



Directorate for Geosciences (GEO)



Research in the Directorate for Geosciences (GEO) seeks to advance the state of knowledge about the Earth, including its atmosphere, continents, oceans, interior, and Sun, and the processes that modify and link them together.

The Directorate for Geosciences supports programs and activities through the following:

- [Crosscutting Programs and Activities](#)
- [Education and Outreach Activities](#)
- [Division of Atmospheric Sciences \(ATM\)](#)
- [Division of Earth Sciences \(EAR\)](#)
- [Division of Ocean Sciences \(OCE\)](#)

 **For More Information**

Visit the GEO Directorate home page, <http://www.geo.nsf.gov/>.

**DIRECTORATE FOR GEOSCIENCES****Crosscutting Programs and Activities**

In addition to the programs mentioned in the other sections, the Directorate for Geosciences supports crosscutting programs and activities that include:

- [Biogeosciences](#)
- [Collaborations in Mathematical Geosciences \(CMG\)](#)
- [Earth System History \(ESH\)](#)
- [Ecology of Infectious Diseases \(EID\)](#)
- [Integrated Carbon Cycle Research \(ICCR\)](#)
- [Water Cycle Research \(WCR\)](#)
- [Other Programs and Activities](#)

• Biogeosciences

As part of the Directorate for Geosciences' fundamental goal—"to advance the scientific understanding of the integrated Earth systems through supporting high-quality research" (*NSF Geosciences Beyond 2000*, NSF 00-27; <http://www.geo.nsf.gov/adgeo/geo2000.htm>)—a new program has been initiated to develop research in the biogeosciences more fully. The Biogeosciences Initiative evolves from a wealth of recent planning between the Directorate and the scientific community, as well as from planning activities within the Atmospheric Sciences (ATM), Earth Sciences (EAR), and Ocean Sciences (OCE) Divisions in NSF's GEO Directorate. Biogeosciences explores how organisms influence—and are influenced by—the Earth's environment. The emergence of this field is characterized by conceptual and technological advances, opening new avenues of research and the development of shared methods, paradigms, and vocabulary that are bridging disciplinary differences.

 **For More Information**

Contact Dr. Rachael Craig, Directorate for Geosciences, by telephone, 703-292-8233; or by e-mail, rcraig@nsf.gov.

• Collaborations in Mathematical Geosciences (CMG)

The CMG Program is jointly funded by the Divisions of Atmospheric Sciences (ATM), Earth Sciences (EAR), and Ocean Sciences (OCE) (in NSF's GEO Directorate) and by the Division of Mathematical Sciences (DMS) (in NSF's MPS Directorate). The goals of the CMG activity are (a) to enable collaborative research at the intersection of mathematical sciences and geosciences and (b) to encourage cross-disciplinary education through summer graduate training activities. Research topics under (a) should fall within one of the following two broad themes: (1) mathematical and statistical modeling of large complex geosystems or (2) representing uncertainty in geosystems. Research projects supported under this activity should be essentially collaborative in nature. Research groups should include at least one mathematical scientist and at least one geoscientist. Projects under category (a) should be of 3 to 4 years in duration. It is not the intent of this activity to provide general support for infrastructure. Projects under category (b) are not restricted to topics (1) and (2).

 **For More Information**

Contact Dr. Stephen Meacham, Directorate for Geosciences, by telephone, 703-292-8527; or by e-mail, smeacham@nsf.gov.

• Earth System History (ESH)

The ESH competition is a coordinated paleoscience research initiative of the U.S. Global Change Research Program (USGCRP) that is jointly supported by the NSF Directorate for Geosciences' Divisions of Atmospheric Sciences (ATM), Earth Sciences (EAR), and Ocean Sciences (OCE); by NSF's Office of Polar Programs (OPP); and by the National Oceanic and Atmospheric Administration's (NOAA) Office of Global Programs. The goals of the ESH competition are (1) to encourage innovative research on the natural variability of the Earth's climate system from records preserved in geobiologic archives and (2) to provide a comprehensive understanding of Earth's changing climate with regard to forcing mechanisms, interactions, and feedbacks.

For More Information

Contact Dr. David Verardo, Directorate for Geosciences, by telephone, 703-292-8527; or by e-mail, dverardo@nsf.gov.

• Ecology of Infectious Diseases (EID)

The EID Program is jointly funded by the NSF Directorates for Biological Sciences and Geosciences, the National Institutes of Health, and the National Institute of General Medical Sciences. The EID program encourages development of predictive models and discovery of principles for relationships between anthropogenic environmental change and transmission of infectious agents. To that end, research should focus on understanding the ecological determinants of transmission by vectors or abiotic agents, the population dynamics of reservoir species, and transmission to humans and other hosts. Proposals may focus on terrestrial, freshwater, or marine systems and organisms.

For More Information

Contact Dr. Samuel Scheiner, Directorate for Biological Sciences, by telephone, 703-292-8481; or by e-mail, ssscheine@nsf.gov.

• Integrated Carbon Cycle Research (ICCR)

The ICCR Program reflects the Directorate for Geosciences' commitment to a national effort aimed at significantly increasing our understanding of the processes that regulate the transport and transformation of carbon within and among the terrestrial, oceanic, and atmospheric environments of the Earth. The program solicits innovative proposals from U.S. academic institutions to conduct basic research in the scientific aspects of the global carbon cycle, including studies of the chemical, biological, ecological, and physical processes driving carbon distribution; transformation; and transport within and between terrestrial, atmospheric, and oceanic environments.

For More Information

Contact Dr. Rachael Craig, Directorate for Geosciences, by telephone, 703-292-8233; or by e-mail, rcraig@nsf.gov.

• Water Cycle Research (WCR)

The WCR Program encompasses research that contributes to an enhanced understanding of water cycle processes. The U.S. Global Change Research Program (USGCRP) has placed high priority on research into the water cycle. Specific recommendations are detailed in *A Plan for a New Science Initiative on the Global Water Cycle* (USGCRP, 2001, <http://www.usgcrp.gov/usgcrp/ProgramElements/water.htm>). Federal agencies other than NSF bear primary responsibility for developing and maintaining an observational infrastructure required for the day-

to-day assessment of water distribution, movement, and quality. The water cycle research envisioned for support by NSF focuses on fundamental processes and interactions to which NSF can contribute basic understanding that complements the other activities in the total federal program.

 **For More Information**

Contact Dr. L. Douglas James, Directorate for Geosciences, by telephone, 703-292-8549; or by e-mail, ldjames@nsf.gov.

• **Other Programs and Activities**

The Directorate for Geosciences also participates in the following Foundation-wide programs and activities:

- Biocomplexity in the Environment (BE)
- Environmental Research and Education (ERE)
- Experimental Program to Stimulate Competitive Research (EPSCoR)
- Graduate Teaching Fellows in K-12 Education (GK-12)
- Grant Opportunities for Academic Liaison with Industry (GOALI)
- Human and Social Dynamics (HSD)
- Major Research Instrumentation (MRI)
- Partnerships for Innovation (PFI)
- Nanoscale Science and Engineering (NSE)

 **For More Information**

Visit the NSF Crosscutting Programs home page,
<http://www.nsf.gov/home/crssprgm/start.htm>.



DIRECTORATE FOR GEOSCIENCES

Education and Outreach Activities

In addition to the discipline-specific education and outreach activities supported by the Directorate for Geosciences, the Directorate participates in the multiagency Globe Program. Globe is a developing international effort that links scientists and schoolchildren through a global information network. It is designed to promote general science literacy related to environmental and global change issues.

For More Information

Visit the Globe Program Web site, <http://www.globe.gov>. For information about Globe activities within NSF, contact the Globe program director in the Directorate for Geosciences by telephone, 703-292-7858; or by e-mail, globe@nsf.gov; or visit the GEO Directorate home page, <http://www.geo.nsf.gov>; or the Education and Human Resources Directorate home page, <http://www.ehr.nsf.gov>. Additional information about programs in the EHR Directorate can also be found in the EHR section of this Guide.

Geosciences Education Program

The Geosciences Education Program supports education activities that integrate geoscience research and education, as well as lead to improvement in the quality of geoscience education. A program announcement is released annually and proposals at all education levels are encouraged. Abstracts of previous awards are available at <http://www.geo.nsf.gov/adgeo/education.htm>.

For More Information

See program announcement NSF 03-515; or contact the program by e-mail, geoed@nsf.gov; or visit the GEO Directorate home page, <http://www.geo.nsf.gov/>.

Digital Library for Earth System Education

The Directorate for Geosciences supports the development of a well-organized, high-quality digital library of educational materials for learner access to data describing the Earth system. These are the raw materials needed to implement discovery-based pedagogies that research indicates are most effective for learning the methods and content of science. The Digital Library for Earth System Education (DLESE) Program provides the structure and services needed to transform the plethora of exciting Earth materials and data available on the Web into a community resource with the potential to transform Earth system education.

For More Information

Contact Dr. Michael Mayhew by e-mail, mmayhew@nsf.gov; or visit the GEO Directorate home page, <http://www.geo.nsf.gov>.

Opportunities for Enhancing Diversity in the Geosciences (OEDG)

The OEDG Program is part of the Directorate for Geosciences' effort to broaden the participation of groups traditionally underrepresented in the geosciences, including women, minorities, and persons with disabilities. For further information about OEDG—implemented in fiscal year (FY) 2001—see the FY 2002 program announcement

NSF 02-104. Future announcements will be issued biennially.

 **For More Information**

Contact the program by e-mail, geo_diversity@nsf.gov; or visit the GEO Directorate home page, <http://www.geo.nsf.gov/geo/diversity>.

Other Programs and Activities

In addition to the programs and activities mentioned here, the GEO Directorate participates in the following NSF-wide education and outreach activities:

- Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE)
- Math and Science Partnership (MSP)
- Faculty Early Career Development (CAREER)
- Integrative Graduate Education and Research Training (IGERT)
- Presidential Early Career Awards for Scientists and Engineers (PECASE)
- Program for Persons with Disabilities (PPD)
- Research Experiences for Teachers (RET)
- Research Experiences for Undergraduates (REU)
- Research in Undergraduate Institutions and Research Opportunity Awards (RUI/ROA)

 **For More Information**

Visit the NSF Crosscutting Programs home page, <http://www.nsf.gov/home/crsspgrm/start.htm>.



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Division of Atmospheric Sciences

The Division of Atmospheric Sciences (ATM) supports research to increase understanding of the behavior of Earth's atmosphere and its interactions with the Sun. Included are studies of the physics, chemistry, and dynamics of Earth's upper and lower atmospheres and its space environment; research on climate processes and variations; and studies to understand the natural global cycles of gases and particles in Earth's atmosphere. NSF also provides support for participation by the U.S. scientific community in international scientific research endeavors, such as the World Climate Research Program.

The ATM Division supports the following programs and activities:

- [Lower Atmosphere Research](#)
- [Upper Atmosphere Research](#)
- [Centers and Facilities](#)

Submission of Proposals to ATM

Proposals may be submitted at any time during the year for all programs in the ATM Division except special programs such as Earth System History (ESH); Coupling, Energetics, and Dynamics of Atmospheric Regions (CEDAR); and Geospace Environmental Modeling (GEM). Proposals submitted to ATM that request the allocation of observation and computing facilities must also be submitted to the appropriate facility manager. (For more information, see Lower Atmospheric Observing Facilities or National Center for Atmospheric Research under the Centers and Facilities section.) Proposals should be submitted to the appropriate NSF program and should follow the guidelines printed in the NSF Grant Proposal Guide (see <http://www.nsf.gov/cgi-bin/getpub?gpg> for latest version). For projects that propose the use of lower atmospheric observing facilities or computing resources, a facility request also is required. A facility request should be sent to the manager of each facility where the proposed work would take place. Procedures for requesting the use of a facility are established by the institution managing the facility. It is important for institutions submitting a request to seek advice from the Lower Atmospheric Observing Facilities manager at NSF. Those submitting facility requests requiring more than \$500,000 in deployment costs are required to submit a preproposal to NSF 4 months before the actual deadline for submission of proposals.

Any questions on the use of computing resources should be directed to the Director, Scientific Computing Division (SCD), National Center for Atmospheric Research (NCAR), P.O. Box 3000, Boulder, CO 80307; or visit the SCD Web site, <http://www.scd.ucar.edu>.

For More Information

Write to the Division of Atmospheric Sciences, National Science Foundation, 4201 Wilson Boulevard, Room 775, Arlington, VA 22230; or contact the division by telephone, 703-292-8520; or visit the ATM Division home page, <http://www.geo.nsf.gov/atm>.

• Lower Atmosphere Research

The following programs make up the Lower Atmosphere Research Section. For complete information, visit the Lower Atmosphere Research Section Web site, <http://www.geo.nsf.gov/atm/lower.htm>.

1. [Atmospheric Chemistry](#)
2. [Climate Dynamics](#)
3. [Large-Scale Dynamic Meteorology](#)
4. [Mesoscale Dynamic Meteorology](#)
5. [Paleoclimate](#)
6. [Physical Meteorology](#)

1. Atmospheric Chemistry

Supports research to measure and model the concentration and distribution of gases and aerosols in the lower and middle atmosphere. The program also supports research on chemical reactions among atmospheric species, the sources and sinks of important trace gases and aerosols, aqueous-phase atmospheric chemistry, the transport of gases and aerosols throughout the atmosphere, and improved methods for measuring the concentrations of trace species and their fluxes into and out of the atmosphere.

2. Climate Dynamics

Supports research on the processes that govern climate and the causes of climate variability and change, methods to predict climate variations, the assembly and analysis of modern climatic data, and the development and use of climate models to diagnose and simulate climate and its variations and changes.

3. Large-Scale Dynamic Meteorology

Supports basic research to improve the understanding and prediction of atmospheric motion on scales from synoptic to planetary. Research topics include general circulation of the troposphere and stratosphere, synoptic-scale weather phenomena, atmospheric predictability, data assimilation, and parameterization of physical processes and numerical methods for use in large-scale models.

4. Mesoscale Dynamic Meteorology

Supports research on all aspects of mesoscale meteorological phenomena, including studies of the morphological, thermodynamic, and kinematic structure of mesoscale systems; the development of mesoscale systems and precipitation processes; and the energy transfer between scales.

5. Paleoclimate

Supports research on the natural evolution of Earth's climate with the goal of providing a baseline for present variability and future trends through improved understanding of the physical, chemical, and biological processes that influence climate over the long term.

6. Physical Meteorology

Supports basic research on the physics of the atmosphere, with emphasis on cloud and precipitation physics; the transfer of solar and terrestrial radiation; atmospheric measurements, including active and passive remote sensing; and atmospheric electricity and acoustics. The program also supports research in micrometeorology, particularly turbulence, boundary-layer processes, and wave phenomena.

• Upper Atmosphere Research

The following programs make up the Upper Atmosphere Research Section. For complete information, visit the Upper Atmosphere Research Section Web site, <http://www.geo.nsf.gov/atm/upper.htm>.

1. [Aeronomy](#)
2. [Magnetospheric Physics](#)
3. [Solar-Terrestrial](#)

1. Aeronomy

Supports research on upper and middle atmosphere phenomena of ionization, recombination, chemical reaction, photoemission, and transport; the transport of energy, momentum, and mass in the mesosphere/thermosphere/ionosphere system, including the processes involved and the coupling of this global system to the stratosphere below and magnetosphere above; and the plasma physics of phenomena manifested in

the coupled ionosphere/magnetosphere system, including the effects of high-power radio wave modification.

2. Magnetospheric Physics

Supports research on the magnetized plasma envelope of the outer atmosphere, including energization by solar wind; the origin of geomagnetic storms and substorms; the population by solar and ionospheric sources; the origin of electric fields; the coupling among the magnetosphere, ionosphere, and atmosphere; and waves and instabilities in the natural plasma. Also supported are ground-based observational programs at high latitudes. Theoretical research programs may include numerical simulations using a variety of magnetohydrodynamics, hybrid, and particle codes. The analysis of data from all sources, whether ground-based or from spacecraft, is also supported.

3. Solar-Terrestrial

Supports research on the processes by which energy in diverse forms is generated by the Sun, transported to the Earth, and ultimately deposited in the terrestrial environment. Major topics include helioseismology, the solar dynamo, the activity cycle, the magnetic flux emergence, solar flares and activity, coronal mass ejections, solar wind heating, interactions with cosmic rays, and solar wind/magnetosphere boundary problems. Studies on terrestrial influences include solar spectral irradiance changes, solar “constant” changes and climatic impacts; C14 and Sun/climate connections; and solar activity and its effects on the terrestrial environment of various time scales.

• Centers And Facilities

1. [Lower Atmospheric Observing Facilities \(LAOF\)](#)
2. [Upper Atmospheric Facilities \(UAF\)](#)
3. [National Center for Atmospheric Research \(NCAR\)](#)
4. [UNIDATA](#)

1. Lower Atmospheric Observing Facilities (LAOF)

The LAOF Program supports multiuser national research facilities that offer educational opportunities and serve the observational needs of the atmospheric science research community. These facilities include the following:

- **Aircraft**—Located at the National Center for Atmospheric Research (NCAR) is a four-engine Lockheed EC-130Q Hercules; at the University of Wyoming, a Beech King Air; and at the South Dakota School of Mines and Technology, an armored T-28. These aircraft can be equipped with sensors to measure meteorological and chemical state parameters. A variety of instruments can be selected for a particular project, or users may supply specialized instrumentation.
- **Radar**—NCAR operates an airborne X-band—a dual-beam, rapid-conical-scanning, multiple-frequency radar—and a transportable multiparameter S/X-band Doppler radar. Colorado State University (CSU) operates a transportable CSU S-band radar that provides two complete transmit and receive channels.
- **Other Facilities**—NCAR operates surface-observing systems that measure surface fluxes of trace chemical species, water vapor, sensible heat, and momentum. NCAR also operates a network of surface meteorology stations that measure wind, temperature, humidity, pressure, solar radiation, and precipitation.

NCAR also provides a number of systems that measure the vertical profile of temperature, moisture, pressure, and winds in the troposphere.

Eligibility Requirements for LAOF Proposals

LAOF are available on a competitive basis to all qualified scientists. Use of LAOF is based on the scientific merit of the research proposed, the capabilities of the facilities to carry out the proposed observations, and the availability of the facility during the requested time.

For More Information

Write to the following or visit the corresponding home pages:

- Division Director, Atmospheric Technology Division, National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO 80307-3000; or visit the ATD Web site, <http://www.atd.ucar.edu>.
- Facility Manager, Wyoming King Air, Department of Atmospheric Science, P.O. Box 3038, University Station, Laramie, WY 82071; or visit the department's facilities Web site, <http://flights.uwyo.edu/>.
- Facility Manager, T-28, Institute of Atmospheric Sciences (IAS), South Dakota School of Mines and Technology, Rapid City, SD 57701; or visit the IAS research aircraft Web site, <http://www.ias.sdsmt.edu/institute/t28/index.htm>.
- Facility Manager, CSU-CHILL Radar, Department of Atmospheric Sciences, Colorado State University, Fort Collins, CO 80523; or visit the CSU-CHILL Web site, <http://chill.colostate.edu>.

2. Upper Atmospheric Facilities (UAF)

NSF supports four large incoherent-scatter radar multiuser facilities located along a longitudinal chain from Greenland to Peru. Each facility is also equipped with powerful optical diagnostic instruments. In response to a need for more understanding of global-scale thermospheric and ionospheric problems, these facilities have been upgraded and realigned into a chain extending from the edge of the polar cap to the magnetic equator.

The major goal of the UAF Program is to promote basic research on the structure and dynamics of the Earth's upper atmosphere. Research is supported through the following activities:

- **Sondrestrom Research Facility**—Located in Sondre Stromfjord, Greenland, this facility is operated by SRI International under cooperative agreement with NSF. The facility allows observations on the edge of the polar cap, the cusp, and the northern part of the auroral oval.
- **Millstone Hill Radar**—Located near Boston, Massachusetts, and operated by the Massachusetts Institute of Technology under a cooperative agreement with NSF, this facility is south of the auroral oval in a region where significant midlatitude phenomena are observed. The radar provides observations of high-altitude regions from almost directly above the radar in Sondre Stromfjord to almost directly above the next radar in the chain at Arecibo, Puerto Rico.
- **Arecibo Observatory**—Located in Arecibo, Puerto Rico, this observatory is operated by Cornell University's National Astronomy and Ionosphere Center under cooperative agreement with NSF. At Arecibo's latitude, scientists have obtained evidence of particle precipitation in the atmosphere, composition changes in the atmosphere after magnetic storms, gravity waves propagating from the auroral region, and the penetration of magnetospheric electric fields.
- **Jicamarca Radio Observatory**—Located at the magnetic equator in Jicamarca, Peru, this observatory is owned by the Instituto Geofisico de Peru. Through a cooperative agreement with Cornell University, NSF acts as the principal sponsor of the facility, which provides a subcontract to the Institute.

For More Information

Write to the following addresses or visit the corresponding home pages:

- Director, Sondrestrom Research Facility, Radio Physics Laboratory, SRI International, Menlo Park, CA 94025; or visit the facility Web site, <http://isr.sri.com>.
- Director, Millstone Hill Radar, MIT, Haystack Observatory, Westford, MA 01886; or visit the facility Web site, <http://hyperion.haystack.edu>.
- Director, NAIC for Arecibo Observatory, Cornell University, Ithaca, NY 14853; or visit the NAIC Web site, <http://www.naic.edu>.
- Jicamarca Radio Observatory Project, Department of Electrical Engineering, Cornell University, Ithaca, NY 14853; or visit the observatory Web site, <http://jicamarca.ece.cornell.edu/>.

3. National Center for Atmospheric Research (NCAR)

The National Center for Atmospheric Research (NCAR) in Boulder, Colorado, is a focal point for research in the field of atmospheric and related sciences.

NCAR is supported by NSF and managed under a cooperative agreement between NSF and the University Corporation for Atmospheric Research, a nonprofit consortium of North American universities with graduate programs in atmospheric sciences.

The facilities at NCAR serve the entire atmospheric sciences research community and part of the ocean science community. Facilities include a computing and data center that provides supercomputer resources and services for the development and production of large models and for archiving, manipulating, and visualizing large data sets. For information on other NCAR facilities, see Lower Atmospheric Observing Facilities elsewhere in this section.

NCAR's scientific research programs focus on subjects such as large-scale atmospheric and ocean dynamics; global and regional atmospheric chemistry; the variable nature of the Sun and the physics of the corona; the physics of clouds, thunderstorms, and precipitation formation and their interactions and effects on larger scale weather; and human society's impact on and response to global environmental change. NCAR also provides fellowships for visiting scientists to conduct research and interact with NCAR scientists.

The Scientific Computing Division (SCD) is part of NCAR. SCD's goal is to enable the best atmospheric research in the world by providing and advancing high-performance computing technologies. SCD offers computing, research data sets, data storage, networking, and data analysis tools to advance NCAR's scientific research agenda.

For More Information

For further information about the Scientific Computing Division (SCD), write to the Division Director, Scientific Computing Division, National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO 80307-3000; or visit the SCD home page, <http://www.scd.ucar.edu>.

For further information about NCAR in general, write to the Director, National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO 80307; or visit the NCAR home page, <http://www.ncar.ucar.edu>.

Eligibility Requirements for NCAR Proposals

Support for facilities and visiting scientists is provided on a competitive basis to qualified scientists according to scientific merit, the availability of facility time, and the level of resources.

4. UNIDATA

UNIDATA is a national program to help universities access, analyze, and display a wide range of atmospheric data on their own computers, often in real time. The program is managed by UCAR and is supported by NSF's Division of Atmospheric Sciences. UNIDATA serves a broad community, including teaching and research professionals in weather forecasting, climate studies, atmospheric analysis and modeling, and related disciplines.

For More Information

Visit the UNIDATA home page, <http://www.unidata.ucar.edu>.



DIRECTORATE FOR GEOSCIENCES

Division of Earth Sciences

The Division of Earth Sciences (EAR) supports research and education in most areas of the solid-Earth and surficial-terrestrial sciences. Emphasis is on the support of basic research aimed at improving our understanding of the Earth's structure, composition, natural processes, evolution, paleobiology, and interactions with the Earth's biosphere, atmosphere, and hydrosphere. In addition, EAR provides support for instrumental and observational infrastructure and encourages innovative educational activities in the earth sciences.

The research programs and activities in the EAR Division are organized into two areas:

- Core Research
- Special Emphasis

Core Research programs support research in the following areas: the solid Earth, with emphasis on our understanding of the Earth's dynamic behavior and structure; surficial-terrestrial research, which deals with processes related to the Earth's environmental envelope and near-surface phenomena; and instrumentation and facilities and education, which focuses on the development and acquisition of instrumentation for the research community and educational aspects of the earth sciences.

Special Emphasis areas include research directed toward special scientific opportunities that accommodate the changing needs of the scientific community. This research is often interdisciplinary or multidisciplinary in character or focuses on newly emerging areas of the earth sciences.

For More Information

Write to the Division of Earth Sciences, National Science Foundation, 4201 Wilson Boulevard, Room 785, Arlington, VA 22230; or contact by telephone, 703-292-8550; or visit the EAR Division home page, <http://www.geo.nsf.gov/ear>.

• Core Research Support Programs

The Division of Earth Sciences (EAR) supports fundamental research through programmatic discipline, as well as interdisciplinary and multidisciplinary proposals that may involve one or more disciplines. Especially welcome are proposals for research in newly emerging areas of science that may not fit easily into one of the program categories.

The following programs make up the Core Research Support in the EAR Division. The titles of these programs indicate in general terms the subject matter covered by each and should be taken in the broadest sense and not necessarily restricted to their specified discipline of science.

1. Continental Dynamics
2. Education and Human Resources
3. Geology and Paleontology
4. Geophysics
5. Hydrologic Sciences
6. Instrumentation and Facilities
7. Petrology and Geochemistry
8. Tectonics

1. Continental Dynamics

Supports multidisciplinary research that will result in a better understanding of the processes that govern the origin, structure, composition, and dynamic evolution of the continents and continental building blocks. This program is especially geared toward projects whose scope and complexity require a cooperative or multi-institutional approach and multiyear planning and execution. The program is intended to fund only relatively large projects that do not fit

easily within other EAR programs and that offer broad support for major sections of the earth sciences community. The program also funds research as part of the International Continental Scientific Drilling Program.

 **For More Information**

Contact the program by telephone, 703-292-8559; or visit the EAR Division home page, <http://www.geo.nsf.gov/ear>.

2. Education and Human Resources

Coordinates the division's efforts to improve earth science education for U.S. citizens and provides a liaison between the earth sciences research community and NSF's Directorate for Education and Human Resources. The program supports EAR's participation in NSF-wide programs such as Research Experiences for Undergraduates Sites.

 **For More Information**

Contact the program by telephone, 703-292-8557; or visit the EAR Division home page, <http://www.geo.nsf.gov/ear>.

3. Geology and Paleontology

Supports studies directed toward a better understanding of physical, chemical, geological, and biological processes at or near the Earth's surface and the landforms, sediments, fossils, low-temperature fluids, and sedimentary rocks that they produce. Areas of research may include paleontology, paleoecology, stratigraphy, paleoclimatology, geomorphology, glacial geology, sedimentology, soil genesis, sedimentary petrology, diagenesis, and organic geochemistry and biogeochemical cycles.

 **For More Information**

Contact the program by telephone, 703-292-8551; or visit the EAR Division home page, <http://www.geo.nsf.gov/ear>.

4. Geophysics

Supports laboratory, field, theoretical, and computational studies related to the composition, structure, and processes of the Earth's interior. Topics include studies in seismicity and seismic wave propagation; the nature and occurrence of earthquakes; and the Earth's magnetic, gravitational, and electrical fields and its internal temperature distribution. Support also is provided for geophysical studies of active deformation, including global-positioning-system-based geodesy and fundamental laboratory studies of properties and behavior of earth materials in support of geophysical observation and theory.

 **For More Information**

Contact the program by telephone, 703-292-8556; or visit the EAR Division home page, <http://www.geo.nsf.gov/ear>.

5. Hydrologic Sciences

Supports basic research dealing with the Earth's hydrologic cycle and the role of water on and near the continental surfaces of the Earth. The program views hydrologic sciences as a geoscience interactive on a wide range of space and time scales with ocean, atmospheric, and solid earth sciences as well as plant and animal sciences. Supported projects may involve water in the form of precipitation, lakes, streams, and groundwater, and interactions with landforms, soils, the atmosphere, the biosphere, and the Earth's crust. The program encourages integrated studies of water balance and fluxes among the various reservoirs.

 **For More Information**

Contact the program by telephone, 703-292-8549; or visit the EAR Division home page, <http://www.geo.nsf.gov/ear>.

6. Instrumentation and Facilities

Supports the acquisition or upgrade of equipment required for research, the development of new instrumentation and techniques that extend current research capabilities in the earth sciences, the operation of multiuser regional or national facilities that provide access to complex and expensive instrument or database systems for a significant segment of the earth sciences research community, and the funding of research technicians.

 **For More Information**

Contact the program by telephone, 703-292-8558; or visit the EAR Division home page, <http://www.geo.nsf.gov/ear>.

7. Petrology and Geochemistry

Supports research on igneous, metamorphic, and hydrothermal processes that occur within the Earth and other planetary bodies and on the minerals, rocks, fluids, and ore deposits resulting from these processes. Included are studies in mineralogy, crystallography, petrology, volcanology, geochemistry, and economic geology. Supported research includes field, laboratory, theoretical, and computational studies.

 **For More Information**

Contact the program by telephone, 703-292-8554; or visit the EAR Division home page, <http://www.geo.nsf.gov/ear>.

8. Tectonics

Involves studies in structural geology, tectonics, geochronology, petrology, paleomagnetism, and other fields related to understanding the tectonic history of the lithosphere through time. Supported research includes field, laboratory, and theoretical studies of the processes and kinematics accompanying deformation at plate boundaries and in plate interiors.

 **For More Information**

Contact the program by telephone, 703-292-8552; or visit the EAR Division home page, <http://www.geo.nsf.gov/ear>.

• Special Emphasis Areas

Certain research areas within the Division of Earth Sciences may be selected for emphasis on the basis of special scientific opportunities. Frequently, these opportunities are related to areas of national priority such as the environment, the U.S. Global Change Research Program, and the National Earthquake Hazard Reduction Program.

For More Information

The following is a list of Special Emphasis Areas in the EAR Division. Further information on any of the programs can be found in the corresponding program announcement (if available), or on the EAR Division home page, <http://www.geo.nsf.gov/ear>.

- Cooperative Studies of the Earth's Deep Interior (CSEDI) ([NSF 95-155](#))
- Earth System History ([NSF 02-191](#))
- Fundamental Earthquake Studies of the National Earthquake Hazard Reduction Program (NEHRP) ([NSF 92-93](#))
- Water and Energy: Atmospheric, Vegetative, and Earth (WEAVE) Interactions (This program does not have a program announcement. Please refer to the program's Web page for further information, http://www.nsf.gov/geo/egch/gc_weave.html.)

In addition, the Division of Earth Sciences has initiated the EarthScope Program under NSF's Major Research Equipment and Facility Construction (MREFC) support. EarthScope is a scientific infrastructure initiative for new observational facilities that will address fundamental questions about the evolution of continents and the processes responsible for earthquakes and volcanic eruptions. The integrated observing systems that will comprise the EarthScope facility include USArray—maps in 3-D the Earth's interior by means of seismic and magnetotelluric systems; Plate Boundary Observatory (PBO)—monitors the distortion of the Earth's surface by means of geodetic systems; and the San Andreas Fault Observatory at Depth (SAFOD)—defines the conditions and physics of an active plate boundary fault at depth. All data from the EarthScope facility will be openly available in real time to maximize participation from the scientific community and to provide ongoing educational outreach to students and the public. For EarthScope science and education support, see program solicitation [NSF 03-567](#). For general information, see the EarthScope home page, <http://www.earthscope.org>.



DIRECTORATE FOR GEOSCIENCES

Division of Ocean Sciences

The Division of Ocean Sciences (OCE) supports basic research and education to further understanding of all aspects of the global oceans and their interactions with the Earth and the atmosphere. OCE also supports the operation, acquisition, construction, and conversion of major shared-use oceanographic facilities needed to carry out oceanographic-related research programs.

OCE supports research through the following sections:

- [Ocean Section](#)
- [Marine Geosciences Section](#)
- [Integrative Programs Section](#)

At any given time, certain research areas within the OCE Division may be selected for emphasis on the basis of special scientific opportunities. Further information on global change research programs and other focused programs is available via the appropriate links on the OCE Division home page, <http://www.geo.nsf.gov/oce>.

For More Information

For further information, including deadline and target dates, extended program descriptions, and publications, write to the Division of Ocean Sciences, National Science Foundation, 4201 Wilson Boulevard, Room 725, Arlington, VA 22230; or contact the division by telephone, 703-292-8580; or visit the OCE Division home page, <http://www.geo.nsf.gov/oce>.

• Ocean Section

The Ocean Section of the Division of Ocean Sciences funds projects dealing with the disciplinary sciences of biological, chemical, and physical processes in the ocean. The section is composed of the following programs:

1. [Biological Oceanography](#)
2. [Chemical Oceanography](#)
3. [Physical Oceanography](#)

In addition to these regular programs, there are occasional announcements of opportunity to participate in global change research programs and other initiatives.

For More Information

Write to the Ocean Section, Division of Ocean Sciences, National Science Foundation, 4201 Wilson Boulevard, Room 725, Arlington, VA 22230; or contact the division by telephone, 703-292-8582; or visit the OCE Division home page, <http://www.geo.nsf.gov/oce>.

1. Biological Oceanography

Supports research on ocean productivity; the distribution, abundance, physiology, and life history of pelagic, coastal, and deep-sea marine organisms and their interactions with environments; structures of pelagic and benthic food chains; primary and secondary production; interactions between deep-sea biological processes and the ocean ecosystem; the specialization of deep-sea organisms; the ecology of the Great Lakes and factors regulating productivity; and marine biotechnology.

2. Chemical Oceanography

Supports research on physical and chemical properties of seawater, including kinetic and thermodynamic equilibria of chemical species and compounds in seawater; fluxes between sea floor sediments, their interstitial waters and overlying seawater; fates of materials deposited on the sea floor; alterations and interactions of material moving through the ocean; interactions and interdependencies between chemical processes and marine organisms; air/sea exchanges of manmade and naturally mobilized chemicals; and chemical properties of the ocean surface.

3. Physical Oceanography

Supports research on the description, analysis, and modeling of oceanic circulation and transport; the effects of circulation on energy and momentum transport; physical circulation processes, eddy generation, and turbulent mixing on continental shelves; mixing processes and circulation in estuaries; wind-generated tides and surface and internal waves; small-scale transport processes such as diffusion, conduction, convection, and three-dimensional turbulence; and physical properties of seawater and circulation and mixing processes in lakes.

• Marine Geosciences Section

The Marine Geosciences Section supports research on processes that occur on and below the sea floor and at the water/sediment/rock interface. The section also supports facilities dedicated to such research. The section is composed of the following programs:

1. [Marine Geology and Geophysics](#)
2. [Ocean Drilling Program](#)

For More Information

Write to the Marine Geosciences Section, Division of Ocean Sciences, National Science Foundation, 4201 Wilson Boulevard, Room 725, Arlington, VA 22230; or contact the program by telephone, 703-292-8581; or visit the OCE Division home page, <http://www.geo.nsf.gov/oce>.

1. Marine Geology and Geophysics

Supports research on the structure of continental margins, oceanic rise systems, and deep-sea sedimentary basins; the evolution of ocean basins; processes controlling exchanges of heat and chemical elements between seawater and oceanic rocks; tectonic and volcanic activity at midocean ridges; chemical and mineralogic variations in marine sediments; the deposition, erosion, and distribution of marine sediments; geologic and oceanographic processes controlling sedimentary systems; past oceanic circulation patterns and climates; the evolution of microfossil groups; paleoenvironmental controls on fossil groups and sediment types; and interactions of continental and oceanic geologic processes.

2. Ocean Drilling Program (ODP)

Explores, on a global scale, the Earth's crust beneath the ocean in order to learn more about the composition, structure, and history of the submerged portion of the Earth's surface. The drilling process involves collecting and logging geologic samples from the floor of deep ocean basins through rotary coring and hydraulic piston coring. The logs and samples of the cores are available to qualified scientists throughout the world for research projects.

- **ODP Operations**—The drilling program has taken samples at various sites, including the North Atlantic Ocean, Norwegian Sea, Mediterranean Sea, southern and equatorial Atlantic Ocean, Pacific Ocean off the west coast of South America, Weddell Sea off Antarctica, Indian Ocean, and western and equatorial Pacific Ocean.

The general contractor for the overall management and operation of the ODP is Joint Oceanographic Institutions, Inc. (JOI), a consortium of major U.S. oceanographic institutions. The drilling operations are managed by Texas A&M University; logging is managed by the Lamont-Doherty Earth Observatory at Columbia University.

- **U.S. Science Support**—NSF provides funding for the participation and drilling-related research performed

by U.S. scientists. Activities include investigations of potential drilling regions, especially by means of regional geophysical field studies; the feasibility and initial development of downhole instruments and techniques; and downhole geophysical and geochemical experiments. In addition, NSF will consider proposals for studies that lead to a long-range definition of future drilling objectives. To be considered for support, proposed projects should be clearly relevant to the drilling plans of the international drilling community and focus on predrilling or drilling-concurrent activities. Postcruise studies should generally be submitted through other appropriate NSF programs in the areas of ocean and earth sciences and polar programs.

Additional support for U.S. scientists may be obtained through the JOI-U.S. Science Advisory Committee (JOI-USSAC). This NSF-sponsored program consists of planning activities such as workshops to define concepts and develop problem-related drilling programs, including U.S. participation in Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES); support for U.S. scientists participating on the drill ship; and support for necessary follow up studies related to initial publication of drilling results. Requests for proposals may be issued for other surveys, regional and topical syntheses of existing data, or the development of down-hole tools and instrumentation as these tasks are identified.

Other Pertinent Information

Proposals for drilling specific sites should be submitted to the JOIDES Planning Committee Chairman, c/o Joint Oceanographic Institutions, Inc., 1755 Massachusetts Avenue, NW., Suite 800, Washington, DC 20036; or contact by telephone, 202-232-3900.

Applications for scientific participation aboard a ship should be submitted to the Manager of Science Operations, Ocean Drilling Program, Texas A&M University, College Station, TX 77843-3469. Appropriate support may be provided by JOI-USSAC.

Submit requests for data and samples of core material to the Curator, Ocean Drilling Program, Texas A&M University, College Station, TX 77843-3469; or visit the ODP home page, <http://www-odp.tamu.edu/curation>.

For information on logs and the logging program, write to the Borehole Research Group, Lamont-Doherty Earth Observatory, Palisades, NY 10964; or visit the group's home page, <http://www.oceandrilling.org>.

Proposals for planning activities and workshops may be submitted to the JOI-USSAC Chairman, c/o Joint Oceanographic Institutions, Inc., 1755 Massachusetts Avenue, NW., Suite 800, Washington, DC 20036.

• Integrative Programs Section

The Integrative Programs Section supports the activities and facilities necessary to enable or support NSF-funded research and training of oceanographers across disciplines. Examples of research and training support include technology development and dedicated educational activities. Facilities supported include ships, submersibles, large shipboard equipment, and shared-use instruments to collect and analyze data. The University-National Oceanographic Laboratory System (UNOLS) schedules these facilities and expeditionary programs.

1. Oceanographic Facilities
 - Ship Operations
 - Oceanographic Instrumentation
 - Oceanographic Technical Services
 - Shipboard Scientific Acquisitions and Upgrades
2. Oceanographic Technology and Interdisciplinary Coordination
3. Ocean Education Program

Special Proposal Submission Requirements

Proposals for field programs that require the use of University-National Oceanographic Laboratory Systems (UNOLS) ships in the following calendar year must be submitted by the February 15 target date. For example, proposals requesting ship time in the calendar year 2004 must be submitted by February 15, 2003. For further information, including the UNOLS Shiptime Request Form, visit the UNOLS Web site, <http://www.unols.org/scheduling.html>.

 **For More Information**

Write to the Integrative Programs Section, Division of Ocean Sciences, National Science Foundation, 4201 Wilson Boulevard, Room 725, Arlington, VA 22230; or contact the section by telephone, 703-292-8583; or visit the OCE Division home page, <http://www.geo.nsf.gov/oce>.

1. Oceanographic Facilities (Ship Operations, Oceanographic Instrumentation, Technical Services, and Shipboard Scientific Acquisitions and Upgrades)

Support for major oceanographic facilities is concentrated at institutions that have substantial research programs in oceanography and also support the research projects of other institutions. Before submitting a proposal for support in these areas, institutions should seek advice from the relevant program officer. Specific instructions on how to submit proposals can be found in the publication *Division of Ocean Sciences (OCE): Proposal Submission Deadlines for Research Ship Operations, Instrumentation and Equipment, and Technical Services Support (NSF 00-39)*.

2. Oceanographic Technology and Interdisciplinary Coordination

Supports a wide range of multidisciplinary activities that broadly seek to develop, transfer, or apply instrumentation and technologies that will benefit research programs supported by NSF, and enhance the conduct of basic ocean sciences research. Instrumentation and technology projects supported by this program must be broadly usable and be of benefit to more than just one particular research project. The scope of projects varies from short-term feasibility studies to the development, construction, and at-sea testing of a prototype to demonstrate that useful and applicable data can be obtained using it. If ocean research is to be undertaken, joint consideration with the relevant research program may be conducted for the instrument development phase of the project. In addition, the Interdisciplinary Coordination Program area supports a limited number of research approaches that cross the four basic ocean science subdisciplines (physics, chemistry, biology, and geology and geophysics).

3. Ocean Education Program

Provides support for programs—many of them agency-wide—emphasizing educational opportunities at all levels. The Division of Ocean Sciences has recently initiated a new program to establish a network of coordinated centers that will facilitate collaborations and communications between ocean science researchers and educators. These Centers for Ocean Science Education Excellence (COSEE) will foster the integration of ocean research into high-quality educational materials, allow ocean researchers to gain a better understanding of educational organizations and pedagogy, provide educators with an enhanced capacity to understand and deliver high-quality educational programs in the ocean sciences, and provide material to the public that will promote a deeper understanding of the ocean and its influence on each person's quality of life and our national prosperity.