EAR Data and Sample Working Group of October 6, 2021:

- “Earth in Time” recommendations (NASEM, 2020):
 - Data: EAR should develop and implement a strategy to provide support for FAIR practices within community-based data efforts.
 - Samples: EAR should facilitate a community working group to develop mechanisms for archiving and curation of currently existing and future physical samples and for funding such efforts.
 - Cyberinfrastructure: EAR should initiate a community-based standing committee to advise EAR regarding cyberinfrastructure needs and advances.
- EAR COV (2021) recommendations endorse “Earth in Time” recommendations on data and samples

Dr. Goldstein concluded with an update on EAR progress on data and samples:

- Completed
 - Updated Geoinformatics solicitation to strengthen management and utility of EAR-supported cyberinfrastructure and data resources (NSF 21-583)
 - Formed EAR Data & Samples WG
- Ongoing
 - Clarify data & sample expectations within EAR solicitations
 - Updating EAR Data & Sample Policy and revisiting associated practices (e.g., for Annual & Final Project Reports)
 - Engaging in strategic planning regarding EAR support for data & sample resources (in consultation with relevant entities within and outside NSF)
 - Identifying potential community planning activities on data & samples

Dr. Robin noted that URGE was equally funded across all divisions and the front office, so there’s a cohort across the directorate that’s very committed to this issue.

Discussion

In response to a question about a specific tribal advisory agreement to provide oversight guidance and accountability on data collected on tribal or indigenous lands, Dr. Goldstein said it is clearly being considered in EAR and in OPP.

Dr. Stammerjohn asked if there is an NSF-specific tribal advisory agreement to provide oversight guidance and accountability on data collected on tribal or indigenous lands. Ms. Crain said there's not a specific tribal advisory or agreement. But there's lively discussion about these issues, especially data stewardship and data sovereignty. She mentioned having a more informed discussion with outside experts at a future meeting.

In response to another question about data collection and the development of a GEO-wide program, Dr. Isern said EarthCube is GEO-wide and works across NSF. Rather than a central pot of money, NSF would rather see the divisions coordinate their investments.

General Discussion on Approaches to Addressing Climate Equity – 3

Dr. Kraft asked for report outs on discussions within the breakout groups.

Dr. Stammerjohn said her group discussed if it would be possible to implement a climate equity element into their research projects. The response was that they did not have expertise and could a resource be provided for guidance on how to implement climate equity elements into projects and whether that will be a co-PI or a collaboration with other infrastructure. They also asked if it applied all small projects, where it would be more challenging. Dr. Cook added a question about studying a science topic that itself addresses climate equity.

Dr. Romanowicz said her group asked how to add this work in a time of limited resources. Different types of institutions have different capacity; a broad range of approaches is needed. And support is needed to enable these efforts. The group said there is a need for examples of successful projects where people have integrated research and outreach. Information about what is successful needs to be distributed. Another theme was building trust with the groups they want to reach. Researchers come in at the last minute and haven't worked this through ahead of time. They discussed small projects possibly having a stronger impact and asked about identifying stakeholders.

Dr. Richardson said starting with success stories would make sense. Her group asked how many climate change proposals are funded and, of those, how many address equity in their BI. They also asked if any of the proposals weave equity throughout. They also asked how the BI could better address climate equity, what PIs can do and what metrics should be used. The group also talked about NCAR's removal of the human impacts of climate from its portfolio. It also discussed what NCAR has done to address climate equity and could NCAR function as a hub for climate equity related activity among the geoscience community. The group also discussed Arctic research and how to better avoid parachute science, i.e., how PI's can better incorporate interactions with native communities in their research plans. The group asked if there are success stories within the NSF funding portfolio, re recognizing tribal lands, information transfer among tribal communities, and interactions of those tribal communities with folks from the outside. The group also discussed accountability and whether outcomes of proposals are consistent with what the PIs said they would do initially. Also, the subcommittee should ask for data that are available to the COVs in order to explore those datasets. It also asked if the definitions of diversity have kept up with the labels and how well NSF defines diversity. It also asked about metrics for success.

Dr. Kraft said she would craft a directive for a subcommittee and put forward a vote by email on its formation. Who is on the subcommittee is another question, she said.

Dr. Kraft provided concluding thoughts and she and others thanked the committee and staff for their work. Dr. Kraft adjourned the meeting.