

## GEOSCIENCES

**\$709,100,000**

The FY 2006 Budget Request for the Directorate for Geosciences (GEO) is \$709.10 million, an increase of \$14.94 million, or 2.2 percent, over the FY 2005 Current Plan of \$694.16 million.

### Geosciences Funding

(Dollars in Millions)

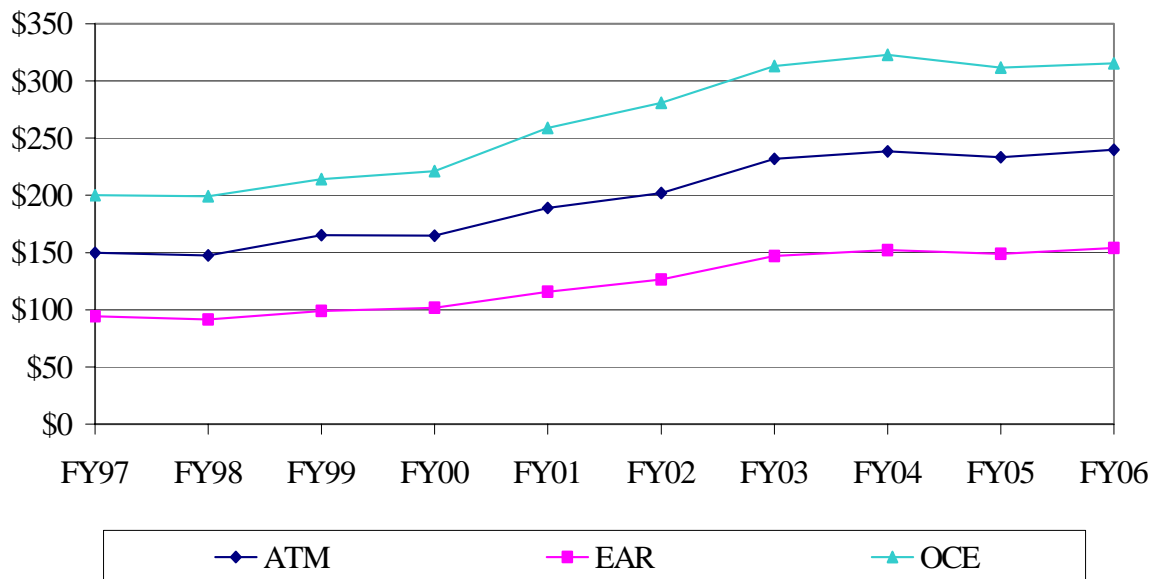
	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005	
				Amount	Percent
Atmospheric Sciences (ATM)	238.40	233.43	239.79	6.36	2.7%
Earth Sciences (EAR)	152.03	148.96	154.07	5.11	3.4%
Ocean Sciences (OCE)	322.98	311.77	315.24	3.47	1.1%
<b>Total, GEO</b>	<b>\$713.41</b>	<b>\$694.16</b>	<b>\$709.10</b>	<b>\$14.94</b>	<b>2.2%</b>

Totals may not add due to rounding.

The Directorate for Geosciences (GEO) supports the research, infrastructure, and education in the atmospheric, earth, and ocean sciences needed to advance our understanding of the integrated Earth system.

### GEO Subactivity Funding

(Dollars in Millions)



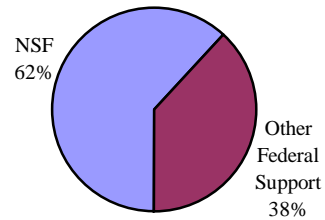
## RELEVANCE

GEO supports basic research that contributes to a better understanding of the many processes that affect the global environment such as the role of the atmosphere and oceans in climate, the planetary water cycle, and the effects of increased concentrations of greenhouse gases in the atmosphere. Support is

provided for interdisciplinary studies in climate and hydrologic systems, biogeochemical dynamics, ecological systems and dynamics, solid earth processes, and solar influences on the Earth system. Basic research supported by the Directorate for Geosciences enables preparation for and subsequent mitigation of the effects of these and other inevitable natural events. Lives are saved and property is preserved through better prediction and understanding of natural environmental hazards such as earthquakes, tornados, hurricanes and tsunamis. Associated with these studies is the need for databases and cyberinfrastructure to provide the scientific community with the resources to assemble and utilize data and information efficiently and effectively.

GEO is the principal source of federal funding for university-based basic research in the geosciences, providing about 62 percent of the total federal support in these areas. Not only does GEO play a critical role in addressing the nation's need to understand, predict and respond to environmental events and changes, but also helps to determine the best use of Earth's resources. Fundamental research in the geosciences advances scientific knowledge of Earth's environment, including resources such as fresh water, energy, minerals, and biological diversity. GEO-supported activities contribute to national and global observational capabilities and infrastructure for land, ocean, and atmospheric processes.

**Federal Support for Basic Research in Geosciences at Academic Institutions**



*Summary of Major Changes by Division*

*(Dollars in Millions)*

**GEO FY 2005 Current Plan.....\$694.16**

**Atmospheric Sciences (ATM)**

Increased support will target the following areas: the operation of the High-performance Instrumented Platform for Environmental Research (HIAPER), which begins full operation in FY 2006; the operation of the Advanced Modular Incoherent Scatter Radar (AMISR); and improved cyberinfrastructure and numerical models which will allow new discoveries, greater access to atmospheric data, and improved understanding of the atmospheric environment. +6.36

**Earth Sciences (EAR)**

Increased support focuses on operational and scientific support of the EarthScope facility, which is being constructed through the MREFC Account, and improving the cyberinfrastructure available to earth scientists. +\$5.11

**Ocean Sciences (OCE)**

Areas receiving increased funding support include developmental activities related to the Ocean Observatories Initiative (OOI), operation of the academic research fleet, and development of advanced ocean research cyberinfrastructure. +\$3.47

Subtotal, Changes +\$14.94

**FY 2006 Request, GEO.....\$709.10**

Summary of Major Changes by Directorate-Wide Investments (Dollars in Millions)

**GEO FY 2005 Current Plan.....\$694.16**

Research no change

Disciplinary and interdisciplinary research supported by GEO will remain approximately level in FY 2006.

Funding supports awards central to 21<sup>st</sup> Century geoscience. As research breakthroughs are realized from recent advances in computation, modeling, and observation techniques, a research enterprise has developed that is multidimensional, multidisciplinary, information-driven, education-oriented, and internationally engaged.

Natural Hazards +\$7.00

Building on years of research on understanding and predicting impacts resulting from environmental phenomena, research activities on preparation and response to extreme environmental events such as hurricanes, earthquakes and tsunamis, tornados, space weather events will be augmented in FY 2006 as part of GEO’s “all hazards” approach to natural hazards research.

New Facility Operations +\$7.13

Several new facilities are becoming increasingly operational in FY 2006. As the EarthScope facility, being constructed through the MREFC Account, continues to grow in capability, operational support is ramping up to enable its full utilization. The High-Performance Instrumented Airborne Platform for Environmental Research (HIAPER) aircraft constructed through the MREFC Account will be fully operational in FY 2006, as will the Advanced Modular Incoherent Scatter Radar.

**GEO Facilities Funding**  
(Dollars in Millions)

Facilities	FY 2005			Change over	
	FY 2004 Actual	Current Plan	FY 2006 Request	FY 2005 Amount	FY 2005 Percent
Academic Research Fleet	\$82.50	\$83.20	\$83.20	\$0.00	0.0%
Advanced Modular Incoherent Scatter Radar	12.40	12.50	11.00	-1.50	-12.0%
Alaska Regional Research Vessel	0.30	0.30	0.30	0.00	0.0%
EarthScope	1.70	4.69	7.32	2.63	56.1%
Integrated Ocean Drilling Program	35.10	32.10	30.00	-2.10	-6.5%
Incorporated Research Institutions for Seismology	13.00	12.16	13.31	1.15	9.5%
Ocean Observatories Initiative	2.90	3.00	4.00	1.00	33.3%
Ocean Drilling Program		5.90	2.00	-3.90	-66.1%
Scientific Ocean Drilling Vessel	2.10	0.50		-0.50	-100.0%
Other GEO Facilities	20.50	20.30	22.27	1.97	9.7%
<b>Total, GEO</b>	<b>\$170.50</b>	<b>\$174.65</b>	<b>\$173.40</b>	<b>-\$1.25</b>	<b>-0.7%</b>

Linking Educational Programs	+\$2.51
A major effort to facilitate linkages across NSF's programs to promote education and diversity will be initiated in FY 2006.	
NSF-wide Educational Programs	no change
Participation in NSF-wide programs to support education, diversity, and new faculty across all areas of science and education will be maintained at the FY 2005 level.	
Net, all other program changes .....	-\$1.70
Subtotal, Changes	\$14.94
<b>FY 2006 Request, GEO.....</b>	<b>\$709.10</b>

### PRIORITY AREAS

In FY 2006, GEO will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics.

#### GEO Investments in NSF Priority Areas (Dollars in Millions)

	FY 2004	FY 2005	FY 2006	Change over	
	Actual	Current Plan	Request	Amount	Percent
Biocomplexity in the Environment	37.22	37.22	37.22	0.00	0.0%
Nanoscale Science and Engineering	7.94	7.94	6.14	-1.80	-22.7%
Mathematical Sciences	7.07	7.07	7.07	0.00	0.0%
Human and Social Dynamics	1.35	1.35	1.35	0.00	0.0%

**Biocomplexity in the Environment:** In FY 2006, GEO provides \$37.22 million, level with the FY 2005 Current Plan, to support a set of coordinated activities in environmental science, engineering and education that advance scientific knowledge about the connection between the living and non-living Earth system. In FY 2006, a special focus on integrated natural cycles will be initiated, including an emphasis on environmental genomics in partnership with the Directorate for Biological Sciences and the Office of Polar Programs. Also included is \$4.0 million related to homeland security, used to study the Ecology of Infectious Diseases.

**Nanoscale Science and Engineering:** In accord with the planned rampdown of the Priority Area, GEO's FY 2006 support for Nanoscale Science and Engineering drops \$1.80 million, to a level of \$6.14 million. Activities will focus on:

- Development and application of chemical and biological sensor technology for making rapid, high-precision observations at submicroscopic spatial and volumetric scales;
- Support for crosscutting studies aimed at understanding the distributions and behavior of nanoscale structures throughout the Earth, atmosphere, and oceans; and

- Development of heavily instrumented interdisciplinary Earth System Observatories that facilitate our understanding of nanoscale geoscience processes, including platforms to detect and characterize nanoscale particles and their interactions throughout the atmosphere and oceans.

**Mathematical Sciences:** In FY 2006, GEO supports multidisciplinary research involving the partnering of mathematicians and geoscientists to investigate topics spanning the earth, atmospheric, and ocean sciences at a level of \$7.07 million, unchanged from the FY 2005 level.

**Human and Social Dynamics:** In FY 2006, GEO provides \$1.35 million to engage the social science community in understanding and predicting behavior in response to extreme events (earthquakes, tsunamis, hurricanes, tornados, solar disruptions, etc.) and other natural processes affecting society.

## QUALITY

GEO maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. The share of basic and applied research funds that were allocated to projects that undergo merit review was 75 percent in FY 2004, the last year for which complete data exist. OMB's definition of competitive, merit-based review does not include Federally Funded Research and Development Centers. Therefore, support for the National Center for Atmospheric Research, although regularly merit-reviewed, is not considered as funding that undergoes competitive, merit-based review for this calculation. If included, the merit-reviewed share of GEO funding would rise to 87 percent.

To ensure the highest quality in processing and recommending proposals for awards, GEO convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The Directorate also receives advice from the Advisory Committee for Geosciences (AC/GEO) on such issues as: the mission, programs, and goals that can best serve the scientific community; how GEO can promote quality graduate and undergraduate education in the geosciences; and priority investment areas in geoscience research. The AC/GEO meets twice a year and members represent a cross section of the geosciences, with representatives from many different sub-disciplines within the field; a broad range of academic institutions and industry; broad geographic representation; and balanced representation of women and under-represented minorities.

## PERFORMANCE

NSF's FY 2006 budget is also aligned to reflect funding levels associated with the Foundation's four strategic outcome goals and the ten investment categories highlighted in the FY 2003-2008 Strategic Plan. These categories were designed as a mechanism to better enable assessment of program performance and to facilitate budget and performance integration.

## Geosciences

### By Strategic Outcome Goal and Investment Category

(Dollars in Millions)

	FY 2005		FY 2006 Request	Change over FY 2005	
	FY 2004 Actual	Current Plan		Amount	Percent
<b>People</b>					
Individuals	23.55	23.95	23.95	0.00	0.0%
Institutions	3.14	3.50	3.50	0.00	0.0%
Collaborations	4.09	2.60	5.10	2.50	96.2%
	30.78	30.05	32.55	2.50	8.3%
<b>Ideas</b>					
Fundamental Science and Engineering Centers Programs	392.41	371.58	377.82	6.24	1.7%
	14.51	14.07	14.12	0.05	0.4%
	406.92	385.65	391.94	6.29	1.6%
<b>Tools</b>					
Facilities	170.50	174.65	173.40	-1.25	-0.7%
Infrastructure and Instrumentation	17.14	16.89	22.89	6.00	35.5%
Federally-Funded R&D Centers	83.55	81.95	83.00	1.05	1.3%
	271.19	273.49	279.29	5.80	2.1%
<b>Organizational Excellence</b>					
	4.52	4.97	5.32	0.35	7.0%
<b>Total, GEO</b>	\$713.41	\$694.16	\$709.10	\$14.94	2.2%

Totals may not add due to rounding.

GEO will continue its commitment to education, training, and increasing diversity in FY 2006. The FY 2006 budget will maintain award size and continue to focus on multidisciplinary research activities, inter-agency partnerships, and international activities with special attention given to broadening participation at all levels. In addition, development of new infrastructure remains a priority, with ongoing support for the acquisition of new regional research vessels and increased support for the operation of the EarthScope facility being constructed through the MREFC Account.

### Recent Research Highlights

#### Global Seismic Network

The Global Seismic Network, developed by IRIS and supported by the National Science Foundation in partnership with the U.S. Geological Survey, was the primary data source for rapid location and warning - within eight minutes -- of the Great Sumatra Earthquake of December 26, 2004. However, the seismic warning was not linked to the necessary communications and civil infrastructure in the resultant tsunami region in order to disseminate a warning in time to save lives.



#### JOIDES Resolution Completes 20 Years of Ocean Drilling

After 20 years, the equivalent of more than 16 circumnavigations, and the recovery of greater than 220 km of sediment and rock cores from nearly 1,800 holes drilled in the ocean floor, the JOIDES Resolution research vessel returned to its home port of Galveston, Texas in October 2003. The homecoming marked the end of the final voyage of the Ocean Drilling Program (ODP) and the beginning of the newly inaugurated Integrated Ocean Drilling Program to be

jointly led by the United States and Japan. In keeping with the tradition established by Captain Cook's exploration vessel of the same name, the JOIDES Resolution spent a generation addressing fundamental questions about the Earth. The seafloor samples acquired by the Resolution have provided new insights into Earth's climate history, the deep biosphere, seismically-active ocean margins, oceanic crustal structure, the flux of fluid and energy through the ocean floor, the formation of the present-day ocean basins, and the consequences of meteorite impacts.

Over the history of the program, 1,800 scientists from 30 nations participated in ODP cruises. Fifteen hundred U.S. scientists from more than 160 universities and research centers in 46 states sailed as shipboard scientists or used the program's sample and data archives. Many of the program participants were graduate students who have gone on to become leaders of the U.S. marine science community. With the participation of these U.S. scientists, the Resolution became the first vessel to sample microbes from hundreds of meters beneath the seafloor, to retrieve fluids that originate deep in seismogenic subduction zones, to recover pieces of the oceanic lower crust and upper mantle, to acquire cores that contain evidence of periods of catastrophic global warming, and to deploy seismometers in boreholes as part of an effort to expand the global seismic monitoring network. These and other scientific results of ODP are documented in over 18,000 scientific publications and reports.

### **Space Weather Summer School**

The Center for Integrated Space Weather Modeling conducted its third annual summer school at Boston University in August 2003. The summer school is targeted for college students and young scientists wishing to learn more about space weather and how it is simulated using complex computer models. The school instructs students on the basic physics behind space weather as well as the impacts of space weather on technical systems. The hands-on approach allows students to run models independently and explore the varying response of Earth's geospace environment to different conditions in the sun and solar wind.



### **Reaching Out to Communities and Kids with Science**

The Reaching Out to Communities and Kids with Science in San Francisco (SF-ROCKS) supported by the Opportunities to Enhance Diversity in the Geosciences program operates at four ethnically diverse high schools in the San Francisco Unified School District (Burton, Balboa, Washington, and Marshall high schools). Since the beginning of our funded project in the fall of 2001, the SF-ROCKS program has exposed more than 500 freshmen at the high schools to the SF-ROCKS lesson plans that are part of the integrated science course curriculum at the schools. The lesson plans incorporate aspects of the geology and meteorology of the area adjacent to the high schools are designed to increase the students' awareness of the unique geologic setting of the communities in which they live. At the end of their freshman year, a select group of high school students are invited to the SFSU campus for a 2-week summer institute where they take part in geoscience research

projects with SFSU faculty and students. As a result of their participation in the institute, many of the students are exposed to university life for the first time and have an opportunity to learn more about careers in geology, meteorology, and oceanography.

**Other Performance Indicators**

The tables below show the number of people benefiting from GEO funding, and trends in award size, duration, number of awards and funding rates.

**Number of People Involved in GEO Activities**

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Senior Researchers	4,471	4,200	4,400
Other Professionals	2,633	2,500	2,600
Postdoctorates	666	600	600
Graduate Students	2,347	2,200	2,300
Undergraduate Students	1,410	1,300	1,400
<b>Total Number of People</b>	<b>11,527</b>	<b>10,800</b>	<b>11,300</b>

**GEO Funding Profile**

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
<b>Statistics for Competitive Awards:</b>			
Number	1,419	1,330	1,400
Funding Rate	33%	31%	31%
<b>Statistics for Research Grants:</b>			
Number of Research Grants	804	760	790
Funding Rate	30%	28%	28%
Median Annualized Award Size	\$114,730	\$114,730	\$114,730
Average Annualized Award Size	\$149,050	\$149,050	\$149,050
Average Award Duration, in years	2.9	3.0	3.0



**ATMOSPHERIC SCIENCES**

**\$239,790,000**

The FY 2006 Request for the Division of Atmospheric Sciences (ATM) is \$239.79 million, an increase of \$6.36 million, or 2.7 percent, over the FY 2005 Current Plan of \$233.43 million.

**Atmospheric Sciences Funding**

(Dollars in Millions)

	FY 2005			Change over FY 2005	
	FY 2004 Actual	Current Plan	FY 2006 Request	Amount	Percent
Atmospheric Sciences Research Support	156.65	153.38	158.69	5.31	3.5%
National Center for Atmospheric Research	81.75	80.05	81.10	1.05	1.3%
<b>Atmospheric Sciences</b>	<b>\$238.40</b>	<b>\$233.43</b>	<b>\$239.79</b>	<b>\$6.36</b>	<b>2.7%</b>
Major Components					
Research and Education Grants	125.05	121.60	126.51	4.91	4.0%
Science and Technology Centers	4.00	3.88	3.88	0.00	0.0%
Facilities					
National Center for Atmospheric Research (NCAR)	81.75	80.05	81.10	1.05	1.3%
Upper Atmospheric Radar Facilities	19.50	19.91	18.40	-1.51	-7.6%
Other Facilities and infrastructure	8.10	7.99	9.90	1.91	23.9%

**About ATM:**

The extreme weather events of 2004 remind us that weather and climate affect every aspect of our daily lives. Tropical storms over the Atlantic Ocean, Caribbean Sea or Gulf of Mexico can develop into fierce hurricanes that pound the East Coast, spawning tornadoes and producing torrential rains and floods, and resulting in large numbers of fatalities and billions of dollars of damage to property. In the upper reaches of the Earth’s atmosphere, huge solar storms can damage satellites, disrupt communication and navigation systems, and cause widespread failures in the electrical power grid. The human impacts of urban pollution, and extreme weather can be severe and costly. In order to improve our ability to predict and mitigate these events, we need to further our understanding of the physics, chemistry and dynamics of the Earth’s atmosphere, from the Earth’s surface to the sun, on timescales ranging from minutes to millennia. We need to understand better the underlying trends, the impact of man-made changes, the complex interactions between systems, and the coupling among the atmosphere, the biosphere and the oceans. The Division of Atmospheric Sciences supports such research through the provision of large, complex facilities, community modeling projects, cyber infrastructure and individual research grants, providing about 60 percent of the total federal support for academic atmospheric research.

ATM provides support for: 1) basic science projects and 2) the acquisition, maintenance and operation of observational and cyber infrastructure facilities (and services) that enable modern day atmospheric science research activities.

For the science activities supported by the Division, a variety of modes of support are used. Although the majority of this support is through the traditional “individual investigator” merit-reviewed, multi-year grants, ATM also supports: small scale, limited-duration exploratory research projects; collaborative or multi-investigator group projects focusing on a particular project subject or activity; large center or center-like projects; and the funding for the research conducted by NSF’s National Center for Atmospheric Research (NCAR) that extends and enhances research at universities.

Facility funding is provided through cooperative agreements to NCAR and several other institutions to acquire, maintain and operate specific observational and cyberinfrastructure facilities that support the research and educational activities of NSF sponsored projects, scientists, and students.

Facilities are approximately 46 percent of the ATM portfolio. Of the remaining 54 percent, approximately 49 percent of funds support new awards and 51 percent are committed to funding awards made in previous years.

#### **ATM priorities for FY 2006:**

- **Natural Hazards:** Building on years of research on understanding and predicting impacts resulting from environmental phenomena, including two recent NCAR-sponsored workshops on Early Warning Systems, scientists from academia and NCAR's Institute for the Study of Society and Environment will augment research activities on understanding, preparing and responding to extreme environmental events;
- **Support for Biogeochemical Cycles:** including emphasis on understanding the sources, sinks and processes which control the atmospheric abundance and distribution of carbon, water and other nutrient elements;
- Support for new **Environmental Modeling** that employs data assimilation and innovative mathematical and statistical techniques to improve predictions of fundamental space, atmospheric and Earth system processes;
- Improved **Cyberinfrastructure and Numerical Models** which will allow new discoveries, greater access to atmospheric data, and improved understanding of the atmospheric environment;
- Continued support of **Interagency and International Programs**, including the U.S. Weather Research Program, the National Space Weather Program and cooperative international science programs;
- Continued **Construction and Deployment** of new infrastructure, including the next-generation upper atmospheric radar system, AMISR (the Advanced Modular Incoherent Scatter Radar); and the new high-altitude NCAR aircraft, HIAPER (High Performance Instrumented Airborne Platform for Environmental Research).

#### **Changes from FY 2005:**

- Research and education grants and centers: increase by \$4.91 million to a total of \$126.51 million, and includes:
  - an increase of \$3.35 million in research activities aimed at understanding the Earth's hydrologic cycle;
  - an increase of \$3.35 million in research on natural hazards (i.e. severe weather and space weather);
  - an increase of \$2.0 million for cyber infrastructure investments; and
  - a decrease of \$3.85 million in other disciplinary programs.
- Facilities increase by \$1.45 million to a total of \$109.40 million, and includes:
  - an increase of \$3.0 million for deployment, operations and maintenance of the new HIAPER research aircraft;
  - an increase of \$1.50 million for deployment, operations and maintenance of AMISR (the Advanced Modular Incoherent Scatter Radar); as well as a planned decrease of \$3.0 million for the final construction costs of AMISR; and
  - a decrease of \$1.50 million across several NCAR programs.

Additional information on major ATM-supported facilities is available in the Facilities Chapter.

**EARTH SCIENCES**

**\$154,070,000**

The FY 2006 Request for the Division of Earth Sciences (EAR) is \$154.07 million, an increase of \$5.11 million, or 3.4 percent, over the FY 2005 Current Plan of \$148.96 million.

**Earth Sciences Funding**

(Dollars in Millions)

	FY 2004	FY 2005	FY 2006	Change over FY 2005	
	Actual	Current Plan	Request	Amount	Percent
Earth Science Project Support	119.75	115.19	119.73	4.54	3.9%
Instrumentation and Facilities	32.28	33.77	34.34	0.57	1.7%
<b>Earth Sciences</b>	<b>\$152.03</b>	<b>\$148.96</b>	<b>\$154.07</b>	<b>\$5.11</b>	<b>3.4%</b>
Major Components:					
Research and Education Grants	124.95	120.05	121.31	1.26	1.0%
Science and Technology Centers	6.88	6.76	6.76	0.00	0.0%
Facilities					
Incorporated Research Institutions for Seismology (IRIS)	13.00	12.16	13.31	1.15	9.5%
EarthScope Operations	1.70	4.69	7.32	2.63	56.1%
Other Earth Sciences Facilities	5.50	5.30	5.37	0.07	1.3%

**About EAR:**

Earthquakes are perhaps the most destructive yet unpredictable natural phenomena known; the toll from December’s earthquake and tsunami in Asia, with more than 160,000 lives lost and billions of dollars in property damage, is but the most recent example of this incredible force. Research supported by the Division of Earth Sciences seeks to improve our understanding of how earthquakes and tsunamis are triggered and to forecast where major earthquakes are likely to occur. EAR supports research and education activities that improve our understanding of processes that govern the behavior and characteristics of the Earth’s surface environment and determine its internal structure, composition and dynamics. EAR funding supports theoretical, computational, laboratory and field studies, and state-of-the-art scientific infrastructure needs. New understanding gained from such studies provides the scientific basis for 1) predicting natural hazards such as earthquakes, tsunamis, volcanic eruptions, floods and droughts, and the mitigation of their impacts; 2) discovery and management of mineral, energy, and water resources; and 3) environmentally sound decision-making. EAR projects are often partnered with and complementary to focused efforts by other federal and state agencies.

The EAR portfolio has three major modes of support: research and education grants, centers, and facilities.

- EAR research and education grants range in scope from individual-investigator awards for research based at the investigator’s home institution, to awards to major user groups with responsibility for experiments at national or international user facilities.
- EAR centers include two Science and Technology Centers (STCs).
  - SAHRA (Sustainability of semi-Arid Hydrology and Riparian Areas) crosses disciplinary boundaries to link multi-scale processes through models that can readily be used to guide decision-making in water resources management in arid climates. The modeling integrates ecological, socio-economic, and hydrologic principles at the river basin scale, and uses site-

- specific data from the San Pedro (Arizona) and Rio Grande Basins from GIS, remote sensing, and field-based censuses.
- NCED (National Center for Earth-Surface Dynamics) integrates erosion and sedimentation physics in holistic applications to interactive systems reshaping the Earth's surface. These processes need to be better understood because they are critical in achieving environmental sustainability and public safety.
  - EAR also supports major world-class facilities that are needed by certain subfields to answer the highest priority science questions. This category includes support for shared research facilities such as:
    - Incorporated Research Institutions for Seismology (IRIS) for seismological research and global hazard monitoring,
    - UNAVCO, Inc. for precision geodetic measurements using Global Positioning Systems (GPS),
    - Other shared research facilities are accelerator-based mass spectrometers, ion-beam microprobes, and synchrotron beam lines.

The program also funds the research and educational needs for instrumentation and computational infrastructure at universities and colleges throughout the nation. Additional information on major EAR-supported facilities is available in the Facilities Chapter of this document.

Facilities are approximately 15 percent of the EAR portfolio. Of the remaining 85 percent, approximately 44 percent of funds support new awards and 56 percent are committed to funding awards made in previous years.

#### **EAR priorities for FY 2006:**

- **EarthScope Operation and Science Support:** The new EarthScope facility, being constructed through the MREFC Account, is continuing to ramp up operations and to increasingly enable new science at the intersection of several subfields within the earth sciences. Supporting the operation of the facility and the science it enables continues to be a high priority for EAR. Additional information can be found in the MREFC Chapter.
- **Maintaining a strong, flexible program of research and education grants to create new ideas and technologies and attract and train students** is the primary focus in stewardship of the portfolio. Emphasis will be given to increasing the support for theoretical research across the portfolio, followed by biological geoscience and cyberscience.

#### **Changes from FY 2005:**

- Research, education grants and centers increase \$1.26 million to a total of \$121.31 million. EAR will continue to support forefront areas of geology, with continued emphasis on EarthScope science, hydrology, cyberscience, and geobiology. Education and outreach activities receiving continued emphasis include enhancing K-12 science teacher training, expanding diversity within the research community, integrating research and education, and include the training of young physicists.
- Facilities increase by \$3.85 million to a total of \$26.0 million. The increase is primarily for EarthScope operations as new stations are installed and come online and support for the shared research facilities noted above.

**OCEAN SCIENCES**

**\$315,240,000**

The FY 2006 Request for the Division of Ocean Sciences (OCE) is \$315.24 million, an increase of \$3.47 million, or 1.1 percent over the FY 2005 Current Plan of \$311.77 million.

**Ocean Sciences Funding**

(Dollars in Millions)

	FY 2005			Change over FY 2005	
	FY 2004 Actual	Current Plan	FY 2006 Request	Amount	Percent
Ocean Section	120.35	115.98	117.28	1.30	1.1%
Integrative Programs Section	118.40	113.70	114.97	1.27	1.1%
Marine Geosciences Section	84.23	82.09	82.99	0.90	1.1%
<b>Ocean Sciences</b>	<b>\$322.98</b>	<b>\$311.77</b>	<b>\$315.24</b>	<b>\$3.47</b>	<b>1.1%</b>
Major Components:					
Research and Education Grants	194.85	181.64	190.61	8.97	4.9%
Long-term Ecological Research Centers	3.63	3.63	3.63	0.00	0.0%
Facilities					
Academic Research Fleet	82.50	83.20	83.20	0.00	0.0%
Integrated Ocean Drilling Program (IODP)	35.10	32.10	30.00	-2.10	-6.5%
Other Ocean Sciences Facilities	6.90	11.20	7.80	-3.40	-30.4%

**About OCE:**

The oceans play a pivotal role in climate, contain the largest and most unexplored habitat for life on Earth and provide routes for commerce and sites for recreation. The oceans are also the source of important food and energy resources in great demand by society. Movement of the oceanic plates build spectacular undersea mountain ranges, but also causes earthquakes and tsunamis that wrench and reshape the margins of the ocean basins with disastrous impacts on coastal communities. Research supported by the Division of Ocean Sciences enable ocean scientists to make major breakthroughs in the understanding of ocean biology, chemistry, geology and physics. Scientific advances have, in part, been created by an extraordinary period of invention and discovery from which new capabilities have emerged in the areas of computation, molecular biology, deep drilling and ocean-observing technologies. Research and education supported by OCE improve understanding of the physical, chemical and biological processes that characterize both coastal seas and deep ocean basins, and the geological and geophysical processes that shape the continental shelves and deep sea floor. Support is also provided for the facilities and infrastructure required to gain access to the ocean, including research vessels, manned deep diving submersibles and a wide range of technologically advanced observational instrumentation. Ocean science is a highly interdisciplinary research endeavor that is fundamental to the understanding of the Earth's climate, to resource and hazard assessment, and to the health of the ocean's complex and diverse ecological systems.

The OCE portfolio has three highly integrative programmatic areas of support: research grants, education grants, and facilities to serve the research and education activities.

- OCE research grants range in scope from individual-investigator awards for research based at the investigator's home institution, to awards to major user groups with responsibility for experiments at national or international user facilities.
- OCE education grants support graduate students and undergraduate research experiences, K-12 educational activities, and informal education for the general public. The Centers for Ocean

Science Education Excellence (COSEE) form a major education and outreach network that facilitates the dissemination of ocean-centered educational material and information.

- OCE also supports acquisition, operation, and maintenance of major world-class facilities that are required to provide access to the oceans in order to address the highest priority science questions.

Additional information on OCE-supported facilities is available in the Facilities Chapter of this document.

Facilities are approximately 41 percent of the OCE portfolio. Of the remaining 59 percent, approximately 55 percent of funds support new awards and 45 percent are committed to funding awards made in previous years.

### **OCE Priorities for FY 2006:**

**Maintaining a strong, flexible program of research and education grants and the requisite facilities support to create new ideas and technology and attract and train students**, is the highest priority in stewardship of the portfolio. Specifically:

- Ocean observations for research and operations are increasingly important for the advancement of ocean science, with many of today's most important discoveries coming from measurements made at the same locations over sustained time periods. The availability of long time-series data extending over several decades – allowing us to “explore-in-time” – is a key element for managing living resources, understanding ocean ecosystems and for resolving uncertainties about the role of the oceans in climate change.
- The Integrated Ocean Drilling Program (IODP) represents an international partnership of scientists, research institutions, and funding agencies organized to explore the evolution and structure of Earth as recorded in the ocean basins. Ocean drilling is an essential capability used to examine processes ranging from changes in the Earth's climate to the rifting and drifting of continents.
- Natural Hazards: Hurricanes, earthquakes and tsunamis can be better predicted with greater understanding of the mechanisms causing such events. Solid Earth Cycles and Geodynamics is a research focus of the NSF-led Integrated Ocean Drilling Program. Improved seismic monitoring capabilities will also be provided through seafloor observatories.
- Non-Equilibrium Ecosystem Dynamics: Many oceanic processes are inherently nonlinear, so that small perturbations at one frequency can cause large-scale changes at another. Today we also have human influences of enormous scale on fisheries and on climate, and these add to an already complex system. The introduction of exotic species, the proliferation of harmful algal blooms and the effectiveness of marine reserves, are all examples where sophisticated ecosystem knowledge is required.
- The network of Centers for Ocean Science Excellence (COSEE) and other ocean education programs are engaging communities in ocean exploration and discovery; increasing awareness, understanding, and appreciation of the oceans; strengthening science and technology education; motivating people from all backgrounds to pursue science and technology careers generally and ocean sciences careers specifically.
- A diverse range of facilities and technical support activities are provided to enable scientific advancement in all areas of ocean science. This includes operation of the academic research fleet to ensure that appropriate ship time and capabilities are provided to meet project requirements for NSF-sponsored studies. Provision of new facilities and infrastructure is coordinated with the Federal Oceanographic Facilities Committee's (FOFC) plan for renewal of the academic fleet.

**Changes from FY 2005:**

- Research and education grants increase by \$8.92 million to a total of \$190.56 million. OCE will continue to support forefront areas of ocean science, with expanded emphasis on complex systems, biogeochemical cycles and pathways, and the temporal exploration of the oceans. Education and outreach activities will receive continued emphasis: enhancing COSEE, expanding diversity within the research community, integrating research and education, including the training of young ocean scientists.
- Support for facilities decreases \$5.50 million to a total of \$121.0 million. This includes:
  - A decrease of \$1.0 million for planning activities for the Ocean Observatories Initiative (OOI) project, since the start of this MREFC investment has been deferred to FY 2007.
  - A decrease of \$5.30 million in ship operations funding owing to a reduced requirement for research vessel usage. Decreased usage is the result of flat research budgets and decreased cost sharing for ship-time from other ocean agencies.
  - A planned \$2.10 million decrease for maintenance and operation of the drillship *Joides Resolution* as its operation phases out prior to the phase-in of a more capable drillship for the IODP.
  - An increase of \$3.0 million as installment payment towards construction of a new, replacement regional class research vessel for the academic fleet.

