

Atmospheric Sciences and Climate Change Programs in the FY 2009 Budget

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HIGHLIGHTS

- Budget requests for major agencies that fund atmospheric sciences and climate change show growth above the FY 2008 enacted levels. As part of the American Competitiveness Initiative (ACI), the National Science Foundation's (NSF) request would increase by 13.6 percent to \$6.9 billion. The National Oceanic and Atmospheric Administration (NOAA) would grow by 5.2 percent above the FY 2008 enacted budget to \$4.1 billion. Increases would be in climate research, including reinstating key climate sensors dropped from the National Polar-Orbiting Operational Environmental Satellite System (NPOESS), extreme weather warnings and forecasts, and the next generation of geostationary weather satellites. The National Aeronautics and Space Administration's (NASA) overall budget would increase by 2.9 percent to \$17.6 billion. This includes an Administration initiative to begin development of new Earth remote sensing missions in response to the National Research Council's (NRC) decadal survey in Earth sciences. The Department of Energy's (DOE) Office of Science would increase by 18.8 percent; Biological and Environmental Research (BER) would increase by 4.4 percent to \$568.5 million while Advanced Scientific Computing Research would increase by 5.0 percent to \$368.8 million.

- The Climate Change Science Program (CCSP) would increase by 10 percent to \$2.0 billion. The Climate Change Technology Program (CCTP) that parallels the CCSP would receive \$4.4 billion, an increase of \$114 million over the FY 2008 enacted level.

- The Administration announced plans in February 2008 to enhance the Nation's Earth observing capabilities. This was in response to the government's and NRC's assessments of the impact of the 2006

downsizing of NPOESS. The downsizing resulted in the cancellation of planned critical climate sensors. The plan would reinstate three key climate sensors by including \$74 million in the NOAA FY 2009 budget request and would begin a series of new research missions by including \$103 million and a proposed \$910 million for FY 2009-FY2013 in the NASA FY 2009 request.

- In 2005, more than 60 countries and the European Commission met in Brussels and agreed to a plan that, over the next 10 years, would revolutionize understanding of the Earth. Agreement for a Global Earth Observation System of Systems (GEOSS) was reached by member countries of the International Group on Earth Observations (IGEO). A fourth GEOSS meeting at the ministerial level was held in November 2007 in Cape Town, South Africa, representing 73 member nations and 52 international organizations. Discussions included drought assessments and prediction, land cover measurements, global air quality, data distribution, data sharing, and emergency warnings.

- The National Space Weather Program (NSWP) would continue in FY 2009 with an increase in NASA's Living with a Star Program and potential growth in NSF's solar-terrestrial programs. Construction of the NSF's Advanced Modular Incoherent Scatter Radar (AMISR) is nearing completion and operations are ramping up. NASA's Solar Dynamics Observatory (SDO) would launch in December 2008. NSF would continue support for a center for research on space weather at Boston University. Space weather research results and applications are now reported in the AGU journal *Space Weather Quarterly*. The second Space Weather Enterprise Forum will be in Washington, DC, in May.

INTRODUCTION AND POLITICAL ENVIRONMENT

The Kyoto Protocol 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 the year 2012. More than 100 nations have ratified the Protocol and many developed countries have begun efforts to reduce their emissions. The U.S. supports many research and development activities important to emission reductions, but has not signed the Protocol.

Climate change is a very complex issue. As a result, policymakers need an objective source of information about the causes of climate change, its

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potential environmental and socio-economic consequences, and the adaptation and mitigation options to respond to it. The World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988 to help address these issues. The IPCC has three working groups: WGI–Physical Science Basis; WGII–Impacts, Adaptation and Vulnerability; and WGIII–Mitigation of Climate Change. In a noteworthy international recognition of climate change research and assessment, the IPCC shared the 2007 Nobel Peace Prize with former Vice-President Albert Gore.

The complete Fourth Assessment was released in November 2007. WGI's latest report provides the strongest evidence for man-made climate change and a strong message that decisive action is required now.

In December 2007 a UN Climate Change Conference was held in Bali that produced an Action Plan. The Plan emphasizes that mitigation actions by developing countries must be supported and enabled by technology, financing, and capacity building. This implies support by industrialized countries. The willingness expressed by developing countries to take an active role against climate change has effectively erased the main excuse of the U.S. for not acting on climate change.

Research on and operational forecasting of tropical conditions and storms would receive increased support in the FY 2009 budget. The joint US-Japan Global Precipitation Mission (GPM), a follow-on to the successful Tropical Rainfall Measurement Mission (TRMM), would receive increased support in the NASA FY 2009 budget with the core spacecraft to be launched in 2013. NOAA launched the first of a new series of geostationary satellites, GOES 13, in May 2006. GOES 13 carries no new instruments, but is a more capable spacecraft and provides better coverage of severe mid-latitude and tropical storms. The next in the series, GOES O, will be launched in 2008.

The three NASA Earth Observing System spacecraft, Terra, Aqua and Aura, will not be replaced at the end of their missions. Weather and climate researchers planned to rely increasingly on NOAA's future operational missions for long term, continuous data. This strategy was thrown into disarray by serious problems with these future missions.

NOAA, jointly with NASA and the Department of Defense (DOD), is developing the NPOESS system. Major cost growth and schedule delays, primarily in the principal imaging instrument, led to severe restructuring of the program including the loss of six instruments, five of which were vital to the continuity of the climate record. Continuing problems with the key imaging sensor also would result in delays in the NPOESS Preparatory Project (NPP) that was scheduled for launch in 2010 to bridge the gap between EOS and NPOESS. Studies by the NRC and the Administration have resulted in mitigation efforts to replace these sensors and to address a decadal strategy for earth observations with additions to the NASA and NOAA FY 2009 budget requests.

NOAA has begun the acquisition phase with industry for the next-generation geostationary meteorological satellite program, GOES-R, that is currently planned for launch in 2015. The advanced spacecraft in this program were intended to carry greatly improved instruments for imagery, atmospheric sounding and possibly ocean coastal imagery. In an effort to avoid cost growth and technical risk, the hyperspectral sounder (HES) has been cancelled and the number of spacecraft reduced. HES would have provided details of the mesoscale humidity and temperature environment of severe weather and tropical storms. The Advanced Baseline Imager (ABI) may provide limited sounding capability.

Globally, 2007 was the fifth-warmest year on record since 1880 and one of the ten warmest on record for the USA. The year was marked by exceptional drought in the US Southeast and West with an active wildfire season, heat waves, and tornadoes. In February 2008 more deadly tornadoes struck the Midwest. Prior to the Atlantic hurricane season, U.S. forecasters were calling for an above-normal frequency of tropical storms and hurricanes. As Pacific El Niño conditions weakened, the forecasts became more dire. The U.K. Meteorological Office, based on a coupled atmosphere-ocean model, GloSea, predicted a mild season. There were, in fact, near-normal conditions with six hurricanes, two of which became major storms. Hurricane Humberto was the first hurricane to make landfall in the U.S. since 2005. La Niña conditions developed in the Pacific during the latter half of 2007 and likely will persist into the first part of 2008.

In-situ and satellite data from ICESat, a laser altimeter, have shown rapid decline in Arctic sea ice to an unprecedented low extent during the summer of 2007. This has serious biological implications for Arctic

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species. It may signal a fundamental transition from perennially ice-covered to a seasonally ice-free ocean. The summer of 2007 saw the opening of the Northwest Passage. Issues of sovereignty, economic resources, and environmental input are emerging.

In FY 2007 the value of unmanned aircraft as platforms for environmental observations became evident. NASA and NOAA scientists used unmanned aircraft to identify wildfires in California, penetrate the Atlantic Hurricane Noel at low levels, and aid in fighting forest fires in Alaska.

The two-year International Polar Year (IPY) began March 1, 2007 and will conclude in March 2009. Scientists from over 60 nations are participating and conducting two annual observing cycles in each polar region to understand environmental change in these regions and how they influence the climate in the rest of the world. NSF is the lead U.S. agency.

NATIONAL SCIENCE FOUNDATION (NSF)

NSF's total budget would increase to \$6.9 billion, an increase of \$822.1 million or 13.6 percent above FY 2008 (see Table II-7). Research and Related Activities would increase by 16 percent to \$5.6 billion. Major Research Equipment and Facility Construction (MREFC) would fall to \$147.5 million. This includes \$2.5 million for the design of the Advanced Technology Solar telescope. The Alaska Region Research Vessel (ARRV), the Ocean Observatories Initiative (OOI), and the National Ecological Observatory are not slated for construction funding in FY 2009. They require further design activities.

NSF's Geosciences Directorate (GEO) would receive an increase of \$96.0 million or 12.8 percent above the FY 2008 estimate for a total of \$848.7 million. The OOI represents part of GEO's contribution to the GEOSS and remains a high priority with a Final Design Review planned for early 2009. The Science and Technology Centers for Multi-Scale Modeling of Atmospheric Processes at Colorado State University, for Coastal Margin Observation and Prediction at Oregon Health and Science University, and for Integrated Space Weather Modeling at Boston University would continue with level funding of \$4.0 million each. Two cross-Foundation areas receiving emphasis in FY 2009 would be the Dynamics of Water in the Environment (WATER) and Cyber-Enabled Discovery and Innovation (CDI). GEO also would contribute

support to the Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) program that involves observing the signal refraction between GPS satellites by means of a constellation of microsattellites.

The Atmospheric Sciences Subactivity (ATM) would increase by \$31.3 million or 13.6 percent to \$260.6 million. Atmospheric Sciences Research Support would increase by 15.6 percent to \$165.2 million. The National Center for Atmospheric Research (NCAR) would increase by 10.4 percent to \$95.4 million. This increased investment would accelerate progress in understanding the Earth system and research infrastructure capabilities. The increases would include full operation of the HIAPER aircraft, operation of the AMISR radar, improved cyberinfrastructure and numerical models, research on natural hazards due both to weather and space weather, the U.S. Weather Research Program, the National Space Weather Program, and cooperative international programs.

NSF's Office of Polar Programs (OPP) would receive \$490.9 million in FY 2009, an increase of \$48.4 million above the FY 2008 estimate. The OPP supports atmospheric science and climate research together with oceanographic and biological research in the Arctic and Antarctic regions. Arctic Sciences has priorities in the Arctic Observing Network and in Understanding Environmental Change in the Arctic. Antarctic Sciences has priorities in the East Antarctic Ice Sheet and Lithosphere, Life in the Polar Night, paleoclimate records from West Antarctica, the Ice Cube Neutrino Observatory, and the 10-meter South Pole Telescope.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

NOAA's total budget would increase by 5.2 percent or \$202.5 million above the FY 2008 enacted level to \$4.1 billion. Primarily, this increase is for the next generation of geostationary satellites. It would include additions for support of the President's Ocean Initiative, climate monitoring and research, weather warnings and forecasts, and reinstating key climate sensors originally cut from the reduced NPOESS program.

The National Environmental Satellite, Data and Information Service (NESDIS) would increase by \$202.8 million or 21.2 percent above the FY 2008 enacted level to \$1.2 billion. The next-generation geostationary satellites, now entering the acquisition phase beginning with GOES-R, would be funded at \$477.0 million, an increase of \$242.2 million above

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the FY 2008 enacted level with a launch date planned for 2015. There are planned reductions both in present and planned polar-orbiting satellite programs. The Administration initiative to restore climate measurements would provide \$74 million to fly a CERES instrument both on the NPP and the first NPOESS satellites and to develop the Total Solar Irradiance Sensor (TSIS) for a future flight. The Administration provided funds in FY 2007 to fly the OMPS-Limb ozone scanner on the NPP mission. In June 2007 the new NOAA Satellite Operations Facility (NSOF) opened.

Oceanic and Atmospheric Research (OAR) would decrease by 4.0 percent to \$382.6 million. New climate reanalysis data sets would be developed. Research in climate change, drought, water vapor processes, and testing unmanned aircraft systems would be expanded. In 2007 NOAA and NASA scientists flew an unmanned aircraft, the Aerosonde UAS, into Hurricane Noel giving researchers the first real-time low-altitude look at such a storm.

The National Weather Service (NWS) would seek \$930.7 million in FY 2009, an increase of 2.0 percent or \$19.3 million over the FY 2008 enacted level. There would be increases in hurricane and climate support operations, the Advanced Weather Interactive Processing (AWIPS) system, and hurricane forecast modeling. In October 2007 the NWS began issuing geographically specific “storm based warnings” for severe weather that reduce the area warned by as much as 70 percent compared to the previous county-by-county warnings.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA’s budget would increase to \$17.6 billion, or 2.9 percent over FY 2008 (see Table II-12). The Science Mission Directorate would be funded at \$4.4 billion, with the Earth Science program funded at \$1.4 billion, an \$87 million increase over FY 2008.

The Living with a Star program within Heliophysics supports research on Sun-Earth interactions. It would be funded at \$223.8 million, up \$6.7 million. Support for the Solar Dynamics Observatory would decrease by \$66.0 million with a launch planned after December 2008. The program is examining a cost-constrained Solar Probe mission to take in-situ measurements very close to the Sun. Analyses in FY 2008 will determine FY 2009 activities. Heliophysics programs have impressive capabilities for observing solar structure and phenomena. For example, the Wind,

ACE, Soho, and STEREO Missions provide unique information on solar energetic particles and the solar wind.

Earth Sciences will continue to support the three remarkably successful Earth Observing System (EOS) missions Aqua, Aura, and Terra, together with ten special mission satellites and the A-Train of satellites flying in formation as a “super-observatory” (Aura, Aqua, Calipso, Cloudsat, and Parasol.) In June 2008 NASA will launch the Joint U.S.-France Ocean Surface Topography Mission (OSTM). Later in the year GOES O will be launched for NOAA and the Orbiting Carbon Observatory (OCO) that will measure global sources and sinks for carbon dioxide.

The Administration has made a commitment to spend \$910 million over six years to begin five of the highest-priority Earth observing missions identified in the NAS decadal survey of Earth sciences. In FY 2009 \$103 million will support the development of the Soil Moisture Active Passive (SMAP) mission and ICESat-2, a follow on to the 2003 ICESat. The next two missions would be the Climate Absolute Radiance and Refractivity Observatory (CLARREO), a joint effort with NOAA and the Deformation, Ecosystem Structure and Dynamics of Ice mission (DESDyn1) whose development would begin in 2013.

There are delays in the launch of NPP because of instrument development problems. The Glory global aerosol mission is seriously challenged because of cost growth due to delays in the primary instrument. The Land Data Continuity Mission (LDCM) and the Global Precipitation Mission (GPM) are in the formulation phase. NOAA and NASA are considering options to replace QuikSAT, the ocean vector winds mission. (See Chapter 9 for more on NASA.)

OTHER AGENCIES

The FY 2009 DOE Office of Science (SC) budget would increase by 18.8 percent to \$4.7 billion (see Table II-11). Biological and Environmental Research (BER) would increase by 4.4 percent to \$568.5 million. BER’s climate change research program that is an integral and vitally important component of the Climate Change Science Program (CCSP) would receive an increase of \$18 million or 14 percent to \$146 million. Emphasis still would be on the role of clouds and aerosols in an effort to parameterize better their effects in climate change prediction models. Global carbon cycle and basic research on the biological

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sequestration in the biosphere would be continued with support coming from the Climate Change Technology Program (CCTP).

The FY 2009 budget request for the Environmental Protection Agency (EPA) would be \$7.1 billion, a decrease of \$330 million or 4.4 percent below the FY 2008 enacted level. The reduction would fall heavily on clean water activities. The Clean Air and Climate Change activity would be funded at \$938.6 million, a reduction of \$33.1 million below the FY 2008 enacted level. EPA activities include work on climate adaptation and mitigation. Many of the reductions in EPA research areas would be offset by increases in Homeland Security related research.

CLIMATE CHANGE PROGRAMS

The U.S. Global Change Research Program (USGCRP), an interagency climate research program, was codified by the Global Change Research Act of 1990. Its goal is to increase 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 needs to be used especially in the developing world. There is evidence that such research is being recognized and appropriate activities undertaken. Such activities should increase now that the developing world has expressed willingness to take an active role against climate change.

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) whose aim is to strengthen and coordinate the federal leadership of climate change related to technology R&D. The time has arrived to examine the results from the Initiatives and the programs that have emerged from them and lay out new goals and objectives to deal with issues resulting from the IPCC's Fourth Assessment Report and the Bali Action Plan. Nationally, the US needs to strengthen its own climate research activities and regain its leadership role in climate studies.

CLIMATE CHANGE SCIENCE PROGRAM (CCSP)

The USGCRP and the CCRI have been merged into a CCSP. The program, consisting of 13 departments and agencies, is coordinated

through an interagency program office located within NOAA. In the FY 2009 budget, the CCSP would increase by \$177.0 million or 10 percent for a total of \$2.0 billion (not including the Smithsonian; see Table I-9).

The CCSP released its Strategic Plan in July 2003 which was reviewed by the NRC. During FY 2009, the CCSP would continue research into important scientific uncertainties and preparation of Synthesis and Assessment reports. Emphasis will be given to the impacts of climate change and the science of adaptation. These reports would be reviewed by the NRC under terms of a continuing advisory agreement.

Among other areas, the following climate change issues will be addressed in FY 2009: development of an integrated Earth system analysis capability, an end-to-end hydrologic projection and application capability, and an abrupt change early warning system; quantification of climate forcing and feedbacks by aerosols, non-carbon dioxide greenhouse gases, water vapor, and clouds; and ecological forecasting. Details of agency activities will be provided in the 2009 edition of *Our Changing Planet, U.S. Climate Change Science Program for Fiscal Year 2009*, a supplement to the President's Budget for Fiscal Year 2009.¹

CLIMATE CHANGE TECHNOLOGY PROGRAM (CCTP)

The CCTP was created by the President in 2002 and was authorized in the Energy Policy Act of 2005. A *Vision and Framework for Strategy and Planning* and a *Strategic Plan* have been published outlining the program's goals and priorities. The program continues to provide strategic direction, planning, and analyses to help coordinate and prioritize activities within the activities of federally funded climate change technology R&D. In FY 2009 the CCTP would receive \$4.4 billion, an increase of \$114.0 million. The CCTP is extensive in its scope. It involves 11 federal departments and agencies. DOE plays a lead role in this program. Since it is scattered throughout the Executive Branch and crosses program boundaries, it is difficult to discuss an integrated program. In FY 2009 the CCTP will continue to focus on implementing the elements of the Vision and Framework document and the Strategic Plan.²

¹ Reports and general information are available at www.climatescience.gov

² Reports and general information about CCTP are available at www.climateotechnology.gov