U.S. GLOBEC - Global Ocean Ecosystems Dynamics: Pan-Regional Synthesis

PROGRAM SOLICITATION
NSF 07-594

REPLACES DOCUMENT(S):
NSF 05-552

National Science Foundation

Directorate for Geosciences
Division of Ocean Sciences

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

January 08, 2008

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

U.S. GLOBEC - Global Ocean Ecosystems Dynamics: Pan-Regional Synthesis

Synopsis of Program:

As the culmination of a series of solicitations for the U.S. Global Ocean Ecosystem Dynamics Program (U.S. GLOBEC), this solicitation seeks a broader understanding of climate impacts on marine ecosystems that builds upon findings from the three regional U.S. GLOBEC studies: the Northwest Atlantic, the Northeast Pacific, and the Southern Ocean. Investigators submitting proposals in response to this solicitation should focus on: (1) synthetic activities, including conceptual and analytical modeling activities that capitalize upon and integrate concepts, methods, and/or data from the prior solicitations; (2) broad-scale studies including comparisons across system types, encompassing both GLOBEC and non-GLOBEC study areas; and/or (3) the development of management strategies at the population, community, and ecosystem levels. Participation of investigators new to the U.S. GLOBEC program is strongly encouraged to maximize the scope of the synthesis.

Cognizant Program Officer(s):

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

- David L. Garrison, telephone: (703) 292-7588, email: dgarriso@nsf.gov

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

- 47.050 --- Geosciences

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 15 About 15 integrated, interdisciplinary projects, of two or three year duration.

Anticipated Funding Amount: $7,000,000 The Program anticipates awards totaling $7,000,000, subject to availability of funding. Please see Section IV. AWARD INFORMATION for details about anticipated funding.

Eligibility Information

Organization Limit:

Proposals may only be submitted by the following:

- Academic Institutions located in the U.S.: U.S. universities and colleges located in the U.S.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- For-profit organizations: U.S. commercial organizations, especially small businesses with strong

capabilities in scientific or engineering research or education.

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 Proposal Preparation Instructions:** NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) proposal preparation guidelines apply.

B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required under this solicitation.
- **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):

  January 08, 2008

Proposal Review Information Criteria

Merit Review Criteria: National Science Board approved criteria apply.

Award Administration Information

Award Conditions: Standard NSF award conditions apply.

Reporting Requirements: Standard NSF reporting requirements apply.

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I. INTRODUCTION

This solicitation is being issued under the auspices of the U.S. Global Ocean Ecosystem Dynamics (U.S. GLOBEC) program. The goals of U.S. GLOBEC include understanding and, ultimately, predicting how populations of marine animals (holozooplankton, fish, benthic invertebrates, seabirds, and marine mammals) respond to changes in the global climate. The U.S. GLOBEC program is a component of the U.S. Global Change Research Program. U.S. GLOBEC is also a component of the International GLOBEC program, a core project of the International Geosphere-Biosphere Program (IGBP), with co-sponsorship from the Scientific Committee on Oceanic Research (SCOR) and the Intergovernmental Oceanographic Commission (IOC), and affiliate intergovernmental programs within ICES (International Council for the Exploration of the Seas) and PICES (Pacific ICES).

Prior phases of U.S. GLOBEC research have been supported jointly by the NSF Ocean Sciences Division and Office of Polar Programs, and the National Oceanic and Atmospheric Administration Center for Sponsored Coastal Ocean Research and the National Marine Fisheries Service (NMFS), with additional participation by NASA. It is expected that NOAA research scientists and other Federal Researchers will participate in Pan-Regional Synthesis as no-cost collaborators.

Specific goals of the U.S. GLOBEC program are: (1) to understand the potential impacts of climate variability and change on the dynamics of shelf ecosystems and on the distribution, abundance and production of several specific target species; (2) to embody this understanding in conceptual and quantitative models capable of capturing population and ecosystem responses over a broad range of spatial and temporal scales; and (3) to improve predictions of U.S. living marine resource populations which can lead to enhanced management capabilities. U.S. GLOBEC science and implementation plans and other program reports are available at http://www.usglobec.org/reports.php.

U.S. GLOBEC has comprised three regional ecosystem programs -- Northwest Atlantic/Georges Bank (NWA), Northeast Pacific (NEP) and Southern Ocean (SO) -- and a series of technology and modeling development projects. Data collection and process studies in each of the three regions have been funded through a series of previous solicitations. Publications resulting from these U.S. GLOBEC studies are cataloged at http://www.usglobec.org/papers.php, and the entirety of the data derived from these research programs can be freely accessed at http://www.usglobec.org/data.php (see below for more details).

The U.S. GLOBEC program is now focused on comparing and contrasting the results from the prior phases of U.S. GLOBEC, and on extending these results with comparisons to, or tests within, other comparable ecosystems. This solicitation seeks to build upon this effort, and support the synthesis and integration of results across study regions. For all three regions, synthesis and comparative analysis efforts are presently underway, as described further below. The priority focus for the Pan-Regional Synthesis phase of U.S. GLOBEC will be to achieve a broader understanding of climate impacts on marine populations and ecosystems employing hypotheses, concepts, methods and/or data derived from the regional studies in the Northwest Atlantic, Northeast Pacific, and Southern Ocean. This solicitation marks the culmination of synthesis in U.S. GLOBEC. The Pan-Regional Synthesis program, its goals, and the research themes are described in the Program Description Section below.

Electronic Data Access: The synthesis and comparative analysis opportunities described in this solicitation are open to scientists without past involvement in U.S. GLOBEC as well as those who have had funding through previous GLOBEC activities. U.S. GLOBEC Data Policy requires that all data collected under the U.S. GLOBEC program and associated documentation be made available to all researchers. The U.S. GLOBEC Data Policy (U.S. GLOBEC Report 10) is available at http://www.usglobec.org/reports/datapol/datapol.contents.html. Again, data for all three U.S. GLOBEC regional programs is available at http://www.usglobec.org/data.php.

II. PROGRAM DESCRIPTION

Part I. Regional Program Descriptions and Current Status

A. U.S. GLOBEC Northwest Atlantic / Georges Bank Program (NWA)

Within the overall U.S. GLOBEC goals, the NWA / Georges Bank Program has the following specific goals:

- To determine the mechanisms by which physical and biological processes control the population dynamics of the target organisms (early life stages of cod and haddock and their copepod prey, e.g., *Calanus finmarchicus*, *Pseudocalanus* spp., and *Oithona*) in the NWA / Georges Bank area;
- To develop conceptual and quantitative models capable of predicting ecosystem dynamics and responses on a broad range of space and time scales; and
- To understand the effects of climate variability and climate change on the distribution, abundance and production of the target organisms.

The specific objectives and scientific questions related to these goals are described in greater detail in the U.S. GLOBEC NWA Plan (Report No. 6), available at http://www.usglobec.org/reports/nwaip/nwaip.contents.html.

The NWA regional program included modeling studies together with broad-scale and process-oriented field studies on Georges Bank and the surrounding continental margin and shelf, in the context of the larger oceanic boundary region with emphasis on the processes and phenomena that affect the ecosystem of the Bank. Each process-oriented field study focused on a particular physical process and the influence of that process on the bank's biology: Phase I – stratification, Phase II - source/retention/loss of water and organisms from the Bank, and Phase III – cross frontal exchange. The coordinated modeling and field effort was in support of improving the predictability and management of U.S. marine resources through better understanding of the NWA / Georges Bank ecosystem.

The U.S. NWA Program is now nearing completion of its regional synthesis phase (Phase IV). Phase IVa initiated the overall synthesis effort resulting in several data integration and modeling studies. Phase IVb proposals were selected to place the research findings of the Georges Bank program into the context of basin-scale phenomena in the North Atlantic, and to use that knowledge to

predict the Georges Bank ecosystem response to future climate variability with international and other U.S. GLOBEC study areas.

B. U.S. GLOBEC Northeast Pacific Program (NEP)

Within the overall U.S. GLOBEC goals, the NEP program has the following specific goals:

- To determine how changing climate, especially its impacts on local wind and buoyancy forcing and basin-scale currents, affect spatial and temporal variability in mesoscale circulation and water column structure;
- To quantify how physical features in the NEP, and variability related to climate change, impact zooplankton biomass, production, distribution, and the retention and loss of zooplankton from coastal regions, and how these, in turn, influence the distributions of higher trophic levels, such as forage fish, salmon, and marine birds and mammals;
- To quantify the impacts of key coastal physical and biological processes on controlling juvenile salmon growth and survival in the coastal zone of the NEP;
- To determine the extent to which high and variable mortality of juvenile salmon in the coastal regions of the Northeast Pacific is responsible for large inter-annual variation in adult salmon populations, and to determine whether and how the proximate mortality causes (*e.g.*, predation, parasites, starvation, loss by advection) are affected by climate variability; and
- To compare the impacts of climate variability and change (such as El Niño-La Niña cycles and regime decadal variability) on similar marine animal populations (copepods, euphausiids, salmon) across the sub-regions of the NEP.

The specific objectives and scientific questions related to these goals are described in greater detail in the U.S. GLOBEC NEP Implementation Plan (Report No. 17), available at http://www.usglobec.org/reports/rep17/nepip.contents.html.

The NEP regional program has two sub-regions, the California Current System (CCS) and the Coastal Gulf of Alaska (CGOA). Thus far, the NEP program has consisted of regionally combined modeling, retrospective and pilot field studies (Phase I) and separate sub-regional field and model studies (Phase II). These studies have resulted in substantial new data sets and understanding of the physical-chemical-biological interactions in shelf, slope and adjacent deep-ocean habitats in the NEP.

Synthesis (Phase III) in the CCS was initiated with funding in 2004 and in the CGOA in 2005. The objective of Phase III is the integration and synthesis of data collected during the field phases of the NEP program, and the implementation of robust and reliable coupled biophysical models, leading to improved knowledge of, and predictive tools for, the impact of climate variability on specific marine populations and ecosystems of the eastern North Pacific.

C. U.S. GLOBEC Southern Ocean Program (SO)

Within the overall U.S. GLOBEC goals, the SO program has the following specific goals:

- To elucidate shelf-circulation processes and their effect on sea-ice formation and Antarctic krill (*Euphausia superba)* distribution, and
- To examine the factors that govern Antarctic krill survivorship and availability to higher trophic levels, including penguins, seals and whales.

The program also seeks to improve the predictability of living marine resources – including their abundance, distribution and behavior – with respect to local and global climatic shifts. The U.S. SO GLOBEC Implementation plan (International GLOBEC Report No. 7A) may be found at http://www.globec.org/.

The goals of the first phase of the US SO GLOBEC program were accomplished through broad-scale synoptic studies and process-oriented investigations, conducted primarily during the austral winter (2001-2002). These studies addressed the following questions:

- What is the physical environment of the Western Antarctic Peninsula shelf and how does it govern the distribution of and the resources available to krill?
- What physical, chemical and biological factors govern krill recruitment?
- What is the relationship between the physical environment, krill ecology and the success of krill-dependent predators?

The field and process studies undertaken in the first phase of SO-GLOBEC resulted in new data sets and an increased understanding of climatic and geophysical forcing factors that structure ecological communities in the Southern Ocean.

The first SO GLOBEC Synthesis and Modeling activities were initiated in 2005 with goals that included: (1) improved knowledge of the impact of environmental and climate variability on specific marine species, communities, and ecosystems of Antarctic continental shelf waters; (2) circulation, sea ice, ecosystem, and coupled physical-biological models that can be used to examine impacts of environmental and climate variability on Antarctic ecosystems; (3) detailed and quality controlled datasets of physical, chemical and biological conditions that will be used in model validation and can provide a baseline and basis for future research in the region; and (4) new indices or strategies that provide increased understanding of the structure and function of Antarctic marine food webs.

Part II. Program Description: U.S. GLOBEC Pan-Regional Synthesis (PRS Phase)

This solicitation for Pan-Regional Synthesis is the culmination of U.S. GLOBEC. The objective of Pan-Regional Synthesis is to seek a broader understanding of climate impacts on marine animal populations and ecosystems that will build upon regional studies in the Northwest Atlantic, Northeast Pacific, Southern Ocean, and elsewhere. A higher-order synthesis effort incorporating basin-scale and circum-Antarctic efforts, for example, and comparative analyses among U.S. and International GLOBEC studies and related programs is required to meet the overarching GLOBEC goal of predicting the effects of global climate change on marine ecosystems. A copy of the U.S. GLOBEC Implementation Plan for Pan-Regional Synthesis may be found at: http://www.usglobec.org/.

Proposals are sought to compare, contrast, and/or extend the concepts, hypotheses, models and/or data from two or more study regions, including at least one of the three U.S. GLOBEC focus regions (NWA/Georges Bank, Northeast Pacific, or Southern Ocean). The remaining region(s) may be drawn from U.S. GLOBEC, GLOBEC International, or elsewhere. For the purposes of this solicitation, the Northeast Pacific will be considered a single U.S. GLOBEC region.

The focus of Pan-Regional Synthesis within the U.S. GLOBEC Program is the synthesis of individual elements within each regional program, as well as comparative analysis among them and other with other research programs. The importance of comparative analysis has been recognized in U.S. GLOBEC since its inception. The overall synthesis and integration effort includes comparing the dynamics of closely related taxa in relation to physical processes (e.g. stratification, upwelling and downwelling, or sea ice extent). Some examples of cross-cutting issues suitable for comparative analysis are top-down vs. bottom-up controls on productivity, and the importance of topographic controls on local and regional circulation patterns. Synthetic studies of population and system states over time in relation to climate forcing are also desired.

Integrated understanding of the effects of climate on the systems represented in U.S. GLOBEC will require comparison with results of national and international programs in other similar systems. The worldwide GLOBEC program and related research efforts provide opportunities for comparative analyses and to address basin-scale processes. Some examples are comparisons with other

studies of calanoid copepods and gadoids on bank and shelf systems in the North Atlantic; copepods, euphausiids, and salmonids in the North Pacific; and euphausiids, calanoid copepods, and upper trophic level predators (*e.g.*, seabirds, penguins, seals and cetaceans) in continental shelf waters of the Southern Ocean.

Modeling is expected to be a major focus of the GLOBEC Pan-Regional Synthesis, having already played a central role in the regional studies. Here, models are broadly defined to encompass validated models of all kinds – conceptual, mathematical, numerical, and statistical.

A. Research Themes and Questions

U.S. GLOBEC held its first Pan-Regional Synthesis Workshop in November 2006. At this Workshop, the science community had the opportunity to discuss and to define the goals and approaches of pan-regional synthesis. The Workshop report can be obtained at http://www.usglobec.org/workshops/synth06/index.php.

Based on the consensus developed at this Workshop, three research themes were identified for the Pan-Regional Synthesis phase. These general themes, and representative research questions appropriate to each, are described below. Proposed work may address more than one of these or other themes.

1. The influence of climate on physical and biological processes: Synthetic understanding of how basin- and global-scales changes in climate force physical processes that in turn determine local- and regional-scale biological communities is fundamental to the success of U.S. GLOBEC.

Some example questions appropriate to this theme include: How will features of global climate (*e.g.*, the North Atlantic Oscillation (NAO), the Pacific Decadal Oscillation (PDO), global warming, and acidification) that affect physical processes in the ocean (*e.g.*, fresh water input, wind patterns, and circulation) affect regional ecosystems? Are there common features and responses among the ecosystems? How are the thresholds of response for climate defined in each ecosystem? How do climate-mediated changes in physical conditions interact with organism behavior and influence species distributions, trophic interactions, and community structure? How does climate influences on primary production and lower trophic levels determine the life cycles, distribution, abundance, and species composition of higher trophic levels? How does this understanding support, and provide specific strategies for, ecosystems approaches to management? What defines the capabilities of models for reliable forecasts of end-to-end ecosystem change?

2. Population dynamics and recruitment of target species: This theme seeks to identify the processes controlling the population dynamics and recruitment of the target organisms as a function of system type, and to ascertain how these processes would be affected by a changing climate. This analysis could be done by comparing/contrasting the different systems being studied.

Some example questions appropriate to this theme include: What are the common mechanisms that control population dynamics and recruitment across/between regions in response to climate change? How valuable are frameworks, like ecological theories or simulation modeling, to determine the differences and commonalities between the systems? What key environmental/ecosystem indicators emerge that can relate these findings to ecosystem-based management needs and do these have commonalities across regions?

3. Ecosystem structure and function: Taking the knowledge gained in U.S. GLOBEC about target species' physiology, behavior and population dynamics, the third theme seeks to better understand ecosystem response to climate change, particularly in connection with other, anthropogenic forcing. This activity should provide guidance on how to assess ecosystem level questions using GLOBEC concepts, methods and/or data, and on further implications for the management of marine resources in a changing climate.

Some example questions appropriate to this theme include: What is the role of individual species dynamics in determining ecosystem and food web dynamics? How has climate forcing altered ecosystem structure and function across regions? What are the characteristics that contribute to the resilience and sensitivity of ecosystems? To what extent does the strength of climate effects in systems result from different anthropogenic/historical effects? How does climate change impact the range and distribution of top predators and their impacts on ecosystems?

B. Research approaches

This phase of the U.S. GLOBEC program aim at synthesis among the U.S. GLOBEC study regions, as well as comparison with other systems worldwide. The intent is to coordinate activities that collectively address the program goals stated above. Examples of appropriate approaches to be applied are described below. It is anticipated that proposed work may utilize more than one of these approaches.

1. Synthesis of Data Sets across U.S. GLOBEC and other study regions:

Answering the questions posed above will require a concerted effort to integrate the results of physical observations, estimates of *in situ* animal abundances, the condition and reproductive rates of plankton, and the distributions of predators. Data from multiple disciplines need to be integrated to enable inter-annual comparisons of population processes and their coupling to the physical structure and variability of the environment. Integration of data sets from the long-term observation program (LTOP), process and survey components of the regional programs, remote sensing data, retrospective data sets, and modeling analyses will contribute to the development of multidisciplinary synthesis research efforts.

2. Physical/biological modeling:

Conceptual and quantitative models to investigate physical and coupled physical/biological processes have been developed and used in the U.S. GLOBEC program. Circulation models have been used to explore the influence of wind forcing on alongshore and cross-shelf flow using realistic regional bathymetry and forcing. Ecosystem models have been developed to examine the specific contributions of multiple zooplankton grazers (micro, meso, and macro) to energy transfer from lower trophic levels to higher levels. In Pan-Regional Synthesis, these and other modeling approaches (including both prognostic and data-assimilative) will be encouraged, with the aim of comparing and contrasting responses to climate variability across system types. Effort is also encouraged on the further development of approaches that effectively couple the lower and upper trophic levels. Modeling approaches that can be readily adapted and applied to different regions into a comprehensive "toolbox" will be key for comparative studies. This effort will provide predictive tools for advancing understanding of climate-related changes to ecosystems, an important consideration in an ecosystem approach to management.

3. Comparative Regional Studies:

This solicitation encourages comparative studies with other GLOBEC regions and non-GLOBEC-funded studies in similar shelf systems elsewhere. Comparative studies could include such topics as analyses of target zooplankton or predator taxa with other

species having similar (or contrasting) life histories; comparative study of regional circulation and ecosystem responses to basin- and larger-scale climate influences; contrasts of the effects of wind and buoyancy forcing on near-shore retention and loss of pelagic organisms. Comparative studies could employ remote sensing and bio-physical models to analyze ecosystem responses to climate variability in different regions, or develop new indices and measures for comparison. The proposals aiming at comparison should clearly identify the processes and characteristics that will be better understood through generalizations to and/or contrasts with the other systems. By encouraging proposals that reach beyond the three U.S. GLOBEC study sites, this solicitation does not downplay the value of studies that integrate the data sets, models and understanding gained entirely within U.S. GLOBEC.

4. Scientific development and evaluation of metrics to characterize environmental and ecosystem status and change.

The more complete understanding of pan-regional ecosystem dynamics gained through the U.S. GLOBEC program should allow for the design of more efficient and more informative monitoring programs in the region. Achieving this improvement will involve determining indices (sets of key parameters) to optimally characterize the status of the ecosystem, particularly in relation to potential higher trophic level production. Determining the optimal spatial and temporal scales for sampling and reporting of these key parameters will provide important information for transitioning GLOBEC monitoring activities to long-term monitoring programs. An important goal is for the indices to identify environmental influences on living marine resource variability (*e.g.*, cod and haddock, salmon, and krill) and protected species (*e.g.*, marine mammals) that can be incorporated into the assessment of the status of these resources and populations in the region. Indices may be derived from directly measured parameters (from field observations), remotely sensed parameters, or from output of specific configurations of coupled physical-biological models.

C. Coordination of Pan-Regional Synthesis and dissemination of results

As the culmination of U.S. GLOBEC, the two most important objectives for the Pan-Regional Synthesis phase are to achieve a comprehensive pan-regional synthesis, and to disseminate the understanding and data/model products to the scientific community as well as to natural resource managers and lay people. The National Office for U.S. GLOBEC will help to coordinate inter-project communication and to facilitate dissemination activities. As part of its coordination activities, the National Office will host yearly (nominally, Fall 2007, 2008 and 2009) Pan-Regional Synthesis Workshops. The Third and Fourth Pan-Regional Synthesis Workshops in 2008 and 2009 will provide an opportunity for communication and coordination among the projects funded under this announcement. Funded investigators will be expected to attend these two Workshops, with support for their participation provided by the National Office.

In addition to hosting the Pan-Regional Workshops, the National Office will request the active participation of Pan-Regional Synthesis investigators in efforts to hold symposia, to contribute to synthesis publications (*e.g.*, books), to transfer knowledge to fisheries managers, and to communicate to the public. Proposals are encouraged that include well-defined dissemination plans that leverage/form partnerships with established outreach programs (*e.g.*, NSF COSEE, NOAA Sea Grant College Programs, non-profit groups, *etc.*), and/or envision novel/integrative techniques to promote dissemination of Pan-Regional Synthesis results.

D. Who may apply

Proposals are encouraged from single investigators as well as integrated multidisciplinary teams. Researchers from NOAA and/or other Federal agencies are eligible to participate as no-cost collaborators, or funded by cooperating agencies, but they cannot be lead Principal Investigators. Participation of investigators new to the U.S. GLOBEC program is greatly encouraged.

III. AWARD INFORMATION

NSF anticipates recommending and supporting about 15 projects or proposals of 2-3 year duration with a total support of approximately $7,000,000. Actual awards depend on the quality of proposals reviewed and availability of funds.

IV. ELIGIBILITY INFORMATION

Organization Limit:

Proposals may only be submitted by the following:

- Academic Institutions located in the U.S.: U.S. universities and colleges located in the U.S.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- For-profit organizations: U.S. commercial organizations, especially small businesses with strong capabilities in scientific or engineering research or education.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI:

None Specified

Additional Eligibility Info:

Researchers from NOAA and/or other Federal agencies are eligible to participate as no-cost collaborators, or funded by cooperating agencies, but they cannot be lead Principal Investigators. Participation of investigators new to the U.S. GLOBEC program is greatly encouraged.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Instructions: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the guidelines specified 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-PUBS (7827) or by e-mail from nsfpubs@nsf.gov.

Proposers are reminded to identify the program solicitation number (NSF 07-594) 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.

B. Budgetary Information

Cost Sharing: Cost sharing is not required under this solicitation.

C. Due Dates

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

  January 08, 2008

D. FastLane Requirements

Proposers are required to prepare and submit all proposals for this program solicitation through use of the NSF FastLane system. Detailed instructions regarding the technical aspects of proposal preparation and submission via FastLane are available at: http://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.

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.

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.

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:

- David L. Garrison, telephone: (703) 292-7588, email: dgarriso@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.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
National Science Foundation
Arlington, VA 22230