

# Paleo Perspectives on Present and Projected Climate (P4CLIMATE)

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## PROGRAM SOLICITATION

NSF 22-612



**National Science Foundation**

Directorate for Geosciences  
Division of Atmospheric and Geospace Sciences  
Division of Earth Sciences  
Division of Ocean Sciences  
Office of Polar Programs

### Full Proposal Target Date(s):

October 20, 2022

October 20, Annually Thereafter

## IMPORTANT INFORMATION AND REVISION NOTES

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Innovating and migrating proposal preparation and submission capabilities from FastLane to Research.gov is part of the ongoing NSF information technology modernization efforts, as described in [Important Notice No. 147](#). In support of these efforts, proposals submitted in response to this program solicitation must be prepared and submitted via Research.gov or via Grants.gov and may not be prepared or submitted via FastLane.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide (PAPPG)* ([NSF 22-1](#)), which is effective for proposals submitted, or due, on or after October 4, 2021.

## SUMMARY OF PROGRAM REQUIREMENTS

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### General Information

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#### Program Title:

Paleo Perspectives on Present and Projected Climate (P4CLIMATE)

#### Synopsis of Program:

Much can be learned about the climate system using existing historical observations and models of current climate, but those records and models do not reflect the range of climate behavior on multi-decadal to millennial time scales, or capture tipping points, thresholds, and other key features of the climate system. For that, data from geological records or other environmental archives are required.

The PALEO PERSPECTIVES ON PRESENT AND PROJECTED CLIMATE (P4CLIMATE) competition is a coordinated paleoclimate science initiative that is funded by the National Science Foundation (NSF) Divisions of Atmospheric and GeoSpace Sciences (AGS), Earth Sciences (EAR), Ocean Sciences (OCE), and Office of Polar Programs (OPP) in the Geosciences (GEO) Directorate. The annual P4CLIMATE competition supports the scientific objectives of the National Science Foundation by fostering interdisciplinary research and synthesis of climate data.

The goal of the interdisciplinary P4CLIMATE solicitation is to utilize observational and modeling studies to provide paleo perspectives addressing the two research themes: 1) Past Regional and Seasonal Climate; and 2) Past Climate Forcing, Sensitivity, and Feedbacks.

OPP will accept proposals to this solicitation A) with and without fieldwork in the Arctic, and B) only without fieldwork in the Antarctic. Proposals that have fieldwork in Antarctica should be submitted to the annual solicitation for proposals that have fieldwork in Antarctica.

#### Cognizant Program Officer(s):

*Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.*

- David J. Verardo, telephone: (703) 292-4695, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)
- Jonathan G. Wynn, telephone: (703) 292-4725, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)
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- David F. Porter, telephone: (703) 292-2930, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)
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- Mea S. Cook, telephone: (703) 292-7306, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)
- Alberto Perez-Huerta, telephone: (703) 292-7079, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)

**Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):**

- 47.050 --- Geosciences

**Award Information**

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**Anticipated Type of Award:** Standard Grant or Continuing Grant

**Estimated Number of Awards:** 35

Approximately 35 new awards per year will be made with a typical award duration of up to three years.

**Anticipated Funding Amount:** \$14,000,000

\$14,000,000 per year, subject to the availability of funds.

**Eligibility Information**

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**Who May Submit Proposals:**

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E. Unaffiliated individuals are not eligible to submit proposals in response to this solicitation.

**Who May Serve as PI:**

There are no restrictions or limits.

**Limit on Number of Proposals per Organization:**

There are no restrictions or limits.

**Limit on Number of Proposals per PI or co-PI:**

There are no restrictions or limits.

**Proposal Preparation and Submission Instructions**

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**A. Proposal Preparation Instructions**

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
  - Full Proposals submitted via Research.gov: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: [https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=pappg](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg).
  - Full Proposals submitted via Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: [https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=grantsgovguide](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)).

**B. Budgetary Information**

- **Cost Sharing Requirements:**

Inclusion of voluntary committed cost sharing is prohibited.
- **Indirect Cost (F&A) Limitations:**

Not Applicable
- **Other Budgetary Limitations:**

Not Applicable

**C. Due Dates**

- **Full Proposal Target Date(s):**

October 20, 2022

October 20, Annually Thereafter

**Proposal Review Information Criteria**

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**Merit Review Criteria:**

National Science Board approved criteria. Additional merit review criteria apply. Please see the full text of this solicitation for further information.

## Award Administration Information

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**Award Conditions:**

Additional award conditions apply. Please see the full text of this solicitation for further information.

**Reporting Requirements:**

Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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## I. INTRODUCTION

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The rapid increase in atmospheric greenhouse gases is altering Earth's climate into a warmer state, and the magnitude and rate of this change is historically unprecedented. Documenting past climate change – its magnitude, mechanisms, rates, and feedbacks – provides critical context for understanding the present climate state and reducing uncertainties in predictions of future climate. Observations and numerical models at historical timescales can inform past climate variability, however, they provide a limited view of the range of Earth's climate variability, and of the response of the climate system to changes in greenhouse gas concentrations and other drivers. Studying past climate states from geological records and environmental archives offers the opportunity to investigate how the climate system varies and how it responds to forcings and perturbations operating over a far broader range of timescales and climate states

## II. PROGRAM DESCRIPTION

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Proposals to P4CLIMATE are expected to address one or both of the research themes described in detail below:

**P4CLIMATE Research Themes****I. Past Regional and Seasonal Climate**

Earth's climate varies across a range of spatial and temporal scales, and regional and short-term variability is often very different from long-term global changes. Understanding changes in regional climate variability and trends are important research goals because people and societies experience climate change most directly at a regional scale.

Regional climate trends and variability are already impacted by warming temperatures and feedbacks on the hydrological cycle. Extended periods of climate extremes and short-term changes in annual climate patterns and in the frequency and intensity of extreme weather events can have significant impacts on agriculture and infrastructure, and ultimately on entire economies and societies. Anticipating and mitigating those impacts requires an understanding of the sensitivity of short-term (weather and seasonal) regional climate to warming trends. That understanding, in turn, requires a process-based approach to identify and characterize regional changes in climate trends and extremes and to explore the drivers of those changes.

Paleoclimate reconstructions can provide a context for recent (post-Industrial) climate trends and extremes and can serve as test cases for attribution studies to

identify the factors that drive those trends and extremes. The 'real-world' tests provided by paleo data will strengthen assessments of current and future conditions.

Proposals are particularly sought to improve understanding of processes, drivers, and feedbacks of climate variability at seasonal and regional scales. Examples include (but are not limited to): local sea-level change; permafrost thaw and feedbacks to the climate system; regional hydroclimate extremes and habitability; and regional teleconnections.

## II. Past Climate Forcing, Sensitivity, And Feedbacks

Characterizing and quantifying the role and thresholds of climate forcings and feedbacks to the climate system is necessary to improve projections of future climate variability. Despite significant scientific progress in understanding the functioning of the climate system, there remain many uncertainties because of its complex and non-linear nature. For instance, cloud radiative feedback is known to affect Earth's climate sensitivity to greenhouse gas forcing and warming, yet the magnitude and the mechanisms of these feedbacks remains a challenging source of uncertainty.

Proposals are particularly sought to advance understanding of climate processes, forcings, sensitivity, and feedbacks. Examples include (but are not limited to): triggers, thresholds, and tipping points of climate forcings and feedbacks; controls, responses, and impacts of past land- and sea-ice changes, particularly during warm climate intervals; quantifying aerosol forcing by integrating modern observations, modeling, and assimilation of proxy data; the role of state-dependence in climate feedbacks; and climate forcing beyond CO<sub>2</sub> (other greenhouse gases, volcanic, aerosols).

### Additional Considerations

Proposers are encouraged to involve one or more of several approaches to address the research themes of the P4CLIMATE solicitation:

- **Synthesis:** Comprehensive and innovative synthesis of existing data and model-data comparison and integration. Examples include (but are not limited to): statistical approaches to proxy-model integration, efforts to break down "language barriers" between data and models, integrating or bridging between global and regional proxy records, establishing connections between polar and non-polar regions. Research projects that seek to use existing and archived digital data are strongly encouraged.
- **Applying Novel methodologies:** Applying novel analytical and reconstruction methodologies to enhance the interpretation of paleoclimate records. Examples include (but are not limited to): multiproxy reconstruction, data assimilation and forward proxy modeling, and applying new chronological constraints (bayesian or new calibration) to provide precisely dated records of past climate variability and rates (e.g., sea level) to better inform climate projections (benchmarking of climate models).
- **Evaluating uncertainties:** Identifying, quantifying, and characterizing sources of uncertainties in reconstructions of past climate variability and in the sensitivity of Earth's climate system to climate forcing, processes, and feedbacks. Examples include (but are not limited to): development of robust tools for statistical assessment of uncertainties (analytical method of primary data, age, and proxy).

In addition, the P4CLIMATE competition expects proposals to adhere to FAIR (Findability, Accessibility, Interoperability, and Reuse) data principles. The competition also encourages submission of proposals that include a clear commitment to broadening participation and stakeholder engagement.

- **FAIR data principles:** The projects funded under P4CLIMATE are expected to develop climate information (paleo data and models) that are findable, accessible, interoperable, and reusable (FAIR). Although different research communities may have their own data management practices and standards, and these norms may change over time, adhering to the FAIR practices for sharing of data and research product will ensure reproducibility, enhance reusability of proxy data, and accelerate paleoclimate scientific discoveries.
- **Broadening participation:** The P4CLIMATE program seeks projects that involve researchers and students with diverse experiences and backgrounds in research that advances the research goals and themes of P4CLIMATE. Proposals are particularly encouraged from minority-serving institutions (MSI), predominantly undergraduate institutions (PUI), non-R1 institutions, early-career researchers or other new principal investigators or institutions that have been underrepresented in paleoclimatology and geosciences. Proposers are encouraged to explore innovative outreach efforts that advance principles of belonging, accessibility, justice, equity, diversity, and inclusion. Examples could include (but are not limited to): engaging historically underrepresented groups in geosciences and paleoclimatology, as well as partnering with faculty and students at minority serving institutions, community colleges, and K-12 schools.
- **Stakeholder engagement:** Where appropriate, the P4CLIMATE program encourages submission of proposals that include plans to reach out to community stakeholders early in the process to develop research questions, and for the co-production of knowledge. These stakeholder engagement activities could enhance the important societal impacts and policy implications of P4CLIMATE research efforts.

The P4CLIMATE program is committed to supporting interdisciplinary and multidisciplinary research under the two research themes identified above, including studies that involve international collaborations supported via currently established NSF partnerships with other agencies. In addition to research proposals, the P4CLIMATE program may consider additional proposal types described in the PAPPG and some NSF-wide solicitations. For these opportunities, proposers are encouraged to contact the NSF program officer(s) whose expertise is most germane to the proposal topic to request the required approval prior to any submission. The program does not consider EAGER, RAISE, RAPID, GOALI, Mid-Career Advancement, Postdoctoral Fellowships or CAREER proposals, which should be submitted to programs in participating GEO disciplinary areas.

Projects that include new fieldwork in the Antarctic should be submitted to the relevant solicitations in OPP, not to the P4CLIMATE program.

## III. AWARD INFORMATION

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**Anticipated Type of Award:** Continuing Grant or Standard Grant

**Estimated Number of Awards:**

Approximately 35 new awards per year will be made with a typical award duration of up to three years.

**Anticipated Funding Amount:** \$14,000,000 per year, subject to the availability of funds.

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

## IV. ELIGIBILITY INFORMATION

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### Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E. Unaffiliated individuals are not eligible to submit proposals in response to this solicitation.

### Who May Serve as PI:

There are no restrictions or limits.

### Limit on Number of Proposals per Organization:

There are no restrictions or limits.

### Limit on Number of Proposals per PI or co-PI:

There are no restrictions or limits.

## V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

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### A. Proposal Preparation Instructions

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**Full Proposal Preparation Instructions:** Proposers may opt to submit proposals in response to this Program Solicitation via Research.gov or Grants.gov.

- Full Proposals submitted via Research.gov: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal and Award Policies and Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: [https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=pappg](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg). Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov). The Prepare New Proposal setup will prompt you for the program solicitation number.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov*. The complete text of the *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: ([https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=grantsgovguide](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov).

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

**Collaborative Proposals.** All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via Research.gov. PAPPG Chapter II.D.3 provides additional information on collaborative proposals.

See PAPPG Chapter II.C.2 for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the PAPPG instructions.

**The following instructions supplement the PAPPG and the NSF Grants.gov Application Guide:**

#### Guidelines for Data Management Plan

All proposals require a Data Management Plan (DMP) that must clearly describe a strategy for the dissemination and sharing of research data. The DMP must be traceable and verifiable from the beginning to the end of a project (i.e., proposal, review, and annual/final report) to help achieve NSF goals regarding data, as well as specific research P4CLIMATE goals.

At a minimum, all metadata files, full data sets, derived data products, and physical collections, regardless of publication status, must be made publicly accessible within two (2) years of collection in long-lived and publicly accessible archive. This includes software and derived data products (e.g., model results, output, and workflows). Information regarding appropriate data centers and repositories can be found on the NSF GEO website and the AGS, EAR, OCE and OPP websites. Information regarding Division/Office-specific additional requirements for data can also be found on those websites. In the event of an award, the grantee will adhere to the minimum solicitation criteria plus any Division/Office-specific requirements.

Final Reports for all awards must include a statement (in the section titled "Products" under Other Products, Other Publications, or Website, or Other Internet Sites) describing the implementation of the DMP and where the data can be found.

Any requested limit on access to data, samples, or other information beyond the two-year moratorium period must be based on a compelling justification and documented in the proposal DMP.

Any limitation on access that arises following an award is subject to Program Director approval and documentation in NSF record systems.

#### Guidelines for Proposals Involving Broadening Participation

Broadening participation activities should be described in the project description showing a well-justified contribution to the relevant P4CLIMATE research

theme(s). Broadening participation activities may include (but are not limited to) establishing partnerships with varied institution types (e.g., K-12 schools, minority-serving institutions, community colleges), use of various approaches (e.g., unique webcasting, social media, virtual reality experiences or other activities) to promote awareness of paleoclimate science, or engagement of paleoclimate researchers in annual conferences of professional societies focused on fostering diversity in science. Proposals should address how project activities will be implemented to achieve broad engagement with relevant scientific communities and should further address how planned activities contribute to relevant geoscience communities. Predominantly Undergraduate Institutions (PUIs) are encouraged to submit proposals via the Research in Undergraduate Institutions (RUI) solicitation guidelines, and to discuss these submissions with a Program Officer prior to submission.

#### **Guidelines for Proposals Involving Stakeholder Engagement**

If stakeholder engagement activities are included, those activities should be described in the project description showing a well-justified contribution to the relevant P4CLIMATE research theme(s). Stakeholder engagement efforts may involve non-academic partners including (but not limited to) federal, state, and local land, water and other resource management agencies or organizations, schools, libraries, tribes and Indigenous-serving organizations; non-profits; cultural organizations; and businesses. Investigators and stakeholder partners are encouraged to work closely to develop and evaluate creative approaches to achieving meaningful engagement for mutual benefit. Co-production of knowledge is one form of engagement with regional community stakeholders. All relevant activities must be explicitly described, justified, and supported in both the proposal text and project budget.

#### **Guidelines for Proposals Involving Fieldwork**

Projects that include new fieldwork in the Antarctic should be submitted to the relevant solicitations in OPP, not to the P4CLIMATE program.

## **B. Budgetary Information**

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#### **Cost Sharing:**

Inclusion of voluntary committed cost sharing is prohibited.

## **C. Due Dates**

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- **Full Proposal Target Date(s):**

October 20, 2022

October 20, Annually Thereafter

## **D. Research.gov/Grants.gov Requirements**

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#### **For Proposals Submitted Via Research.gov:**

To prepare and submit a proposal via Research.gov, see detailed technical instructions available at: [https://www.research.gov/research-portal/appmanager/base/desktop?\\_nfpb=true&\\_pageLabel=research\\_node\\_display&\\_nodePath=/researchGov/Service/Desktop/ProposalPreparationandSubmission.html](https://www.research.gov/research-portal/appmanager/base/desktop?_nfpb=true&_pageLabel=research_node_display&_nodePath=/researchGov/Service/Desktop/ProposalPreparationandSubmission.html). For Research.gov user support, call the Research.gov Help Desk at 1-800-673-6188 or e-mail [rgov@nsf.gov](mailto:rgov@nsf.gov). The Research.gov Help Desk answers general technical questions related to the use of the Research.gov system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

#### **For Proposals Submitted Via Grants.gov:**

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: <https://www.grants.gov/web/grants/applicants.html>. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: [support@grants.gov](mailto:support@grants.gov). The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

**Submitting the Proposal:** Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

Proposers that submitted via Research.gov may use Research.gov to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

## **VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES**

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Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal

and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in PAPPG Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: [https://www.nsf.gov/bfa/dias/policy/merit\\_review/](https://www.nsf.gov/bfa/dias/policy/merit_review/).

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research - NSF Strategic Plan for Fiscal Years (FY) 2022 - 2026*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

## A. Merit Review Principles and Criteria

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The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

### 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 the 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?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and other underrepresented groups in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

#### **Additional Solicitation Specific Review Criteria**

Proposals to the P4CLIMATE solicitation must clearly state how the proposed projects will address one or both of the two research themes described in the program description.

## **B. Review and Selection Process**

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Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements or the Division of Acquisition and Cooperative Support for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

## **VII. AWARD ADMINISTRATION INFORMATION**

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### **A. Notification of the Award**

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Notification of the award is made to *the submitting organization* by an NSF Grants and Agreements Officer. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

### **B. Award Conditions**

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An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1)\*; or Research Terms and Conditions\* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

\*These documents may be accessed electronically on NSF's Website at [https://www.nsf.gov/awards/managing/award\\_conditions.jsp?org=NSF](https://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF). Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov).

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at [https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=pappg](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg).



## Administrative and National Policy Requirements

### Build America, Buy America

As expressed in Executive Order 14005, [Ensuring the Future is Made in All of America by All of America's Workers](#) (86 FR 7475), it is the policy of the executive branch to use terms and conditions of Federal financial assistance awards to maximize, consistent with law, the use of goods, products, and materials produced in, and services offered in, the United States.

Consistent with the requirements of the Build America, Buy America Act (Pub. L. 117-58, Division G, Title IX, Subtitle A, November 15, 2021), no funding made available through this funding opportunity may be obligated for an award unless all iron, steel, manufactured products, and construction materials used in the project are produced in the United States. For additional information, visit NSF's [Build America, Buy America](#) webpage.

### Special Award Conditions:

Grantees are required to adhere to the minimum solicitation criteria for Data Management Plans plus any Division/Office-specific requirements.

## C. Reporting Requirements

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For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at [https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=pappg](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg).

Final Reports for all P4CLIMATE awards must include a statement (in the section titled "Products" under Other Products, Other Publications, or Website, or Other Internet Sites) describing the implementation of the Data Management Plan and where the data can be found.

Final Reports for all P4CLIMATE awards are expected to specifically address progress on activities related to proposed Broader Impacts. Information should be provided in the Accomplishments section, such as in response to questions about opportunities for training and professional development, dissemination of results to communities of interest, and impact on society beyond science and technology. The impacts of these activities should be provided in the Impacts section, such as in response to questions about impacts on society beyond science and technology.

## VIII. AGENCY CONTACTS

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*Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.*

General inquiries regarding this program should be made to:

- David J. Verardo, telephone: (703) 292-4695, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)
- Jonathan G. Wynn, telephone: (703) 292-4725, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)
- Joseph Carlin, telephone: (703) 292-8562, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)
- Rainer Amon, telephone: (703) 292-7979, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)
- David F. Porter, telephone: (703) 292-2930, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)
- Alan Wanamaker, telephone: (703) 292-7516, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)
- Mea S. Cook, telephone: (703) 292-7306, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)
- Alberto Perez-Huerta, telephone: (703) 292-7079, email: [p4climate@nsf.gov](mailto:p4climate@nsf.gov)

For questions related to the use of FastLane or Research.gov, contact:

- FastLane and Research.gov Help Desk: 1-800-673-6188
- FastLane Help Desk e-mail: [fastlane@nsf.gov](mailto:fastlane@nsf.gov)
- Research.gov Help Desk e-mail: [rgov@nsf.gov](mailto:rgov@nsf.gov)

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: [support@grants.gov](mailto:support@grants.gov).

## IX. OTHER INFORMATION

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The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF [Grants Conferences](#). Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on [NSF's website](#).

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this mechanism. Further information on Grants.gov may be obtained at <https://www.grants.gov>.

## ABOUT THE NATIONAL SCIENCE FOUNDATION

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The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

*Facilitation Awards for Scientists and Engineers with Disabilities (FASSED)* provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.E.6 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <https://www.nsf.gov>

- **Location:** 2415 Eisenhower Avenue, Alexandria, VA 22314
- **For General Information**  
(NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**
  - Send an e-mail to: [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov)
  - or telephone: (703) 292-8134
- **To Locate NSF Employees:** (703) 292-5111

## PRIVACY ACT AND PUBLIC BURDEN STATEMENTS


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The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a

party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See [System of Record Notices, NSF-50](#), "Principal Investigator/Proposal File and Associated Records," and [NSF-51](#), "Reviewer/Proposal File and Associated Records." Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton  
Reports Clearance Officer  
Policy Office, Division of Institution and Award Support  
Office of Budget, Finance, and Award Management  
National Science Foundation  
Alexandria, VA 22314

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	National Science Foundation, 2415 Eisenhower Avenue, Alexandria, Virginia 22314, USA Tel: (703) 292-5111, FIRS: (800) 877-8339   TDD: (703) 292-5090 or (800) 281-8749					<a href="#">Text Only</a>