

USGCRP HIGHLIGHTS AND FY 2001 BUDGET

Introduction



The U.S. Global Change Research Program (USGCRP) seeks to provide a sound scientific understanding of the human and natural forces that influence the Earth's climate system—and thus provide a sound scientific basis for national and international decisionmaking on global change issues. The USGCRP seeks to observe, understand, predict, and assess the critical natural and human-induced dynamic states and trends of the Earth's global environmental system across a wide range of time and spatial scales.

USGCRP Objectives

- Determine the origins, rates, and likely future course of natural and anthropogenic changes.
- Increase understanding of the combined effects of multiple stresses on ecosystems.
- Understand and model global environmental change and its processes on finer spatial scales and across a wide range of timescales.
- Address the potential for surprises and abrupt changes in the global environment.
- Understand and assess the impacts of global environmental change and their consequences for the United States.

This multi-agency National Research Program is coordinated through the National Science and Technology Council's Committee on Environment and Natural Resources (CENR). The CENR has established a Subcommittee on Global Change Research (SGCR) to oversee the coordination of USGCRP activities, in cooperation with the Office of Science and Technology Policy (OSTP) and the Office of Management and Budget (OMB). The SGCR is composed of representatives of the departments and agencies participating in the USGCRP, including: the Departments of Agriculture (USDA), Commerce (National Oceanic and Atmospheric Administration [DOC/NOAA]), Defense (DoD), Energy (DOE), Health and Human Services (National Institutes of Health [HHS/NIH]), the Interior (U.S. Geological Survey [DOI/USGS]), and State (DOS), the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), and the Smithsonian Institution (SI). USGCRP science results provide useful information for environmental decision-making on issues such as climate change, stratospheric ozone depletion, changes in ecosystems, and global land cover and land use.

A Record of Accomplishment

The USGCRP began as a Presidential Initiative in 1989 and was codified by the Global Change Research Act of 1990. In the decade since, the program has led to substantial increases in knowledge, advanced predictive understanding, and documented evidence of global environmental change, including major scientific advances in the understanding of stratospheric ozone depletion, the El Niño–Southern Oscillation (ENSO) phenomenon, global climate change, tropical deforestation, and other issues.

- USGCRP-supported science helped explain the origins and behavior of the Antarctic ozone hole and showed that it was caused by human activities. Ongoing research and observations have shown that emissions controls implemented under the Montreal Protocol on Substances That Deplete the Ozone Layer have begun to decrease the concentration of several ozone-depleting gases at the Earth’s surface.
- USGCRP-supported observations and analyses played a prominent role in demonstrating that emissions of greenhouse gases resulting from human activities are changing the composition of the atmosphere; that such changes have likely contributed to the global average temperature increase of between 0.7° and 1.5o F observed since about 1860; and that much larger and more rapid increases in temperature are likely to occur in the next 100 years if emissions are not reduced.
- The scientific community, working in the context of the USGCRP, successfully predicted the onset of the 1997–1998 El Niño and the subsequent La Niña, as well as some of the resulting climate anomalies around the world. Some societies were able to make limited but significant advance preparations; in some cases, economic consequences and loss of life and property were reduced.
- Satellite observations supported by the USGCRP, in coordination with cooperative international research programs, have documented and quantified large-scale changes in land cover and land use, such as the loss of tropical forest in Brazil, Southeast Asia, and Africa. Increasingly rapid changes, driven largely by human activities, are contributing to biodiversity loss, changes in atmospheric composition, and climate change.

These global environmental issues present long-term challenges at local and regional scales as well. Over the next decade, the USGCRP will support research to explore the interrelationships of these problems and identify their global, regional, and local impacts. Could global warming be influencing the timing and duration of El Niño events? Have human land-use practices—which are known to be a factor in carbon cycling—created large-scale carbon sinks, and can these sinks be maintained? How did the large, global-scale, very rapid

climate changes observed in the paleoclimate record occur, and what might trigger similarly rapid changes in the future? By providing answers to such questions, science can help us better understand and deal with the causes and consequences of global environmental change.

FY 2001 Budget Highlights

For FY2001, the President is requesting \$1.74 billion for the USGCRP—an increase of \$47 million above the amount enacted for FY2000 (see Tables 1 and 2 for details). Of this amount, \$845 million is for scientific research and improvements to surface-based monitoring (an increase of \$87 million, or 11 percent), and \$897 million is for NASA’s development of Earth-observing satellites and associated data systems to help provide a fuller understanding of climate change and other global changes (a decrease of \$40 million—reflecting the phasing down of funding for large development projects). Important highlights of the USGCRP budget request include the following:

- \$28 million in new funding to enhance NOAA surface-based climate observations, including creation of a climate reference network to provide—for the first time—automated, simultaneous, and ideally located measurements of changing temperatures, precipitation, and soil moisture across the United States. Measurements of atmospheric trace gases, aerosols, ocean temperatures, and ocean currents also will be expanded.
- \$308 million (a 13 percent increase) for research on changes in the Earth’s water cycle, which is one of the primary determinants of the Earth’s climate. The water cycle is emerging as a top research priority because changes appear to be occurring already. The launch of NASA’s Earth Observing System (EOS) Aqua spacecraft in December 2000 will support this research by providing new global measurements of humidity, cloud properties, sea ice, precipitation, soil moisture, runoff, and snow.
- \$224 million (a 9 percent increase) for research on the potential effects of climate change and other stresses on forests, coastal areas, croplands, and other ecosystems. New studies will improve our understanding of the relationships among land cover, land use, climate, and weather and assist in identifying “thresholds” for significant changes in ecosystems.
- \$229 million (an 11 percent increase) for the multi-agency carbon cycle science initiative begun in FY2000. This request includes funds to study how carbon cycles between the atmosphere, the oceans, and land and to understand and quantify the role of various natural and managed lands—including agriculture, forests, and grasslands—as sources or sinks for atmospheric carbon dioxide. Such carbon sinks may help the United States and other nations offset greenhouse gas emissions.

Table 1

U.S. Global Change Research Program

FY 1999–FY 2001 Budget by Agency
(discretionary budget authority in \$millions)

AGENCY	FY 1999	FY 2000	FY 2001 Request
Scientific Research			
Department of Agriculture (USDA)	52	53	85
Department of Commerce (DOC/NOAA)	63	67	95
Department of Energy (DOE)	114	114	123
Department of Health and Human Services (HHS/NIH)	40	46	48
Department of the Interior (DOI/USGS)	27	27	25
Environmental Protection Agency (EPA)	16	21	23
National Aeronautics and Space Administration (NASA)	218	236	252
National Science Foundation (NSF)	182	187	187
Smithsonian Institution (SI)	7	7	7
Scientific Research Subtotal	719	758	845
Space-Based Observations			
National Aeronautics and Space Administration (NASA)	937	937	897
U.S. Global Change Research Program Total	1,656	1,695	1,742

Because Department of Defense (DoD) research activities are conducted for defense-related missions, they are not included in this USGCRP budget crosscut. Related DoD research does contribute to USGCRP goals, however.

DOE total for FY 2000 excludes \$3.1M transferred to Small Business Innovative Research/Technology Transfer Program (SBIR/STTR).

New Research and Assessment Highlights

- USGCRP-funded analyses are revealing new information about long-term climate change. According to “proxy” temperature records embodied in glaciers and ice sheets, lake sediments, corals, tree rings, and the like, the 1990s appear to have been the warmest decade (and 1998 the warmest year) in the past 1,000 years.
- Several new analyses show that the climate record of the 20th century cannot be explained solely by accounting for solar variability, volcanic eruptions, and El Niño cycles. It appears more likely that greenhouse gases from human activities were the dominant drivers of these global-average temperature increases in the 20th century.
- New model results indicate that radiative forcing that can be attributed to tropospheric ozone since 1800 is about one-fourth the forcing from carbon dioxide (CO₂) during the same period—providing evidence that human-caused pollution in the lower atmosphere is having significant effects on global climate. This forcing is about two-thirds as large as direct forcing by tropospheric aerosols. (The latter forcing is in the opposite direction: aerosols cool, whereas ozone warms.) These forcings vary by location; sulfate aerosols have the largest effect in northern mid-latitudes, whereas ozone’s contribution is largest in other locations.
- Emerging evidence suggests that we may already be witnessing the effects of climate change on terrestrial and ocean species and ecosystems. A series of scientific analyses published this year provides evidence that climate change is playing a role in the demise of several frog and toad species in Costa Rica, shifts in the growing season in Europe, shifts in growth of grass and forb species in Colorado, changes in bird ranges in western Europe, coral bleaching throughout the global tropics, and alterations in patterns of ocean biodiversity.
- The air-to-sea flux of CO₂ was measured directly for the first time using meteorological techniques on-board ship. This result paves the way for progress in understanding the processes that control the uptake of carbon by the ocean.
- Appreciable insight was gained into changes taking place at high latitudes. For example, the extent and thickness of Arctic sea ice have been decreasing, leading to significant reductions in sea ice volume. The thickness of ice cover in some regions of Greenland has been decreasing, although in other areas it is increasing. Observations in Antarctica show evidence for the existence of ice streams in the interior—the extent and rate of which exceed previously expected values.
- USGCRP-supported scientists played a key role in the Intergovernmental Panel on Climate Change (IPCC) 1999 Special Report on *Aviation and the Global Atmosphere*. This report is the first international assessment of how current and future aviation may increase global climate and stratospheric ozone depletion. The assessment was groundbreaking by virtue of its involvement of both the scientific and aviation-technology communities. It is providing key input to pending national and international decisions regarding the rapidly growing aviation industry.
- U.S. scientists also have played important roles in IPCC Special Reports on *Emissions Scenarios*; *Methodological and Technological Issues in Technology Transfer*; and *Land Use, Land-Use Change, and Forestry*—all of which have been

published in 2000. The USGCRP coordinates the U.S. Government's scientific and technical review of the products of these international assessments.

- A substantial number of USGCRP-supported U.S. researchers are contributing to the IPCC's Third Assessment Report on the state of understanding of climate change and its impacts, which is scheduled to be completed early in 2001.
- The USGCRP is supporting the first National Assessment of the Potential Consequences of Climate Variability and Change. The Overview report of the National Assessment Synthesis Team will be published in late 2000.

Observation, Monitoring, and Data Management Highlights

In the past year, scientists have achieved substantial scientific accomplishments in observations and monitoring to improve our understanding of the Earth system. Initial steps were taken to preserve important surface-based measurement systems for temperature and precipitation. Satellite remote sensing helped improve short-term weather prediction and quantification of the availability of fresh water globally by measuring global rainfall over the tropics; helped scientists understand the role of oceans in removing carbon dioxide from the atmosphere by producing near-daily ocean color maps; facilitated improved seasonal climate forecasts by documenting the waxing and waning of El Niño; and improved short-term weather prediction and tracking of major hurricanes and tropical storms globally by resuming global measurement of winds at the ocean surface.

Researchers used satellite radar data to determine thinning and thickening rates for the Greenland ice sheet, provide the first detailed radar mosaic of Antarctica, and provide daily observations of the polar regions from space. They produced the first satellite-derived assessments of global forest cover, continued to measure concentrations of ozone and ozone-depleting substances, and implemented a 17-year data record of aerosols and cloud properties directed toward predicting annual to decadal climate variations. Finally, a series of new satellites—including the first elements of the NASA Earth Observing System (EOS), which has been under development for the past decade—was launched successfully.

- EOS-Terra (previously called EOS-AM), the flagship of the EOS satellite series, was launched in December 1999. Terra will observe clouds, aerosols, trace gases, land surface, and ocean properties, as well as the Earth's radiation budget. It will make important contributions to USGCRP investigations of the carbon cycle, climate change, atmospheric chemistry, ecological changes, and the water cycle.
- The Active Cavity Radiometer Irradiance Monitor (ACRIMSAT) satellite was launched in December 1999 to consolidate and extend more than 20 years of observations of total solar irradiance. Continuity in satellite-based solar observations is essential for USGCRP climate change research to elucidate solar-terrestrial connections and the effect of solar variations on the atmosphere and weather, and to distinguish between natural variability caused by solar forcing and that induced by anthro-

pogenic greenhouse gases.

- Landsat-7 was launched in April 1999. High-quality data distribution began in August 1999. Seasonal image collection to refresh the global archive began in July 1999, and more than 50,000 acquisitions were archived. Landsat-7 also includes a 15 m resolution panchromatic band for the study of ecosystem disturbances. This imaging contributes directly to the monitoring of land cover and land-use changes—key elements for understanding and quantifying how such changes affect the global and regional carbon cycle and the biology and biogeochemistry of ecosystems.
- The QuikSCAT spacecraft, launched in June 1999, joins the Tropical Rainfall Measuring Mission (TRMM) and the Ocean Topography Experiment/Poseidon (TOPEX/Poseidon) to form a powerful suite of space-based observational assets to track phenomena such as El Niño/La Niña events. QuikSCAT measures sea-surface wind speed and direction at a spatial resolution of 25 km over at least 90 percent of the ice-free global oceans every two days. Data from this mission are being used to improve short-term weather forecasts and are important for climate change research.
- Through the EOS Data and Information Systems (EOSDIS), Earth science data products are provided routinely to end-users within five days of receipt or production of the requested data product. These products comprise data from currently operating space assets, including: precipitation measurements and observations of tropical storms from TRMM, ocean productivity measurements from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS), detection of ocean surface height changes used to predict El Niño occurrence and strength from TOPEX/Poseidon, and sea-ice motion and Antarctic mapping from Canada’s RADARSAT. The data also include measurements of stratospheric trace chemicals from the Upper Atmospheric Research Satellite (UARS), Antarctic ozone hole measurements from the Total Ozone Mapping System (TOMS), land use and land cover data from heritage Landsat missions, and measurements of incoming solar radiation and outgoing radiation from the Earth by the Earth Radiation Budget Experiment (ERBE). Similar arrangements are in place to meet the anticipated demand for data products from EOS-Terra, EOS-Aqua, and other satellite missions.

The National Assessment of the Potential Consequences of Climate Variability and Change

It has long been known that climate varies, and that such variations can have important effects on our society. One of the things we have learned over the past few decades is that we are changing the concentrations of greenhouse gases, some of which have very long atmospheric lifetimes. The consequent effects also will be long-lived. Past emissions of greenhouse gases and the long-term nature of the atmosphere’s response already have committed us to a degree or more of additional warming. Although reducing emissions clearly will slow the increase in atmospheric concentra-

tions and reduce the amount and rate of climate change in the future, some further change will be inevitable because of emissions that have already occurred. As these changes are occurring, we will continue to experience climate variations, with some types of events occurring more often and some less often.

The National Assessment effort now underway in the USGCRP is examining the degree to which particular regions and sectors of the United States are vulnerable to climate variations and change, the potential ecological and socioeconomic impacts of climate variations and change, and options available to adapt and prepare for the next few decades and the next century. The National Assessment also is identifying key information gaps and research needs (i.e., information that is still required to answer questions of interest to resource managers and decisionmakers).

The assessment effort has included a series of regional workshops with participation by a broad range of public and private stakeholders, to identify issues of interest, as well as a series of regional and sectoral analyses, most of which are being completed this year. The national-level product of the assessment is an Overview report by the National Assessment Synthesis Team that is expected to be completed in fall 2000. The Overview is undergoing a rigorous peer review that includes several rounds of technical review, full agency review, and a 60-day public comment period before it is submitted to the President and the Congress. The Global Change Research Act of 1990 calls for this type of assessment of the potential consequences of global changes on a periodic basis (not less than every four years). Assessment will continue to be an important ongoing component of the USGCRP.

Although the first National Assessment will soon be completed, we expect many of the lessons learned during this process to play a significant role in the definition of future USGCRPresearch activities. This first assessment is part of a larger evolution of the USGCRP. During much of the first decade of its existence, the USGCRP concentrated on observing and documenting change in the Earth's physical systems and understanding why these changes are occurring. The USGCRP is now appropriately developing a broader research effort that also includes improved understanding of how global change will affect the Earth's biological systems—and the human societies that are dependent upon them—and making useful scientific data and information more broadly available for public and private planning and decisionmaking.

To accomplish these goals, we must greatly improve our capabilities for conducting regional-scale assessment of global change and its potential consequences around the country. Our current level of understanding tells us that climate change and its effects will vary by region, but our ability to project specific regional effects remains limited.

We also need to learn more about the interactions of natural and human-induced climate change and variability and other human-induced changes in the environment—such as pollution, land-use change, resource extraction, and invasive species, many of which are regional in scale. In addition, we need to achieve an integrated understanding not only of the nature and extent of physical and biological effects of climate change but also of their ramifications for our social and economic systems.

Table 2

U.S. Global Change Research Program

FY 2000 – FY 2001 Budget by Program Element
(discretionary budget authority in \$millions)

PROGRAM ELEMENT	FY 2000	FY 2001 Request
Understanding the Climate System	498.6	485.4
Understanding the Composition and Chemistry of the Atmosphere	387.9	365.4
Global Water Cycle	273.8	308.1
Global Carbon Cycle	204.2	229.2
Understanding Changes in Ecosystems	205.6	223.6
Understanding the Human Dimensions of Global Change	91.8	95.3
Paleoclimate: The History of the Earth System	29.6	27.4
U.S. Global Change Research Total Change	1,691.4	1,734.7

USGCRP total excludes \$4.0 million for DOI/USGS data management in FY 2000 and FY 2001 and \$3.1 million for DOE Small Business Innovative Research/ Technology Transfer (SBIR/STTR) program in FY 2000 and FY 2001.

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