

Critical Zone Observatories (CZO)

PROGRAM SOLICITATION

NSF 12-575

REPLACES DOCUMENT(S):

NSF 06-588



National Science Foundation

Directorate for Geosciences
Division of Earth Sciences

Full Proposal Deadline(s) (due by 5 p.m. submitter's local time):

February 05, 2013

IMPORTANT INFORMATION AND REVISION NOTES

Other Revisions

- This solicitation describes the intent to establish a network of CZOs;
- The objectives of the CZOs have been focused and redefined.
- Previous funding through the CZO program ([NSF 06-588](#)) is not required for proposers wishing to submit a proposal under the current 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 18-1](#)), which is effective for proposals submitted, or due, on or after January 29, 2018.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Critical-Zone Network (CZN)

Synopsis of Program:

Observations have always informed critical decisions and knowledge building throughout human history. Earth observations are a critical ingredient for understanding and predicting the sustainability or disruption of natural services that support basic human needs including water, food, energy, mineral resources, and safe habitation. Such observations are collected by seismic networks, atmospheric and ocean-based sensors (detecting, e.g., ozone, greenhouse gases, ocean currents, sea ice extent), river and tide gauges, and satellites that observe changing terrestrial features including receding glaciers, growth of deserts and urban centers, and evolving vegetative covers.

One pressing challenge is to develop terrestrial observatories that could document and inform prediction of the multi-scale and less visible transport of energy and material, and evolution of the Earth's **critical zone**. This zone -the thin veneer of Earth that extends from the top of the vegetation to the base of weathered bedrock- is critical because it is where fresh water flows, soils are formed from rocks, and terrestrial life flourishes. This zone provides most of the ecosystem services on which societies depend. Its intrinsic resilience, natural evolution, and fate in the face of human land use and climate change needs to be understood and predicted in order to inform our strategies for sustaining a wide range of human activities. Unprecedented pressures are being placed on the critical zone, and understanding the interrelated processes, system dynamics, sensitivities, and thresholds in this zone is of vital importance for informing human decisions.

NSF seeks proposals to establish a networked set of Critical Zone Observatories (CZO) that will address pressing interdisciplinary scientific questions concerning geological, physical, chemical, and biological processes and their couplings that govern critical zone system dynamics. The CZOs are expected, collectively, to 1) measure and quantify the significant processes of the critical zone on appropriate time and space scales; 2) develop a unifying theoretical framework that integrates new understanding of coupled hydrological, geochemical, geomorphological, sedimentological and biological processes; and 3) develop, couple and validate system-level models to predict how

the critical zone responds to external forces such as anthropogenic, climatic, and/or tectonic processes. Each observatory must contribute to strengthening the scientific basis for decision-making, particularly with regards to impacts on health, safety, and environment due to observed and predicted changes in the critical zone.

An overarching goal of the critical zone observatory network, which will be comprised of US-based sites (50 states plus territories), is to offer scalable and transferable information that could enhance the scale and scope of the knowledge building and societal benefits that will accrue beyond where the specific CZOs are located. Amongst the strategies contemplated in this program are diversifying the coverage of observatories in terms of geography, geology, and types of environments; leveraging existing infrastructure and legacy data; coordinating observations, data management, modeling, and educational activities among CZOs; and coordinating activities that address common questions at multiple observatories. All CZOs will be expected to collect a common set of measurements in addition to site-specific measurements describing the geological, physical, chemical, hydrological, and biological characteristics of the site. In addition, it is anticipated that the CZOs will adhere to common data management policy and use common data management tools. The network of CZOs will additionally serve as a community resource to engage investigators beyond the CZO awardees in critical zone research.

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.

- Richard F. Yuretic, telephone: (703) 292-4744, email: ryuretic@nsf.gov

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

- 47.050 --- Geosciences

Award Information

Anticipated Type of Award: Cooperative Agreement

Estimated Number of Awards: 8

Anticipated Funding Amount: \$8,000,000

The awards will be up to \$5,000,000 over 5 years per CZO, pending availability of funds.

Eligibility Information

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.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization: 1

Collaborative Proposals submitted as separate submissions from multiple organizations are NOT allowed for this competition. Instead, any proposal to the CZO solicitation should be a single submission that includes sub-award support for all partner organizations that are requesting funding from NSF. Any one institution may submit only one CZO proposal as Lead institution.

Limit on Number of Proposals per PI or Co-PI: 1

An individual may serve as PI or co-PI on only one proposal. An individual may serve as Senior Investigator on one additional proposal.

Proposal Preparation and Submission Instructions

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=papppg.
 - 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).

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 Deadline(s)** (due by 5 p.m. submitter's local time):

February 05, 2013

Proposal Review Information Criteria

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

Award Conditions:

Standard NSF award conditions apply.

Reporting Requirements:

Standard NSF reporting requirements apply.

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I. INTRODUCTION

The critical zone, where most terrestrial life thrives on Earth, is under unprecedented pressure due to human demands for food, water, space, and other resources. In this zone, from the top of the vegetation to the weathering front, multiple components of the Earth system interact through coupled processes that operate at different temporal and spatial scales. These coupled processes directly influence and are affected by climate, anthropogenic activity and cycles of water, nutrients, and other chemicals. They also modulate the effects of climatic, tectonic, biologic, and human drivers on the critical zone form, function, and evolution. As the critical zone is highly heterogeneous and complex, a network of Critical Zone Observatories (CZO) would provide data needed to document processes and evaluate predictive models of how critical zone components co-evolve and respond to natural and anthropogenic pressures. Understanding and quantifying these changes are important for informing critical decisions on how humans can best mitigate, adapt or respond to slow or abrupt changes in the critical zone.

A conceptual system model would guide the design of CZO measurement strategies to determine the complex interactions governing critical zone form, function, and evolution. In turn, interdisciplinary CZO teams would refine and test these models using state-of-the-art CZO measurements that would flow from a variety of sources including in situ environmental sensors, geochemical and microbiological analyses, remote sensing, and surface and subsurface imaging. These system models would take into account feedbacks in time and space, quantify rates of change in the critical zone due to external drivers, be capable of reconciling observations from multiple scales, and be able to estimate parameters when direct observations are not available. Each CZO observatory is therefore part of the hypothesis/observation/model cycle that iterates in both directions. This iteration is required if we are to predict the fate of the critical zone and ecosystem services that they provide. Models can facilitate the design and optimization of observation systems; conversely, CZO observations can be assimilated into models to better define functional dependencies between forcing functions and constrain the range of effective responses to system forcing. A distinct advantage of networked CZOs is that the multiple sites offer opportunities for cross-validating models developed at other sites.

A comprehensive study of the critical zone requires that the CZO network includes a diverse set of sites with respect to (for example) lithology, climate, erosional/depositional settings, and land-use histories. Each CZO would have a research plan that includes data gathering, integration, and synthesis activities as well as training. These activities are expected to be readily integrated with those at other CZOs and to facilitate the participation of a broad range of scientists.

Additional documents that are useful descriptors of community planning related to this solicitation may be accessed through www.nsf.gov/geo/ear/programs/czo_moreinfo.jsp

II. PROGRAM DESCRIPTION

We solicit proposals to establish the Critical Zone Observatory network through US-based observatories at which interdisciplinary research is conducted to address the common goal of predicting the fate of the critical zone and the ecosystem services it provides by examining integrative scientific questions about geological, physical, chemical, and biological processes that govern critical zone dynamics. Successful proposals will be motivated by pressing scientific questions and organized around a conceptual model, not by data gathering for site characterization alone. Successful proposals will be guided and implemented by an integrated field and modeling approach, with advancements in each component providing the impetus for improvements in the other. Each CZO in the network will be expected to:

1. Identify one or more primary research focus/foci;
2. Develop (and enhance over time) a unifying theoretical framework that couples hydrological, geochemical, geomorphological, sedimentological and biological processes;
3. Measure and quantify the significant processes of the critical zone on appropriate time and space scales;
4. Integrate efforts in several subfields addressing critical zone processes (e.g. hydrology, geochemistry, geobiology, geomorphology, sedimentology, pedology, and ecology);
5. Develop and validate systems models to predict how the critical zone responds to external drivers such as anthropogenic actions, climate, biologic, hydrologic, and tectonic drivers; and assess how severely these impact the ecosystem services provided by the critical zone.
6. Serve as a community resource to engage a broad cadre of investigators in research relevant to the critical zone;
7. Adhere to centralized data management policies and use common data management tools;
8. Be an active member of the CZO network.

In addition, proposals should:

- Present and elaborate the questions to be investigated with an explanation of why the site proposed is optimal for answering these questions;
- Present and elaborate the integrative models to be tested;
- Describe the techniques and tools to be employed, including cyber-infrastructure, to acquire and disseminate field data;
- Describe plans for instrument deployments considering (for example) the advantages of nested observatories;
- Specify the data sets needed or available from archival sources to describe geological, physical, chemical, biological and other relevant characteristics of the site and to facilitate cross-site studies;
- State policy for data access;
- Describe modes of access to the observatory by scientists not supported by the CZO grant;
- Present plans to implement education and outreach activities.

Investigators are encouraged, where appropriate, to work in association with existing projects, observational networks, experimental

watersheds, long-term ecological research sites, research centers, or testing and evaluation facilities, whether supported by NSF or other agencies such as USEPA, USGS, USDA, DOE, NOAA, etc. The project description should make clear how the proposed work differs from and augments activities already supported. A letter stating the specifics of cooperation from the ongoing activity for the proposed project should be included as Supplementary Documentation.

CZO COORDINATION:

Each CZO is required to participate in collaborative network activities facilitated by a CZO National Office. Along with the Director of the National Office, the PI or co-PI of each CZO will participate in the CZO network implementation group, whose goals are to: (1) facilitate communication among CZOs; (2) promote dissemination of information and resources both among the CZOs and to additional stakeholder communities beyond the reach of individual CZOs; (3) identify common concerns and needs; (4) identify opportunities to leverage resources or develop synergistic activities; (5) provide input into the development of agendas for annual PI meetings; and, (6) coordinate implementation of data publication. Communication will occur through monthly teleconferences and semi-annual face-to-face meetings held each Fall, and in conjunction with Spring annual PI meetings. Funds to support travel to the two physical meetings should be included in each CZO budget request. Operational support for the CZO National Office will be managed through a limited-term third-party cooperative agreement from NSF that will be issued after the CZO awardees have been identified. Note that organizations involved in CZO awards will not be eligible to serve as the CZO National Office contractor.

Another important component of CZO network will be the common set of measurements that each CZO will make to describe site characteristics and allow cross-site studies. During the negotiation period of the cooperative agreements, there will be a meeting of NSF and all PIs to decide on common measurements, protocols, and data management for the network of CZOs.

III. AWARD INFORMATION

The CZOs will be supported via a cooperative agreements. It is expected that the terms and conditions of the cooperative agreement will include clauses that would foster collaboration among observatories in the network.

IV. ELIGIBILITY INFORMATION

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.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization: 1

Collaborative Proposals submitted as separate submissions from multiple organizations are NOT allowed for this competition. Instead, any proposal to the CZO solicitation should be a single submission that includes sub-award support for all partner organizations that are requesting funding from NSF. Any one institution may submit only one CZO proposal as Lead institution.

Limit on Number of Proposals per PI or Co-PI: 1

An individual may serve as PI or co-PI on only one proposal. An individual may serve as Senior Investigator on one additional proposal.

Additional Eligibility Info:

None Specified

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal 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 Grant Proposal Guide (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: [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. 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/bfa/dias/policy/docs/grantsgovguide.pdf>).
- 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.

1. **Project Description:** Due to the complex nature of the CZOs, PIs will be allowed to use 20 pages to describe their projects. It is expected that the project description will include:

- Scientific justification: The proposal must clearly describe the CZO's vision, goals and anticipated outcomes. The vision and goals should be informed by current knowledge of critical zone science within which the proposed work would occur. The proposal should provide evidence of an effective structure among core and partnering organizations that will work together to realize the project's vision and goals. The proposal should also clearly indicate how the intended work differs from, builds on, or is otherwise informed by prior efforts
- Implementation plan: The project description should present a clear plan on the activities that will take place at the CZO and in conjunction with other CZOs (e.g. instrument deployment, data gathering, archiving, synthesis, outreach and education). The implementation plan should articulate how the activities align with the goals of the CZO, and provide a timeline of when the activities will be performed and under which PIs guidance and planning.
- Engagement plan: The proposal should include a detailed plan on how the CZO would engage other scientists and fulfill the expectation of being a community resource. The plan should provide information on the activities that will take place to attract scientists not affiliated with the CZO proposal.
- Dissemination plan: The proposal should discuss how scientific products (samples, data, models, outreach materials) that are collected/created by the CZO will be broadly shared and disseminated. The project description should also discuss how the findings of scientific and education activities will be communicated.
- Results from Prior NSF Support: Prior NSF Support results should be reported for the PI, Co-PIs, and all other Senior Personnel named in the budget pages, if they have received funding from NSF in the last five years. Information on prior awards is required if it is relevant to the proposed scope of work. Each PI or Co-PI who has received more than one prior award (excluding amendments) must report on at least one award most closely related to the proposal; publications from that award may be included in the references. The results of any prior NSF investment(s) should be clearly demonstrated and supported by data. A discussion of both successes and lessons learned from previous support must be included. The project description should also clearly indicate how the intended work differs from, builds on, or is otherwise informed by prior efforts.

2. Special information and Supplementary Documentation:

Management Plan (governance structure, up to 4 pages): The management plan should describe the management and administrative structure with sufficient detail to demonstrate the capability for conducting the proposed work; identify the members of the CZO leadership team; and the level of effort of the main participants.

Postdoctoral Researcher Mentoring Plan (PRMP, up to 1 page): Proposals that request funding to support postdoctoral researchers must include a description of the disciplinary and cross-disciplinary mentoring activities that will be provided for such individuals. Only one PRMP should be submitted, even if multiple postdoctoral researchers from different institutions are involved. Please be advised that if required, FastLane will not permit submission of a proposal that is missing a PRMP. See Chapter II.C.2.j of the PAPPG for further information about the implementation of this requirement.

Data Management Plan (DMP, up to 2 pages): The DMP should describe how the CZO will use and contribute to centralized efforts for data management explained in <http://www.criticalzone.org/data.html>

- The types of data, samples, physical collections, software, and other materials to be produced in the course of the project;
- The standards to be used for data and metadata format and content (where existing standards are absent or deemed inadequate, this should be documented along with any proposed solutions or remedies);
- Policies for access and sharing including provisions for appropriate protection of privacy, confidentiality, security, intellectual property, or other rights or requirements;
- Policies and provisions for re-use, re-distribution, and the production of derivatives;
- Plans for archiving data, samples, and other research products, and for preservation of access to them;
- Some data policy will be mandated at the network level as appropriate;
- Support for a data manager should be included in each CZO budget request.

Letters of Collaboration: This supplementary documentation should include any letters of collaboration from individuals or organizations that are integral parts of the proposed project, (such as the involvement of collaborator organizations that are not supported by sub awards) or documentation of permission to access sites, materials, or data for research or other associated project activities. Letters of collaboration should focus solely on affirming that the individual or organization is willing to collaborate on the project as specified in the project description of the proposal for the duration of the project. No additional text, praiseworthy statements or elaboration of the nature of activities to be undertaken by the collaborator and endorsements of the potential value or significance of the project for the collaborator, may be included. Letters of collaboration are not required for any individual designated as a principal investigator or senior personnel (and having a biosketch), nor are letters of collaboration required for any organization that will be a subawardee in the proposal budget (inclusion of biographical sketches and current and pending support statements for individuals and subaward budgets for organizations are considered to be implicit statements affirming involvement in the proposed project). However, individuals and organizations providing letters of collaboration must be included in the COI matrix (see below).

The project description should document the nature and need for all collaborations. Each letter of collaboration must be signed by the designated collaborator. Requests to collaborators for letters of collaboration should be made by the PI well in advance of the proposal

submission deadline, because they must be included at the time of the proposal submission.

Conflicts of Interest (COI) matrix: Each proposal must include a COI matrix table in a single alphabetized table, with the full names and institutional affiliations of all people with conflicts of interest for all senior personnel (PI and co-PIs) and any named personnel in the project budget. Conflicts to be identified are (1) Ph.D. thesis advisors or advisees, (2) collaborators or co-authors, including postdoctoral researchers, for the past 48 months, and (3) any other individuals with whom or institutions with which the senior personnel (PI, co-PIs, and any named personnel) have financial ties, including advisory committees (please specify type). Spouses, significant others and relatives with appropriate scientific credentials should also be listed in the COI matrix. (This list generally replicates information that should be provided in the biographical sketches, but it is collated into one alphabetized table to facilitate the identification of individuals who would have conflicts of interest in the review of the proposal.) If submitting via Grants.gov, complete the information and attach as a PDF file (see Field 5, Additional Single Copy Documents, on the NSF Grant Application Cover Page). Each Project should submit ONE COI matrix table for their PROJECT: the COI matrix will include the names of all individuals associated (named) with that project and their COI according to the following template:

- Column A: PI, coPI or Senior Personnel on project or any individual or organization providing a letter of collaboration (last name, first name).
- Column B: Institution of PI, coPI or senior personnel on project.
- Column C: name of person with whom there is a conflict for the person in column "A" (last name, first name).
- Column D: institution of person in column "C".
- Column E: type of COI.

Please provide COI matrix alphabetized by Column A then Column C.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Other Budgetary Limitations:

Funds to support travel to the two physical meetings should be included in each CZO budget request.

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

February 05, 2013

D. FastLane/Grants.gov Requirements

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. 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. 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

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/.

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

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 addressing the standard NSF review criteria of Intellectual Merit and Broader Impacts identified in the Grant Proposal Guide, proposals submitted in response to this solicitation will be evaluated against the following criteria:

- **Potential for Scientific Impact:** What is the potential impact of the proposed CZO? In what ways can the proposed activities have catalytic or transformative impact on critical zone sciences? Is the scope of the proposed CZO addressing pressing scientific questions? To what extent does the proposed CZO fulfill a need for important critical zone knowledge in a locale that is currently underrepresented in NSF or Federal investments?
- **Potential for societal impact:** How important are the expected outcomes for predicting the fate of ecosystem services associated with the critical zone proposed? What is the nature of the climate or anthropogenic threat, which specific ecosystem services are under threat for depletion or disruption, and how will the CZO inform decisions to avert or manage the threat? What is the likelihood of up-scaling and generalizing models generated in the CZO?
- **Suitability of the CZO team:** Is there appropriate core expertise in the CZO team for disciplinary measurement, process evaluation, modeling and synthesis? How well integrated is this set of expertise? Are the roles and contributions of all PIs, co-PIs, other senior investigators and subawardees clearly articulated and justified?
- **Appropriateness and scientific need for proposed activities:** In what ways is the proposed work tactical, strategic, innovative, and informed by current research on the critical zone? Is the timeline of proposed activities appropriate? Are cross-site activities likely to contribute to the network-wide products?
- **Adequacy of the Management Plan:** Does the proposal provide sufficient detail regarding the roles and responsibilities of PIs, co-PIs, senior personnel, and partners? Are the proper mechanisms set in place to coordinate these efforts?
- **Adequacy of Engagement Plan:** Does the proposal present a sufficient plan for engaging scientists outside the core CZO team?
- **Adequacy of the Dissemination Plan:** What mechanisms have been identified for communicating research results to audiences within and beyond the critical zone research community, and will these mechanisms be sufficient?

B. Review and Selection Process

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

A. Notification of the Award

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

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. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from 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.

C. Reporting Requirements

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.

VIII. AGENCY CONTACTS

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:

- Richard F. Yuretic, telephone: (703) 292-4744, email: 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.

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.

IX. OTHER INFORMATION

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

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

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
National Science Foundation
Alexandria, VA 22314

X. APPENDIX

For more information on this solicitation, link to www.nsf.gov/geo/ear/programs/czo_moreinfo.jsp.

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