Antarctic Research

PROGRAM SOLICITATION
NSF 12-539

REPLACES DOCUMENT(S):
NSF 11-532

National Science Foundation

Office of Polar Programs
Division of Antarctic Sciences

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

May 31, 2012

IMPORTANT INFORMATION AND REVISION NOTES

Important Reminders

A revised version of the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), NSF 11-1, was issued on October 1, 2010 and is effective for proposals submitted, or due, on or after January 18, 2011. Please be advised that the guidelines contained in NSF 11-1 apply to proposals submitted in response to this funding opportunity. Proposers who opt to submit prior to January 18, 2011, must also follow the guidelines contained in NSF 11-1.

Cost Sharing: The PAPPG has been revised to implement the National Science Board's recommendations regarding cost sharing. Inclusion of voluntary committed cost sharing is prohibited. In order to assess the scope of the project, all organizational resources necessary for the project must be described in the Facilities, Equipment and Other Resources section of the proposal. The description should be narrative in nature and must not include any quantifiable financial information. Mandatory cost sharing will only be required when explicitly authorized by the NSF Director. See the PAPP Guide Part I: *Grant Proposal Guide (GPG)* Chapter II.C.2.g(xi) for further information about the implementation of these recommendations.

Data Management Plan: The PAPPG contains a clarification of NSF's long standing data policy. All proposals must describe plans for data management and sharing of the products of research, or assert the absence of the need for such plans. FastLane will not permit submission of a proposal that is missing a Data Management Plan. The Data Management Plan will be reviewed as part of the intellectual merit or broader impacts of the proposal, or both, as appropriate. Links to data management requirements and plans relevant to specific Directorates, Offices, Divisions, Programs, or other NSF units are available on the NSF website at: http://www.nsf.gov/bfa/dias/policy/dmp.jsp. See Chapter II.C.2.j of the GPG for further information about the implementation of this requirement.

Postdoctoral Researcher Mentoring Plan: As a reminder, each proposal that requests funding to support postdoctoral researchers must include, as a supplementary document, a description of the mentoring activities that will be provided for such individuals. Please be advised that if required, FastLane will not permit submission of a proposal that is missing a Postdoctoral Researcher Mentoring Plan. See Chapter II.C.2.j of the GPG for further information about the implementation of this requirement.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Antarctic Research
Astrophysics & Geospace Sciences (AAGS), Earth Sciences (AES), Glaciology (AG), Integrated System Science (AISS), Ocean & Atmospheric Sciences (AOAS), Organisms & Ecosystems (AOE)

Synopsis of Program:

Scientific research and operational support of that research are the principal activities supported by the United States Government in Antarctica. The goals are to expand fundamental knowledge of the region, to foster research on global and regional problems of current scientific importance, and to use Antarctica as a platform from which to support research. The U.S. Antarctic Program provides support for fieldwork only when a compelling justification exists for doing the work in Antarctica (i.e., the work can only be done or is best done, in Antarctica). The program also supports Antarctic-related analytical research performed at home organizations.

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.

- Sonia Esperança, Program Director, Antarctic Integrated System Science, telephone: (703) 292-4735, email: sesperan@nsf.gov
- Alexandra Isern, Program Director, Antarctic Earth Sciences, telephone: (703) 292-7581, fax: (703) 292-9079, email: aisern@nsf.gov
- Peter Milne, Program Director, Antarctic Ocean & Atmospheric Sciences, telephone: (703) 292-4714, fax: (703) 292-9079, email: pmilne@nsf.gov
- Diana Nemergut, Program Director, Antarctic Organisms & Ecosystems, telephone: (703) 292-7448, email: dnemergu@nsf.gov
- Julie Palais, Program Director, Antarctic Glaciology, telephone: (703) 292-8033, fax: (703) 292-9079, email: jpalais@nsf.gov
- Vladimir Papitashvili, Program Director, Antarctic Astrophysics & Geospace Sciences, telephone: (703) 292-7425, fax: (703) 292-9079, email: vpapita@nsf.gov
- James Swift, Program Manager, Antarctic Research and Logistics Integration, telephone: (703) 292-7450, fax: (703) 292-9079, email: jswift@nsf.gov
- Jessie L. Crain, Research Support Manager, OPP/AIL, telephone: (703) 292-7457, fax: (703)292-9080, email: jlcrain@nsf.gov
- Timothy M. McGovern, Oceans Projects Manager, OPP/AIL, 755S, telephone: (703) 292-4248, fax: (703)292-9080, email: tmcgover@nsf.gov

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

- 47.078 --- Office of Polar Programs

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 50 approximately

Anticipated Funding Amount: $50,000,000 In FY 2013, the Division of Antarctic Sciences anticipates committing approximately $50M over the duration of the awards made in response to this solicitation, contingent on the availability of funds. Anticipated amounts available by program are: AOE, $10M; AAGS, $11M; AES, $9M; AG, $7M; AISS, $6M; and AOAS, $7M. (See section III)

Eligibility Information

Organization Limit:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the Grant Proposal Guide, Chapter I, Section E.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI:

None Specified

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- Letters of Intent: Not Applicable
- Preliminary Proposal Submission: Not Applicable
- Full Proposals:
  - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg.
  - 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: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)

B. Budgetary Information

- Cost Sharing Requirements: Inclusion of voluntary committed cost sharing is prohibited.
- Indirect Cost (F&A) Limitations: Not Applicable

- Other Budgetary Limitations: Not Applicable

C. Due Dates

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

  May 31, 2012

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

Reporting Requirements: Standard NSF reporting requirements apply.

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I. INTRODUCTION

Scientific research and its operational support are the principal activities supported by the United States Government in Antarctica. The goals are to expand fundamental knowledge of the region, to foster research on global and regional problems of current scientific importance, and to use Antarctica as a platform from which to conduct research. The U.S. Antarctic Program provides support for fieldwork only when a compelling justification exists for doing the work in Antarctica (i.e., the work can only be done, or is best done, in Antarctica). The program also supports analytical research, as well as modeling and synthesis activities, performed at home organizations.

The Division of Antarctic Sciences strongly encourages proposals from persons under-represented in science and from investigators new to Antarctic research with the goal of broadening participation with respect to both individuals and institutions. The program also strongly encourages international collaborations and research-related education and outreach.

The National Science Foundation funds and manages the U.S. Antarctic Program, which supports research in the areas described in Section II.

II. PROGRAM DESCRIPTION

RESEARCH AREAS

Astrophysics and Geospace Science

The Polar Regions are often called Earth's windows to outer space. This term originally applied to study of the aurora and other phenomena related to the interaction of the solar wind with the Earth's magnetosphere in the domain that we now call Geospace. Today, the concept of Earth's polar atmosphere as a window to outer space extends to research in other fields, such astronomy and astrophysics. For example, favorable atmospheric conditions over the Amundsen-Scott South Pole Station located on the high Antarctic Plateau enable scientists to use this window for better understanding the internal structure of the Sun, to study our Milky Way and other galaxies, and to probe the early Universe with unprecedented precision. Antarctica's deep, clear ice sheet is used also as a "window" providing an extraordinarily transparent medium to detect neutrinos — elusive particles that fill the Universe but rarely interact with ordinary matter — only when they collide directly with a proton or neutron in an atomic nucleus. The cubic-kilometer IceCube Neutrino Observatory, built deep in the ice sheet at the South Pole Station, is now operational, taking advantage of this highly transparent medium.

The Antarctic Astrophysics and Geospace Sciences (AAGS) Program focuses on studies of the polar middle and upper atmosphere, near-Earth space (Geospace), and beyond to the Sun, galaxies, and the Universe.

Antarctic middle and upper atmosphere (mesosphere and thermosphere) research focuses on aeronomy of the middle and upper atmosphere where processes of dissociation and ionization are important. Proposals are welcome that deal with atmospheric temperature changes and dynamics of neutral winds at altitudes from 30 to a few hundred kilometers, particularly in the context of planetary atmospheric tides and climate change dynamics. Proposals dealing with interactions of the middle and upper atmosphere with either the stratosphere or the Antarctic ozone layer are especially encouraged.

Antarctic geospace research on solar wind interaction with the Earth's magnetosphere and ionosphere focuses on deriving characteristics and physical mechanisms from the interplay of energetic charged particles with (and within) the geomagnetic field. Proposals are welcome that deal with the global interaction of the solar wind with the magnetosphere and its manifestation through precipitation of charged particles over both the northern and southern polar regions (aka *Aurora Borealis and Australis*, respectively) and electrical currents and fields that propagate from the magnetosphere to the ionosphere. Proposals that deal with dissipation of solar wind energy and momentum through the magnetosphere and into the ionosphere are especially encouraged.

Antarctic astronomy and astrophysical studies of the Universe, including cosmic ray and solar physics, focus on fundamental physics issues and history of the Universe. Proposals for study of the Cosmic Microwave Background radiation and high-energy neutrino physics, as well as topics in galactic astronomy, solar and cosmic ray physics are welcome. This research activity is primarily conducted at the South Pole Station and on NASA's long-duration balloon flights launched from McMurdo; research proposals to exploit unique capabilities of these ground- and balloon-based platforms are encouraged. Proposals in astronomy and astrophysics for studies at another nation's Antarctic facility also are welcome, but they must be collaborative with scientists from other nation, who lead the project at their nation's Antarctic facility.

Major goal of the AAGS program is to sponsor "cutting-edge" and new emerging research areas that require or benefit from the unique atmospheric or other conditions of the southern polar region. Proposals are welcome that either use Antarctica as an observing platform or contribute to the understanding of the role the Antarctic continent and surrounding Southern Ocean play in the changing global environmental processes. Interdisciplinary studies that might help improving our understanding of potential solar activity forcing on the polar neutral atmosphere are especially encouraged.

Organisms and Ecosystems

The Antarctic Organisms and Ecosystems (AOE) Program supports research at all levels of biological organization, from molecular, cellular, and organismal to communities and ecosystems over regional and global scales. Accordingly, the program welcomes integrative and interdisciplinary approaches toward fundamental questions in biological and environmental science related to polar regions. Investigators also are encouraged to develop and apply theory and innovative technologies to understand how organisms adapt to and live in high-latitude environments and how populations and ecosystems respond to global change.

Particular emphases include:

- Marine ecosystems. Polar marine environments are characterized by complex interactions among biotic, chemical and physical processes, in areas that include the marginal ice-zone, continental shelves, polynyas, and open-ocean systems. Studies that examine food webs, primary and secondary production, the interplay between ecology and biogeochemistry, and the relationship between climate change and ecosystems are welcomed. Polar marine systems are predicted to experience under-saturation with respect to carbonate minerals within several decades; therefore proposals that address organism responses to ocean acidification are particularly encouraged. Remote sensing techniques, long-term observations, and modeling are appropriate tools to enhance these areas of research.
- Terrestrial and freshwater ecosystems. Organisms in ice-free areas, in ephemeral streams, and in perennially ice-covered lakes show remarkable persistence in the face of harsh conditions. The Antarctic Organisms and Ecosystems program supports research on adaptive mechanisms in the context of the present day hydrologic and biogeochemical environment. The McMurdo Dry Valleys of southern Victoria Land are of particular interest due to the large body of data available through ongoing research programs, including the McMurdo Dry Valleys LTER, but other locations can be proposed. Research in support of future field exploration of subglacial lakes is also considered.
- Population dynamics, physiological ecology, and adaptation. The extremes of light, temperature, and moisture have resulted in unusual adaptations within organisms at all levels of organization. Research concerning metabolic, physiological and behavioral adaptations of marine and terrestrial organisms, their population dynamics, and their diversity is supported. Long-term observations are also supported, with the goal of understanding the impact of environmental change on organismic and ecological processes.
- Genomics. "Genome-enabled" biology provides a foundation for understanding the genetic basis of organism-environment interactions. The unusual Antarctic environment presents a compelling natural laboratory for the study of environmental genomics. A 2003 National Research Council report, *Frontiers in Polar Biology in the Genomics Era*, addresses some of these opportunities.

Earth Sciences

Antarctica is a dynamic and diverse continent with mountains, volcanoes, deserts, fossils, and some of the Earth's most ancient crust. The continental shelves and ocean basins surrounding Antarctica record ice-sheet histories as well as unique geodynamic processes and other geologic phenomena. Much of this geology is hidden beneath thick ice sheets or beneath the sea, therefore, innovative approaches are needed to decipher its history. Projects supported by the Antarctic Earth Sciences (AES) Program provide insights into Antarctica's rich history and lead to increased understanding of the processes that shape it today.

AES encourages and supports field, laboratory, and theoretical work in both terrestrial and marine settings in the fields of geology,

geophysics, and other areas of earth sciences. The program also supports research at the intersection between earth sciences and biology, glaciology, and oceanography and considers proposals jointly with AISS as appropriate. Proposals could address such diverse topics as:

- Understanding the ice sheets using sediment records from continental margins to reconstruct their history and determine the geologic controls of their formation and stability
- Deciphering paleoenvironmental and paleobiological records to understand global climate, ocean circulation, and the evolution of life
- Exploring Antarctica's tectonic evolution; from its central role in Gondwana's breakup to the present-day deformation driving volcanism, rifting, and orogenesis
- Investigating unique processes; such as the formation of subglacial lakes or the aeolian and permafrost sculpting of the Dry Valleys

Work on previously collected samples and data is encouraged. Proposers should investigate availability of existing samples through individual researchers and repositories such as:

- United States Polar Rock Repository at Ohio State University. http://bprc.osu.edu/rr/
- Antarctic Marine Geology Research Facility at Florida State University from the Southern Ocean and Antarctica. http://www.arf.fsu.edu/
- Paleobotany Collection of the University of Kansas curating more than 10,000 specimens of Antarctic fossil plants from throughout the Transantarctic Mountains. http://paleobotany.bio.ku.edu/PaleoCollections.htm
- UNAVCO's online archive of GPS data from field campaigns and continuous stations. http://unavco.org/polar
- IRIS's online archive of seismic data from field campaigns and continuous stations. http://www.iris.edu/

Ocean and Atmospheric Sciences

The Antarctic atmosphere and surrounding oceans play a major role in global transport of heat, momentum, and biogeochemical cycles. They are key components of the global ocean circulation and planetary climate dynamics. As a coupled system they serve both as indicators and determinants of climate and ecosystem variability and change. The Antarctic Ocean and Atmospheric Sciences (AOAS) Program is intended to foster advances in understanding of the physics and chemistry of both oceanic and lower atmospheric processes and environments at high southern latitudes and their links at local, regional and global scales across the Antarctic continent and Southern Ocean. Innovative approaches involving surface and/or satellite-based field observations and/or modeling studies are particularly encouraged.

Major program elements include but are not limited to:

- Physical oceanographic studies probing the dynamics and kinematics of the circulation of the polar southern oceans, the effects of interface driving forces such as wind, air-sea-ice exchange, solar radiation, tides, water mass production and modification processes, ocean dynamics in the pack ice, glacial and continental margins, as well as the seasonal effect of polynyas on ventilation and relationships to the distribution of marine biota
- Meteorological studies investigating atmospheric circulation systems and dynamics covering aspects from mesoscale and/or global exchange and balances of heat, momentum, moisture, and radiation across the range of meteorological phenomena of the Antarctic continent and oceans, as well as operational and observational meteorology
- Climate dynamics studies advancing knowledge of the processes responsible for circulation across synoptic and global scales pertinent to the atmosphere over the Antarctic continent and southern hemisphere, causes of climate variability and change, numerical parameterization, modeling, data assimilation, climate predictability and simulation studies
- Atmospheric chemistry studies emphasizing measurement and modeling of the concentrations, distributions, and fluxes of gases and aerosols in the Antarctic atmosphere, and the processes, transport and chemical reactions of these species, including exchanges among the atmosphere, the Antarctic continent, and surrounding seas
- Chemical oceanographic studies characterizing the chemical composition of and processes occurring in the Southern Ocean, tracking biogeochemical fluxes within ocean basins and across their boundaries, and the application of chemical tracers to study time and space scales of physical and biogeochemical oceanic phenomena
- Sea ice studies encompassing material characteristics from the individual crystal level to large-scale patterns of freezing, deformation, and melting and the relationships of sea-ice dynamics with the ocean and atmosphere over a variety of temporal and spatial scales relevant to physical, chemical and biological processes

Glaciology

The Antarctic ice sheet covers about 98% of the continent, extending over almost 14 million square km. The largest mass of ice on Earth, it contains the equivalent of 60 m of sea-level rise if all of its ice were to melt. The Antarctic Glaciology (AG) Program is an interdisciplinary program concerned with the history and dynamics of the Antarctic ice sheet. The program encompasses the study of the continental East Antarctic Ice Sheet as well as the marine-based West Antarctic Ice Sheet and supports research on the floating ice shelves fringing the continent (including the icebergs that break off of those ice shelves), as well as the glaciers draining the interior of the continent. Another key area of interest is determining the Cenozoic history of the ice sheet, including the uplift of the Transantarctic Mountains and its interaction with global climate (e.g., response to the Pliocene warming). Much of the glacial geological research in the Transantarctic Mountains relates to understanding the history of the ice sheet during the Cenozoic Era, especially during the Quaternary Period.

Recent program emphases include

- Study of climate change from ice cores (including development of new ice-core processing and analysis methods)
- Numerical modeling of the ice sheet and numerous ice streams around the continent
- Glacial record preserved in sediments and exposed in outcrops around the continent
- and Studies of ice sheet dynamics (including its subglacial hydrology from ground-based measurements and from remote sensing data obtained from aircraft and satellites).

An ongoing initiative supported by the program is the multidisciplinary West Antarctic Ice Sheet program (WAIS). This program, which is supported by the AG, AES, AOAS, and AISS programs, is designed to advance understanding of the West Antarctic Ice Sheet. Scientists participating in the WAIS program want to know what triggers marine ice sheet collapse and to evaluate the possibility that this could happen in West Antarctica. Predicting the ice sheet's future behavior requires an understanding of its history, current state (including the nature of the bed), internal dynamics, and coupling to the current global climate system.

A related activity involving studies of the Antarctic ice sheet is the Center for Remote Sensing of Ice Sheets (CReSIS). CReSIS, a Science and Technology Center established by the National Science Foundation (NSF) in 2005, develops new technologies and computer models to measure and predict the response of sea-level change to the mass balance of ice sheets in both Antarctica and Greenland. CReSIS provides students and faculty with opportunities to pursue research in a variety of disciplines; to collaborate with world-class scientists and engineers in the United States and abroad; and to make meaningful

contributions to the study of climate change impacts on world sea level. As such, CReSIS scientists also collaborate extensively with others funded by the Antarctic Glaciology program.

Ice cores from Antarctica and Greenland are important for understanding rapid climate changes and the degree to which these changes are global in extent. The ice cores being drilled as part of the WAISCORES program will complement those already under study from Byrd Station and Siple Dome in West Antarctica and Taylor Dome and Vostok Station in East Antarctica. Ice cores are unique in that they contain continuous, or nearly continuous, records of annual precipitation, atmospheric temperature, and components of the atmosphere, including gases as well as soluble and insoluble aerosol particles from a variety of sources (biogenic, terrestrial, solar, marine, volcanic, and anthropogenic). The WAIS Divide ice core will provide a Southern Hemisphere equivalent to the Greenland ice cores and will allow detailed comparison of environmental conditions between the Northern and Southern Hemispheres. Proposals to compare these records are welcome.

The Glaciology Program relies on ice-core curation and ice coring and drilling services for polar research. The following organizations provide this support.

- National Ice Core Laboratory (NICL), a government-owned facility for storing, curating, and studying ice cores recovered from the ice-covered regions of the world (http://www.nicl-smo.sr.unh.edu/).
- Ice Drilling Program Office and Ice Drilling Design and Operations (IDPO-IDDO), a university collaboration of Dartmouth College, the University of New Hampshire, and the University of Wisconsin-Madison provides scientific leadership and oversight of ice coring and drilling activities and provides drilling support for field parties in Antarctica, Greenland, and non-polar areas. If you are preparing a NSF proposal that includes any kind of support from the IDPO/IDDO as part of your proposed project, you *must* contact IDPO at IceDrill@Dartmouth.edu *at least six weeks* before you submit your proposal to obtain a written letter of support and cost estimate to include as supplementary documents in your NSF proposal. You should also notify your relevant NSF Program Manager that your proposal requires support from the IDPO/IDDO. (http://icedrill.org/scientists/scientists.shtml).

A detailed description of NICL, IDPO, and IDDO services and requirements for obtaining their support is available on the "Information for Proposers" page (http://www.usap.gov/proposalInformation/) on the USAP.gov web portal.

Integrated System Science

Disciplinary science discoveries increasingly highlight the need for integrative approaches. It is also increasingly apparent that, to discern the importance of human involvement in a naturally varying world, the co-dependence of physical, chemical, geological, biological, glaciological, oceanic, and atmospheric systems must be considered.

The Antarctic Integrated System Science (AISS) program invites projects that cross disciplinary boundaries. Successful AISS projects will lead to a deeper understanding of complex interactions that govern the Antarctic environment and its past, present, and future roles in the Earth system. Investigations supported by AISS must cross disciplinary boundaries and contribute significantly to research addressing fundamental questions about our planet. Investigators are encouraged to propose innovative collaborative projects that address fundamental research questions regarding global change and other basic research discovery challenges as delineated in recent community reports.

Proposals could address such diverse questions as:

- Why are some regions of Antarctica warming faster than the rest of the planet, and what are the implications for those regions, Antarctica more broadly, and Earth?
- How do synergistic effects from ozone depletion, climate change, and other anthropogenic perturbations alter Antarctic and Earth systems?
- What is the likely contribution of Antarctic ice to global sea-level rise?
- Are Antarctica's ice sheets stable, and if so over what time scales and under what circumstances might they become unstable?
- What do the records of past environmental change and biological succession and survival tell us about future change?

The AISS program was established to complement and advance science being pursued by NSF's disciplinary programs. AISS will not support projects that recast disciplinary questions into a form requiring minimal expertise from other disciplines when progress is possible within a discipline, or those projects that simply combine separate disciplinary questions without attention to the integration of results. In addition, projects that are overly broad in scope and for which tractable research strategies are impractical, are discouraged.

Workshop reports relevant to community thinking in this area include *Setting a Course for Antarctic Integrated System Science* and *A Research Program for Projecting Sea Level Rise from Land ice Loss*. Those considering submission to AISS are strongly encouraged to contact the program director in advance.

Related NSF Opportunities

The Division of Antarctic Sciences encourages the use of other proposal mechanisms that could help advance knowledge and understanding of the Antarctic. For instance, Major Research Instrumentation, EAGER, Research Coordination Networks, Research Opportunity Awards, Research Experiences for Undergraduates, Rapid Response Awards and Exploratory Research Awards. We draw specific attention to the following:

Research Coordination Network Proposals: The Antarctic Sciences Division encourages proposals to establish Research Coordination Networks (RCN, see NSF 11-531). RCNs are expected to advance a field or combination of fields through exchange of information or resources, integration of research activities, and/or creation of new collaborative networks

Ocean Acidification: The effects of ocean acidification could significantly affect strategies for developing practices towards the sustainability of ocean resources. Basic research concerning the nature, extent and impact of ocean acidification on oceanic environments in the past, present and future is required. http://www.nsf.gov/pubs/2012/nsf12500/nsf12500.htm

Decadal and Regional Climate Prediction using Earth System Models (EaSM): EASM is focused on the prediction of future climates and their consequences for human systems on time scales of several decades and shorter and global to regional and finer spatial scales. A time span of several decades is chosen because within this timeframe modeled climate change responses appear to be insensitive to CO_2 forcing scenarios. http://www.nsf.gov/pubs/2012/nsf12522/nsf12522.htm

Partnerships for International Research and Education (PIRE): The primary goal of PIRE is to support high quality projects in which advances in research and education could not occur without international

collaboration. PIRE seeks to catalyze a higher level of international engagement in the U.S. science and engineering community. http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12819

U. S. ANTARCTIC PROGRAM NOTES:

- New investigators (http://www.nsf.gov/od/opp/ant/antproginfo.jsp). If you have not performed research in Antarctica, the URL below contains information that may be useful. In addition, new investigators are encouraged to contact program directors in the program of interest - see the ANT and AIL staff directories.
- Instrumentation. ANT supports and encourages the development and acquisition of relevant instrumentation and technology by investigators in a number of different ways, both internal to USAP and through broader NSF competitions.
    - NSF has a range of specialized programs and opportunities, including Science and Technology Centers: Integrative Partnerships (STC) awards and through smaller, proof-of-concept efforts such as NSF EAGER (EArly-concept Grants for Exploratory Research) awards. The NSF Directorate for Engineering funds the Engineering Research Centers (ERC) program and also the NSF SBIR (Small Business Innovations Research) and STTR (Small Business Technology Transfer) programs, which require participation of industrial partners. Investigators who have an interest in instrumentation development through any of these competitions are asked to contact the appropriate NSF Program Director, through their ANT science program director if this is unknown.
    - ANT actively encourages investigators to participate in NSF's annual MRI (Major Research Instrumentation) program (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5260), conducted through the Office of Integrative Activities (OIA).
    - Instrumentation and technology development may also be included in proposals submitted to the annual Antarctic Research solicitation. However, investigators are reminded that such proposals must be for the development and/or acquisition of instrumentation needed for research in the Antarctic. It is recommended that investigators contact their ANT science program directors to discuss possible funding pathways before any instrumentation and technology submission.

- Environmental impact research. Environmental research is integrated into the disciplinary programs described above. An emphasis is research to help reduce the environmental impact of activities in Antarctica. Areas of inquiry might include effects of past practices, current impacts, and resilience of ecosystems. The goal is to foster and maintain Antarctica's natural conditions while supporting the range of scientific research that can be done best in Antarctica. Investigators who wish to conduct environmental research are encouraged to contact the appropriate program director in the Division of Antarctic Sciences (See the ANT roster at http://www.nsf.gov/staff/staff_list.jsp?org=ANT&orgId=287&subDiv=y&from_org=ANT).
- Medicine and human behavior. Research involving human subjects, while outside the scope of the Division of Antarctic Sciences, may be of interest to mission agencies, such as NASA or the National Institutes of Health. For guidance on potential NSF support of research involving human subjects, investigators are encouraged to contact Dr. Polly Penhale, Office of Polar Environment, Health, and Safety, OPP (PEHS roster), as well as the cognizant program officer in the relevant mission agency.

- The Antarctic Artists and Writers Program (NSF 11-549), managed by the Division of Antarctic Sciences, enables serious writings and works of art that exemplify the Antarctic hertiage of humankind. The program seeks to increase public understanding of the Antarctic region, including the continent and the surrounding oceans, as well as the associated research.
- The annual program for media representatives to visit and interview research teams and others in the U.S. Antarctic Program is managed by NSF's Office of Legislative and Public Affairs. Information concerning the media program can be found at http://www.nsf.gov/news/news_summ.jsp?cntn_id=122320.

FACILITIES, LOGISTICS, AND SUPPORT

Facilities for research in Antarctica include three year-round research stations with scientific equipment and laboratories, helicopters, ski-equipped airplanes, surface vehicles, a wide array of additional research facilities and temporary camps, a research icebreaker, and an ice-strengthened research ship. These facilities are operated by NSF's Division of Antarctic Infrastructure and Logistics (AIL) (703-292-8032) through support contracts and through agreements with other Federal agencies.

The U.S. Antarctic Program includes many organizations that provide logistical and operational support to meet the needs of the field research program. NSF's prime Antarctic logistics contractor, Lockheed-Martin Antarctic Support Contractor (LMASC) based in Centennial, Colorado, coordinates research support and field operations in Antarctica and has a planning group that can assist investigators with questions about field or logistical support. Investigators are strongly encouraged to contact the LMASC Science Planning Group with questions during the proposal preparation phase. For additional information, contact Jessie Crain (703/292-7457, email: jlcrain@nsf.gov), or Tim McGovern (703/292-4248, email: tmcgover@nsf.gov), OPP/AIL.

Other organizations offer technical support for research, and your proposal must include a summary document or letter of support from that organization in the supplemental documents section. A list of these organizations and more detailed descriptions of the research support provided by each is available at http://www.nsf.gov/od/opp/ant/solicitation_resources/prop_prep_info.jsp.

The U.S. Antarctic Program maintains a web portal (http://www.usap.gov/) that links to research, logistics, and operational information about U.S. activities in the Antarctic. Besides information concerning USAP stations, ships, and related field support, the site provides more detailed descriptions of the research support provided by other organizations. Investigators should use the web portal to access information for proposal preparation purposes. The "Information for Proposers" page (http://www.usap.gov/proposalInformation/) provides links to resources that will be useful as you prepare your proposals.

Non-U.S. facilities; international cooperation

The U.S. Antarctic Program welcomes proposals from U.S. scientists that involve collaboration and cooperation with scientists from other nations. Such proposals are usually the result of scientist-to-scientist discussions of potential collaborations. When discussing such projects with foreign colleagues, remember that individuals cannot commit U.S. Antarctic Program resources. U.S. scientists wishing to do research with other nations' Antarctic programs are asked to contact an Office of Polar Programs program director before submitting a formal proposal. Your acceptance of a generous offer from another nation's Antarctic program could be construed as commitment of U.S. resources for some later project.

Automated data collection

The U.S. Antarctic Program supports various automated data collection programs. These include automated geophysical data observatories, automatic weather stations, data from seismic and GPS stations, and other data streams. More detailed information about these programs is available on the "Information for Proposers" page (http://www.usap.gov/proposalInformation/) on the USAP.gov web portal.

RESEARCH SHIPS

Investigators who require time on an ice-capable research vessel should consult the vessel operating schedules at http://usap.gov/calendarsAndSchedules/ or the relevant program director in Antarctic Sciences to determine availability of ship time. All investigators that request ship time must fill out a UNOLS ship request form (https://strs.unols.org/Public/diu_login.aspx) and submit the form as a supplemental document with their proposals.

The U.S. Antarctic Program operates two research ships - the 230-foot *Laurence M. Gould* and the 308-foot *Nathaniel B. Palmer*. The capabilities of research ships and instruments available for not-to-interfere underway measurements on behalf of investigators who do not join a cruise can be found on Marine Operations home page on the U.S. Antarctic Program web site, USAP.gov.

Other vessels. University-National Oceanographic Laboratory Systems (UNOLS) vessels operate in the Southern Ocean in some years (http://www.unols.org/). In addition, ships that provide operational support near McMurdo may be able to provide underway research support in the Southern Ocean and the Ross Sea. Contact Tim McGovern, (703)292-4248, ax: (703)292-9080, email: tmcgover@nsf.gov, the cognizant program director in NSF's Office of Polar Programs to discuss potential use of operational support vessels. Research ships of other Antarctic Treaty nations operate in Antarctic waters; see "Non-U.S. facilities; international cooperation".

SAMPLES AND DATA

Samples for Research. Specimens collected in the Antarctic are available to qualified investigators for study. For information, including the policies and procedures for obtaining samples, contact the facilities listed on the "Information for Proposers" page (http://www.usap.gov/proposalInformation/contentHandler.cfm?id=1751) on USAP.gov.

Data for Research and Data Curation. Detailed descriptions of the facilities that curate data for research are available on the "Information for Proposers" page (http://www.usap.gov/proposalInformation/contentHandler.cfm?id=1751) on USAP.gov.

U.S. ANTARCTIC PROGRAM ENVIRONMENTAL STEWARDSHIP

Protection of the environment has high priority for nations that operate in the Antarctic. The Antarctic Treaty System, with its Agreed Measures for the Conservation of Fauna and Flora (1964) and its Protocol on Environmental Protection (1991), prescribes comprehensive protection measures. The U.S. Government is pledged to uphold these principles and NSF operates the U.S. Antarctic Program in accordance with U.S. and international requirements regarding protection of the environment.

The U.S. implements these environmental protection agreements through the *Antarctic Conservation Act of 1978* (Public Law 95-541), as amended by the Antarctic Science, Tourism, and Conservation Act of 1996 (PL 104-227). The regulations issued under the Act govern the taking of fauna and flora; entry into protected areas; introduction of non-native species; material management and waste disposal; and use of designated pollutants. A permit system enables investigators to apply to collect specimens and enter protected areas for compelling scientific purposes. The system provides for public comment on each application.

If your research involves any of the activities listed above, an Antarctic Conservation Act permit may be required for the proposed activities. If there is any question as to whether a permit is required, contact an Office of Polar Programs science program director, the permit officer (Nadene Kennedy, nkennedy@nsf.gov), or the environmental policy specialist (Adrian Dahood, adahood@nsf.gov). Additional permits may be required for certain activities such as research involving marine mammals or importation of bird or mammal tissue, plants or soils. Please contact the environmental officer for additional information.

All activities within the U.S. Antarctic Program, including scientific research, science support, construction, operations, logistics, and facilities maintenance, are subjected to environmental impact assessment specific to the proposed action or governed by a program-wide environmental impact statement. NSF carefully reviews each research proposal and does not give approval unless the project (sometimes modified for this purpose) complies with Antarctic environmental standards.

Sample Permits

Your Antarctic research may require the collection of Antarctic specimens. As mentioned in the U.S. Antarctic Program Environmental Stewardship section, the Antarctic Conservation Act (ACA) governs the taking of Antarctic fauna and flora. A permit system enables investigators to apply to collect Antarctic specimens. Transshipment and importation of Antarctic samples is governed by regulations of the countries involved (e.g., New Zealand, Chile, and the United States), to obtain permits required for collection, transshipment, and importation. Consult "Information for Proposers" on USAP.gov web site for more details on permits required for transshipment and importation (http://www.usap.gov/USAPgov/proposalInformation/documents/Permit%20Guide.pdf).

III. AWARD INFORMATION

In the U.S. Antarctic Program, NSF expects each year to fund approximately 50 new standard or continuing research grants with durations of 1 to 5 years.

In FY 2013, the Division anticipates committing approximately $50M over the duration of the awards in all programmatic areas in response to this solicitation, subject to the availability of funds.

In addition, and separate from these awards to organizations, field and laboratory support will be available in Antarctica for those projects for which fieldwork has been proposed and approved.

IV. ELIGIBILITY INFORMATION

Organization Limit:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the Grant Proposal Guide, Chapter I, Section E.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI:

None Specified

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

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 Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG 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: (http://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.

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. Chapter II, Section D.4 of the Grant Proposal Guide provides additional information on collaborative proposals.

Antarctic research proposal preparation:
Supplemental instructions

The following instructions supplement the *NSF GPG* and the *NSF Grants.gov Application Guide* guidelines. Proposals not following these instructions are subject to return without review

Contents:

1. Page limit
   Proposals must not exceed 15 pages in the project description section (see *NSF GPG* or *NSF Grants.gov Application Guide* for details).

   The normal 15-page limit for the Project Description will be strictly enforced, according to the *NSF GPG,* Chapter II, C., 2.dii. However, a proposer can request a waiver from the ANT Division Director but must consult the appropriate program director before beginning this process, which is described in the *NSF GPG*, Chapter II, A.

2. Reporting on prior support
   Proposals submitted to this solicitation must report on prior support from NSF. The GPG requires that reporting on prior support is limited to a single award within the last 5 years for each PI, CoPI, or Co-I named on the cover sheet. Furthermore, when an investigator has received more than one award, the report on prior support must cover the one

award most closely related to the new proposal (NSF GPG, Section II.C.2.d.iii.).

3. Data and sample disposition
   NSF and OPP policy requires that grantees and investigators make samples and data available to other researchers and that all proposals describe plans for managing and sharing data or explain why a management plan is not needed. This plan or explanation of no need must be submitted as a Supplementary Document (See NSF's GPG Chapter II.C.2.j). The management plan required by NSF must address the requirements of OPP's Guidelines and Award Conditions for Scientific Data, which call for submission of metadata, as well as derived data products, samples, physical collections, and other supported materials to national data centers and other specified repositories. Please see OPP's Guidelines and Award Conditions for Scientific Data and NSF's GPG Chapter II.C.2.j for more details.

   OPP expects investigators to share these things (data, samples, etc., as above) with other researchers at no more than incremental cost and within a reasonable time. Unless otherwise justified, samples and data should be made publicly available no more than one year after collection. Investigators should use national and international standards to the greatest extent possible for collecting, processing, and communicating OPP-sponsored data sets. Also, the program strongly encourages the use of national data centers, sample repositories, museums and other registration and curation systems.

   The data management plan proposed and approved through the NSF award process must define which data sets are to be considered real time data and thus made available immediately. After an award is made, data management will be monitored primarily through the Annual and Final Report process and through evaluation of subsequent proposals. In subsequent proposals, data management must be reported by the PI and Co-PIs under "Results of prior NSF support."

   For all OPP-supported projects collecting routine, real-time data, using general USAP instruments:

   1. Real-time data must be made publicly available immediately.
   2. All data must be submitted to a national data center data repository within six months of collection and be fully quality controlled.
   3. All data sets and derived data products must be accompanied by a metadata profile and full documentation.

   For physical and chemical oceanographic data, principal investigators are encouraged to consider compliance with the CLIVAR data policy (http://www.clivar.org/resources/data/clivar-data-policy) and submit their data to the appropriate Data Assembly Centers (http://www.clivar.org/resources/data/clivar-data-assembly-centres-dacs).

   In addition, all awardees must submit a metadata listing to the Antarctic Master Directory (http://www.usap-data.org/) as soon as possible after collection but no later than 6 months prior to expiration of the award. Some examples of these resources are listed on the USAP web portal.

4. Antarctic or Southern Ocean Proposals Involving ***No*** Fieldwork
   Proposals should be clear about whether or not field work in Antarctica is needed. If no field work is required, the statement "This proposal does not require field work in the Antarctic must be included as the last line of the proposal Summary."

5. Antarctic or Southern Ocean Proposals Involving Fieldwork
   The U.S. Antarctic Program is committed to the principle that scientific needs should determine the research conducted in Antarctica, with logistics deriving from and supporting the research rather than dictating it. Prepare your proposal to NSF with the presumption that science can be supported operationally, even if it has not been done before.

   Project Descriptions must contain sufficient information for reviewers and NSF staff to make a judgment about the scientific need for fieldwork. For projects that request lab space to conduct analytical work, investigators must justify the need to conduct analyses in Antarctica rather than analyzing samples in their home laboratory.

   Prior discussion with a science program director in the Office of Polar Programs (703-292-8033) can help define research objectives that match the operational realities at any given time and will help NSF plan changes in operational support to meet research needs. To determine field support needs, and to help estimate costs and feasibility, proposers must submit an Operational Requirements Worksheet (ORW). Details and instructions are available at http://www.nsf.gov/od/opp/ant/solicitation_resources/prop_prep_info4.jsp#orw.

   For investigators who have not previously worked in Antarctica or who would like additional advice about field or logistical support, contact with the Division of Antarctic Infrastructure and Logistics of the Office of Polar Programs (703-292-8032) during proposal preparation also can be helpful.

   Completing the ORW is time consuming and must be done before the proposal is submitted. OPP recommends proposers start this process at least two weeks before final proposal submission. Proposals lacking these *Operational Requirements Worksheets* are subject to return without review.

   Some aspects of fieldwork that should be considered when preparing your proposal follow below. A detailed description of this information is available at http://www.nsf.gov/od/opp/ant/solicitation_resources/prop_prep_info.jsp under the heading "Section III".

   - Deployment of Scientific Instruments and Equipment
     NSF's goal for scientific instruments and equipment deployed in Antarctica is to maximize the likelihood of successful operation within the operating parameters of the U.S. Antarctic Program (USAP). Information about proper development and engineering tests of new or existing instruments and equipment prior to deployment is available at http://www.nsf.gov/od/opp/ant/solicitation_resources/prop_prep_info4.jsp#instruments.

   - Electromagnetic Spectrum Management
     Deployed science field programs that use radio spectrum must coordinate their requirements with USAP Spectrum Manager, a service provided to NSF by the U.S. Navy. Details about spectrum management for emitters and passive systems are available at http://www.nsf.gov/od/opp/ant/solicitation_resources/prop_prep_info4.jsp#esm.

     If you have questions, contact Patrick Smith (pdsmith@nsf.gov) in OPP's Antarctic Infrastructure and Logistics Division.

   - Information Security Management
     United States law and Executive Office of the President guidance regarding information security requirements for Federal information systems apply to the information technology (IT) infrastructure of the USAP.

All grantee scientific research instrumentation, personal computing devices (e.g., laptop computers), and remote interactions from home institution computing/networks to systems within the USAP general network infrastructure (i.e., within the usap.gov domain) must comply with NSF/USAP information security requirements.

USAP information security policy, guidance instructions, advisories, and other related information can be found on the USAP web portal on the USAP Information Security Program homepage (http://www.usap.gov/technology/contentHandler.cfm?id=1562).

- Environmental protection and waste management
  You must convince the Foundation that your project, if approved, can be performed in compliance with Antarctic environmental regulations. The ORW will help you define field plans. Failure to document environmental stewardship practices and waste generation estimates in your proposal could change the Foundation's decision from award to declination.

  Please refer to the section U.S. Antarctic Program Environmental Stewardship in this solicitation for additional information about permitting and environmental impact assessments.

  If you have questions, contact Adrian Dahood (email: adahood@nsf.gov), OPP Environmental Policy Specialist.

- Safety and health
  A project that involves work in Antarctica must consider aspects of the research that may pose safety and health risks. Current U.S. Antarctic Program policies regarding safety and health are consistent with U.S. laws and regulations affecting research in the USA. The Office of Polar Programs has staff that are assigned full time responsibilities in safety and health. Please feel free to contact them (see roster) during proposal preparation.

  Details about health and safety issues are available at http://www.nsf.gov/od/opp/ant/solicitation_resources/prop_prep_info4.jsp#sah.

- Underwater diving
  The U.S. Antarctic Program supports a scientific diving program similar to those of institutional members of the American Academy of Underwater Science. Scientific divers are expected to comply with guidelines in the *Antarctic Scientific Diving Manual* (NSF 99-22), available from the support contractor's dive coordinator (1-800-688-8606). Additional information about scientific diving requirements is available at http://www.nsf.gov/od/opp/ant/solicitation_resources/prop_prep_info4.jsp#diving.

- Radioactive materials and waste
  If you wish to use low-level radioactive materials (open or sealed sources) in Antarctica, you need to do so under your organization's radiation use license and with the approval of NSF. Budget for this in your proposal, buy the materials through your organization, and register as a radioisotope user with your radiation safety office. Additional information about the use of radioactive materials in Antarctica is available at http://www.nsf.gov/od/opp/ant/solicitation_resources/prop_prep_info4.jsp#radioactive2.

- Use of Controlled Substances
  If your Antarctic research requires the use of controlled substances that are regulated by the Drug Enforcement Agency (DEA), this use must be clearly identified in the proposal and you must contact the cognizant program officer for guidance regarding current policies for transport, use, and storage. Acquisition and use of controlled substances must occur through your organization's controlled substance program. You or your organization must have appropriate DEA registrations to order, transport, and use controlled substances in Antarctica. PIs must include costs of controlled substances, including transportation costs to the USAP port of departure, in the research budget. Coordination with NSF and the Antarctic Support Contractor is necessary to ensure that transport of controlled substances to Antarctica is done properly.

- Research ship EEZ clearances
  Any research that is north of 60 °S and involves work in the Exclusive Economic Zone (EEZ) of another nation (typically within 200 nautical miles of the coast of that nation), including underway measurements such as collecting multibeam data, gravity data, or surface water samples, requires an appropriate research clearance from the nation involved.

  Justify any EEZ work in your proposal, and provide information needed for a permit application in the Operational Requirements Worksheets. NSF's prime Antarctic contractor assists in the preparation of and provides to NSF the application for clearance. NSF must submit the application to the Department of State, which must receive it no later than 6 months before the cruise.

- Composition of field teams
  The size and general composition of your field team must be justified in your proposal. In addition, identify in your ORW the number of people who will be involved in the prospective field project. Team members must be scientists, technicians, students, educators, or others with experience or strong interests in the goals of the project, must be necessary to the completion of the project as described in the proposal, and must have a direct interest in its outcome. NSF may request institutional certification of the qualifications of team members, especially in unusual circumstances such as when family members are proposed as part of a field team.

  Parties must have field safety expertise that is appropriate for the anticipated activities, conditions, and hazards. Examples of potentially hazardous situations include mountaineering, working in crevassed terrain, and working on sea ice. Investigators should consider augmenting their teams with persons experienced in field safety, particularly if the group is inexperienced in Antarctic fieldwork. Training of field party members in first aid is highly recommended. Feel free to consult with NSF (see roster) during proposal preparation.

- Physical and psychological screening
  Because medical facilities in Antarctica are not equipped to deal with all possible medical emergencies, and because immediate medical evacuation may be impossible, it is important that all persons deploying to Antarctica be in good health. Before deploying, participants must meet physical and dental health criteria established for the program. Candidates for work during the austral winter isolation also must pass a psychological screening.

  The Antarctic support contractor will provide prospective travelers to the Antarctic with the U.S. Antarctic Program medical and dental examination forms. Travelers are responsible for completing their physical and dental examinations and sending the completed forms to the support contractor. Candidates for the winter isolation period will be provided instructions for the psychological screening. Information concerning physical and dental screenings

is available on the U.S. Antarctic Program web portal at http://www.usap.gov/travelAndDeployment/deploymentPackets.cfm.

B. Budgetary Information

Cost Sharing: Inclusion of voluntary committed cost sharing is prohibited

Budget Preparation Instructions:

Budget provisions for field services in Antarctica

In Antarctica, many support services are provided and paid for by the NSF-funded U.S. Antarctic Program. Many common-use items are bought and shipped to Antarctica in bulk for allocation to field parties. This practice, while affecting the way an investigator plans for fieldwork, lowers the cost of acquiring, maintaining, and shipping items to Antarctica. However, as with other research programs at NSF, requests for field support must be outlined in sufficient detail in the proposal so that reviewers and NSF program officers can assess whether this support is appropriate for the research program proposed.

Investigators should use their proposals and Operational Requirements Worksheets (ORWs) to specify services and items of equipment that are required for their research. To plan and budget for acquisition of these items, NSF must know well in advance what they are and approximately how much they cost.

Costs for the following items must be included in your funding request (questions related to this list should be directed to your cognizant program officer or Research Support Managers in the Division of Antarctic Infrastructure and Logistics):

- Physical and dental examinations, including blood work, for all persons going to Antarctica. Note: Awards cannot be used to support medical or dental treatment that may be required to meet physical and dental health criteria established for the program as per the "Physical and psychological screening" section in Section V. 5. of this solicitation.
- Living expenses (per diem) during travel to and from Antarctica. Budget these costs under foreign travel
- Laboratory consumables above those that are normally stocked by the contractor, project-specific equipment, laboratory supplies, and field supplies that the contractor does not have in stock or equipment and supplies required at home organizations. (http://www.usap.gov/usapgov/proposalInformation/)
- Batteries to operate remote equipment.
- Non-recoverable and potentially non-recoverable equipment, such as moorings (except for the anchor mass), drifters, XCTDs, and satellite tracking tags
- Dedicated mountaineer/sea ice specialist is required if your team will be in the field for greater than two weeks working in technical terrain.
- A certified explosives blaster required to detonate any explosives in the field.
- Equipment that will be dedicated to your project for multiple years, if you are submitting a proposal with several field seasons. This includes UNAVCO and IRIS/PASCAL equipment that cannot be supplied from their equipment pools.
- Cargo and sample shipping within the continental United States. The U.S. Antarctic Program provides southbound and northbound shipment between a U.S. port and Antarctica without cost to the grantees, but transport between the U.S. port and the home organization is paid for using your grant funds. USAP ships temperature-sensitive samples to their final destination.
- Specialized packaging or preparation of equipment needed for transport of special equipment to and/or from Antarctica.
- If your team travels on a tour ship or other private transportation that is not sponsored by a National Antarctic Program your group may need to obtain private medical evacuation insurance.

Note: The USAP issues at no charge to the award limited amounts of basic polar clothing including insulated underwear, mukluks, thermal boots, parkas, insulated overalls, gloves, and other extreme-cold-weather gear.

Commercial air travel

Do ***not*** budget in your proposal for commercial air travel between your home organization and the departure point for Antarctica (normally Christchurch, New Zealand, or Punta Arenas, Chile). The Foundation's Antarctic support contractor will issue tickets at no cost to your grant. Under most circumstances the tickets issued will not include travel from a point outside the United States. If you contemplate such foreign travel, please discuss this with your program director.

If a foreign scientist is part of your field Program, NSF generally expects that person to be cleared medically through their nation's Antarctic program (if relevant) and to provide their airfare and travel expenses to and from the southern hemisphere point of departure. Exceptions must be discussed with your cognizant program officer.

Do budget in the proposal for accompanied excess baggage needed for your research as well as for per diem during this travel and for any travel not involving deployment to Antarctica.

Insurance

Do not budget for life or disability insurance. NSF does not provide insurance for grantee personnel in Antarctica, and it does not fund acquisition of this insurance in its research grants.

Persons traveling to Antarctica are expected to have insurance appropriate to their normal life situations so that any needed health care, compensation for property loss, worker's compensation, or survivor benefit will be provided for.

Emergency medical care for U.S. Antarctic Program participants in Antarctica is provided in clinics at the year-round stations. Persons who need hospital care will be transported to health care facilities in New Zealand, South America, or the United States, at which point they or their sponsors will be responsible for medical costs.

Check your health and life insurance policies to be sure that flights aboard scheduled military aircraft are covered.

All research staff (paid or volunteer) should be affiliated in some manner with your organization(s), so that any worker's compensation issues arising from injuries sustained while deployed can be addressed by your organization.

C. Due Dates

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

May 31, 2012

D. FastLane / Grants.gov Requirements

- For Proposals Submitted Via FastLane:

  Detailed technical instructions regarding the technical aspects of preparation and submission via FastLane are 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.

  Submission of Electronically Signed Cover Sheets. The Authorized Organizational Representative (AOR) must electronically sign the proposal Cover Sheet to submit the required proposal certifications (see Chapter II, Section C of the Grant Proposal Guide for a listing of the certifications). The AOR must provide the required electronic certifications within five working days following the electronic submission of the proposal. Further instructions regarding this process are available on the FastLane Website at: https://www.fastlane.nsf.gov/fastlane.jsp.

- 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://www07.grants.gov/applicants/app_help_reso.jsp. In addition, the NSF Grants.gov Application Guide provides additional technical guidance regarding 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.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program where they will be reviewed if they meet NSF proposal preparation requirements. 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 who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with the 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.

A. NSF Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board (NSB)-approved merit review criteria: intellectual merit and the broader impacts of the proposed effort. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two NSB-approved merit review criteria are listed below. The criteria include considerations that help define them. These considerations are suggestions and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and for which the reviewer is qualified to make judgements.

What is the intellectual merit of the proposed activity?
How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.) To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

What are the broader impacts of the proposed activity?
How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

Examples illustrating activities likely to demonstrate broader impacts are available electronically on the NSF website at: http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf.

Mentoring activities provided to postdoctoral researchers supported on the project, as described in a one-page supplementary document, will be evaluated under the Broader Impacts criterion.

Additional Solicitation Specific Review Criteria

Rationale for access to Antarctica

NSF supports fieldwork in Antarctica for research that can only be done or is best done in Antarctica. Proposals must make a compelling case that the fieldwork is needed to accomplish the goals of the proposed investigation. External reviewers will be asked to comment on the importance of fieldwork, and program officers will consider this issue in their recommendation.

Operational feasibility

Proposals involving fieldwork will also be evaluated for operational feasibility, which includes resource availability, environmental protection and waste management provisions, safety and health measures, and safeguards of radioactive materials. Proposers must recognize that proposals may be declined for operational reasons. For proposals involving fieldwork in the Antarctic, this operational evaluation is based largely on the Operational Requirements Worksheets that the proposer must complete as instructed in Section V.A. (Proposal Preparation and Submission Instructions). While the full ORW will not be given to reviewers, a summary ORW, produced from information provided by the proposer as part of completing the full ORW, must be included in the proposal as a "Supplementary Document" and will be provided to reviewers.

All Antarctic field participants must also meet specified U.S. Antarctic Program health and dental requirements. See Section V.B. (Budget Preparation).

Candidates for wintering at the year-round stations are screened for psychological fitness.

AISS Additional Review Criteria

External reviewers and panel will be asked to comment on the synergism among the various disciplinary components proposed and the likelihood that the project will contribute to progress on a fundamental research question that can be answered with knowledge obtained from Antarctica and/or the Southern Ocean.

Joint support from international partners and other federal agencies

International collaborative proposals, especially when joint fieldwork is involved, as well as proposals that involve other US federal agencies require special efforts for coordination between the sponsoring organizations. NSF will engage potential partner organizations as required to determine project feasibility prior to making awards.

NSF's BROADER-IMPACTS REVIEW CRITERION

Antarctica presents exceptional opportunities for projects in all of the program areas described in the "Research Areas" section of this solicitation to respond to NSF's broader-impacts proposal evaluation criterion — "What are the broader impacts of the proposed activity" — that asks how well the proposed activity will advance understanding while promoting teaching and learning; how well it will broaden the participation of underrepresented groups; to what extent it will enhance the research and education infrastructure (facilities, instruments, networks, partnerships, etc.); how well the results will be disseminated broadly to enhance scientific and technological understanding; and what may be the benefits to society of the proposed activity.

The Foundation's Advisory Committee for Polar Research, Working Group on Implementation of the Broader Impacts Criterion (then called "criterion 2"), has produced a document, Criterion 2 Background and List of Representative Activities, that proposers may want to consider when addressing the broader-impacts review criterion. The NSF Office of Budget, Finance, and Award Management has also prepared a document, *Merit Review Broader Impacts Criterion: Representative Activities*, describing activities that demonstrate broader impacts. [Note: The term "Criterion 2" used to be synonymous with the term "Broader Impacts Criterion." The latter term alone is currently used. The OPP Advisory Committee completed their work on the issue prior to this change in the criterion name.]

Proposers are encouraged to develop "Broader Impacts" activities that are specific to their research. Awareness of or collaboration with other Foundation programs also may be helpful in achieving broader impact.

A program of potential interest is PolarTREC. This program, funded by the Foundation and managed by the Arctic Research Consortium of the U.S., enables K-12 teachers to participate in polar research by working closely with scientists as a pathway to improving science education. The program's website (http://www.polartrec.com/) provides information about how researchers can participate. This activity offers a way for polar scientists to integrate education outreach into their research and help to meet the broader impacts criterion.

NSF staff also will give careful consideration to the following in making funding decisions:

Integration of Research and Education
One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

Integrating Diversity into NSF Programs, Projects, and Activities
Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- 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.

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 formulate a recommendation to either support or decline each proposal. 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 is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director accepts the Program Officer's recommendation.

A summary rating and accompanying narrative will be completed and submitted by each reviewer. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers, 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.

In all cases, 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 and 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.

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 letter, 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 letter; (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 letter. 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 http://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 *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

Special Award Conditions:

Metadata. Principal Investigators of OPP-awards are required to submit metadata files for all data sets and derived data products in the form of a Directory Interchange Format (DIF) entry, to the Antarctic Master Directory, via the USAP Data Coordination Center (http://www.usap-data.org/), which OPP funds for this purpose. Further information on DIF generation can be found at the Global Change Master Directory (http://gcmd.gsfc.nasa.gov/). This specific metadata (DIF) requirement is necessary for USAP obligations under the Antarctic Treaty. OPP policy also requires that the full data sets and sets of derived data products be transferred to a nationally recognized or program officer-approved data repository. Investigators also are expected to submit their metadata (DIF) at the time that they submit their final reports to NSF.

Antarctic Bibliography. Investigators funded through ANT are requested to send the Bibliography one copy or a URL to the online version of every publication developed under the award, labeled with the award number, to assure its citation in this valuable reference tool. Doing so will waive the General Grant Condition that requires submission of copies of every publication, developed under an NSF award, to the cognizant NSF program officer.

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 at least 90 days before the end of the current budget period. (Some programs or awards require more frequent project reports). Within 90 days after 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 that PI. 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 FastLane, for preparation and submission of annual and final project reports. Such reports provide information on activities and findings, project participants (individual and organizational), publications, and other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system. Submission of the report via FastLane constitutes

certification by the PI that the contents of the report are accurate and complete. The project outcomes report 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.

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:

- Sonia Esperança, Program Director, Antarctic Integrated System Science, telephone: (703) 292-4735, email: sesperan@nsf.gov
- Alexandra Isern, Program Director, Antarctic Earth Sciences, telephone: (703) 292-7581, fax: (703) 292-9079, email: aisern@nsf.gov
- Peter Milne, Program Director, Antarctic Ocean & Atmospheric Sciences, telephone: (703) 292-4714, fax: (703) 292-9079, email: pmilne@nsf.gov
- Diana Nemergut, Program Director, Antarctic Organisms & Ecosystems, telephone: (703) 292-7448, email: dnemergu@nsf.gov
- Julie Palais, Program Director, Antarctic Glaciology, telephone: (703) 292-8033, fax: (703) 292-9079, email: jpalais@nsf.gov
- Vladimir Papitashvili, Program Director, Antarctic Astrophysics & Geospace Sciences, telephone: (703) 292-7425, fax: (703) 292-9079, email: vpapita@nsf.gov
- James Swift, Program Manager, Antarctic Research and Logistics Integration, telephone: (703) 292-7450, fax: (703) 292-9079, email: jswift@nsf.gov
- Jessie L. Crain, Research Support Manager, OPP/AIL, telephone: (703) 292-7457, fax: (703)292-9080, email: jlcrain@nsf.gov
- Timothy M. McGovern, Oceans Projects Manager, OPP/AIL, 755S, telephone: (703) 292-4248, fax: (703)292-9080, email: tmcgover@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, National Science Foundation Update is a free e-mail subscription service 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 Regional Grants Conferences. Subscribers are informed through e-mail when new publications are issued that match their identified interests. Users can subscribe to this service by clicking the "Get NSF Updates by Email" link on the NSF web site.

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this new 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 40,000 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 provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 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 http://www.nsf.gov

- Location: 4201 Wilson Blvd. Arlington, VA 22230
- 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
Division of Administrative Services
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