

Atmospheric Sciences and Climate Change Programs in the FY 2006 Budget

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HIGHLIGHTS

- Budget requests for major agencies that fund atmospheric sciences and climate change are mixed. The National Science Foundation's (NSF) request would increase 2.4 percent to \$5.6 billion; however, \$48.0 million of the \$132.2 million increase is a transfer of funds from the Coast Guard. The National Oceanic and Atmospheric Administration (NOAA) would decrease by 8.2 percent below the FY 2005 budget, but with increases in an expanded tsunami warning network, climate research, extreme weather warnings and forecasts, and weather satellites. The National Aeronautics and Space Administration's (NASA) budget would increase by 2.4 percent with Exploration Systems rising by 17.9 percent. The Department of Energy's (DOE) overall budget would fall 3.8 percent, while Biological and Environmental Research would decrease by 21.7 percent from the elimination of earmarks.

- The U.S. Global Change Research Program (USGCRP) and the Climate Change Research Initiative (CCRI) have been merged into what is now known as the Climate Change Science Program (CCSP). The CCSP would decrease by \$27.0 million to \$1.9 billion, a decrease of 1.4 percent (see Table I-9). The Climate Change Technology Program (CCTP) that parallels the CCSP would receive \$2.9 billion, a decrease of \$174 million or 5.7 percent.

- The Space Studies Board of the National Academy of Sciences (NAS) is developing a decadal strategy for research in the earth sciences. A report, *Earth Sciences and Applications from Space: A Community Assessment and Strategy for the Future* will influence the direction of future research, especially in NASA. An interim preliminary report will be available in the spring of 2005.

- Nearly 60 countries and the European Commission, meeting in Brussels, agreed to a plan that over the next 10 years will revolutionize understanding of the Earth. Agreement on the plan for a Global Earth Observation System of Systems (GEOSS) was reached by member countries of the international Group on Earth Observations (GEO). Some 40 international organizations also support the emerging global network. Interest has accelerated since the tsunami tragedy that devastated parts of Asia and Africa.

- The National Space Weather Program (NSWP) would continue in FY 2006 with a 16 percent increase in NASA's Living with a Star Program and level funding for NSF's solar-terrestrial programs. The upper atmosphere radar facility, AMISR, will begin partial operation in 2005. The NAS report, *Sun to the Earth and Beyond: A Decadal Research Strategy in Solar and Space Physics*, published in 2004, will influence the direction of future solar-terrestrial research.

INTRODUCTION AND POLITICAL ENVIRONMENT

The Kyoto Protocol legally entered into force on February 16, 2005. The Protocol was adopted at the Conference of the Parties 3 (COP 3) in Kyoto, Japan on December 11, 1997. The Protocol sets binding targets to reduce emissions 5.2 percent below 1990 levels by 2012. More than 100 nations have ratified the Protocol and many developed countries have begun efforts to meet their emission targets. The U.S. supports many R&D activities important to emission reductions, but has not signed the Protocol.

Monitoring of the atmosphere and its constituents is an international responsibility. The GEOSS has as its goal the achievement of comprehensive, coordinated, and sustained observations of the Earth system to improve Earth monitoring, increase understanding of Earth processes, and enhance prediction of the behavior of the Earth system. Global observations suffer from large temporal and spatial gaps in data coverage, erosion of existing infrastructure, inadequate data archiving, and no assured continuity for many systems. A start has been made to rectify the situation, but it will take years to implement and will be a continuing process.

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A trend is emerging in federal agency responsibility for Earth remote sensing that will affect researchers in the latter part of the current decade and into the next. NASA currently operates the three major Earth Observing System (EOS) spacecraft (TERRA, AQUA and AURA) and a considerable number of smaller missions aimed at specific Earth processes. The three EOS spacecraft will not be replaced at the end of their missions. Weather and climate researchers will have to rely on the National Oceanic and Atmospheric Administration's (NOAA) future operational missions for long term, continuous, global data. Researchers already make use of the current NOAA meteorological spacecraft, but recognize the limitations of the instruments.

Later in this decade NOAA, jointly with NASA and the DOD, will begin the polar-orbiting NPOESS program. In the first half of the next decade, NOAA will begin the geostationary GOES-R program. The advanced spacecraft in these programs will carry greatly improved instruments based on the heritage of the current EOS instruments. These will be the backbone of weather and climate observations. NASA will continue to operate individual research missions aimed at specific processes and technology demonstrations. Part of this transition may be seen in the plans for NASA to develop new Landsat class instruments for NOAA to operate on NPOESS spacecraft.

The President's space exploration initiative continues to shape the NASA budget. The initiative calls for human return to the Moon by 2020 in preparation for human exploration of Mars. In response, NASA has reorganized its corporate structure into four Mission Directorates: Science, Exploration Systems, Space Operations, and Aeronautics. Other issues facing NASA are returning the Space Shuttle to operation and either servicing or de-orbiting the Hubble Space Telescope.

Globally, 2004 was the fourth warmest year on record since 1880. Moderate to extreme drought continued to affect large parts of the Western U.S. The year was dominated by the devastating Indian ocean tsunami. Nine tropical storm systems affected the U.S., including six hurricanes. Four of the hurricanes including Charley, a Category Four storm, affected Florida. In total, tropical systems cost the U.S. an estimated \$42 million.

With the threat of materials released into the atmosphere, research on atmospheric diffusion and transport of such materials has become

increasingly important. Agents that enter the atmosphere may interact not only with each other, but chemically and biologically with the media that transport them.

The burgeoning commercial importance of weather, climate, and space weather information is illustrated by the increasing use of such knowledge by the reinsurance industry and futures markets. The growth of private weather and climate services and their partnerships with universities and users is further evidence.

NATIONAL SCIENCE FOUNDATION (NSF)

NSF's total budget would increase to \$5.6 billion, up \$132.2 million or 2.4 percent (see Table II-7). Within this increase is a transfer of \$48.0 million from the U.S. Coast Guard associated with costs to operate and maintain three polar icebreakers. Adjusting for this transfer would result in an increase of \$84.2 million or 1.5 percent. (For more on the NSF budget, please see Chapter 7.)

NSF's Geosciences Directorate would receive an increase of \$14.9 million or 2.2 percent for a total of \$709.1 million. The Atmospheric Sciences Subactivity (ATM) would increase by \$6.4 million or 2.7 percent to \$239.8 million. Atmospheric Sciences Research Support would increase by 3.5 percent to \$158.7 million. The National Center for Atmospheric Research (NCAR) would increase by 1.3 percent to \$81.1 million. These increases will target full operation of the HIAPER aircraft, operation of the upper atmosphere radar, the Advanced Modular Incoherent Scatter Radar (AMISR), and improved cyberinfrastructure and numerical models.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

NOAA's total budget would decrease by 8.5 percent or \$332.9 million below FY 2005, which includes congressional additions, with reductions in all offices except the National Environmental Satellite, Data and Information Service (NESDIS) and the National Weather Service (NWS). NOAA couches its budget request in terms of a FY 2006 base that reflects the FY 2005 program without the one-time congressional additions. In these terms, the request is an increase of 7.3 percent above the FY 2006 base. It includes significant additions for Global Earth

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Observations, Climate Research, an expanded Tsunami Warning Network, and full funding for NOAA satellite systems.

NESDIS would increase by 8.1 percent above the FY 2006 base to \$963.9 million. The next generation polar-orbiting meteorological satellites, NPOESS, would increase by \$16.1 million to \$321.0 million, an amount matched by the DOD and aimed at the first launches late in this decade. An additional \$11.0 million would support adding a Landsat class instrument (to be supplied by NASA) to the NPOESS payload. The next generation geostationary satellites, beginning with GOES R, would be funded at \$240.5 million with a launch date in 2012. The NESDIS budget would include \$12.0 million for data archives and exploitation.

The Office of Oceanic and Atmospheric Research (OAR) would increase by 7.2 percent above the FY 2006 base to \$372.2 million, which is \$41.6 million below the FY 2005 enacted level. This includes an increase of \$18.0 million to a total of \$177.6 million for climate research. The tropical Pacific and Atlantic buoy arrays, TAO and PIRATA, would be upgraded (with responsibility for operation transferred to the NWS), new climate reanalysis data sets would be developed, and research in aerosols, clouds, and climate change would be expanded.

The NWS would seek \$6.0 million to strengthen the tsunami warning program. NWS would receive an increase of \$1.1 million for a total of \$7.4 million for the U.S. Weather Research Program aimed at improving global weather forecasts and forecasts for severe storms, particularly hurricanes. The Space Environment Center would stay at \$6.9 million.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA's budget would increase by \$386 million or 2.4 percent to \$16.5 billion. NASA would streamline its structure into four mission directorates - Science, Exploration Systems, Space Operations, and Aeronautics. Space science and Earth science would be combined into the Science Mission Directorate. Support for the Hubble Space Telescope (HST) is part of this mission.

With the reorganization, it is not possible to compare FY 2006 levels with FY 2005 programs. The new Science Mission Directorate would be funded at \$5.5 billion. Funding for HST would be reduced to \$190.7 million from \$215.7 million to provide for a robotic deorbiting of

Hubble. Living with a Star would increase to \$234 million, or 16 percent. The Earth System Science Pathfinder Spacecraft program would increase to \$136.0 million or 26 percent. Funding would support the launch of the Solar-Terrestrial Relations Observatory and preparing the Solar Dynamics Observatory for launch. NASA will undertake to build a Landsat class instrument for NOAA to operate in the NPOESS program. The NPOESS Preparatory Program spacecraft seems likely to slip beyond a 2007 launch date because of instrument development problems. (For more on the NASA budget, see Chapter 10.)

OTHER AGENCIES

The DOE's Office of Science (SC) budget would decrease by 3.8 percent to \$3.5 billion. Much of the reduction would come from the elimination of \$79.6 million in congressional earmarks in Biological and Environmental Research (BER), leaving the budget reduction for SC at 1.6 percent. BER's budget would decrease by 21.7 percent to \$455.7 million. BER's climate change program would be maintained at nearly level funding. Emphasis will be on the role of clouds and aerosols in an effort to parameterize better their effects in climate change prediction models used in international assessments. Global carbon cycle and basic research on the biological sequestration in the biosphere would be continued. BER reconfigured its atmospheric science program to support aerosol research emphasizing radiative forcing due to indirect effects on clouds and the role of black carbon and organic aerosols on climate.

DOD's Science and Technology programs would decrease by 21.3 percent. Total basic research ("6.1") funding would decline by 12.9 percent to \$1.3 billion, applied research ("6.2") would fall 14.7 percent to \$4.1 billion, and advanced technology development by 24.5 percent to \$5.1 billion. The Army and Air Force have been traditional sponsors of atmospheric research and have a significant interest in the CCTP.

EPA's total budget would decrease from \$8.0 billion to \$7.6 billion, a decrease of 6 percent. The S&T programs in clean air and global change would be reduced by 6.0 percent to \$188.0 million.

CLIMATE CHANGE PROGRAMS

The USGCRP, an interagency climate research program, was codified by the Global Change Research Act of 1990. Its goal is to increase

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understanding of the Earth system and provide a sound scientific basis for national and international decision making on global change issues. That program has produced a large body of important and useful research that now needs to be used, especially in the developing world.

In June 2001 the President established two climate initiatives: the Climate Change Research Initiative (CCRI) that focuses on areas of uncertainty and reduction of those uncertainties, and the National Climate Change Technology Initiative (NCCTI) to strengthen and coordinate federal leadership of climate change related technology R&D.

CLIMATE CHANGE SCIENCE PROGRAM (CCSP)

The USGCRP and the CCRI have been merged into a CCSP; however, there are separate budgets for each. The program, consisting of 13 departments and agencies, is coordinated through an interagency program office located within NOAA. The USGCRP would increase by \$11.0 million or less than 1.0 percent to \$1.7 billion. CCRI would decrease by \$38.0 million or 17.0 percent to \$183.0 million. That would provide \$1.9 billion or a decrease of 1.4 percent in the CCSP (see Table I-9). Expenditures for NASA satellites are the largest item in the CCSP budget, consuming about 62 percent of that budget.

The CCSP released its strategic plan in July 2003, which was reviewed by the National Research Council. Research efforts are coordinated through a set of seven linked interdisciplinary research elements: Atmospheric Composition, Global Climate Variability and Change, Global Water Cycle, Land Use and Land Cover Change, Global Carbon Cycle, Ecosystems, and Human Contributions and Responses.

The Global Change Research Act of 1990 directs the program to prepare assessments that focus on a variety of science and policy issues important for public discussion and decision making. These assessments will cover the full range of CCSP goals. Three draft assessments have been released for public comment. They cover Greenhouse Gas Emissions and Atmospheric Concentrations, the North American Carbon Budget, and Climate Models. It is important to note that much of the material is in scenario form, that is they are “what ifs”. They are not predictions. More assessments will be released during FY 2006. A workshop in Washington, DC in late 2005 or early 2006 will engage constituencies and provide feedback on research and measurement developments.

CLIMATE CHANGE TECHNOLOGY PROGRAM (CCTP)

The CCTP is composed of two parts, a climate change technology related R&D program and the NCCTI. There is a significant deployment aspect to this program, and thus much of the CCTP program is not classified as R&D. The CCTP is guided by the United Nations Framework Convention on Climate Change of 1992 of achieving stabilization of greenhouse gas concentrations in the atmosphere that would prevent dangerous anthropogenic interference with the climate system, yet within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.

CCTP funding would fall \$174.4 million or 5.7 percent to \$2.9 billion (see Table 1). The CCTP goals are to reduce emissions from energy end use and infrastructure, energy supply, and non-CO₂ gases; advance CO₂ capture and sequestration; enhance measurement and monitoring; and fortify the foundations. A Strategic Plan is being developed.

The CCTP crosses program boundaries, thus making it difficult to discuss an integrated program. Renewable energy, hydrogen fuel initiative, FutureGen, nuclear energy (Gen IV), fusion energy (ITER), and carbon sequestration are some key areas of focus for the CCTP.

Table 1: Climate Change Technology Program
(budget authority in millions of dollars).

Agency	FY 2004 Actual	FY 2005 Enacted	FY 2006 Request	% Change FY 05-06
Department of Agriculture	45	48	35	-27.3%
NIST (Commerce)	28	30	7	-75.1%
Department of Defense	52	75	60	-20.5%
Department of Energy	2,390	2,497	2,509	0.5%
Dept. of the Interior	1	1	1	0.0%
Department of Transportation	30	26	2	-90.9%
Environmental Protection Agency	110	109	113	4.0%
NASA	227	244	128	-47.7%
National Science Foundation	11	11	11	6.6%
TOTAL CCTP	2,893	3,040	2,866	-5.7%