

**CORE QUESTIONS and REPORT TEMPLATE
for
FY 2021 NSF COMMITTEE OF VISITOR (COV) REVIEWS**

Date of COV: June 21 – 24, 2021
Program/Cluster/Section: All EAR Division programs
Division: Earth Sciences (EAR)
Directorate: Geosciences (GEO)
Number of actions reviewed: 376 Awards: 158 Declinations: 212 Other: 6
Total number of actions within Program/Cluster/Division during period under review: Awards: 1912 Declinations: 3409 Other: 113

COV Membership

	Name	Affiliation
COV Chair or Co-Chairs:	Jacqueline Dixon	University of South Florida

COV Members:	Lihini Aluwihare (AC-GEO) Jose Luis Antinao Estella Atekwana Wendy Bohrson Michele Cooke Anne Egger Abby Kavner Charles Mandeville Arnold Miller Patrick Reed Jennifer A. Roberts Wendy Smythe	<i>UC San Diego, Scripps Institution of Oceanography</i> <i>University of Indiana Bloomington</i> <i>University of Delaware</i> <i>Colorado School of Mines</i> <i>University of Massachusetts Amherst</i> <i>Central Washington University</i> <i>University of California Los Angeles</i> <i>U.S. Geological Survey</i> <i>University of Cincinnati</i> <i>Cornell University</i> <i>University of Kansas</i> <i>University of Minnesota, Duluth</i>
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SUMMARY STATEMENT OF EAR PERFORMANCE

First and foremost, the committee would like to commend EAR for the high standard of service and leadership they have maintained over the review period. The COV is impressed with the professional and productive performance of POs and mission/program support personnel in response not only to the normal work load, but also to the many challenges the past four years introduced (i.e., government shutdown, moving to Alexandria, and global pandemic). The quality and dedication of EAR personnel ensured that the proposal-review process proceeded in a fair and balanced way, that high-quality research continued to be funded, and that vulnerable populations (e.g., students, post-docs, early-career researchers)

were supported. The highlights of accomplishments and other metrics show that these programs are impacting scientific discovery, workforce training, outreach, and all other essential activities of the programs. We are profoundly grateful for their service.

We also commend EAR leadership for their proactive strategic planning over the 2017-2020 review period. EAR is well positioned to lead the Earth science community response to three out of four "out-of-the-gate-priorities" defined by the Biden administration, including racial justice, economic recovery, and climate change. EAR is working closely with NSF to develop and implement its BAJEDI (belonging-accessibility-justice-equity-diversity-inclusion) initiative. In addition, basic research on critical mineral deposits, paleoclimates, and changes in climate-related surface hydrology, sea level, and ecosystem health are essential for a sustainable future and are highlighted in EAR's programs.

MERIT REVIEW CRITERIA

An understanding of NSF's merit review criteria is important in order to answer some of the questions on the template. Reproduced below is the information provided to proposers in the Grant Proposal Guide about the merit review criteria and the principles associated with them. Also included is a description of some examples of broader impacts, provided by the National Science Board

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

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

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities. These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. Both criteria are to be given full consideration during the review and decision-making processes; each criterion is necessary but neither, by itself, is

sufficient. Therefore, proposers must fully address both criteria. ([PAPPG Chapter II.C.2.d.\(i\)](#) contains additional information for use by proposers in development of the Project Description section of the proposal.) Reviewers are strongly encouraged to review the criteria, including [PAPPG Chapter II.C.2.d.\(i\)](#), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

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

3. Examples of Broader Impacts

The National Science Board described some examples of broader impacts of research, beyond the intrinsic importance of advancing knowledge.¹ “These outcomes include (but are not limited to) increased participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education at all levels; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a globally competitive STEM workforce; increased partnerships between academia, industry, and others; increased national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education. These examples of societally relevant outcomes should not be considered either comprehensive or prescriptive. Investigators may include appropriate outcomes not covered by these examples.”

¹ [NSB-MR-11-22](#)

INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, returns without review, and withdrawals) that were *completed within the past four fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

SECTION I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments: The review process continues to be the gold standard. The system of <i>ad hoc</i>, panel, and PO reviews provides the opportunity for multiple perspectives on proposals and facilitates development of a strong and balanced portfolio. The committee appreciates and commends the efforts required by EAR staff to maintain high standards, while making necessary adaptations during the government shut-down of 2018 and global pandemic of 2020.</p>	Yes

<p>2. Are both merit review criteria addressed</p> <ul style="list-style-type: none"> a) In individual reviews? b) In panel summaries? c) In Program Officer review analyses? <p>Comments: Both merit review criteria are addressed at all levels in all EAR programs. The committee commends EAR personnel for their efforts to educate reviewers and panelists about the review process, including newsletters, on-line resources, and pre-panel workshops. A concern noted in the evaluation of all programs, however, is the cursory treatment of broader impacts of the proposals compared to intellectual merit within <i>ad hoc</i> (outside) reviews and occasionally panel summaries. This is not a new problem, nor is it unique to EAR. Though the PI/reviewer community is getting better at addressing both review criteria, challenges remain: many <i>ad hoc</i> reviewers lack (or feel they lack) expertise to provide substantive reviews of BI, and/or the community as a whole has still not</p>	<p>a, b, & c) IM yes; BI yes, but often less substantive reviews for BI</p>
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fully embraced their importance. In addition, the weight placed on IM in the review process appears consistently greater than that placed on BI. The appearance of differential weight on these two categories sends a message to the EAR community as a whole that BI are not as important as IM. EAR needs to be more transparent about how BIs are factored into the final decision; a guiding principle throughout EAR should be that no proposal will be funded without a robust BI component. The committee noted that the CAREER program has developed a more balanced approach; perhaps practices from the CAREER program can be applied across EAR.

Recommendation 1: *The COV recommends EAR continue to strengthen its offering of workshops and other forms of professional development for Program Officers (POs) and prospective and current Principle Investigators (PIs) that emphasize the importance of, the breadth of activities that can be considered, the evidence base for effective practices, and accepted strategies for assessing the effectiveness of broader impact activities. These efforts include NSF- or community-sponsored workshops associated with professional meetings, on-line proposal writing clinics in advance of panels, and improved communication of opportunities to partner with existing programs involving substantive BIs, such as Research Experiences for Undergraduates (REUs) and programs that facilitate collaboration with Minority Serving Institutions (MSI).*

Recommendation 2: *The COV recommends EAR provide clear guidelines to reviewers and panelists about what to look for in BIs to encourage substantive and equitable reviews (e.g., implementation of evidence-based best practices). EAR should continue to encourage panels to list strengths and weaknesses of BI, a recommendation that will be easier to implement with templates for panel summaries, which the COV understands is in development.*

Recommendation 3: *The COV recommends both BI and IM scores be recorded and considered as part of portfolio management to quantitatively track how BI and IM influence funding decisions.*

3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?

Mostly yes

Comments:

Almost all reviewers provide substantive comments, though review quality is variable. Many contained constructive and detailed information addressing both IM and BI strengths and weaknesses. The most helpful reviews provided all of this and in the summary (or elsewhere) provided an indication of why the reviewer ranked the proposals as excellent, very good, etc. These types of constructive and thorough reviews are the most helpful. Other reviews were terse, did not provide the rationale for the ranking, and/or lack specificity (e.g., “the broader impacts are weak...”). For multi-disciplinary proposals, not all disciplinary aspects received the same level of substantive review. Reviews of BI were often less substantive than those for IM, reflecting reviewers selected primarily for their expertise in the proposal science. Even with variable *ad hoc* review quality, the COV is confident sufficient information was provided to panels and POs to make informed funding decisions.

Recommendation 4: *The COV recommends EAR POs consider ways to cultivate and recognize the reviewer community by providing feedback to ad hoc reviewers on the quality of their reviews, without an undue increase in PO workload. One strategy is to simply inform reviewers that they can request feedback on the utility of their reviews; another is to highlight meritorious reviewers in a public forum, such as EAR To the Ground.*

Recommendation 5: *The COV recommends POs continue to expand their efforts to personalize invitations to review with the intention of expanding the reviewer pool and increasing reviewer response rate to all programs. In particular, the committee recommends targeted invitations to ad hoc reviewers and panelists with experience and/or expertise in broader impacts in addition to those with expertise in the proposed science.*

<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments:</p> <p>Yes, typically the panel summaries were complete and addressed weaknesses and strengths on both review criteria. Panel reviews of broader impacts were variable in terms of substantive evaluation and apparent weight in the final scoring. Panel summaries included most relevant information, however, in many cases, the ranking or decision were not included, despite the form clearly indicating this should be articulated. In some cases, the panel simply reiterated the reviewer comments with no additional insight.</p> <p>In all cases, consensus was reached, even in one case where the panel had to give the sole recommendation because all 5 <i>ad hoc</i> reviews were either declined (2) or not responded (3).</p> <p>We refer back to Recommendation 5 as a way to increase substantive panel review of broader impacts.</p>	<p>Yes</p>
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5. Does the documentation in the jacket provide the rationale for the award/decline decision?

Yes

[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]

Comments:

Yes, in all cases, PO review analyses were consistent, giving context for awarding or declining projects, with careful consideration of reviews and panel discussion. PO review analyses provided details that allowed us to understand the decision and its context. PO comments varied in length and level of detail and typically provided a rationale for the declination; they always included an opportunity to talk with the PO.

In cases where PO seemed to reverse panel rankings, they based their decision on analysis of *ad hoc* reviews and carefully explained it in their review and in the feedback to PIs. In other cases, documentation of PO discretionary decisions for funding to achieve a more balanced portfolio was lacking.

Recommendation 6: *We recognize that funding decisions based on portfolio balance are an important tool in the PO toolkit. The COV recommends EAR POs provide clear language to more clearly document when portfolio balance has been. For example: "Decisions related to portfolio balance raised the status of the proposal from Competitive to Highly Competitive based on criteria of balance among science objectives, geography, career level, diversity, and inclusion." A statement like this indicates that portfolio balance was a factor without breaching confidentiality.*

Recommendation 7: *The COV recommends POs increase transparency in funding decisions by providing not only rationales for panel rankings, but additional discussion related to high-risk/high-reward status of projects. For example, POs should include emails and conversation notes related to proposal evaluation in EAGER and RAPID grant jackets. These notes can demonstrate that multiple NSF staff reviewed and provided feedback to PIs.*

Recommendation 8: *The COV recognizes the workload on POs and PDs has increased substantially, but they continue to ensure that high-quality disciplinary and interdisciplinary science is being funded. Many also prioritize getting relevant information out to early-career scientists, as well as preparing the community to respond to new initiatives and other priorities. As such, we see that PO/PDs have a lot of responsibility/high workload, not just finding reviewers and panel members, but also training panels, ensuring that panels are reviewing both criteria, then balancing the portfolio, etc. Viewed in a potentially negative light, however, there might be concern that POs/PDs have an outsized influence on final outcomes. The COV recommends undertaking initiatives to streamline workload and help minimize program-to-program idiosyncrasies, including: development of division-wide reporting templates, training materials to be completed online, and consistent quantitative metrics.*

<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: Yes, in most cases documentation was complete, constructive, and an accurate description of the overall rationale for the decision. PIs were provided with enough context, documentation, feedback and suggestions needed for improving their projects, awarded or not. When PO comments were less detailed, enough review information was available from panel and <i>ad hoc</i> reviewers. In one observed case, <i>ad hoc</i> reviews were mixed and limited in scope and depth, combined with a panel summary that did not resolve these issues, highlighted in the PO analysis, which provided a rationale and justification for the final decision. In some cases, unfunded PIs received only a standard denial letter and could use more guidance on why the proposal was rejected. Often, however, those denial letters included an invitation for a follow up phone call to chat about the proposal.</p> <p><i>Recommendation 9:</i> <i>The COV sees post-decline decision conversations between PIs and POs as important for the development of PIs, especially early-career researchers, and would like to see them encouraged. We recommend EAR develop standard text for decline communications to encourage PIs to contact their PO, describing what PIs can expect from those conversations.</i></p>	<p>Yes</p>
<p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>Comments:</p>	

SECTION II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: We acknowledge the time and effort POs put into the choice of reviewers and managing the COIs. We recognize the work that goes into finding reviewers and chasing reviews, particularly in the large interdisciplinary proposals where COIs can dominate the review prospects. With respect to IM, we found the choice of reviewers was excellent. With respect to BI, many <i>ad hoc</i> reviewers and panelists lacked sufficient experience to provide substantive comments.</p> <p><i>Recommendation 5, which recommends targeted invitations to ad hoc reviewers and panelists with experience and/or expertise in broader impacts in addition to those with expertise in the proposed IM, is also relevant here.</i></p>	Yes
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: Yes, prior to participation in an ad hoc review or panel, reviewers and panelists are appropriately informed about NSF Conflict of Interest (COi) policy. COI was either self-reported or detected by the system and appropriately considered. Proper documentation was given in the reviewer list. COI actions were recorded in panel and PO summaries; in all cases when a COI was recognized, those with COIs were not assigned to review and had to leave the room / virtual room when project was discussed. We remain impressed with the robust way that NSF resolves conflicts of interest.</p>	Yes
<p>3. Additional comments on reviewer selection:</p>	

SECTION III. Questions concerning the management of the program under review.

Please comment on the following:

MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

Comments:

The COV found that EAR programs are very well-managed. We commend the hard work and dedication of staff to maintain high standards in the face of government shut-downs, moving operations, and the global pandemic. We also commend the strong culture of collaboration that has been nurtured within EAR. This culture, combined with distribution of program officers among the programs, serves EAR well as POs negotiate proposal funding and develop new and revise existing solicitations.

The COV would like to highlight EAR leadership's successful management of the many challenges that occurred during the review period. These include the transition to the No Deadlines policy, the government shutdown, and the global pandemic.

In addition, the COV has made recommendations that reflect evolving community priorities related to archiving and public availability of data, communications, and the development, review and administration of shared user facilities. We present several recommendations specifically for the Integrated Activities programs. Finally, the COV developed strong recommendations for more robust diversity, equity, and inclusion practices at all levels of EAR and NSF. The COV feels that these issues should be at the forefront of program management recommendations, but they appear in SECTION IV question 9 of the template.

Transition to No Deadlines Policy: Of particular interest for the 2017-2020 review period is the impact of the transition to the No Deadlines Policy. The goals of this transition were to reduce workload in the scientific community and at NSF, to increase reviewer response rate, and to increase proposal success rate. The IF program led the way with the change to no deadlines in 2012. As part of a pilot, GG, GLD, HS, and SGP changed their solicitations to remove deadlines for proposal submission in the spring of 2015. The remaining Disciplinary Programs (CH, PH and TE) followed suit with FY2018 being the first full fiscal year without deadlines.

The consequences of the transition to No Deadlines are encouraging. Preliminary data suggest there has been no significant change in PI and institutional demographics for these programs. The funding rate increased in all EAR programs and the average number of proposals a PI has to submit before getting funded decreased by roughly 24%. Both PI and reviewer workload decreased as submissions decreased in all programs following the transition. Unfortunately, changes in the NSF staff workload were more nuanced. Though the number of proposals decreased, the work associated with planning for ad hoc reviewers and panels, managing conflicts of interest, coordinating co-review across the division, and overall annual budget planning became more complex and time-consuming.

Recommendation 10: *The COV congratulates EAR staff for the successful transition to the No Deadlines policy and recommends the policy be continued with attention to efficiencies in EAR staff workload.*

US Government Shutdown in 2018: During the Government Shutdown from December 22, 2018 to January 25, 2019, NSF personnel were furloughed and forbidden to perform any work for 35 days. Due to the adoption of the no deadlines policy and continued operation of on-line functions, the shutdown had minimal impact on submission numbers. However, there was significant impact on the review process. Previously scheduled panels were rescheduled or canceled. In the case of canceled panels, review was done with *ad hoc* and PO review only. Exceptions to the standard review protocol ensured funding decisions could be made in a timely manner and were appropriately documented in the PO analyses.

EAR Response to the Global Pandemic: The COV commends EAR's flexibility and attentiveness to community needs during the 2020 COVID-19 pandemic. Staff transitioned to telework starting in mid-March, 2020. All panels transitioned to virtual panels as the world shifted to fully on-line communications. NSF staff communicated directly with investigators to gauge need and provided options such as supplemental funding, no-cost extensions, and re-budgeting of funds across budget categories. The quality and dedication of EAR personnel ensured EAR continued to operate at full capacity, the proposal review process proceeded in a fair and balanced way, high-quality research continued to be funded, and vulnerable populations (e.g., students, post-docs, early-career researchers) were supported.

Archiving and public availability of data: The COV concurs with and emphasizes the recommendations from the NASEM *Earth in Time* Report regarding the importance of data and sample curation:

Recommendation 11:

- a) *EAR should facilitate a community working group to develop mechanisms for archiving and curating currently existing and future physical samples, and for funding such efforts. Importantly, the working group should address the types of metadata that should be included with samples and potential mechanisms for pairing metadata with its physical samples.*
- b) *EAR should develop and implement a strategy to support FAIR (Findable, Accessible, Interoperable, Reusable) practices within community-based data efforts. FAIR data standards will improve the longevity, utility, and impact of EAR-funded data. Although NSF promotes FAIR data practices in spirit, the financial cost makes EAR support for long-term, compliant data storage difficult in times of level budgets.*
- c) *EAR should develop synergy and communication with national programs already established to deal with preservation of geoscience datasets at the national level, such as the data preservation program managed by the USGS (NGDPP).*

Communications: EAR staff devotes a great deal of time to communicating with PIs, potential PIs and the community at large. We commend EAR for continuing this labor-intensive but essential activity: it is a strength of the Division, and we acknowledge the substantial workload involved in maintaining open lines of communication. In particular, we note recent efforts focused on increasing communication with underrepresented individuals and societies that support underrepresented professionals and students, such as National Association of Black Geoscientists (NABG) and Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS). Furthermore, the EAR Communications team, working with Office of Legislative and Public Affairs (OLPA) and the GEO Directorate, coordinated the first ever participation of NSF EAR at the Congressional Black Caucus event.

Recommendation 12: *While the communication strategy is robust and inclusive, and we support continuation of these efforts, we have several recommendations that may help strengthen communication.*

- a) *Community input is key to the success of EAR integrated activities, and community interaction has been a hallmark of EAR programs as it facilitates identification of emerging science innovation. The COV recommends EAR leadership seek clarification on these rulings and work with the general counsel to determine activities that are permitted versus not permitted under the relevant regulations.*
- b) *The COV recommends POs seek enhanced communication modes to inform PIs about funding opportunities, especially in the areas of broader impacts. Among these might be a focused email to department heads/chairs, deans, Vice-Presidents of Research, and other administrative individuals who might proactively work to enhance their PIs' abilities to take advantage of the myriad opportunities that NSF provides.*

Integrated Activities: The Integrated Activities of EAR are in general a considerable strength that allows the division to respond to emerging science and community priorities. The COV commends the division for continuing to allow for and facilitate these emerging areas, and for seeking opportunities to collaborate not only within the division but across divisions and beyond the directorate.

Recommendation 13: *Many Integrated Activities are generated out of community discussions during which emerging science opportunities are outlined; these discussions are often led by PIs whose research is particularly well-suited to the new program. The COV recognizes the value of these discussions, and recommends that review panels for these integrated activities always include panelists who are not part of the group of researchers who led the community discussions.*

Recommendation 14: *Integrated programs train scientists to do a specific style of integrated, collaborative and sometimes shoreline-crossing science. This style of research has great transformation potential as it spans traditional disciplines. When the programs are sunsetted, however, it may leave PIs who were successful in these programs without a natural programmatic home for funding. We recommend that directorate leadership explore ways to ensure and communicate "opportunity continuity" for PIs when programs are sunsetted.*

Development, review, and administration of shared use facilities: The COV is highly impressed by the outstanding record of the EAR Infrastructure and Facilities (IF) program, and the remarkable leveraging of high-quality science that has been accomplished under its auspices over the past decades.

Recommendation 15: *At present, the IF program is unique to EAR at NSF. The COV recommends that the Division Director of EAR proactively engage in conversations with colleagues in other Divisions and other topically-relevant Directorates about the establishment of partnerships to co-utilize and co-develop facilities, perhaps in parallel with the advent of new, interdisciplinary scientific programs that would benefit from dedicated facilities.*

Recommendation 16: *The prior COV review, the recent NASEM Earth In Time report, and the IF project description provided to the COV all highlighted persistent concerns about the difficulties of sunseting facilities that might no longer be central to the missions of EAR or Directorates and Divisions it collaborates with. The COV recommends that EAR initiate a triennial external review process of all EAR-funded facilities that have been funded for at least three years, with a review required prior to the submission of any renewal proposal. A panel of reviewers external to NSF should be chosen by IF POs for their expertise with the scientific management and budgeting of large facilities, as well as their own history of scientific productivity and records of broad impact in their work. For the purposes of the review, a template and rubric should be*

developed that assesses the productivity, vitality, and broader impacts of the facility, and the review should include a site visit by the external reviewers, accompanied by an IF PO.

The outcome of this review should become an important, additional component of any consideration of renewal of the facility.

Recommendation 17: *The challenges associated with sunseting facilities are matched by the challenges of breaking into the system and initiating a new facility, particularly for PIs from underresourced institutions where substantial instrumentation and staff support do not already exist. The committee recommends that IF initiate opportunities to broaden participation in the IF program by incentivizing partnerships between institutions, facilitating communication between facilities PIs, and offering planning workshops.*

Supporting technical staff: We recognize the unique role within GEO that EAR has played in acknowledging the importance of funding technical staff in various smaller scale analytical facilities. Individual PIs or small groups of PIs who oversee institutional facilities face continuing challenges in supporting high quality technical staff.

Recommendation 18: *The COV recommends EAR continue to explore mechanisms and perhaps even consider explicit competitions that help to support some of these smaller scale facilities. This is where undergraduates and graduate students get the most hands on analytical training, so they are a crucial component of workforce developed and geoscience education*

2. Responsiveness of the program to emerging research and education opportunities.

Comments:

EAR engaged in significant strategic planning activities during the 2017-2020 review period, making it responsive to emerging research and education opportunities. Planning efforts included ACGEO and NSF reports, the National Academies of Science, Engineering, and Medicine (NASSEM) report “*Earth in Time (2020)*”, and community development reports (Workshops, RCNs for Long-Range Planning and Development).

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments:

In addition to their responsibilities managing the core programs, Program Directors and other staff invest 20 to 30% of their time working on intra-agency and inter-agency initiatives including crossNSF (e.g., INCLUDES, DISES, GRFP, CAREER, INFEWS, NSF Big Ideas, and MRI), cross-GEO programs (e.g., PREEVENTS, CoPe, EarthCUbe, P2C2, GeoPRISMS, GEOPATHs, and Gold), GEO committees, National Science Board service, EAR Division committees, NSF internal committees, and serve as detailees to other NSF programs in GEO and NSF. These additional collaborations ensure that the priorities of the Earth Sciences community are reflected in new initiatives.

4. Responsiveness of program to previous COV comments and recommendations.

Comments:

EAR provided the COV with a document “FY2020 Updated Response to EAR COV Report” compiled by Jessica Robin (Section Head, IA) and Jennifer Wade (Acting Section Head, DP). The report provides a thorough summary as well as year-by-year documentation of responses to previous recommendations. We commend EAR for their diligence in implementing and tracking the

recommended changes. We will not reproduce the details in their report, but rather highlight significant responses to a few topics.

Value of merit review process: The 2021 COV concurs with earlier COV reports that the combination of ad hoc, panel, and PO reviews continues to be the gold standard for proposal review providing opportunity for multiple perspectives to reach a fair and balanced review. Travel restrictions due to the pandemic showed the utility and effectiveness of virtual panel meetings.

Low reviewer response rate: NSF introduced new interface and dashboard software in 2018 that helped automate identification of potential reviewers, thus reducing workload. The transition to the No Deadlines policy achieved the desired goals of reducing the overall number of proposals submitted by roughly 25%. The decrease in proposal pressure resulted in decreased review requests and also expanded the time-frame for reviewer requests. These changes resulted in increased reviewer response rate to over 50% in 2020.

Broader Impacts: EAR made significant efforts to educate the community on Broader Impacts best practices. This remains a concern as reflected in our 2021 recommendations.

Balance of infrastructure to core programs: We were pleased to see that EAR worked with the community on this issue. EAR has maintained ~30% of its operating budget for infrastructure throughout the review period, which is consistent with community priorities.

Strategic planning: EAR engaged in significant strategic planning activities during the 2017-2020 review period, including ACGEO and NSF reports, the NASEM report “*Earth in Time (2020)*”, and community development reports (Workshops, RCNs for Long-Range Planning and Development). Consideration and implications of all the recommendations from the Earth in Time report are in progress, including topics of interest to the 2021 COV including archiving/curating of physical samples and data, partnerships with other national and international agencies to promote earth science, and improving diversity, equity, and inclusion in the Earth sciences.

Communication: Significant improvements were made with credit given to Elizabeth Zelenski, who was on detail from GEO OAD to EAR and transformed their communications strategy and implementation plan.

SECTION IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

<p style="text-align: center;">RESULTING PORTFOLIO OF AWARDS</p>	<p style="text-align: center;">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p>
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: The breadth of research funded by EAR programs is impressive, and awards are balanced over the full range of disciplines and sub-disciplines. Consistent with the last COV report, EAR has continued to manage a broad mix of grants focused on deep Earth and surface processes, as well as a balance of research- and education-oriented projects. In addition to scientific merit, attention is paid to creating and sustaining balance among program subdisciplines; geographic distribution of awards; institution type, career status, gender, and ethnicity of PIs; and availability of co-funding. Program Officers do an excellent job in balancing these criteria. Their dedication, integrity, knowledge and expertise are crucial to the success of the system and facilitate a more nuanced balancing of portfolios within individual programs over multiple years than could otherwise be achieved.</p> <p>Proposal success rates across disciplinary programs in EAR are in balance with proposal pressure which reflects community demand. The range of success rates for standard proposals across Integrated Activities is greater reflecting differences in the number of submitted proposals and the complexity of multi-disciplinary research.</p>	<p>Yes</p>
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments: In general, we find the duration of awards to be appropriate and commensurate with the costs of doing the proposed research. Award duration is variable across programs, e.g. CAREER grants are 5 years, workshops and exploratory grants usually <1 year, with most other awards averaging between 2 and 3 years. Award durations increase to 3 to 3.5 years in duration when no-cost extensions are figured in.</p> <p>The Division has an acceptable balance between small-scale and large-scale funding initiatives. The data provided to the COV suggest that median annual award size ranges from ~\$120,000/yr to \$535,000/yr with the largest annual budgets going to the large Integrated Activities of IES/FRES, CZO, and GI.</p>	<p>Yes</p>

<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments: Yes. <i>Ad Hoc</i> reviewers and panel members are advised that identifying potentially transformative and innovative science is a key part of the review criteria. The use of RAPID (Grants for Rapid Response Research) and EaGER (Early-concept Grants for Exploratory Research) awards offers opportunities for time-sensitive and high-risk/high-reward research projects. Streamlining of the review mechanism for these projects is warranted and well documented. These are important, but underutilized, funding mechanisms.</p>	<p>Yes</p>
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: Yes. The Earth Sciences are inherently inter- and multi-disciplinary. These are handled through the standard Collaborative Research format for individual PIs, as well as the Integrated Activities, whose themes develop through community workshops and reports.</p> <p>We commend individual programs for seeking novel ways to increase funding by partnering with other NSF units. Co-funding of proposals is another measure of the effectiveness of EAR in engaging outside the division. Figure 16 (below) from the EAR Self-Study shows that EAR has contributed \$20.4 M in co-funding to other NSF units and has received \$70.4 M over the COV period. More than 50% of the outside co-funding came from GEO. The programs with the largest amount of co-funding with EAR include Ocean Sciences (GEO/OCE), the Division of Environmental Biology (BIO/DEB), the Office of Advanced Cyberinfrastructure (CSE/OAC), and Chemical, Bioengineering, Environmental and Transport Systems (ENG/CBET). We commend the effort EAR program directors and staff commit to these multidisciplinary collaborations for the benefit of EAR researchers and of topically relevant science.</p>	<p>Yes</p>

<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments: Yes, during the COV period EAR received proposals and supported research in every state, including Puerto Rico and the U.S. Virgin Islands. The number of proposals received is dominated by California, Texas, New York, Pennsylvania, Colorado, Arizona, and Massachusetts reflecting the greater</p>	<p>Yes</p>
<p>number of Institutions and PIs within those states. The success rate is more balanced across the country.</p>	
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments : Yes. The majority of awards made by EAR are to public, PhD-granting institutions. Private institutions employ fewer researchers, overall, but their success rates are slightly higher. Students and faculty at Masters-degree granting and 4-year institutions have opportunities to participate in research through the REU and IF programs. The COV discussed the issue that the lack of Earth sciences departments at many HBCUs likely limits funding of PIs from those institutions. As discussed below in question 8, we applaud EAR’s coordinated participation of personnel from across all ranks in outreach visits to MSIs and HBCUs. We recommend these visits continue when travel restrictions are lifted. That said, the committee notes that virtual visits—while not ideal—can increase access to institutions and should be considered in addition to in-person visits to increase engagements with these universities.</p>	<p>Yes</p>

<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within seven years of receiving his or her last degree at the time of the award.</p> <p>Comments: Yes, overall, the percentage of proposals received and awards made across EAR PIs at different career stages is fairly similar, although the percentage of awards made to PIs within 5 years of receipt of their terminal degree is slightly lower than the percentage of proposals received. For these earlycareer researchers, providing post-decision feedback is critical, as noted earlier.</p>	<p>Yes</p>
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: Yes, based on the data provided by EAR, proposals integrating research and education are well represented. This is accomplished through broader impacts on individual proposals and targeted funding opportunities (e.g.,</p>	<p>Yes</p>
<p>CAREER, Postdoctoral Fellowships, and REUs). In addition to promoting societal relevance of Earth sciences research, these targeted funding opportunities are critical for broadening participation (see Question 9 below). The COV recommends (see Recommendation 20 below) that the EAR Director convey to the GEO Director and the Director of NSF the need to maintain long-term support for programs that have proven effective in the engagement, recruitment, retention and development of talented underrepresented students. These may include requesting targeted solicitations, DEI supplements to existing EAR-funded research projects, and increased funding for initiatives such as REUs.</p>	

<p>9. Does the program portfolio have appropriate participation of underrepresented groups²?</p> <p>Comments:</p> <p>For the United States to maintain a leadership role in Earth science in the 21st century and effectively address societal issues, it will be necessary to draw upon the talents and life experiences of all segments of our population. Unfortunately, and as has been widely described elsewhere, the Earth sciences are not currently engaging that rich and diverse population, and at all levels we remain one of the least diverse of the STEM fields. NSF has a role to play in efforts to address these concerns. Progress in the next decade requires engagement of underrepresented students at all education levels, identification and active recruitment of students from underrepresented groups, and creation of research experiences for talented students in the field and laboratories of our nation's colleges and universities. As a more diverse population enters the geosciences research workforce, mechanisms need to be in place to support diverse PIs at all career stages. Our current engagement, recruitment, retention, mentoring, and support systems are not yet yielding the desired results: an Earth Science community that resembles the diversity of the American public, and the opportunity to have a successful career in the Earth Sciences irrespective of the ethnic or identity group. The committee recognizes that achieving measurable results in diversity and inclusiveness will require deliberate, intentional long-term efforts that transcend administrations.</p> <p>It is clear that EAR POs and PDs are engaged in thoughtful conversations around BAJEDI (belonging, accessibility, justice, equity, diversity, inclusion) principles. Across EAR, several outreach activities have been carefully developed and implemented. In particular, the coordinated participation of personnel from across all ranks of EAR in outreach visits to MSIs and HBCUs is a strong approach, something everyone at EAR sees value in and</p>	<p>No, but the problem is ubiquitous in the Earth Sciences. NSF can be a leader.</p>
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² NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

hopes to continue when travel restrictions are lifted. That said, the committee notes that virtual visits—while not ideal—can increase access to institutions and should be considered in addition to in-person visits to increase engagements with these universities. The concerted and deliberate engagement at NABG and SACNAS are also encouraging. The committee applauds EAR’s efforts to broaden participation in Earth science, but notes that, despite multi-decade, focused efforts by NSF and other federal agencies, professional organizations, and private foundations, the demographic needle has barely moved. Isolated, targeted programs are not enough: a transformational cultural shift is required, and the EAR division can be a leader in that shift.

An excellent example of EAR’s commitment to BAJEDI principles is the funding of the Unlearning Racism in Geoscience (URGE) program. This program started as a supplement to a standard, disciplinary collaborative research award. The supplement involved developing a 5-month curriculum of video interviews, readings, and ‘pod’ meetings at hundreds of institutions to educate the community about racism in general and systemic racist practices in the geosciences, while also focusing on producing deliverables at the department and program level to directly address these issues. URGE will continue, including three objectives: 1) deepen the community’s knowledge of the effects of racism on the participation and retention of Black, Brown, and Indigenous people in Geoscience; 2) draw on existing literature, expert opinions, and personal experiences to develop anti-racist policies and strategies; and 3) share, discuss, and modify anti-racist policies and strategies within a dynamic community network and on a national stage. We applaud EAR’s ability to support new ideas that emerge from the community—a strategy, which in this case, resulted in a substantial national impact—and we hope that the division can continue to be supportive of these grassroots efforts while also implementing their own strategies.

We recommend that these responsive activities continue and evolve as the community grapples with these challenges. For example, this year in particular has seen the publication of a number of articles and calls to action by underrepresented geoscience (broadly speaking) scholars that should serve as a framework for developing future programming and also, for identifying the most promising BIs. This includes the “[No Time for Silence](#)” call to action by leading black and brown scholars in the geosciences, and recent articles in Nature Communications (Ali et al), AGU Advances ([Morris](#)), Nature Geosciences ([Lawrence](#)), and European Journal of Soil Science ([Berhe and Ghezzehei](#)), well as the various deliverables that will arise from [URGE](#).

At the same time, we expect EAR to be proactive in its diversity, equity, and inclusion work. The commitment to broadening participation and workforce development articulated by the Director of NSF, and more recently by President Biden, may present new funding opportunities that play to EAR’s strengths. In particular, clearly communicating the BAJEDI activities that EAR has already engaged in together with demonstrating proactive development of new programming would make EAR particularly competitive for these initiatives. Although racial and ethnic diversity has not improved markedly in

the grant applicant or awardee pool across EAR, the geological sciences lead both ocean sciences and atmospheric sciences in terms of the number

of doctorates awarded in 2019 to Hispanic or Latino, American Indian or Alaska Native, and Black or African Americans (National Center for Science and Engineering Statistics). This puts EAR in an excellent position within the Directorate to move the needle for racial and ethnic diversity.

Recommendation 19: *The COV recommends EAR build on its track record of successful partnerships to expand coordination with programs that have been successful at broadening access, both within NSF (e.g., Louis Stokes Alliances for Minority Participation (LSAMP), International Research Experiences for Students (IRES), and REU) and outside of NSF at other federal agencies, professional societies, and foundations*

Recommendation 20: *EAR leadership/Director should convey to the GEO Director and the Director of NSF the need to maintain long-term support for programs that have proven effective in the engagement, recruitment, retention and development of talented underrepresented students. This may include requesting targeted solicitations, BAJEDI supplements to existing EAR-funded research projects, and increased funding for initiatives that support diverse and inclusive workforce development, including evidence-based efforts to expand recruitment of students and early-career professionals from other STEM fields to draw talented physicists, chemists, computer scientists and engineering students into applied research opportunities in the Earth Sciences.*

Recommendation 21: *The COV recommends EAR explore best practices to mentor and help retain diverse scholars in an academic/research career path. For example, EAR could explore developing a program to engage with a subset of late-stage URM PhD students (prior to graduation) in a format similar to OCE's Dissertations on Chemical Oceanography Conference (DISCO) and Physical Oceanography Dissertation Symposium (PODS) programs.*

Recommendation 22: *The COV recognizes a growing concern about the negative impact of some research programs in sensitive geographical areas, where "parachute science" neither achieves meaningful engagement nor increases capacity in the impacted under-served community and may, in fact, further alienate these communities. To mitigate this concern, EAR should:*

- a) *Include language in its solicitations, similar to that developed by Polar Programs (e.g., Navigating the New Arctic), to highlight ethical research conduct and to provide guidance on how to build true collaborations with local and Indigenous peoples in NSF-funded research and education. NSF should train panels and POs on how to assess within proposals authentic engagement of local communities and sensitivity to local cultural norms.*
- b) *Utilize the planning grant functionality to enable PIs to collaborate with community leaders to design the research approach and develop cultural awareness. Some ideas include adoption of different tracks depending on the duration and scope of the planned science project). Track I might be at the level of workshops or meetings whereas Track III grants – for programs with greater impact on communities - should*

<p><i>include a cultural sensitivity training component for all participants (even the ones that are not going to the field/site). EAR should follow</i></p>	
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best practices from OISE that uses planning grants to help establish partnerships with international collaborators / institutions and AGU's Thriving Earth Exchange that uses planning grants for community science initiatives. (Note: planning grants may be longer than 1 year to allow for development of meaningful relationships with diverse/international partners.)

Recommendation 23: *The COV recommends EAR continue to increase diversity within its leadership (POs, PDs, DD, etc.). (Note: staff at NSF is reflective of diverse communities) :*

- a) EAR should enhance efforts to focus recruitment of underrepresented minorities (URM) into NSF leadership positions using best practices recruitment approaches for targeting URM researchers.*
- b) EAR should initiate programs to enable sabbaticals to NSF for URM geoscience professionals.*
- c) EAR should investigate rotations of program managers to other federal agencies with proven success in diversity and inclusion efforts.*
- d) EAR should continue to use the panel as an opportunity to educate PIs/community at all levels-from early to mid-to late career. Panels are great opportunities to train and recruit potential future EARPOs.*
- e) EAR should strive to include officers at multiple career stages in all programs.*

<p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments: EAR is well positioned to lead the Earth science community response to three out of four "out-of-the-gate-priorities" defined by the Biden administration, including racial justice, economic recovery, and climate change. EAR is working closely with NSF to develop and implement the BAJEDI (belonging-accessibility-justice-equity-diversity-inclusion) initiative. In addition, basic research on critical mineral deposits, paleoclimates, and changes in climate-related surface hydrology, sea level, and ecosystem health are essential for a sustainable future and are highlighted in EAR's programs.</p> <p>The COV was provided a list of EAR-related external reports and other activities that document the extensive efforts to work with the community to ensure EAR is responding to national priorities, agency mission, and community needs. A sampling of these reports includes:</p> <p>2018 – <u>Enabling FAIR Data Commitment Statement</u>. Coalition on Publishing Data in the Earth and Space Sciences (COPDESS). 2019 - <u>Status of the Geoscience Workforce</u>, 2018. Wilson, C. American Geosciences Institute, Washington, DC. 2020 – <u>A Vision for NSF Earth Sciences 2020-2030: Earth In Time</u>. National Academies of Sciences, Engineering, and Medicine.</p>	<p>Yes</p>
<p>2021 – <u>Vision and Change in the Geosciences: The Future of Undergraduate Geoscience Education</u>. 2021, AGI, ISBN-13: 978-0922152-33-9.</p>	
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p>	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.
No additional comments
2. Please provide comments as appropriate on the program's performance in meeting programspecific goals and objectives that are not covered by the above questions. No additional comments
3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

The COV commends NSF and EAR on their commitment to BAJEDI values. NSF and EAR should publicly highlight their efforts by casting a wide net to reach the public through its website or exploring other social media platforms, as they are able to do so.

Recommendation 25: *Regarding the race- and gender- non-reporting categories masking representation issues, the issue was acknowledged but related to outdated categories at the federal level. The COV recommends EAR elevate the problem to NSF-wide and to OSTP, for example, to improve the definitions at the federal level.*

Recommendation 26: *The COV recommends NSF and EAR develop a procedure for reporting of actions taken on grievances. While recognizing the need to redact anything that risks identifying individuals or institutions, it would be helpful to NSF to provide an annual report that conveys information on the nature and resolution of filed grievances. This could simply be an accounting of how many grievances were filed and how many were resolved successfully.*

Recommendation 27: *We recognize that the two criteria for merit review and the five questions to be addressed within each criterion are NSF-wide and not within the purview of EAR alone to change. However, the committee feels that modifying the questions for the BI criterion would likely lead to more substantial and critical reviews by both ad hoc reviewers and panelists, would better enable POs to adhere fully to the principle that all funded proposals should include strong BI components, and would facilitate stronger discussions and revisions to declined proposals. The COV recommends EAR elevate the issue to a foundation-wide discussion. Revised questions that would help reviewers assess the longterm impacts and efficacy of the broader impacts might be:*

- a) *What is the potential for the proposed activity to benefit society or advance desired societal outcomes?*
- b) *To what extent are the proposed activities grounded in the evidence base and likely to have an impact?*
- c) *Is an appropriate evaluation plan included that assesses the impact of the proposed activities?*
- d) *Is the expertise to carry out the proposed activities and evaluation plan present in the project team?*
- e) *Does the budget support the broader impacts activities?*
- f) *How well does the BI component leverage existing NSF and other federal agency BI investments at their institution (LSAMP, REU, Sea Grant College Programs).*


4. Please provide comments on any other issues the COV feels are relevant. No additional comments.

5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

Perhaps evaluation of DEI efforts should be elevated in importance in the template by adding separate section, instead of relegated to a minor question in SECTION IV.

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SIGNATURE BLOCK:

A handwritten signature in blue ink, appearing to read "Jacqueline Dixon", followed by a stylized flourish.

For the EAR 2021 Committee of Visitors
Jacqueline Dixon
Chair