

Advisory Committee for Geosciences (AC/GEO)  
April 13-14, 2022  
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. Robyn Mieke Dahl  
Dr. Kusali Gamage  
Dr. Luis Alberto González  
Dr. Kristin Wilson Grimes  
Dr. Robyn M. Millan  
Dr. Gary Mitchum  
Dr. Vernon Morris  
Dr. Francisca Oboh-Ikuenobe  
Dr. David B. Parsons  
Dr. Tammi Richardson  
Dr. Alan Robock  
Dr. Barbara Romanowicz  
Dr. Sharon Stammerjohn  
Dr. Cathy Whitlock  
Dr. Daniel Wildcat

NSF Senior Staff:

Melissa Lane

Other Meeting Participants:

Dr. Nicholas Anderson, Program Director, the Division of Atmospheric and Geospace Sciences (AGS)  
Dr. V. Celeste Carter, Listen, Empower, Advance and Deliver (LEAD) Program Director, Advanced Technological Education  
Dr. Clemencia Cosentino, Office of Integrative Activities (OIA)  
Ms. Renée Crain, Research Support & Logistics Manager, Office of Polar Programs (OPP)  
Dr. Craig Clements, San Jose State University  
Dr. Diana Elder, Division Director, the Directorate for Education and Human Resources (EHR)/ Human Resource Development (HRD)  
Dr. Christina Freyman, Evaluator, OIA  
Dr. Steven Goldstein, Division Director, Earth Sciences (EAR)  
Dr. Rosalyn (Roz) Hobson Hargraves, Director, Division of Undergraduate Education  
Dr. Alexandra Isern, Deputy Assistant Director, GEO  
Dr. Anne Johansen, Section Head, AGS

Dr. Brandon Jones, Program Director, GEO  
Dr. Branko Kerkez, University of Michigan  
Dr. Alicia J. Knoedler, Office of Integrative Activities, NSF  
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. Timothy Patten, Deputy Assistant Director, GEO  
Dr. Eric Powell, University of Southern Mississippi  
Dr. Barbara Ransom, Program Director, GEO  
Dr. Paul Sheppard, Executive Officer, OPP  
Mr. Brian Stone, Chief of Staff, Office of the Director (OD)  
Dr. Maurice Tivey, Marine Geosciences Section Head, Division of Ocean Sciences  
Dr. Vashan Wright, Scripps Institute of Oceanography

### **Wednesday, April 13, 2022**

#### **Opening Remarks and Introductions**

Dr. Kraft welcomed everyone to the meeting. She noted that the AC has new members and is larger than in the past. With a large turnover, members were added to minimize the loss of institutional memory. She thanked everyone who helped prepare the meeting, briefly reviewed the agenda and asked AC members to identify themselves, acknowledging those whose terms are ending.

#### **GEO Updates: Directorate, Division, and AC OPP meeting**

Dr. Isern began with a review of NSF’s FY 2022 appropriated budget:

- \$8.838 billion for NSF overall
- Climate and Clean Energy receive \$45 million
- Directorate allocations under development
- GEO’s Budget Themes
  - Climate Change
  - Racial Equity
  - Recovery from the Pandemic

She noted the budget was not as ambitious as the President’s request, but still a sizable increase of \$351 million over FY 2021.

NSF is having cross-directorate climate change discussions around climate change research. The agency’s Climate Change Coordinating Committee has representatives from all directorates and is developing a whole-of-NSF approach to ideas and plans. Four GEO section heads organized lunchtime sessions to discuss what GEO wants to do in the climate change space. She listed some of the ideas and themes that came out of these discussions:

- Climate Interventions
- Climate-Driven Extreme Events
- Sea-Level Rise
- Tipping Points
- Cryosphere Change
- Water Vulnerability

Dr. Isern also referenced the recent System Science report from the National Academies of Sciences (NAS).

For GEO-wide investments, the plan is to be more focused and intentional on decadal-scale outcomes to address the climate imperative and increase investments in use-inspired research to address climate impacts and develop climate solutions.

Across everything being looked at is the importance of justice, equity, diversity and inclusion within all climate investments. GEO is looking at a more community-centric approach. These build on some of the work done through Navigating the New Arctic (NNA) and the Coastlines and People (CoPe) program.

Moving to GEO's racial equity budget theme, there is a focus on three areas.

- Fostering Career Development
  - Pathways into the Geosciences - Earth, Ocean, Polar and Atmospheric Sciences (GEOPATHs)
  - Non-Academic Research Internships for Graduate Students (INTERN)
- Supporting Positive Cultural Change
  - Cultural Transformation in the Geoscience Community, NSF 22-562
- Offering Leadership Opportunities
  - Geoscience Opportunities for Leadership in Diversity - Expanding the Network (GOLD-EN)

Dr. Isern next discussed GEO's ongoing recovery from the pandemic. GEO is doing all it can to support the academic community and mitigate research impacts. Everyone is encouraged to keep in touch with program officers or GEO for available opportunities. NSF has been working to resume field campaigns. There are still impacts, particularly in polar research, but there is a slow resumption of campaigns.

The FY 2023 budget request is on the NSF website. She provided a graphic showing three of the main areas NSF is focusing on:

- strengthening core research programs
- inspiring the missing millions
- accelerating partnerships.

Across those pillars are priority investment areas:

- Climate and Clean Energy Research
- Equity for Underserved Communities
- Discovery Engine: NSF's Research Portfolio

- Emerging Industries
- Research Infrastructure
- Organizational Excellence: Agency Operations and Award Management (AOAM)

NSF's FY 2023 budget request includes:

- Increase to \$10.492 billion
- Climate and Clean Energy emphasis
- NSF-wide goal to support 10,000 Fellowships
- Facilities and infrastructure to increase substantially
- GEO initiating non-Climate Hazards activity

One central tenant is to push into new directions. Investments are targeted to look at climate and clean energy activities in a more intentional way.

There is a substantial change within GEO in the FY 2023 requests around the formation of incubators. She listed four foundational investments made for many years:

- Atmosphere
- Earth
- Oceans
- Cryosphere

She outlined four areas crosscutting this foundational research:

- NSF-Wide Climate Activities: \$33.67M
- GEO Climate Incubators: \$80M
- GEO Cyberinfrastructure Incubator: \$20M
- GEO Education, Diversity, and Equity Incubator: \$7.5M

She described incubators as:

- A nurturing space where new and innovative ideas and activities can grow.
  - Focus on innovation, curiosity-driven, and use inspired research
  - Encompass broad areas of the geosciences working across programs
  - Utilize resources in innovative ways and develop, seek out, and adapt new research support mechanisms

There is an opportunity with the Directorate for Technology, Innovation, and Partnerships (TIP) to help grow and catalyze the geoscience community. Thinking is still evolving, but it's going to be a space to catalyze new ideas and directions within GEO.

Presenting the GEO FY 2023 funding request by division/office, an account formally called Integrative and Collaborative Education and Research (ICER) has been changed to reflect the idea of the new incubators. The new name is Research, Innovation, Synergies and Education (RISE).

Next, she discussed GEO investment and facilities updates. She reviewed:

- Science and Technology Centers

- Harnessing the Data Revolution
- NNA
- Coastlines And People
- Mid-Scale Research Infrastructure
- AI Institutes
- Networked Blue Economy

Dr. Isern highlighted a few GEO major facilities updates

- RV Oceanus
- Retirement
- Human Occupied Vehicle
- Human-occupied vehicle (HOV) ALVIN
- Regional Class Research Vessels (RCRV)

She also outlined TIP, which she said will:

- Advance breakthrough technologies
- Address critical societal and economic challenges
- Accelerate research results to market and society
- Prepare the nation’s future Science, Technology, Engineering, and Mathematics (STEM) leaders

TIP did not get the level of resources expected. But the directorate was organized to be scalable. There are many areas within geoscience that will have a natural partner space with TIP. NSF has traditionally funded foundational research that led to use-inspired research that would get to proof of concepts and early-stage prototypes. Private funds work more on solution development and market ends. TIP will bridge this to be a ramp of opportunity linking public funding of R&D to the private sector.

She also provided a newly created GEO mission statement:

- To fund the development of knowledge and technological innovations to:
  - Understand and adapt to the changes in our earth, ocean, and atmosphere
  - Accelerate the societal benefits of our investments, and
  - Train a diverse and inclusive geosciences workforce.

There is also now a GEO vision statement:

- To support groundbreaking discoveries of the products and processes of the earth, ocean, and atmospheric systems from the past to the present and into the future for the benefit of citizens, decision-makers, educators, and scientists.

Dr. Isern said GEO has been asked to think about whether its name reflects what the geosciences are and whether the public understands what “geoscience” means. This is part of a request from the Director to all directorates. EHR has changed its name; the new acronym is EDU. It is also changing the name of one of its divisions.

## Discussion

In response to a question about nurturing spaces, Dr. Isern said GEO wanted to have an environment where, for example, program officers can come up with concepts they feel are critical and with innovative ways that move science forward.

In response to a question about whether incubators are for program managers, not scientists, she added that her hope was there would be innovative activities or interactions with the research community that program officers would lead.

Asked about climate intervention she said this does refer to geo-engineering.

Responding to a question about TIP, she said equity and programming are plugged into what they're thinking. They have been working across the foundation to build an interesting portfolio of advancing innovation tied to the pillar of missing millions.

She also said there will be opportunities for other incubators and there would be some evolution, perhaps on the lines of Engineering, which has a program focusing on an area with a two-year lifespan.

Asked to describe an outcome of a TIP bridge, Dr. Isern cited an example where NSF had supported instrumentation that got to the point that researchers could spend a lot of time getting the instrument to make measurements, but no one wanted to see the instrumentation being used more broadly in operations. They didn't have the funding to get it in that gap. That's the space TIP is trying to fill.

Dr. Isern also responded to a comment that creating short-lived programs creates a community and you don't want to cancel it. She said NSF will be focusing on subsets of a broader discipline. GEO does not necessarily have to create a new community; it's trying to work with the community in a different way or provide an opportunity to catalyze aspects of the research the community would like to do.

Dr. Kraft asked what NSF-wide incubators would look like in terms of soliciting collaborative proposals. Dr. Isern said it was going to be kept in a separate account at an agency level, but the Office of Management and Budget (OMB) asked that those funds be put in the directorate, so each directorate got some amount. She spoke about having the framework of the solicitation or the topic framed by what local communities want. NSF would like to think of it on a decadal scale, so it's going to have to be a focused effort.

### **AGS Update**

Dr. Major presented highlights from AGS. She listed four new rotators, two section heads (Atmosphere and Geospace) and a Pathways Program Analyst. Also, there is a division director search underway.

She also provided program updates:

- AGS joined the Mid-career Advancement (MCA) solicitation.
- Grand Challenges in Integrative Geospace sciences: Advancing National Space Weather Expertise and Research toward Societal Resilience (ANSWERS).
  - First awards recommended

- Geoscience Lessons from Other Worlds (GLOW) Dear Colleague Letter (DCL) released
  - GEO-wide plus Astronomical Sciences (AST)
- Decadal Survey For Solar And Space Physics (Heliophysics) 2024-2033 now launched
  - Joint with The National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA)

Dr. Major said a new research aviation facility for the National Center for Atmospheric Research (NCAR) opened in 2021 in Broomfield, Colorado. A new Wyoming supercomputer refresh has been launched. Also, the cleanup of the collapsed Arecibo facility has finished, and the site's future is being discussed.

Finally, she provided a pandemic response and recovery update:

- Field Campaigns
  - Most 2020 and 2021 campaigns were postponed due to COVID-19
  - Research flights resumed late 2021. Most campaigns have been rescheduled for 2022/23
  - Some uncertainties remain regarding COVID-19 restrictions overseas. Rising fuel costs also an issue
- AGS Outreach Activities
  - Virtual office hours held periodically
  - Two dedicated sessions for sell research-intensive institutions (Primarily Undergraduate Institution (PUI), community colleges Tribal Colleges and Universities (TCU) and other non-R1) held in March 2022 aimed at broadening participation in AGS programs

### **EAR Update**

Dr. Goldstein presented staffing updates and noted hiring is in process for the Disciplinary Programs Section Head as are searches for four permanent (or rotator) Program Directors and a Science Assistant.

He also provided the following highlights:

- “Beamlines” - Community Facility Support: Synchrotron-based analytical capabilities advancing Earth and Environmental Sciences research and training (NSF 21-592); proposal deadline 3/4/22
- “Geohazards” - Centers for Innovation and Community Engagement in Solid Earth Geohazards (NSF 21-628); proposal target date 3/15/22
- “New EAR/IF Solicitation” - Earth Sciences Instrumentation and Facilities (NSF 22-577); no deadline. New features:
  - Equipment acquisition and technique development limit increased to \$600,000
  - Educational infrastructure proposals from community colleges, Minority Serving Institutions (MSI), non-Ph.D.-granting institutions
  - Continental drilling planning/site survey proposals
  - Technician support
- “GLOW DCL” - Geoscience Lessons for and from Other Worlds (NSF 22-032); from EAR, AGS, Directorate for Mathematical and Physical Sciences (MPS)/The Division of Astronomical Sciences (AST)

- “ORE-CZ DCL”: Opportunities for Research and Education in the Critical-Zone (NSF 22-025); from EAR and EHR/HRD
- EAR Division Director (DD) Climate Letter- encourages climate change-related proposals to EAR — large community response
- Belonging Access Justice Equity Diversity Inclusion (BAJEDI) - New solicitation language on field and lab safety, harassment, respect for regional populations, international work - EAR Program Directors have been proactive

Dr. Goldstein also provided an Earth in Time Update:

<b><u>14 Recommendations</u></b>	<b><u>Status</u></b>
Evaluate IF portfolio, monitor Facilities	IF WG; new Facility reporting requirements
National Consortium for Geochronology	Geochron WG, continuing discussions w/community
<b>Very Large Multi-Anvil Press Facility</b>	<b><u>Fulfilled - funded by NSF-wide MSRI-1 Program</u></b>
Near-Surface Geophysics Center	EAR WG; Workshop Award 2139353, workshops ongoing
SZ4D/CONVERSE	SZ4D WG — EAR & OCE; continuing community development
Continental Critical Zone	CZ WG; 9 clusters & hub awards; ORE-CZ DCL
Continental Scientific Drilling (CSD)	EAR-BIO WG; new IF solicitation includes CSD planning
Archive/Curate Physical Samples	EAR WG; discussions within EAR and w/BIO
Cyberinfrastructure, implement FAIR	EAR WG, cross agency discussions
Improve diversity, equity and inclusion (DEI) in Earth Sciences	EAR WG; new BAJEDI solicitation language; ORE-CZ DCL
Sustain technical staff capacity	EAR WG; new IF solicitation includes technical support
Partnerships - cross boundaries to advance “novel societally relevant research”	Discussions across NSF, interagency, international

### **OCE Update**

Dr. Tivey presented highlights from the various sections, starting with Integrative Programs.

- U.S. Academic Research Fleet:
  - Back to full operations in 2022 with 3,500 operating days scheduled
  - Planned divestment of RV Oceanus in 2022 & RV Endeavour in 2024
  - Global Ocean Biogeochemistry (GO-BGC) Array First Year anniversary in March with 41 floats operational

- Ocean Observatories Initiative (OOI) Coastal Pioneer Array will be relocating to Mid-Atlantic Bight in 2024
- Celebrating OCE Postdoctoral Fellows: 2021 and upcoming 2022 cohorts will receive American Geophysical Union (AGU) professional development training in developing DEI education and outreach projects

Dr. Tivey also briefly discussed the Ocean Section:

- Ocean Section Highlights
  - Doubled number of Faculty Early Career Development (CAREER) Program awards and increased co-funding in 2020 & 2021
  - Dr. Krista Kroecker (UCSC)
    - Modeling effects on kelp availability for primary consumers
    - Incorporating high school and undergraduate students in Sitka Sound field course
    - INTERN: graduate student mariculture planning with Sitka Tribe
  - Dr. Andrew Stewart (UCLA)
    - Modeling Antarctic shelf and offshore water exchange to understand ice shelf melting and heat and CO<sub>2</sub> storage
    - Sampling local waters with undergraduate students has broader impact than a few students in Antarctica

Turning to the Marine Geosciences Section (MGS) Section, Dr. Tivey presented Marine Geology and Geophysics (MGG) Program highlights:

- 3-D inversion model from largest refraction seismic dataset reveals internal structure of active continental margin (Arnulf et al, 2019)
- 349 methane vents discovered in Puget Sound (Johnson et al., 2021)
- GO-BGC floats helping to narrow the gap between in situ and remotely sensed marine carbon (Huang et al. 2022)
- COVID supplements supported “Plume Raiders” cruise in September
- Investigating Southern Ocean iron transport by surface waters
- Deployed 4 GO-BGC floats

Dr. Tivey concluded with suggested discussion topics for AC-GEO:

- NSF return-to-work process
- COVID impacts on ship ops
- RCRV update
- TIP Directorate and budget
- Sense from the community

Also, OCE staff met with three AC-GEO Ocean Science Subcommittee members (Dr. Arnosti, Dr. Mitchum, Dr. Richardson) on April 8, followed by a meeting with the OCE Deputy Director. Dr. Aluwihare was unable to join these meetings. The discussion included NSF’s return to work schedule and the impact of remote work options on staff and panels and COVID-19 impacts on ship operations and the progress of the RCRV construction. There was a high-level discussion of TIP, partnerships and incubators. AC-GEO members relayed their “sense of the community” in terms of research and proposal activity.

## Discussion

Dr. Kraft asked about the reason for an increase in career success. Dr. Tivey said it was due to being proactive with the community and sharing with other divisions. The increase is from three to five per year to about 10.

## **Office of Polar Programs**

Mr. Sheppard provided highlights of last month's AC-OPP meeting, beginning with COVID-19 impacts and updates for the Arctic and Antarctic. The Antarctic Program went from 108 science events in FY 2020 to deploying 19 science events in FY 2021 and 42 science events deploying in FY 2022. The active season will start in FY 2023 with a major deployment in October and is trying to get back to the FY 2020 baseline. For the Antarctic season, he provided the number of canceled projects. There were 83 projects lost in 2020. This year 53 have been lost.

Major constraints were access to Antarctica and Greenland and other international activities in the Arctic; it was difficult getting into gateway cities because of COVID-19 screening and quarantine; there is an expectation of more robust activities north and south with the hope to return to normal soon.

Mr. Sheppard also provided an Antarctic Research Vessel (ARV) update:

- Preliminary Design Phase (January 2022-October 2023)
  - Science Advisory Subcommittee of OPP AC
  - Technical Advisors
- Requests for Information (RFI) released for
  - Vessel Integrator
  - Vessel operator

Mr. Sheppard concluded with three additional topics:

- Ongoing collaborations with Office of Cyberinfrastructure and Engineering
  - Ideas lab opportunity
  - Cross directorate underwater opportunity
- Subcommittee on Diversity, Equity and Inclusion
  - Preliminary findings
  - Future directions
- International Engagement
  - Policy framework for Arctic and Antarctic research and related activities
  - Impacts of Russia-Ukraine conflict on research activities

## Discussion

Responding to a question about McMurdo construction activities, Mr. Sheppard said all activities are ready to resume in October. There will be two cargo vessels in January-February to deliver the remaining construction materials. OPP will be moving out on existing contracts for the Operations Maintenance Center and dormitory.

In response to a question from Dr. Kraft about educational infrastructure for non-R1s Dr. Goldstein said the new solicitation invites proposals for enhancing instrumentation in non-R1

institutions for educational use. Dr. Kraft said it reminded her of the Course, Curriculum, and Laboratory Improvement (CCLI) program.

Dr. Major responded to a question about Paleo Perspectives on Climate Change (P2C2), the most recent incarnation of a long-standing series of programs focused on paleoclimate conceived in 2007. A cross-GEO workshop at the National Academies last summer looked at a refresh of those questions since the first solicitation and program director participants are developing a new set of questions and solicitation to support crosscutting paleoclimate work within GEO for later this year.

In response to a question about diversity, Mr. Sheppard said a small number of institutions can successfully put proposals forward through OPP, so the most obvious thing to do is get out the opportunity. OPP has not tackled drawing in more research universities that have an interest in, and the ability to, successfully put forward proposals.

Dr. Arnosti added that there is a mismatch in timeline and bandwidth. Actual involvement takes much time, and everybody suffers from lack of bandwidth. Even if well connected into the NSF system and you know how to write a proposal, it's still hard to do it. We are not going to see the same reaction times as from those NSF has worked with in the past.

Dr. Parsons referenced the Government-Owned Equipment (GOE) [?] Southern Great Plains regional center, where there's a strong involvement of the tribes and nations which has helped with outreach and increasing diversity.

Dr. Kraft said some of what is being talked about is increasing the rapidity with which things are happening, but building those relationships takes time.

Dr. Wildcat said none of the 37 tribal colleges and universities offer Ph.Ds, which eliminates them from certain kinds of participation in research. There needs to be more effort in K through 12. He suggested working with the Bureau of Indian Education and the Bureau of Indian Affairs. Institutions and human infrastructure do not exist to respond to these kinds of solicitations. This focus is needed to improve diversity, equity and inclusion. It means changing the way scientific organizations do things.

Dr. Isern responded that it's nice to want to broaden institutions, but the infrastructure is not there. She said later in the meeting there will be discussion of a new initiative, Growing Research Access for Nationally Transformative Equity and Diversity (GRANTED), to help provide that capacity.

In response to a question about the increase in career awards, Dr. Major said part of the NSF response to the pandemic was to prioritize funding for early career folks, including pre-tenure faculty. In response to that priority, the program directors made the decision to prioritize that career funding.

Dr. Isern announced the hiring of a new deputy assistant director, Dr. Patten, and thanked Dr. Patino, who filled the role for about eight months.

## **Innovation and Partnerships Panel**

Dr. Patino said NSF is expanding opportunities for use inspired research, taking basic research results to the usability space; the panel will provide examples of geoscientists who have gone into that innovation space.

Dr. Ransom introduced herself as the lead program officer for the GEO Innovation Hub and three panelists, two of whom are directors at Industry–University Cooperative Research Centers (IUCRC), collaborations between one or more universities that want to help a sector of the economy overcome hurdles they can't on their own. Faculty pitch ideas to an advisory board from industry and elsewhere who pay to become center members. The board decides which projects to approve. She introduced Dr. Clements, the director of the Wildfire Interdisciplinary Research Center (WIRC); Dr. Kerkez, a hydrologist who co-founded a company that does hydrology in urban environments; and Dr. Powell, Director for the Science Center for Marine Fisheries.

Dr. Clements, a professor of meteorology, said he focused on fire weather and was getting requests from utilities to do partner projects, including hiring students. His fire weather program received small contracts with utilities in California. They had problems with ignitions, wildfires and risk. His program started a center and he later contacted IUCRC and was selected. It is now in its first year. Service sector companies for the utilities and insurance companies are also members. As an academic, he never thought he would be pitching products to companies. But their needs are similar to his academic research agenda, and they overlap. They hire his students. As a master's program, that is the perfect skill set; they don't require a Ph.D. to work in industry.

Dr. Kerkez said he has been at the University of Michigan almost 10 years. He did research as a Ph.D. student in the mountains studying snowpack, soil and moisture as part of the water balance. As faculty, he became interested in urban hydrology and started making connections with utilities and municipal stormwater managers and saw a significant problem with flooding and algal blooms, which became a research focus. He'd focused on building instrumentation and sensor networks for measuring urban hydrologic systems. He shared those data with stormwater managers and others and began receiving requests for his data, leading him to start a company focusing on smart water systems. He participated in the NSF Innovation Corps (I-Corps™) program, which required talking to hundreds of water managers. He discovered that a sliver of his research had a palpable impact. He started his company in 2020 with a foundation grant and the core market segment is municipal stormwater managers responding to flooding and planning infrastructure in the long term to reduce impacts of climate change. His company provides sensor networks that include hands-on tools and apps used by stormwater managers and first responders.

Dr. Powell said that marine fisheries do not employ scientists but depend on academic connections for their science needs. He was formerly director of an agricultural station at Rutgers University, started to support the oyster fishery. He found CEOs interested in forming an IUCRC. The companies have significant exposure on the northeast and the Gulf of Mexico, and some have processing plants and vessels on the West Coast. Some companies are small, and some are international. After nine years, the companies that formed the center are mostly still

there. They don't have another avenue to get science done except for the academic community. Most problems are associated with Federal stock assessments and quota settings, with some funding related to product development and engineering projects dealing with improvement in fishing gear. The other 75 percent is heavily focused on climate change, which is the biggest challenge for marine fisheries.

Dr. Patino introduced a series of questions presented earlier to the AC about experiences with innovation. The geosciences community needs to make its contributions to society through research that goes to the market. She asked how to incentivize colleagues to move in this direction. She asked panel members to talk how their centers evolved and the path from lab research.

Dr. Powell said before IUCRC, the challenge to providing academic science was with the funding mechanism from the fishing companies. None were useful in the long term. The IUCRC solved many problems because it brought monies together from multiple companies in a predictable way and put all the companies in the same pot, removing internal competition. Beginning with focused projects dealing with specific and practical issues, it expanded into long-term programs, an extended timeline driven by climate change. The companies see they're going to have to find out how to stay in business over the next 50 years.

Dr. Kerkez said that at graduate school and running the lab, one goal was to have research that's useful, recognizing that much of fundamental research may need a lot of time before it translates into tools for people. He began with research and grants. Test beds showed feasibility and led to questions about scaling. People using these technologies wanted it for their use. Open source use used but couldn't be implemented. His group tried hosting training sessions but those attending the training were not starting their own companies. The water sector was effectively abandoned by technology. It became clear that if nobody's doing it, his group would start a company. Research can be useful but making it usable is a different story. Someone closing off a road because of flooding can't use a research paper; they need something tangible. His lab still does fundamental research, but the company has taken those lessons and is trying to turn it into something that works.

Dr. Clements said he couldn't get a research project funded by Federal management agencies to study something that was not applied. Companies need the newest tech now. The partnerships is unique because companies are using his group's intellectual knowledge and experience as scientists but pushing the envelope and asking for more using deep learning models. His group hired an interdisciplinary team of five tenure track faculty. The Forest Service has been building apps and his San Jose State group competes with that. He has expanded from his research to building new models and tools and apps for fire management and companies.

### Discussion

Dr. Robock said the focus is on how to make money. But a lot of what is funded by NSF is not to make money. It's to educate about things we shouldn't do. With climate change, references have been to adaptation or living with global warming, not mitigation. That's one way to address global warming, but we also have to work on not doing global warming. He said he is funded by NSF to work on the potential benefits and risks of climate intervention and geoengineering. It is

important to remember NSF doesn't just fund partnerships with businesses that can make money, it does a lot of fundamental research that will never make money that will warn us about things we shouldn't do.

Dr. Powell said he uses NSF programs designed to promote the ability of companies to make money, which is what the IUCRC does. Companies don't put money into funding projects out of the goodness of their heart but because they have a problem that's costing them money or if they can make more money. With fisheries, the issues are related to situations costing them money or putting them out of business. Most of his research is dedicated toward retaining jobs in fisheries and maintaining successful companies and fisheries. But more than half of his group's research is fundamental, including looking at the shift of animals across the continental shelf with global warming. He does not invent widgets.

Dr. Kerkez said he did not start his company for the money. There's a notion that when moving from science into starting businesses, you lose purity. It's not that we shouldn't fund fundamental research that doesn't have any guarantees of being successful. However, a lot of us are doing research that has the potential to be translated rather rapidly and benefit people. And sometimes it takes companies to do that. He didn't want to start a company but felt nobody else was going to do it. The motivation isn't to make money, but that is part of it. But it's also about getting the things we're doing out there and giving the benefits back to the taxpayers supporting the research.

Dr. Clements said the IUCRC is not making money but building tools and doing the science so corporations can get the science and help drive it forward. They share the intellectual property (IP) together with what's found or created within the IUCRC. Utilities don't want the data they're sharing with the IUCRC to go to other utilities. But the center can use the data from all the utilities. Though there's a profit goal from joining IUCRC, we're in this together to build the best products and do the best science to save lives and property.

Dr. Ransom said use inspired research or translational research is not applied research. It's fundamental research. Use inspired means it's got a goal to help people or the economy. It would be good to think about research projects that can be applied in a short period of time, because the challenges are big and the consequences dire. The use inspired and translational research the panelists are doing can be published in the peer review literature. It's fundamental, basic science. So, it's something our communities need to be thinking about more seriously. It's a different mindset that appears to be too practical, because NSF has not, at least in the geosciences, emphasized that as a priority in selecting projects. But the time has come to start thinking more about societal and economic impacts when picking research projects.

Dr. Kraft said there tends to be a perception from the working community and scientists that sometimes are not always positive. There is a self-selecting community of people who agree to serve on an advisory board, she said, and asked how to overcome challenges of perceptions.

Dr. Powell said there is a considerable amount of babysitting on his board. He talks to the CEOs four or five times a year. Their perception of a problem has to be interpreted in the context of the science issue and they keep putting money into the center and keep using the information. Also,

publication in peer reviewed journals is a necessity. Unless a piece of information gets out into the peer reviewed journals, it's highly unlikely that information is going to make it into the Federal management process. The approach used to manage fisheries involves the best available science, which is information that's gotten through peer review. A primary goal is to get information into the public arena through peer review publications. Also, his board requires there be no IP claim on information by any board member. If there's IP associated with it, it is not publicly available and doesn't benefit companies with respect to sustainable fisheries management.

Dr. Kerkez said he keeps the commercial world and the academic world separate. He writes papers and no longer adds information about what cities might one day look like but focuses on the core data. At conferences, he does not talk about his company. Outside academia, people only care if he has something that works, and having a Ph.D. is seen as a detriment. Perceptions lead to early judgments about what your motivations are and that makes the job hard. Dr. Patino added that NSF needs to assure those who want to have a company feel welcome in the science space and make sure people like Dr. Kerkez don't have to live a dual life.

Dr. Grimes asked what types of workforce skills are essential for students to do this type of work that is included in a normal geoscience education. Dr. Powell said his graduate students are learning what would be expected and applying that information to a particular funded project. Students get contact with the private sector and see that people make a living going to sea. The companies will not hire scientists. But they know these students will be hired in government or by non-governmental organizations (NGO) and it's to their advantage if the students have experience in the fishing industry. Dr. Clements said his students are trained as meteorologists. A unique skill from the program is wildfire science and fire weather education. There are internships and students are on the center's contracts with utilities. Dr. Kerkez said general data fluency is important and learning to code opens doors to Silicon Valley. The geoscience community has large amounts of data that's been collected over the past century and people have started companies over that. He also advised learning ethnographic methods and how to interview people who will tell you if your research is useful. Dr. Clements added that utilities are hiring data scientists. Dr. Grimes said an NSF Research Traineeship (NRT) Program incorporates anthropology for student training with systems thinking.

Dr. Ransom said NSF is moving towards more projects that are community led, where scientists are the experts in the room but also the best listener to help the community solve whatever problem they have. One is called the Civic Innovation Challenge. Another is the convergence accelerator, which will be in TIP. Dr. Clements said his center has a social scientist for that. In fire, you have to survey communities. The big issue is the fire departments aren't doing what they should have been doing.

Dr. Kraft said some of these skill sets could also be potential technical pathways that could be incorporated in some larger programs and asked how to include community college students, so there's potentially short pathways as well as longer pathways. Dr. Ransom said a DCL is out that provides funding for community college faculty and students to work with IUCRCs to train students. It's coming out of the EHR Advanced Technological Education (ATE) program to put community college students and faculty inside research projects to help move a sector of the

economy forward. Dr. Clements said San Jose State has a partnership with community colleges in the region where his center brings students in for paid summer research assistantships, and they work with a faculty member in biology or chemistry. He also gets approached because they have to be fire line-qualified. He's putting a fire weather research station at a community college in the foothills of California to bring in students interested in wildfire sciences. Dr. Kerkez said he's been working with community colleges, motivated by the idea that if you want to, for example, build a large-scale earthquake prediction network, you can't rely on people with master's degrees and Ph.Ds. There is an opportunity to create STEM jobs for people who might want to go to community college. There are opportunities for new kinds of jobs, even if you don't want to or can't go to college.

Responding to a question about how involvement in such projects helped engagement with stakeholders making use of the center's scientific knowledge and whether there have been new scientific partnerships through interaction with private industry, Dr. Powell said everything his center does is directly involved with stakeholders. It does not fund anything that doesn't come out of the fishing community. The IUCRC is interactive with stakeholders on a continuous basis.

In response to a question, Dr. Clements said his center has been working with industry for a few years, partly on new techniques to look at fire danger. This is a competitive space with lots of academics and companies. His center is getting students funded to do that type of cutting-edge research and getting publications out of it using a data set that's proprietary that they wouldn't otherwise have access to.

Dr. Kerkez said engaging with users allows you to question the direction of your hypotheses. It changed where we wanted to do research and impacted the company but also started his thinking about the value proposition of the classroom.

Dr. Powell said fisheries attempt to get other companies to pool their funds. The more companies that buy into the center, the more there is to solve expensive problems. He has helped sell the center to potential partners at times.

Dr. Patino asked the panelists about their institutions' involvement in allowing the establishment of a center or the formation of a company. Dr. Powell said a decision was made early to get the university to sign a memorandum of understanding (MOU) to organize the center, which can pass money back and forth without contracts, because the MOU says it is one unit and everything has to work together. However, an administrator that's proactive for the center might be replaced so internal politics are a continuous challenge.

Dr. Kerkez said starting a company means you work more. He writes papers and does research and anything outside of that gets a pat on the back. Having a good co-founder, especially a former student you mesh with, is important. He does not run the company day to day. Most universities have pushes for entrepreneurship, but oftentimes those units live independent from the academy. His university has an entrepreneurship center, but they're not evaluating his performance review. It's valued but not rewarded.

Dr. Clements said San Jose State is unique in having this type of center because it is not R1 or MSI. Doing research at the level of his center is unique on campus and appreciated. Research used to be a dirty word but is now trending. He proposed hiring five faculty and received approval from the president's office and applied to be an IUCRC, although he did not fill out the proposal at the campus level to be called a center. He needs to have a financial plan that must go through the university governing board of faculty.

Dr. Patino asked the panel to discuss challenges recruiting and working with industry or starting a company. Dr. Kerkez said it's difficult to carry over a scientist's skills when having conversations with users. The difference between usefulness and usability has been a challenge. That is, figuring out if the thing we're making is valuable to somebody has been a challenge. Dr. Powell said one of his biggest headaches is getting a call from a CEO asking for a particular proposal at the next board meeting, when it's something that's foreign to anything he has ever thought about and does not have an academic associated with the center that can do it. He has had to do a nationwide search to find the right person. He has contracts with up to 10 academic institutions to bring in needed expertise. Dr. Clements said his center is contacted by companies saying they're going to solve the wildfire problem. His challenge is getting those companies to engage. There is a lot of competition, and the challenge is selling the center's capability and not being perceived as a threat.

Dr. Mitchum said he set up a faculty mentoring program for his college. Many times, a faculty member who's taking a non-traditional approach has had trouble at promotion time. He wondered if he would recommend the path the panel members are taking to an un-tenured professor. His university might look askance at this. Dr. Clements said the five faculty he hired are junior faculty. He arranged for a letter from the dean saying that engagement as co-director of the center will be positively viewed in tenure promotion. The advantage is a junior faculty getting to write an internal proposal and get funding to get some research going. Dr. Ransom said different institutions have different values they put on activities, but faculty at any level could be part of the center, as long as they weren't in the leadership team, and pitch projects. Industry starts to get familiar with these people and what they do, and the kinds of students they have, and the companies may want to do a contract outside of the IUCRC. It's a way to get increased visibility in an alternative funding stream. There is a requirement to have the higher-level administration acknowledge this person will be viewed positively in tenure and promotion. Dr. Mitchum said that there is a significant non-traditional revenue stream, that counts very highly for tenure promotion. Dr. Powell said being a director you need to be in a tenured position. He spends probably three man-months on center administration. Dr. Kerkez said people have told him this is not good for his career. There's a general sense of what it takes to be successful in academia. But his way of dealing with it has been to do both things, even though it is not realistic. The way he can afford to do non-traditional things is by doing traditional things on the side. Step one is to accept the systems as they are and figure out how to work within those confines. Dr. Mitchum said two jobs and staying up half the night might not be a choice for some people given their family situations. Dr. Millan said there are people who have other commitments, restricting the talent pool that can be participating in these activities. It is important to keep pushing on the university side to make sure the promotion process is recognizing all the things that contribute to the institution.

Dr. Patino asked the panelists for examples of positive outcomes. Dr. Powell said the center supports retention of thousands of fishing industry jobs. Some research projects are funded to do a specific issue and blossom into something bigger. If you put down good products, people in the industry develop respect for you and the university system. Those feeds back on what goes to the legislature when the university is trying to get money. Dr. Kerkez said it helps chiefs close off a road, preventing potential tragedy. Some people reported that had it not been for the data, they would not have invested in marginalized communities. Encouraging students to bring to bear cutting edge techniques and technologies and insights is going to get allies in industry. And the more people in industry preaching the benefits of scientific research and the implications for the economy, the more research will be funded. Dr. Clements said a new faculty member built a fire prediction model and an industry partner built a mechanism to use the output and utilities are using the model. It's a household name within the industry that's in the hands of first responders. Also, students are engaging with utilities and insurance companies have offered to help mentor female students.

Dr. Midyette asked about a hypothetical academic tenure and promotion model under which industry partnerships have the same value as publications. Dr. Kerkez said the university mission is to serve the people of Michigan. But they are not writing him recommendation letters for tenure. Until we open ourselves to the outside community and say universities are part of the broader community, things might not change. Dr. Powell the basic problem is how the faculty line is defined. He has been a mixture between research, teaching and service. Those are looked at differently from the standpoint of performance and expectation. The underlying issue to resolve is how you're defining the faculty line. Dr. Clements said if he gets a large contract from a company to do research and publish the results, it's like a Federal grant. But it might not get the same overhead. There's a game where most of the time the Forest Service doesn't pay for overhead, but you can treat it as a regular grant and publication. Dr. Mitchum agreed that industry contracts and revenue counts at universities. The evaluation letters by peers don't receive much credit and they're not part of the tenure promotion packet. Service hasn't counted much. It has to be built into the research area to figure out a way to make it count.

Dr. Isern said for NSF this is a cultural shift. It is a way of diversifying STEM because it is a way for people to see themselves in a space they want to be in when they don't want to be an academic. She asked the AC advisory for feedback on how to facilitate this innovation space. There's going to be resources; the TIP Directorate is going to grow big.

Dr. Kraft talked about the challenge of translating an idea of core research and what that looks like and how those conversations happen and how to translate academic language to talk to non-academics.

Dr. Isern said feeling dirty for going to industry is an attitude in academia; you're not an actual academic and your students have less value. NSF has been trying to change that attitude. Dr. Mitchum said he does work with Florida doing flooding risk assessment. He had it written in as part of his assigned duties on the Associate Dean side because it didn't count for his professor side. In TIP, if the industries are funding, he doesn't think there's a problem. If it's funded, we'll call it research. Most of his students go into agencies and the private sector and that is valued. It is understood that not every student is going to be an academic. Dr. Isern said NSF is told it is

producing too many Ph.Ds. There's not enough positions in academia. Dr. Mitchum said he was biased because of the ocean sciences, which are close enough to applied that there are a lot of opportunities for students who are not straight academics.

Dr. Gamage said coming from a community college she wished to know how to get faculty involved in these centers. How do we make that connection with somebody at a center to begin that conversation and apply for that solicitation? She asked about outreach to community colleges and said that from the DCL she was not sure about the process. Dr. Ransom said community college students can have a Research Experiences for Undergraduates (REU) over the summer or work actively on a project and return to their college and work on it remotely. In the geosciences, there are a limited number of IUCRCs. NSF is starting to build this in the geosciences and if you're at a community college and they have other disciplines there which match up with some IUCRCs, a faculty member could contact the center director and see if there was interest in collaborating and applying for a project. Dr. Patino mentioned GEOPATHs to engage undergraduate students in geosciences and said community colleges could submit a proposal; there are multiple venues on how you can enter the space of industry partnerships.

### **GEO: What's in a Name?**

Dr. Isern said the director has asked all the directorates if they are properly named. If external groups are to understand what GEO does, NSF wants a directorate name that helps do that. She also said they can consider changing division names.

Dr. Patten discussed a poll of PIs who recently submitted to geosciences, looking at the department names they submitted from. A very significant number of PIs submit from civil and environmental engineering, biology, geography, applied physics, mechanical engineering, physics, chemistry and anthropology. This indicates the interdisciplinary research submitted to GEO.

Dr. González said that as department chair at his university he encouraged submitting a grant via engineering via a courtesy appointment or another affiliation to get more bang for the buck than through geology, and this should be considered in interpreting the polling data.

Dr. Robock asked if the branding is for Congress, the public or the people who would be submitting proposals. Dr. Isern answered that it is all those groups. GEO is serving a wide range of constituents.

Dr. Richardson said that as a biological oceanographer who is chair of a biology department, her colleagues, who are familiar with NSF, ask why he is on AC-GEO. He responds, that's where the ocean sciences fits.

Dr. Patten said a department name is a crude indicator that's not precise. Also, the poll uses the Department of the PI, not the submitting department.

Dr. Romanowicz advocated using "Earth" in the name. GEO is not something everybody understands. Her department name was changed from Geology and Geophysics to Earth and

Planetary Science, because it was expanding from just the solid earth and to make it more understandable to lay people.

Dr. Kraft said she has seen department names change in recent years for multiple reasons, including understanding the direction fields are going.

Dr. Cook said she is in a department of geological sciences which was broadened over the last 10 years and is considering changing its name. About 15 years ago many departments changed from geosciences and geological sciences. Her department is considering using the word “climate” in the name and that may be appropriate for GEO as well.

Dr. Kraft mentioned a Zoom Chat comment about a department that used “Earth,” which was not perceived to include oceans, but she noted there is a danger of the name becoming a laundry list of terms.

Dr. Whitlock said she is in a science department. It includes geology and geography. But she has always been confused at NSF about the hierarchy between GEO and EAR. Having Earth as the name of the whole division seems more appropriate and she referenced the Earth Systems report, which includes the atmosphere, oceans and cryosphere.

Dr. Kraft said it goes back identifying the audience. She also raised the idea that geospace is a component within GEO and how that is considered when getting into exosphere aspects. It starts to get arbitrary to non-geospace scientists.

Dr. Arrowsmith’s school, Arizona State University (ASU), has the School of Earth and Space Exploration. It’s not only earth or space but doing something with it. It’s not just the domain, but what you do in that domain.

Dr. Cook said there are two questions. Should GEO change its name and what it should change it to. She asked with others think about the first part. It would be a big deal to change the name.

Dr. Arnosti said there many pressing issues and if it’s not broken, maybe it doesn’t need to be fixed.

Dr. Parsons said, “climate systems,” doesn’t include weather, turbulence or pollution. Using “climate” leaves out that part of the problem.

Dr. Kraft said changing the name could create a new problem.

Dr. Robock said The National Center for Atmospheric Research, never changed its name, even though it includes oceanography, hydrology and climate science and asked if GEO is a brand that NSF wants to discard. In his Department of Environmental Sciences, people do atmospheric science, but oceanography is in a different department, geology is in Earth and Planetary Sciences, and there’s a geography department, but everyone works together. As the oldest environmental sciences department in the country, it does not want to rebrand with a more

descriptive name. If you're going to change it, there's got to be a good reason and a better name, and you can't lose the brand.

Dr. Kraft provided some comments from the Zoom Chat: it is important to include "water"; "system" is more inclusive than earth sciences; if you're not a scientist you might not know what Earth Systems is; a department that had this discussion settled on Earth, Marine and Environmental Sciences.

Dr. Kraft spoke next to the aspirational aspect and whether DEI is part of it. These topics are not siloed, and the Earth is a complex system. But it becomes a laundry list.

Dr. Isern said a useful part of the discussion is reflecting on relevance and whether "geosciences" is too narrow. She thought the discussion would get into: Who are we? What do we do? What do we fund? And then the mechanics of getting everybody's name in there. But she said maybe the name doesn't change because it is a brand and there could be a loss of recognition. But she asked if GEO is naming itself out of a broader sector that affects what the directorate does. If the GEO name is the first thing people see and they're, like, geoscience? Is that like crystals and things? The mission and vision statement was done to know who we are. What is the ecosystem that the directorate supports?

Dr. Stammerjohn said branding might be less relevant to the science community but more important to Congress. If so, it needs to be updated. It needs to be catchier and cutting edge. With the vision of NSF under the new director with everything cross directorate and interconnected, it's a good idea to hook that, she said, suggesting "integrated" or "system science." Dr. Isern said part of the motivation has to do with Congress.

Dr. Oboh-Ikuenobe said if GEO changes its name, geosciences can remain in the name. But missing is the environment. The millennials are all about sustainability and saving the planet. She did not know of any directorate that has environment in its name.

Dr. Kraft said a question in the Zoom Chat asked if people outside NSF hear "climate" as related to NSF, do they think of the GEO directorate? Environment speaks to people. A question is how to bring more people into the directorate. She noted The Division of Environmental Biology, but there's no use of "environment" at the directorate level.

Dr. Isern said she likes the name "Earth, Environment and Space Studies." She said the word "climate" is politically charged.

Other suggestions from the Zoom Chat include "Ecosphere" and "Atmospheric, Geologic, Oceanographic and Polar Sciences."

Dr. Kraft noted that NSF is not looking for answers today. But one of the challenges is having multiple audiences. They have different lenses and different ways of operationalizing words. When the AC wrote its last report, the audience included multiple groups. Establishing the audience targets your approach.

Dr. Grimes asked if people know we are part of the geosciences. A lot of what was discussed earlier in the day was about the missing millions and supporting people in this enterprise and thinking about race and equity. She asked if that is an important piece. As to engaging that next generation, would a name change that is aspirational be important?

Dr. Kraft said the general public or Congress might not understand what is meant by ecosphere.

Dr. Isern said that in line with the new directorate and embracing use-inspired research, we're thinking about ourselves as an agency and how we interface with the community.

Dr. Kraft asked about what happens next. Dr. Isern said there will be more internal dialogues and it will come up again with the director. If the feeling is it's worth looking at options more seriously, she would come back with options. She would like to understand the process EHR went through with its change and what was driving it.

Dr. Kraft also asked if going out to different groups to ask what they think is part of the process. She also asked about assuring the directorate is appealing to a population that may not necessarily associate in the same way that it has been historically.

Dr. Isern said sometimes just changing your brand is good. It gives you a chance to resell yourself and attract attention for a while. Whether the new name is tons better than the current name, it's a new name. It's new, it's bright, shiny. It's going to be the decade of geoscience and changing the name is a way to say we're here and dominating for the coming decade. It's shining a light on oneself.

Dr. Cook said changing the name just to change the name and draw attention may be neglecting the pain that would go with deciding on a new name. It risks alienating people, as well as pinging us to the top of some list of who's in the news. She said she would not do it just to do it.

Dr. Oboh-Ikuenobe said that even if there's no name change, it is a good conversation for town halls.

Dr. Mitchum said that if name is changed, attention should be given to who on the present team might be left off. This does not represent them, unless you come up with a laundry list name. A short and catchy name helps with branding but there is a danger of who you're leaving out. Dr. Kraft said that goes to who's left out currently.

Dr. Whitlock said that when thinking about a name or branding, it's easy to imagine we are much broader than we are; but there are all the other directorates. We can't take a name that's so broad it's going to interfere.

### **Thursday, April 14, 2022**

#### **Update on the Draft NSF Strategic Plan**

Dr. Meacham introduced the NSF 2022-2026 Strategic Plan released March 28, which tries to capture opportunities that lie ahead for science and engineering research.

The plan is inspired by the NSF vision:

- A nation that leads the world in science and engineering research and innovation, to the benefit of all, without barriers to participation.

He also provided the NSF mission and core values:

- The NSF Mission:
  - To promote the progress of science, to advance the national health, prosperity and welfare, to secure the national defense.
- NSF's Core Values:
  - Scientific leadership
  - Diversity and inclusion
  - Integrity and excellence
  - Public service
  - Innovation and collaboration

He presented a set of goals that flow from the mission with accompanying strategic objectives:

- Empower STEM talent to fully participate in science and engineering
  - Increase the involvement of communities underrepresented in STEM and enhance capacity throughout the nation
  - Grow a diverse STEM workforce to advance the progress of science and technology
- Create new knowledge about our universe, our world, and ourselves
  - Accelerate discovery through strategic investments in ideas, people, and infrastructure
  - Advance the state of the art in research practice
- Benefit society by translating knowledge into solutions
  - Advance research and accelerate innovation that addresses societal challenges
  - Cultivate a global Science & Engineering (S&E) community based on shared values and strategic cooperation
- Excel at NSF operations and management
  - Pursue innovative strategies to strengthen and expand the agency's capacity and capabilities
  - Attract, empower and retain a talented and diverse NSF workforce

Dr. Meacham went on to discuss NSF's opportunities and challenges:

- Building a Sustainable Future
  - Climate and Resilience Research and Innovation
  - Clean-energy research
- Emerging Industries
  - Manufacturing
  - Wireless Technologies
  - Biotechnology
  - Quantum Science and Engineering
  - Artificial intelligence
  - Semiconductors

- People, Technology, and Change
  - The Interaction of People with Technology
  - Conflict and Change
  - The Physics of Aging
  - Non-equilibrium Systems

Dr. Meacham discussed each of the strategic goals individually:

- Goal 1 - Empower STEM talent to fully participate in science and engineering
  - Strategic Objectives
    - 1.1 — Ensure accessibility and inclusivity
      - Increase the involvement of communities underrepresented in STEM and enhance capacity throughout the nation.
    - 1.2 — Unleash STEM talent for America
      - Grow a diverse STEM workforce to advance the progress of science and technology.

Here he discussed what he said is a very ambitious agency priority goal:

- By September 30, 2023, NSF will increase both the number and proportion of proposals received from underrepresented and underserved 1) investigators and 2) institutions by 10 % over the FY 2020 baselines.
- Goal 2 - Create new knowledge about our universe, our world and ourselves
  - Strategic Objectives
    - 2.1 — Advance the frontiers of research
      - Accelerate discovery through strategic investments in ideas, people, and infrastructure.
    - 2.2 — Enhance research capability
      - Advance the state of the art in research practice.
- Goal 3 - Benefit society by translating knowledge into solutions
  - Strategic Objectives
    - 3.1 — Deliver benefits from research
      - Advance research and accelerate innovation that addresses societal challenges.
    - 3.2 — Lead globally
      - Cultivate a global S&E community based on shared values and strategic cooperation.
- Goal 4 - Excel at NSF operations and management
  - Strategic Objectives
    - 4.1 — Strengthen at Speed and Scale
      - Pursue innovative strategies to strengthen and expand the agency's capacity and capabilities.
    - 4.2 — Invest in People
      - Attract, empower and retain a talented and diverse NSF workforce.

### Discussion

In response to a question from Dr. Kraft, Dr. Meacham said the strategic goals are for NSF as an organization and help focus what it pursues. There will be impacts on discussions among PI's

about what they're interested in proposing and there are changes to some language in solicitations to signal to the community NSF's interest in these areas. And you might see it among reviewers and some discussions of proposals. But we're not talking about changing the merit review process.

Dr. Arnosti asked about Goal 4. This is not something we have discussed much. She asked what concrete actions are planned. Dr. Meacham said NSF wants to invest more in training. The NSF Academy provides internal training and opportunities for NSF employees to hone skills through external training. There is a growing range of tools for identifying potential research and reviewers. They would benefit from harnessing the growing range of skills emerging from academia. NSF wants to make sure it equips its workforce to keep up with those skills. For example, not everyone needs to be a data scientist, but it strengthens everyone's ability to perform well if they have some level of understanding and familiarity with data science. NSF is emphasizing the geography of innovation, the widespread availability of talent. It is looking to provide research opportunities to everyone. People have different perspectives on what science can be and what it can do.

Dr. Robock said there was a lot of discussion about broader impacts and how it's used differently in different parts of NSF and asked if there will be an effort to make it clear what it means and how it should be used in reviews.

Dr. Meacham said there are no plans to change the criterion itself but there are efforts to help develop a common understanding. The reviewer training video clearly explains the criterion and identifies examples of broader impacts. Dr. Robock said a lot of people have old ideas and suggested forcing people to watch the video. Dr. Meacham said POs are encouraged to ask their reviewers to watch the video before they review proposals. He suggested asking program officers to make the video available and said the advisory committee can remind NSF staff about the importance of having a clearer understanding of broader impacts and making all the tools available. Dr. Robock said there is a comment in the Zoom Chat from Dr. González that he watched it and it is too vague.

Dr. Kraft asked the AC to focus on the larger strategic plan; this may not be the best time to talk about the operationalization of the review process.

Dr. Grimes asked how NSF is thinking about underrepresented and underserved individuals and institutions in relation to the 10% goal and if it is considering expanding its definitions. How individuals self-identify doesn't always match the current definitions. Dr. Meacham said NSF has to follow Federal government standards for collecting demographic data. Laws prevent compelling people to provide demographic information. And we have a more sophisticated view of the range of identity than is captured by the standard criteria. NSF will not be able to change those criteria in the immediate future. But in the area of underserved institutions, it is easy to know whether a proposal is coming from a certain institution. The available categories help identify whether someone is likely to be underrepresented. The purpose is to ensure a more inclusive research environment in which previously underrepresented communities become better represented and we can gauge that even with imperfect demographics.

Dr. Grimes said that if NSF isn't measuring all different aspects of identity, it is missing the opportunity to be inclusive in its practices. Dr. Meacham said NSF is open to advice and suggestions, adding that NSF is always going to be playing catch up to some extent.

Dr. Parsons said AGS has had discussions about providing more of a breakdown, perhaps by group within AGS. It would not be giving away people's identity. In the weather climate community, a lot of breakthroughs come from interagency and international collaborations. And a lot of the advances are when NSF, NASA and the Department of Defense (DOD) come together. But there's only one comment about streamlining interagency collaborations. Dr. Meacham said it is not highlighted prominently. The reference to streamlining was a Memorandum of Understanding process. For joint solicitations with other agencies, there is a long process that has been relatively bureaucratic. A team took this on and came up with a more streamlined process now being implemented. But a lot of the interagency collaboration to handle it happens less formally at a program level. There won't be any pulling back from that.

Dr. Gamage asked about the current percentage of proposals from underrepresented institutions. Dr. Meacham said he did not have the number. But NSF has been developing the baseline on which the 10% increase is calculated. For emerging research institutions, it's the single digit percentage. But there are programs with greater representation of emerging research institutions. One is the major research instrumentation program, where more than 20% of the funding was going to emerging research institutions.

### **Update on the NSF Learning Agenda and Climate Equity**

Dr. Cosentino said that at the last meeting, the AC broke into three groups, and she provided some of the main themes that emerged in those conversations:

- AC small group discussion themes
  - Research priorities
    - Engaging diverse voices in designing research questions for research or learning agendas, particularly from vulnerable populations
  - Research design
    - Pursuing participatory research methodologies to promote the co-production of knowledge with affected stakeholder communities
  - Research teams
    - Including “translators” in research teams to facilitate the dissemination of research results to different communities
  - Information
    - Securing access to critical and unbiased information to consider the disproportionate impacts of climate change in different communities
  - Virtuous cycle
    - Equitable solutions generate opportunities for greater participation and partnership with diverse stakeholders to make more rapid progress in mitigating and reversing climate change impacts

She said that these reinforced the importance of:

- Barriers to progress
- Opportunities for progress

- Monitoring as a tool for progress

Dr. Freyman continued the presentation by discussing a [draft charter](#) for AC-GAO feedback:

- Drafted a charter for a GEO AC subcommittee:
  - Charge: Support NSF by reviewing NSF's work and providing suggestions or recommendations to advance NSF's efforts in the areas of climate change and equity

Her office has also released call for proposals to obtain support for this work:

- Award: Improving NSF's Analytic Capacity—Using machine learning techniques to analyze the NSF portfolio of investments.

She said AC members are being asked to serve on a subcommittee:

- Charter activities
  - Membership: 5 to 7 members from the AC and other experts
  - Activities:
    - Provide expert guidance on EAC's work to support the subcommittee
    - Provide feedback to NSF on this pilot test of engaging an AC in NSF's Learning Agenda
  - Meetings
    - Quarterly virtual meetings
  - Timeline
    - Estimated to be 1 year

She also discussed next steps:

- Input on the charter and charge welcome!
- NSF's work will continue while the Subcommittee is formed

### Discussion

Dr. Kraft said asked about the process for approval. Ms. Lane said the AC has approved a subcommittee and volunteers can be solicited later in the meeting with a discussion about the charter at that time.

Dr. Romanowicz asked about translators in the research teams and related logistical issues. Dr. Cosentino said the translator role has become increasingly important with the move towards convergent approaches and multidisciplinary teams, where everyone speaks a different language. She said whatever resources are needed will be provided and the team can be enlarged to bring in the needed voices. One voice is AC members, but others can be brought in as needed.

Dr. Kraft suggested that the idea is to work through some of the bigger ideas and questions within the charter using the data provided. She referenced the faculty cluster hiring discussed yesterday. One of the people brought in was a social scientist. Not everybody has that as an option. She also mentioned a question in the Zoom Chat about whether an AC member rotating off the committee can be on the charter subcommittee and thought the answer was that they can. Dr. Patino said the directorate can be translators as well. Dr. Kraft said the operationalization will come later.

Dr. Richardson expressed appreciation for having a product of the earlier discussion. Dr. Kraft agreed that sometimes it's not clear if anything comes of such conversations.

About operationalization coming later, Dr. Cosentino said the solution is not yet cooked, it is being created and she wants to work with whoever volunteers to figure out the path forward.

Dr. Kraft asked AC members to think about volunteering and said it is important to bring different perspectives that have not been heard on the AC by tapping into the larger collective community members represent.

Dr. Kraft also said there was discussion earlier about a question from Dr. González, who said a problem with increasing the number of proposals is lack of expertise and experience writing proposals and lack of support structure. Often these PIs are not succeeding and not submitting again. Awards are proportionate to the number of proposals. Hopefully the number of proposals and awards will increase by 10% and he asked to see strategies that address that. Dr. Meacham said NSF can respond to that through GRANTED and agreed on the barriers that make it difficult for PIs from institutions without the same level of support for preparing proposals. There are also challenges with post-award management. GRANTED works with the natural support community within these organizations to provide resources to strengthen capabilities and encourage partnerships between more research-intensive institutions and less research-intensive institutions. That's going to be a significant effort starting an FY '23. Dr. Aluwihare applauded the opportunity for R1 and more experienced institutions to partner and the mentoring aspect. But there's a lot of inertia in the review system and NSF should be careful about training in the review process.

Dr. Meacham said he welcomed advice on how to effectively sensitize reviews to these issues. But you are our reviewers. PI's and reviewers are the same group. AC members can engage others in their communities on these topics. He suggested organizing a session about the context in which PIs and different universities are operating and how that might affect the review process. Also, it would help if AC members explained that context in proposals. But there is the Research in Undergraduate Institutions (RUI) mechanism where you get free pages to provide reviewers that context. But we need to seriously think of ways to expand our training wheels. We're trying to provide more opportunities to people who had fewer opportunities and there isn't one silver bullet.

Dr. Kraft raised points from the Zoom Chat. Increasing impact, along with the number of proposals, should be considered. It's not just the number, but the specific kinds of programs. Dr. Cook asked in the chat: As we expand the pool of people and institutions proposing, how do we ensure success rates do not crash? To avoid putting in so much work and getting a proposal rejected, some agencies use pre-proposals. The model of having an undergraduate institution or community college partnering with an R1 for support and resources is a way to enable NSF to spread more funding into these institutions. Setting aside money for these kinds of partnerships, or a special call to ask for these kinds of partnerships, would be supportive for faculty at undergraduate and community colleges.

Dr. Meacham said EDU has building activities and at particular types of institutions. One that involves community colleges is ATE. The program officers who run that program are interested in collaborating with directorates. There may be opportunities for GEO to collaborate with ATE. The Engineering Research Center Program and the Science and Technology Center Program encourage research intensive institutions to partner with less intensive institutions, including community colleges, and broaden participation in research. The centers involve 10 to 12 institutions. There is a big spectrum of individual investigator and small team collaboration proposals. He asked if there is an opportunity to foster more participation by community colleges and, if so, how to encourage it. Dr. Parsons said one of the biggest restraints to proposals and research at non-R1 institutions, or schools without strong research departments, is the extensive amount of teaching. People there have raised the issue of whether teaching buyouts can be included in addition to salary.

Dr. Whitlock said the Established Program to Stimulate Competitive Research (EPSCoR) program is an effort to reach across to community colleges and minority serving institutions within particular States to bring everybody together and provide training on successful grant submission and might be a model.

### **Expanding GEO's Institutional Reach: A Plan for Campus Visits**

Dr. Isern said a lot of thought has been given to community outreach and making it more effective. POs do outreach with different types of institutions, so GEO has been talking about areas where there's information to be shared. There have been a lot of office hours during the pandemic. But with a full range of institutions on the AC, this is the best place to ask what information is the most useful for NSF to transmit. She said that for her to talk about grant programs is less effective than having a PO do so because they work closely with different programs; but to discuss administrative challenges, she may be more effective. Dr. Isern said that Dr. Kraft had suggested AGU and big conferences. Dr. Isern said GEO is excited about GRANTED, which came about after hearing from the community about challenges.

### Discussion

Dr. González said there are multiple problems that need to be addressed to increase proposal submission. One is POs can better address questions than PIs. Also, administration in many smaller schools is a hindrance to submissions. There are administrators that won't accept budgeting buyouts for teaching on a grant if there's no one to take over one's obligation. Also, there's no infrastructure, which is a problem PIs cannot solve but administration can. So, a higher-level officer, such as Dr. Isern, can be a better envoy. The problem with using the major conferences is that they are expensive. And when you're teaching four courses a semester, there is time to attend for one day and it can be extremely expensive to travel. Regional or localized meetings would provide better outreach.

Dr. Grimes suggested paying people for their participation at the events being targeted. She also suggested convening people who have been successful getting proposals funded from smaller institutions together on a panel and making that open to other groups to ask questions about the process.

Dr. Parsons noted national conferences of presidents of two-year schools and perhaps a meeting of tribal colleges. Also, national meetings on climate equity could be helpful.

Dr. Whitlock suggested NSF staff work with the State EPSCoR offices and go to small colleges and community colleges and talk to research offices about challenges and help guide EPSCoR funding to that effort. NASA does a good job reaching out to tribal colleges and it would be great to have NSF doing that.

Dr. Kraft said in the Zoom Chat there is agreement about the challenge of AGU. It was also pointed out that the Heads and Chairs Program is a way to educate. That is part of the challenge of not just talking to potential PIs, but the administrators. Which administrators matters because a department chair in one institution might not have the power to make those decisions. NSF is embedded in its own language. Referring to all sort of abbreviations for someone who's never been through the process can be mystifying and intimidating, so that's part of having translators.

Dr. Gamage said that if are planning to visit any small institution, invite the nearby four-year institutions and museums or industry. One of the problems at community colleges is to find collaborators. Dr. Isern said it could be like the NSF Palooza, but broader than a one-on-one visit and NSF could become enablers for some of the goals that have been talked about at this meeting.

Dr. Kraft said that for those types of institutions where students are regionally based, it's harder to take advantage of an opportunity out of State.

Dr. Isern said NSF thinks about the dangers of getting too tied into its own world. The program officers have done much outreach, but it's not the only thing. We should be thinking more broadly about spreading the word and interfacing with the community.

Dr. Parsons said tribal college and university presidents meet in Virginia, close to NSF.

### **Broadening the Institutional Research Base Panel**

Dr. Isern introduced Dr. Knoedler as a leading force in GRANTED. Dr. Knoedler said GRANTED ([information at pp. 3-4](#)) is a new program. NSF needs to expand its knowledge and the way it interacts with institutions attempting to be successful with NSF and new investigators. GRANTED is an FY '23 request so there's a journey before it distributes funding. It is an initiative at this point, not a program. It's not a single solicitation. It tries to engage individuals who have been less engaged by NSF in the past. There is also an external piece about engaging the breadth of experience among research administration staff, technology transfer, corporate relations, research policy and research leadership. The question is how to engage all that knowledge and experience in addition to the investigators to take a holistic approach in building out the research enterprise across all types of institutions and investigators. NSF does a lot of engagement with the external community, including listening sessions. There are not many mechanisms in which NSF shares that information, integrates it and uses it for decision making. OIA is a cross cutting directorate where everybody is supposedly part of its purview. The director talks about pursuing discovery at speed and scale, but how can we reach that if we are siloed? We're not sharing what we're learning from talking with HBCUs or community colleges

or people in rural destinations. How are we to amplify experiences from investigators who have been less engaged with NSF?

Dr. Robock asked how many want to engage with NSF. If there are people that want to do research, they would already be at an institution that emphasizes research. If you're at a community college, you don't have the time and aren't rewarded for research. It's about teaching. There are a few people who would rather be doing more research, but a lot of people are in the place where they are because of what it emphasizes already.

Dr. Knoedler said she didn't have numbers for untapped research potential. But it is unlikely to ever be answered in a quantitative way. From her experience, there were individuals who struggled to be successful with NSF and didn't know how to make their ideas competitive for funding. There's a lot of untapped knowledge and potential around how to build successful partnerships and collaboration. Sometimes the idea isn't ready for primetime, but there are also other barriers. GRANTED is about trying to mitigate barriers that are administrative or that otherwise make it difficult to get resources.

Dr. Richardson said that for a lot of colleagues at non-R1 universities want to involve their students in research with the theme of teaching through research. A friend at a smaller college is always looking for grant funding to help fund undergraduate students and keep them involved.

Dr. Kraft said one of her graduate students wants to teach at a community college and do research at a level he can manage. Another undergrad came from a community college and got interested in science through doing research there. This is a way to reframe untapped research and innovation potential. People at different institutions are asking different questions because of the community they serve and the population that they work with. The questions might be different at a community college, but it doesn't make one more or less valuable. They're all important for the larger, broader conversation. That goes to wanting to broaden participation in general. There's both an equity argument and an argument for the idea that better ideas come from a broader array.

Dr. Knoedler recounted a conversation with a university that recently moved from R2 to R1 and talking about how to sustain some practices and bring them to the R1 level. The institution had at least one person in charge of corporate partnerships, but there was never a focus for that person in research partnerships. How do they learn to form partnerships focused at the institutional level that had a research focus?

Dr. Aluwihare said it is important to think about who gets to be at an R1 institution and the barriers to entering R1 institutions that can be aligned with racial and ethnic backgrounds. It's not fair to say people at four-year universities are not interested in research; they may not have had the opportunities to focus on research.

Dr. Patino said all the perspectives are needed to address climate change. Otherwise, there will continue to be piecemeal approaches. NSF needs to engage individuals from all sorts of institutions.

Dr. Hargraves said NSF needs new ways of thinking of the research enterprise and workforce development. Dr. Kraft said how to shift reviewer mindsets is not an isolated question and it's an important one to keep in mind in the broader perspective of conversations the AC has been having. Dr. Parsons said there's evidence from start-ups that a diverse group of people in leadership, often from diverse backgrounds, leads to greater success. And that's probably true in the research enterprise.

Dr. Smith-Nufio introduced the next session with panelists, prior to starting breakout sessions.

Dr. Hargraves discussed her background and highlighted key features of partnerships between institutions. One is that the partnership is not just a partnership in name. Oftentimes, the work we do at our institutions are complementary and additive and we must understand each other's institutional context and how they complement each other. Some programs in the Division of Undergraduate Education (DUE) focus on access and broadening participation. For example, Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) is for low-income students. The Robert Noyce Teacher Scholarship Program places teachers in high-need school districts. The Improving Undergraduate STEM Education (IUSE) program focuses on research, adaptation and implementation of techniques and new contexts. DUE also has an HSI program with the Division for Hispanic Serving Institutions. DUE tries to craft onramps for institutions that may not have received NSF funding recently. There are tracks where they are focused on building capacity or smaller awards that provide pathways into a larger grant. Barriers to funding include requirements that may make it prohibitive to put together a proposal for a sponsored research office with one person. The institutional review board (IRB) person may be also doing the data analytics for the institution. And there are institutions that have high teaching loads but are interested in research. Also, 10% of DUE awards are to institutions that have not received an NSF award within the last five fiscal years.

Dr. Elder said she is a geologist doing work in arid lands geomorphology and a rotator from Northern Arizona University. She was PI for an REU site program and Undergraduate Mentoring in Environmental Biology (UMEB), which transitioned to an Undergraduate Mentoring in Environmental Biology (UMEB), both oriented toward mentoring undergraduate students. The REU is focused on recruiting from tribal colleges and tribal communities. HRD has its primary focus on broadening participation and includes ADVANCE: Organizational Change for Gender Equity in STEM Academic Professions, which provides models for diversifying the professoriate; The Louis Stokes Alliances for Minority Participation (LSAMP) program, which provides support to alliances of institutions of higher education to help support student recruitment and retention in STEM; The Centers of Research Excellence in Science and Technology (CREST) program, which is oriented around a center model and focused on building research capacity at MSIs; the Historically Black Colleges and Universities - Undergraduate Program (HBCU-UP) to strengthen undergraduate STEM education and research at HBCUs; the Hispanic Serving Institutions (HSI) Program to enhance undergraduate STEM education and increase recruitment, retention and graduation rates; and the Tribal Colleges and Universities Program (TCUP), that includes Federally recognized tribal colleges and universities, Alaska Native serving institutions and Native Hawaiian serving institutions.

Dr. Carter reviewed her background and said she is LEAD program director on the ATE program, a workforce development program focusing on education of the skilled technical workforce. This workforce uses science and engineering theory but does not necessarily need a baccalaureate degree. According to a recent report, the STEM workforce makes up 23% of the total U.S. workforce. Of that, 23%, more than half the STEM workforce, are the skilled technical workers. In 2020, approximately 40% of all U.S. undergraduates were on two-year campuses. Thirty-six percent of first-time freshmen are on two-year campuses: 53% of Native Americans, 50% of Hispanic students, 40% of African American students, 36% of Asian Pacific Islanders, 20% of students with disabilities and a lot of students who come back to a two-year institution already having earned a baccalaureate or a graduate degree to re-skill to get a job in the industry with the right skills and competencies. You can't be responsive to industry unless you form effective partnerships with them. Two-year institutions can also provide a pathway to four-year institutions. Also, two-year institutions are developing applied baccalaureate four-year programs. A highly effective project is [Mentor-Connect](#), which recruits, supports and mentors institutions new to ATE in developing a competitive proposal. There is also a working partners project, which is about how to establish a partnership, especially with industry, and has a leadership institute on how to develop partnerships. Another project to involve the presidents of community colleges is the Community College President's Initiative addressing why it is important to go for Federal funding.

She also mentioned DUE support for the GeoTech Center in the Kentucky Community and Technical College System. There's a large interest in undergraduate research at community colleges. Another initiative is the Community College Undergraduate Research Initiative, which has partnerships with more than 100 community colleges. And there is a new partnership between IUCRCs and ATE, which provides an opportunity for two-year faculty and students to engage in industry-relevant research at IUCRC sites.

Dr. Smith-Nufio prepared the AC for dividing into breakout sessions.

Upon returning from their breakout sessions, the AC received reports on the individual sessions.

Dr. Arnosti said her group started with a discussion of the types of environments that facilitate good partnerships and finding information. Suggestions included getting people together at AGU meetings and a clearinghouse of information. Small regional meetings might be a more appropriate venue for some. There needs to be a shift in perspective from R1 institutions offering to cooperate with other people to a real partnership. Part of the issue is building trust and learning to navigate systems. There is a need to develop equitable and authentic relationships. A way to develop such connections may be mechanisms that permit teaching or sabbaticals at other institutions for a semester. Dr. Hargraves added that professional societies have to think broadly about the variety of available resources and think beyond PI engagement to possible SRO engagement.

Dr. Aluwihare, reporting for her session, said they talked about traditional pathways of bringing R1 and non-R1 institutions together and ensuring R1 institutions know their region in terms of MSI or community colleges and ensuring information is circulated. They discussed getting beyond BI. They talked about authentic collaborations where people are co-PIs with equal co-

creation of scientific knowledge and solicitations that encourage those types of proposals. There was discussion about having pots of money that could be for someone in an R1 to pay for their time to work with community college partners to develop proposals and being more targeted about those opportunities. They discussed facilitating ways to pay for time to give opportunities to develop proposals, including teaching buyouts. They talked about partnering SROs from R1s and non-R1s. They discussed educating reviewers and panelists about the ways people participate in research. There may be biases about adjunct faculty commitment to research, but many adjunct faculty in community colleges are committed to research. They discussed ensuring institutions show support for those faculty. Also, making sure program managers understand and empathize with the challenges people are trying to address in non-R1 institutions.

Dr. Carter said there was also discussion about better education of program officers within NSF about the differences in cultures between R1 and non-R1. The Proposal & Award Policies & Procedures Guide (PAPPG) generally says two months of support is expected, unless additional time is justified. NSF needs to say there are times when it makes sense to have justified additional time to complete a project.

Dr. Stammerjohn, reporting for her session, said they talked about how to bring people together from R1 and non-R1 institutions and needing spaces to bring people together for a meet and greet to talk about concerns. Resources are needed to bring everyone to the table, particularly from the non-R1s. Not everyone has access to big meetings with poster sessions. Research Coordination Networks (RCN) might be one place. It was suggested NSF provide a resource list for tapping into these resources. For BI, there needs to be better guidance and accountability re expectations. There is a question of whether they are supported by program managers and the review panels. Resources would be helpful for outreach.

Dr. Wildcat suggested NSF funding for visiting faculty to go to tribal colleges and universities to understand the available resources and problems. It is a different reality from what research scientists are used to in R1 institutions. Dr. Richardson said she hadn't thought of how much of what we do has been dominated by R1 institutions.

### **Preparation for Meeting with NSF Director and Chief Operating Officer**

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

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

Dr. Kraft welcomed the director and asked AC members to introduce themselves. She summarized the committee's agenda and asked Dr. Oboh-Ikuenobe to provide an example of expanding participation.

Dr. Oboh-Ikuenobe discussed developing collaborations with people across a broad spectrum, including R1 institutions and museums for outreach to the community. This became a pipeline for recruiting students from community colleges. NSF could help define BI activities, as researchers are not good at it and don't know what is beyond training the next generation of scientists.

Dr. Wildcat added that NSF has a role in supporting spaces such as community science centers and museums for engagement. It is not sufficient to contact MSIs and non-R1 institutions about a Request for Proposals (RFP) and invite participation if there isn't a relationship. He provided an example from 2006 when he used a grant to invite tribal college representatives to his campus to talk about climate change research in their homelands. From that was formed the American Indian and Alaska Native Climate Change Working Group. He invited people in tribal colleges and Federal agencies and received support from USGS, the Environmental Protection Agency (EPA), NASA and NOAA. It is an example of the need to support spaces to bring together people who don't know what each other are doing, particularly MSIs and non-R1 institutions. Another example is The Rising Voices Center for Indigenous and Earth Sciences (Rising Voices), which brought together traditional knowledge holders with geoscientists and put together a large proposal. That required 10 years of meetings to build relationships. There is a need for more faculty exchanges between R1 geoscientists and TCU scientists going to R1 institutions to understand the different worlds and environments to build successful partnerships.

Dr. Panchanathan said that was fantastic input and congratulated Dr. Kraft for Whatcom Community College's cybersecurity research and education. He is thrilled with the AC's conversation with the innovation group, and he praised Dr. Isern's work and the emphasis on climate equity. Her vision is aligned with what AC members are talking about and there is no doubt there will be tremendous progress. Part of the vision is taking tangible things that can be translated quickly to real solutions. Those solutions may or may not work, but more fundamental research will be able to deliver optimized solutions. The symbiosis between curiosity driven explorations and use-inspired innovations is going to make NSF and GEO very successful. When innovation is being emphasized, does it take away from fundamental scientific research? The innovation focus is to leverage what's going on in the directorates, particularly GEO, and energizing more activities in the GEO directorate. What happens is investment scale. Many years ago, the National Institutes of Health (NIH) funding was no different from funding levels at NSF today. A conscious approach of trying to focus on certain diseases gave them a platform to draw from their basic biomedical research and use that in the clinical space and use clinical outcomes to further emphasize fundamental research. It is a \$45 billion agency. NSF is an \$8.8 billion agency. You can rest assured that the innovation focus is going to scale the fundamental research several times more than we will be able to do with the normal progression of increases for basic research, which has not been impactful enough.

On another topic he said he wants to constantly think about whether there is a label better representative of what we are doing or will we be doing in the future. You are the experts and work with the community, and I want to listen to what you think might capture that better. If you come back and say the geosciences perfectly exemplifies what we need to be into the future, I'm comfortable with that. But we are challenging ourselves and you to think about other possibilities.

Regarding the learning agenda and the focus on climate equity, he is thrilled to see the conversations the AC is having because that's a very important part of NSF's continuous assessment of how we are moving forward in the aspirations and goals we have set.

Returning to remarks from AC members, he said in his previous employment he worked closely with the science museum, which became a portal for representing his work to the public and attracting young minds and associating with community colleges and all universities by demonstrating the value of what you're doing and how they can contribute into the future. When we talk about broader impacts, these platforms are vehicles we need to use to the fullest extent. All institutions need some form of BI office. One of the focus areas NSF can bring could be museums. I'm encouraging the presidents and chancellors to think about this when they're talking about BI. When I came to the agency, I said that we need R2s, TCUs, MSIs, HBCUs, HSIs and community colleges to have a strong presence of ideas that we invest in at NSF. Talent and ideas are democratized all across our nation. There is no exception. How do we take those talents and ideas and give them the opportunities to be successful in a gold standard merit review process, where ideas get presented in a way that prevails and gets invested in. We are launching a program called GRANTED to provide a virtual resource for institutions that don't have R1 resources for proposal development and the pre-award, post-award kind of infrastructure to put these ideas into a form that competes in our merit review process. How can we have the same thing available for institutions to bootstrap and build that and take advantage of that? NSF will be investing heavily in this starting in a pilot way in '22, then making it available to all individuals and institutions that require that assistance. He calls it a virtual research office available for any faculty member. It's great to have relationship building but we want these things to happen at a faster pace, at a faster scale. It doesn't have to be that the R1 institution is the leading institution and other institutions the partner institutions. It should be flipped in some cases. That partnership can take the form of people from R1s being hosted by R2s and MSIs and R2 folks going into R1s and working in partnership.

He also said he is working with the head of NOAA to create a number of things. There will be a joint workshop in June. When we talk about climate, NSF should work with NASA, NOAA, DOD and a host of other agencies to converge our agendas.

In closing, he mentioned that The President's Council of Advisors on Science and Technology (PCAST) is putting a special focus on wildfires.

### **Wrap-Up and Action Items**

Dr. Kraft listed three action items: talking more about the subcommittee; broader impacts; an NSF response to the report from the last AC. She asked if there are other items for the fall agenda.

Dr. Robock asked for information about what NSF is going to do with NOAA. Dr. Isern said there is discussion about an annual summit to develop a roadmap with short-, medium- and long-term partnership goals and discuss collaboration broadly. It is projected for late September. Dr. Robock asked if NSF is thinking of combining labs with NOAA. Dr. Isern said no; collaboration will be at the program level. As a near-term example, NOAA wants more involvement in CoPe. A longer-term example is partnering to stimulate AI, marine learning and observations.

Dr. Grimes said the offices for BI the director mentioned have the potential to perpetuate inequities along the lines of R1s vs. other types of institutions. If you have resources to begin with, your BI are probably going to be stronger.

Dr. Whitlock asked about other institutions that serve the same role as museums as translators of climate science. It might be worth discussion next time. National parks could be the translators and connectors. Yellowstone can take our science and communicate it nationally and internationally.

Dr. Richardson asked if the director got the point about exchanges. He talked about them on a shorter-term basis and as being virtual. It's important to have a longer-term, in person experience. Dr. Kraft said it's not just about visiting, it's about experiencing. And you don't want somebody charging into an institution thinking they know what's best about that institution. Dr. Arnosti followed up with a point made at her breakout group that it is important for people from R1 institutions to get an idea of the lived experiences of folks at other types of institutions and you can only do that when you're there for a sufficiently long time.

Dr. Parsons emphasized connecting with the general population. For atmospheric science and the mathematics involved, it's hitting some kids in the eighth grade and getting them excited and impacting people happens when we have broader voices.

Dr. Kraft talked about identifying bridging institutions, which is an important thing to reflect on.

Dr. González said you have to spend time at one of these institutions to understand how it works, the available resources and the priorities of the individuals and the nature of the students. If you just come from a visit, you're not going to get it. Also, the compensation in many smaller institutions is much less than at a big school. He does not see a faculty member being able to pay out of pocket for a student to attend a meeting with the salary scales of some of these institutions.

Dr. Robock said the conversation about NSF's plan for broader impacts isn't finished. When you're up for promotion, what really matters is the science. Most people, when they review proposals, they think that too, even though there's words that say it's just as important as the scientific quality of the research. Some people think it has to involve community education or having graduate students. More uniform education about what it is and what it's not for people writing proposals and reviewing proposals is still needed. It's something NSF has to grapple with. It's not working that well. Dr. Kraft said that would benefit from a deeper conversation. It might be conversation to have with the CEO. Dr. Isern suggested having enough time at the next meeting to talk about this. Is there broad confusion in the community? If it's universal, that's something we would address. If it's certain sectors, we address that in a different way.

Dr. Robock asked about surveys throughout NSF or GEO about what people think BI are. Dr. Isern said there are periodic surveys about merit review in general. Dr. Kraft said this keeps coming up in Committee of Visitors (COV) reports. Data from multiple levels would be helpful. Capturing summaries of the COVs might be part of that. Dr. Robock said the AC has asked for funding levels and who gets funded, but NSF was pushing back because of privacy issues. Dr. Isern said there are data that can't be released. But she will ask what more can be shared.

Dr. Parsons asked if program managers could give a five-minute talk on what general broader impacts are and what's important for their section. Dr. Isern said it may be possible to set up a

panel of program officers to talk about broader impacts across GEO. Dr. Kraft said that when early career faculty have come to NSF as a part of the workshop program there was always a presentation about broader impacts that is a synopsis of the video. Dr. González said the materials are vague and not informative. The last two approved COV reports have comments regarding the broader impact statements and how something needs to be done. We need to strengthen the criteria. There are certain activities that routinely appear on broader impacts that doesn't broaden my impact and my activity. It's time we do something to develop stronger recommendations to pass along to NSF leadership. Dr. Mitchum said BI is a good topic for the fall. The POs in the different divisions are a great source of information about this. He suggested individuals gather information ahead of the fall session when meeting with divisions and program officers and collating that information for the AC. Dr. Grimes said it's more about how NSF measures the impacts of BI activities that go into proposals. He would be interested in understanding how GEO is tracking the impacts of BI activities, if it's possible to identify ones that have larger impact or how the suite of different activities is having an impact bigger than any single one. Dr. Patten suggested starting the fall discussion with someone from policy to summarize the broader impact merit review criteria and the principles behind it. Dr. Grimes asked about seeing the portfolio of things NSF funds within GEO and how does GEO track impacts across the suite of things within broader impacts, not measuring the actual impact happening at the level of the project.

Dr. Kraft said that in multiple COV reports there are things that have strong broader impacts that are getting funded, but there's the continued trend of funding things that have high ratings for intellectual merit but poor ratings for BI. But you never see the opposite. The impression from looking at these portfolios is that this is NSF's general thinking. If they are equally valued by NSF why do we keep seeing that trend? If we don't want to keep seeing that, what needs to change? The AC can provide advice.

Dr. Arnosti asked to what extent this is a generational issue. She served on a panel where there were many good science projects that had inspirational broader impacts that were creative and well done. The panel got into the weeds talking about them and the extent to which the PIs had proposed how they were going to assess their effects.

Dr. Richardson said that reviews from her last proposal that was rejected included a comment on the broader impacts section that dinged her for not having assessment.

Dr. Isern said we're seeing things that are more creative and have a complexity to them. They're wired in from the start, not add-ons. It's now a matter of practice for panels to have broader impact specialists. That helps the assessment and helps educate the panel. The COV discussions around broader impacts was also educating everybody.

Dr. Kraft and Ms. Lane asked for volunteers to be on the subcommittee looking at the climate equity learning agenda. The request will be sent by email. Suggestions for outside experts are welcomed.

Dr. Stammerjohn asked re partnerships how to find the time and resources to bring all that together? Dr. Kraft said different institutions have different goals and value systems. There might be a way to be creative with some of that.

Dr. Whitlock said that if assessment is the standard, that's an additional cost to any proposal.

Dr. Kraft thanked everyone and adjourned the meeting.