

# Frontier Research in Earth Sciences (FRES)

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## PROGRAM SOLICITATION

NSF 19-531

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REPLACES DOCUMENT(S):

NSF 16-589

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National Science Foundation

Directorate for Geosciences  
Division of Earth Sciences

### Full Proposal Target Date(s):

February 20, 2019

If a PI intends to submit after the target date, s/he must get approval in advance from one of the Cognizant Program Officers to ascertain if a late proposal can be reviewed in the upcoming competition.

February 05, 2020

First Wednesday in February, Annually Thereafter

## IMPORTANT INFORMATION AND REVISION NOTES

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This new solicitation encourages innovative approaches to investigating the Earth's surface systems, continental lithosphere, and deep interior. When preparing a proposal, investigators should pay special attention to the "Additional Solicitation Specific Review Criteria" outlined in section VI of this solicitation.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide*(PAPPG) (NSF 19-1), which is effective for proposals submitted, or due, on or after January 28, 2019.

## SUMMARY OF PROGRAM REQUIREMENTS

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### General Information

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#### Program Title:

Frontier Research in Earth Sciences (FRES)

#### Synopsis of Program:

The FRES program will support research in Earth systems from its core through the critical zone. The project may focus on all or part of the surface, continental lithospheric, and deeper Earth systems over the entire range of temporal and spatial scales. FRES projects will typically have a larger scientific scope and budget than those considered for funding by core programs in the Division of Earth Sciences (EAR). FRES projects may be interdisciplinary studies that do not fit well within the core programs or cannot be routinely managed by sharing between core programs. Innovative proposals within a single area with results that will have broad relevance to Earth Science research are also encouraged. Investigations may employ any combination of field, laboratory, and computational studies with observational, theoretical, or experimental approaches. Projects should be focused on topics that meet the guidelines for research funded by the Division of Earth Sciences.

#### 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.

- Dennis Geist, telephone: (703) 292-4361, email: [dgeist@nsf.gov](mailto:dgeist@nsf.gov)
- Margaret Benoit, telephone: (703) 292-7233, email: [mboenit@nsf.gov](mailto:mboenit@nsf.gov)
- Richard F. Yuretic, telephone: (703) 292-4744, email: [ryuretic@nsf.gov](mailto:ryuretic@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 /p>

**Estimated Number of Awards:** 5 to 10

It is anticipated that 5 to 10 projects will be funded. Many of the projects will be collaborative research from multiple institutions. There is no upper or lower limit on award size, but investigators proposing projects with budgets of less than \$1,000,000 or more than \$3,000,000 are encouraged to contact a Program Officer before submitting a proposal.

**Anticipated Funding Amount:** \$11,000,000 to \$12,000,000

Amount of anticipated funding depends on the availability of funds.

**Eligibility Information**

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**Who May Submit Proposals:**

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- For-profit organizations: U.S. commercial organizations, especially small businesses with strong capabilities in scientific or engineering research or education.

**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:**

An individual may serve as Principal Investigator, Co-Principal Investigator, or Senior Personnel on only one FRES proposal per year.

**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 FastLane: *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:**

Other budgetary limitations apply. Please see the full text of this solicitation for further information.

### C. Due Dates

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

February 20, 2019

If a PI intends to submit after the target date, s/he must get approval in advance from one of the Cognizant Program Officers to ascertain if a late proposal can be reviewed in the upcoming competition.

February 05, 2020

First Wednesday in February, Annually Thereafter

## Proposal Review Information Criteria

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### Merit Review Criteria:

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

## Award Administration Information

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### Award Conditions:

Standard NSF award conditions apply.

### Reporting Requirements:

Standard NSF reporting requirements apply.

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## I. INTRODUCTION

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Advances in Earth science research may require projects that are not ordinarily awarded by core programs in EAR (Geobiology and Low-Temperature Geochemistry, Geomorphology and Land Use Dynamics, Geophysics, Hydrology, Petrology and Geochemistry, Sedimentary Geology and Paleobiology, and Tectonics). These include multi-investigator interdisciplinary projects, and disciplinary projects whose budgets are greater than those typically funded by core programs and result in outcomes that influence the science well beyond the scope of the project itself.

Overall, the goals of the Frontier Research in the Earth Sciences (FRES) program are to:

- Catalyze significant advances on important problems in the Earth Sciences;
- Support studies of the Earth that build on process-oriented knowledge and enable hypothesis testing;
- Provide opportunity for collaborative research into the dynamics and complexity of Earth processes; and
- Encourage innovative research that transcends the boundaries of the core programs within the Division of Earth Sciences (EAR).

The FRES program will support research in Earth systems over the entire range of temporal and spatial scales. Appropriate topics may include (but are not limited to) effects of mantle dynamics on continental systems; linkages among tectonics, climate, and landscape; interactions involving the Earth's surficial, sedimentary, hydrological, or biotic systems; global cycles that include core and mantle processes; or other themes of similar scope. Projects that emphasize the oceanic lithosphere, marine systems, polar regions, or atmospheric processes are not appropriate for the FRES solicitation.

Investigators are encouraged to consult and refer to readily available community studies and reports that motivate grand challenges or frontier problems in the Earth Sciences, should they be relevant to the proposed research.

## II. PROGRAM DESCRIPTION

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The FRES program invites research proposals that transcend the disciplinary focus and budgetary limitations of core programs in EAR. The program will consider proposals about the processes that operate on and control the evolution of the continents, surface environment, and the Earth's interior over spatial scales that range from global through nanometer scale, and over all timescales. Understanding the processes, dynamics, and evolution of complex systems is typically beyond the abilities and expertise of the single scientist and may require cooperative interdisciplinary efforts and integration of disparate data sets and outcomes.

The FRES program will also support projects that are within the bounds of a single research domain but are larger in scope and budget than those typically funded by core programs. Successful FRES projects will have outcomes that extend beyond those of a single discipline and have relevance to a wider cross-section of Earth science fields. Projects may employ any combination of field, laboratory, and computational studies with observational, theoretical, or experimental approaches.

An essential component of innovation in science is the ability to extrapolate observations and data into new regimes, to develop new hypotheses, or to design new models that can be adapted or applied to broader problems in the Earth sciences. FRES thus presents an opportunity to amplify and extend the outcomes of projects funded by EAR core programs.

FRES welcomes collaborations with researchers outside the disciplinary boundaries of EAR to help address questions in line with EAR goals. Proposers interested in research that transcends that funded by EAR, for example involving interaction of the continents, critical zone, or Earth's interior with the atmosphere, oceans, oceanic lithosphere, or biosphere, must contact the Program Directors in those fields (e.g. AGS, OCE, or BIO) to ensure co-review of the proposal. Likewise, investigators interested in research questions that involve the use of facilities, such as research vessels or aircraft, managed by other NSF organizations must contact the relevant Program Directors in those organizations to ensure co-review of the proposal. Proposers must contact by email the relevant Program Directors from other Divisions and the FRES Program Directors to make sure written consent is given from the other programs to co-review the proposal. Such programs should also be listed on line 2 of the cover page.

FRES funds provide support for projects based on proposals submitted to and evaluated during the annual FRES competition. FRES will not consider proposals submitted to mechanisms exempt from merit review, such as RAPID, RAISE, EaGER, and conference proposals.

The broader impacts activities must be an integral part of the proposed research, and this should be reflected in the explicit plans for broader-impacts activities, expertise of collaborators, the proposal budget, and budget justification. Successful projects will include creative, integrative, and effective activities developed within the context of the mission, goals, and resources of the organizations involved. Partnerships with institutions serving students under-represented in the Earth Sciences are encouraged.

## III. AWARD INFORMATION

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

**Estimated Number of Awards:** 5 to 10 projects

5 to 10 new projects per year. Many projects will be collaborative research proposals from multiple institutions. There is no upper or lower limit on award size, but investigators proposing projects with budgets of less than \$1,000,000 or more than \$3,000,000 are encouraged to contact a program Officer before submitting a proposal.

**Anticipated Funding Amount:** Approximately \$11,000,000 to \$12,000,000 pending availability of funds.

## IV. ELIGIBILITY INFORMATION

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### Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- For-profit organizations: U.S. commercial organizations, especially small businesses with strong capabilities in scientific or engineering research or education.

### 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:

An individual may serve as Principal Investigator, Co-Principal Investigator, or Senior Personnel on only one FRES proposal per year.

## 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 Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal & Award Policies & 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) 292-7827 or by e-mail from [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov). Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.
- 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) 292-7827 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 the NSF FastLane system. 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.

Except as modified below, full proposals should be prepared in accordance with the guidelines in the PAPPG or NSF Grants.gov Application Guide.

### Cover Page:

Indicate any programs outside of EAR that have been contacted and agreed to co-review the proposal.

## Project Description:

The Project Description section should contain three parts, each with specific page lengths (**28 pages** total):

### 1. Proposed Research, including the headers Intellectual Merit and Broader Impacts (**20 pages** maximum):

- A description of the proposed research and how it is poised for major advances, and if relevant why it requires a multidisciplinary team approach.
- A description of how diverse data sets will be integrated to answer the research questions.
- An explanation of how the work goes beyond what can be addressed within the core programs of the Earth Sciences Division.
- The relevance of the research to advancement of the fundamental understanding of Earth sciences, the needs of the general public, or the advancement of education. Plans for student mentoring, outreach, diversity, or other broader impacts should be included.

### 2. The Management and Integration Plan (**4 pages** ;maximum):

- Describe the role and activities of each member of the research team and how the team effort will be coordinated;
- Describe how the disciplinary components of the project will be integrated; describe how data, models, tools and ideas will be disseminated and shared within the research team and across the research community;
- Provide a timeline of expected outcomes.
- Explain how research and education and outreach components will be integrated.

### 3. Results of prior Support (**4 pages maximum** for all PIs, coPIs).

**Projects involving work in foreign countries:** For studies in countries other than the United States, the project description should discuss, where appropriate, collaborations with scientists and students from the host country, and how these individuals will be involved in the project. Collaborations should be well justified, in that they represent true intellectual collaboration and utilize the expertise and specialized skills, facilities, and/or resources of the foreign collaborator. Letters of collaboration must be included in the Special Information and Supplementary Documents section of the proposal. An important provision of the PAPPG (Chapter II.C.2.) states "Some governments require nonresidents to obtain official approval to carry out investigations within their borders and coastal waters under their jurisdiction. PIs are responsible for obtaining the required authorizations. Advance coordination should minimize disruption of the research." Failure to obtain the appropriate permits for all aspects of the research effort may jeopardize not only the proposed research, but also the well being of the personnel. Where relevant, arrangements to allocate samples and data between host country organization(s) or institution(s) and U.S. organization(s) or institution(s) should be discussed in the proposal or in the Data Management plan. Investigators are encouraged to include any such permits (including legally required collecting, import, and export permits for samples, instrumentation, and data), authorizations, and agreements, in the Special Information and Supplementary Documents section of the proposal.

## Supplementary Documents:

**Use of NSF Research Platforms and Facilities:** Projects that will be utilizing NSF research platforms (e.g. ships, airplanes, etc) or other shared use facilities (e.g. field instrumentation, analytical or experimental facilities) are responsible for filing a copy of their Request for Facility Support as a supplementary document in their proposal. PIs must coordinate their requests with the appropriate programs to ensure that access is available to the facility and fits within the time line of the proposed research.

**Data Management Plan:** Proposals must include a data and information management plan as specified in the PAPPG.

**Postdoctoral Researcher Mentoring Plan:** Proposals that request funding for postdoctoral researchers must include a one-page mentoring plan in accordance with guidance in the PAPPG.

**Letters of Collaboration:** As per the PAPPG, letters of collaboration should be limited to stating the intent to collaborate and should not contain endorsements or evaluation of the proposed project. Proposals containing longer letters with additional information describing the research project may be returned without review. Specific information on what will be provided via the collaboration should be described in the Project Description or Facilities, Equipment, and Other Resources. The source of funding of the collaborative work and the status of the funding should also be included in the Project Description or Facilities, Equipment, and Other Resources.

**Collaborators and Other Affiliations Information:** Proposers should follow the guidance specified in [Chapter II.C.1.e](#) of the NSF PAPPG. Grants.gov Users: The COA information must be provided through use of the COA template and uploaded as a PDF attachment.

## B. Budgetary Information

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### Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

### Other Budgetary Limitations:

There is no upper or lower limit on award size, but investigators proposing projects with budgets of less than \$1,000,000 or more than \$3,000,000 are encouraged to contact a Program Officer before submitting a proposal. Project duration may be up to five years.

### Budget Preparation Instructions:

**Budgets for Research Platforms and Facilities:** Projects that will be utilizing NSF research platforms (e.g. ships, airplanes, etc) or other shared use facilities (e.g. field instrumentation, analytical or experimental facilities) are responsible for filing a copy of their Request for Facility Support as a supplementary document in their proposal. Any costs that will be associated with such facilities should be clearly documented, and PIs should coordinate their requests with the appropriate facility to ensure that access is available to the facility and fits within the time line of the proposed research.

## C. Due Dates

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

February 20, 2019

If a PI intends to submit after the target date, s/he must get approval in advance from one of the Cognizant Program Officers to ascertain if a late proposal can be reviewed in the upcoming competition.

February 05, 2020

First Wednesday in February, Annually Thereafter

## D. FastLane/Grants.gov Requirements

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### For Proposals Submitted Via FastLane:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: <https://www.fastlane.nsf.gov/a1/newstan.htm>. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail [fastlane@nsf.gov](mailto:fastlane@nsf.gov). The FastLane Help Desk answers general technical questions related to the use of the FastLane 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: <http://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 FastLane are strongly encouraged to use FastLane 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 *Building the Future: Investing in Discovery and Innovation - NSF Strategic Plan for Fiscal Years (FY) 2018 – 2022*. 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 underrepresented minorities 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**

In addition to the National Science Board merit review criteria, reviewers will be asked to consider several specific criteria when reviewing FRES proposals. These criteria include:

- Does the research require an approach that goes beyond the scope that can be addressed in the core programs of the Division of Earth Sciences Division?
- Will the research outcome advance knowledge primarily in the Earth Sciences as opposed to other geosciences (e.g. ocean, atmosphere), biological sciences, or ancillary fields?
- Are the disciplinary components of the proposed research well integrated?
- Is the management plan likely to result in an effective outcome?

## **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 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 a Grants Officer in the Division of Grants and Agreements. 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) 292-7827 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=papppg](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papppg).

## 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=papppg](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papppg).

## 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:

- Dennis Geist, telephone: (703) 292-4361, email: [dgeist@nsf.gov](mailto:dgeist@nsf.gov)
- Margaret Benoit, telephone: (703) 292-7233, email: [mberoit@nsf.gov](mailto:mberoit@nsf.gov)
- Richard F. Yuretic, telephone: (703) 292-4744, email: [ryuretic@nsf.gov](mailto:ryuretic@nsf.gov)

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: [fastlane@nsf.gov](mailto:fastlane@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 <http://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) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

## PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

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 Systems of Records, *NSF-50*, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and *NSF-51*, "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). 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  
Office of the General Counsel

## X. APPENDIX

### Frequently Asked Questions

#### 1. How big a research team should I be including in my proposal?

FRES is intended to enable comprehensive investigations that will advance the understanding of the continental, surface, and deep Earth systems of the planet. The team should therefore comprise a sufficient number of investigators to accomplish this task. The team should provide the necessary sophistication in data acquisition, interpretations, and models to transform knowledge on an important and significant problem. In unusual circumstances, this could be accomplished by a single investigator.

#### 2. Should my proposal be submitted to FRES, a core program, or shared between core programs?

If you have any questions about the suitability of your project for FRES, you should contact a FRES Program Director in the early stages of the design of the project.

#### 3. Is a model required as part of an FRES proposal?

A particular type of model is not required, but the analysis and interpretation of complex relationships can often be clarified by modeling. A model can take on many forms. Numerical models can be used to represent the complexities of natural systems and these will rely on data collected through field or laboratory data and predict various scenarios based on a given set of conditions. Conceptual models are convenient frameworks to develop logical pathways to test hypotheses and synthesize results.

#### 4. To what extent should the projects be hypothesis-driven? How should I be posing my questions and my hypotheses?

Hypotheses are typically generated from existing observations and theory most often rooted in the disciplinary research within Earth science. Coupling the driving science questions to specific hypotheses is always good practice, as is specific explanation of how data and models address the hypotheses. Your questions may be derived from novel concepts, or existing models may be used to pose questions. FRES projects should provide a long-term mechanism for tactical advancement of Earth science.

#### 5. Why is the budget unbounded?

Larger studies with more components require more diverse expertise to gather data, design and execute models, and interpret those. On the other hand, some interdisciplinary projects that rely on computational and laboratory studies might be less expensive than projects that include more complexity and extensive fieldwork. Your budget must be fully justified and should be appropriate to the complexity of the project and the tools necessary to address that complexity.

#### 6. My project will involve the use of ship or aircraft time managed by another NSF Division. How to I incorporate that into my proposal?

FRES will not provide funds for use of facilities normally supported by other NSF Divisions or Directorates. In this case, you should contact a program director in the other division to ensure that your proposal will be co-reviewed by that program, and formally report on this conversation to both that program director and the FRES program directors via email.

#### 7. My project involves research on marine fossils contained within sedimentary rocks exposed on land. Or, my research is on an oceanic archipelago. Will these be considered by FRES?

Yes - FRES will consider any project within the scope of the Division of Earth Sciences (EAR), including the fields of solid-earth science (geology, geochemistry, geophysics, and continental hydrology). It excludes the sciences of oceanography, marine geology, and atmospheric science.

#### 8. Will the FRES program consider cross-coastal research, which will involve a UNOLS ship?

FRES will consider amphibious research, but the Principal Investigator must contact the relevant Program Director in the Ocean Sciences Division, who must agree to co-review the proposal. A copy of the correspondence must be forward to the FRES Program Directors.

