

NSF Geosciences Budget for FY2005 Would Increase—But Not by Much

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The Geosciences Directorate of the National Science Foundation would receive \$728.5 million in the Bush administration's proposed budget for fiscal year 2005, which was announced on 4 February. That would be a 2.2% increase above the FY2004 enacted level of \$713.1 million.

All three geoscience divisions also would receive modest increases, with atmospheric sciences up 2% to \$243.6 million, Earth sciences rising 2.7% to \$155.6 million, and ocean sciences receiving a 2% boost to \$728.5 million.

Margaret Leinen, associate director for the Geosciences Directorate, said the proposed increases actually represent victories in the current tight budgetary climate.

"When you consider that the total non-defense discretionary spending was a one-half percent increase for the entire [federal] government [in this budget], the increase we got for 'geo' is really quite a vote of confidence on the part of the administration, as [is] the 3% [overall increase] for NSF."

NSF as a whole would receive \$5.75 billion in the proposed budget, up from \$5.58 billion for FY2004. However, this was criticized as insufficient at an 11 February hearing of the Science Committee of the U.S. House of Representatives. At the hearing, Rep. Vernon Ehlers, (R-Michigan), chair of the Subcommittee on Environment, Technology and Standards, said this does not meet the commitment to double the agency's funding over 5 years, under the approved National Science Foundation Authorization Act of 2002. "Although this

[proposed budget] is an increase of 3%, it falls \$1.6 billion below the authorized funding level necessary to complete our doubling commitment," he said.

Support for Geoscience Programs, Initiatives

Leinen said some funding within different geoscience divisions would enable the Directorate's participation in several of NSF's priority, cross-cutting initiatives. Among these is the Biocomplexity in the Environment initiative to study complex environmental systems.

The initiative would be funded—in total—at a level of \$99.83 million, of which \$37.22 million would be through the Geosciences Directorate. In FY2005, the initiative will emphasize studying freshwater systems. For the agency's nanoscale science and engineering priority area, the Geosciences Directorate would receive level funding of \$7.94 million.

In addition to the increased funding for all three divisions, the budget also includes funding for several key geoscience-related projects through NSF's major research equipment and facilities construction projects account (MREFC). For example, the EarthScope geophysical instrument array would receive \$47.35 million, and also receive some funding from other NSF accounts.

Geoscience-related MREFC projects which would see substantial increases include the National Ecological Observatory Network of geographically distributed observatories (NEON), which would receive \$12 million. An ocean drilling vessel is budgeted for \$40.85 million,

to help meet the U.S. commitment to the Integrated Ocean Drilling Program (IODP).

Two other programs are targeted to receive substantial MREFC funding. An Alaska Regional Research Vessel would receive for \$49.32 million, and the Ocean Observatories Initiative (OOI) would receive \$24.76 million.

Leinen said one of the biggest challenges for the Geosciences Directorate is "to understand from the community how much effort we should put into large observing systems versus the rest of the science. That's because you have communities which are really anxious to have these systems on line, and are saying it is new science, it's science you can't do any other way. And that's important," she said. "But that doesn't mean we want to go in a direction that would penalize other single investigator science or even multiple investigator science that isn't looking at these new observing systems."

For several other areas and line items that affect the geosciences, the news was mixed. The budget for the U.S. Polar Research Programs would increase 2.8% to \$281.7 million. Funding for the Long-Term Ecological Research Program would increase 11.2% to \$22.82 million.

However, NSF education programs are on the short end of the proposed budget. The Math and Science Partnership, which received \$139.2 million in FY2004, would be moved to the Department of Education and focus solely on math. At the 11 February hearing, Science Committee chair Rep. Sherwood Boehlert (R-NY) said he was "baffled and disturbed" by this transfer.

"This is one [issue] on which we are going to do battle," he said.

—RANDY SHOWSTACK, Staff Writer

New Experiment Deploys Observing Array in N. Atlantic to Investigate Rapid Climate Change

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Studies of past climate using paleo-data suggest that large and rapid climate changes have occurred throughout history, and that changes in the thermohaline circulation of the ocean are a major factor in many of these cases. Some of these past rapid changes occurred over a period as brief as a decade, whereas we tend to think of significant climate change as occurring over centuries or millennia. The third assessment report of the Intergovernmental Panel on Climate Change (IPCC), released in 2001, discussed the potential slowdown of the North Atlantic thermohaline circulation under a global warming scenario (<http://www.ipcc.ch/>). In addition, a recent U.S. National Research Council report highlighted the concerns over the possibility of rapid changes in climate and their potential socioeconomic impacts (<http://www.nap.edu/catalog/10136.html>). The new U.K. Natural Environment Research Council (NERC) Rapid Climate Change Programme (RAPID) is, in part, a response to such concerns.

Early this year, a major oceanographic experiment began with the deployment of a trans-oceanic observing system in the North Atlantic at 26.5°N as part of RAPID. Modeling studies show that the thermohaline circulation and the heat that it transports northward in the Atlantic produce a substantially warmer climate in Western Europe than would otherwise be the case. They also predict that under a greenhouse gas warming situation, the thermohaline circulation might slow down, possibly leading to cooling of Western Europe and significant socioeconomic impacts. Only very limited observations of the North Atlantic thermohaline circulation are currently available. Some of them suggest that a slowdown might be occurring now. The RAPID program aims to improve on these observations.

Figure 1 shows a schematic of the observing array. U.K. scientists, working with U.S. colleagues, funded through the U.S. National Science Foundation (NSF) under the Climate Variability and Predictability (CLIVAR) program, will deploy this at the North Atlantic's eastern and western

boundaries, and at the mid-Atlantic Ridge at a latitude of 26.5°N. The array will measure currents, temperature, and salinity. The monitoring concept is based on the so-called thermal wind relationship that is familiar to meteorologists and oceanographers. By measuring the density structure and currents on either side of the Atlantic, and accounting for the presence of the mid-Atlantic Ridge, it will be possible to monitor changes in the North Atlantic meridional overturning circulation, of which the thermohaline circulation is the major component.

In addition to this trans-oceanic monitoring, three mooring arrays are being deployed along the eastern seaboard of North America to measure the deep western boundary current, a conduit by which changes in the circulation at high latitudes are communicated to the south (see Figure 2). This work is also jointly funded by NERC and NSF. These new observations will help us understand the changes happening in the North Atlantic, and may provide the basis of an "early warning system" for rapid climate change in the future. The data will also provide a unique resource for testing models both of the thermohaline circulation and its role in climate change.

RAPID is also funding 20 other projects in the United Kingdom covering a range of

Fig. 1. This schematic of the monitoring system at 26.5°N in the North Atlantic shows the deployment of moorings at the western boundary. Background is long-term averaged northward meridional velocity near the western boundary, cm/s (top), at the mid-Atlantic ridge (middle), and at the eastern boundary (bottom). The array has a built-in redundancy, and two of the moored profilers (one at each of the eastern and western boundaries) will have satellite transmission capabilities to give real-time data. Note that the top part of the figure has an expanded horizontal scale compared to the lower two parts.

paleo, observational, and modeling studies. For example, the paleo-studies use a range of proxy data from ice cores, speleothems, marine and lake sediments, and peat bogs to better characterize past rapid changes. While the focus of the program is on the North Atlantic, other causes of rapid climate change are also being considered. One project will examine the influence of El Niño by using paleo-data from corals in the tropical Pacific and numerical modeling.

By using the improved paleo-data to reconstruct past changes, and by combining the present day and paleo-observations with models to test and improve the latter, it should be possible to assess the probability and magnitude of future rapid climate change. In the United Kingdom, results from the program will feed into the work of the Hadley Centre for Climate Prediction and Research (<http://www.met-office.gov.uk/research/hadleycentre/>) and the Tyndall Centre (<http://www.tyndall.ac.uk/>). This work will be used to inform government policy analysts and to develop possible adaptation and mitigation strategies.

The RAPID program has been funded at a level of \$30 million over 6 years and to date, about two-thirds of the funding has been committed. The program has just issued a call for further proposals jointly with the Netherlands Organisation for Scientific Research (NWO) and the Research Council of Norway (NRC). It seeks to extend further international cooperation in this area of research, building on that already taking place between the United Kingdom and the United States through NERC and NSF.

For more information, contact the RAPID Science Coordinator at M.Srokosz@soc.soton.ac.uk or see <http://rapid.nerc.ac.uk/> and <http://www.soc.soton.ac.uk/rapidmoc/>.

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