DEPARTMENT OF THE INTERIOR / U.S. GEOLOGICAL SURVEY

Principal Areas of Focus

Research at USGS contributes directly to CCSP strategic goals, principally through studies designed to understand the interactions between climate, Earth surface processes, and ecosystems on time scales ranging from years to millennia. The goal of global change research at USGS is to improve knowledge and understanding of the Earth's past and present climate and environment, the forces bringing about changes in the Earth's climate, and the sensitivity and adaptability of natural and managed ecosystems to climate changes. This information may be used to assess the impacts of climate change and variability at a landscape scale and to allow policymakers and land and resource managers to gauge the relative sensitivity of particular ecosystems, resources, and regions to climatic change and variability.

USGS supports multidisciplinary studies of past environmental and climatic changes (climate history); process studies that explore the sensitivity of the Earth's surface, the hydrologic cycle, and ecosystems to climate variability; and forecasting of potential future changes and their effects on landscapes and ecosystems (particularly on public lands). The combination of these studies provides integrated long-term perspectives on the effects of climatic change and variability and on the interactions through time among climatic, geologic, and biologic systems on regional and landscape scales.

Program Highlights for FY 2004 and FY 2005

Geographic Analysis and Monitoring (GAM)

Research is directed to understand the rates, causes, and consequences of landscape change over time. This knowledge is used to model processes of landscape change and to forecast future conditions. Studies are designed to document and understand the nature and causes of changes occurring on the land surface; to analyze the impacts of land surface changes (including urbanization) on ecosystems, climate variability, biogeochemical cycles, hydrology, and human health; and to develop the best methods to incorporate GAM science findings in the decisionmaking process.

Hydroclimatology

Research on effects of climate change and variability on the hydrologic cycle focuses on characterizing—and developing predictive methods related to—the hydroclimatology of North America. This includes identification of seasonal variations in regional streamflow in relation to atmospheric circulation for regional streamflow prediction and flood/drought hazard assessment; the linkage between atmospheric circulation and snowpack accumulation (for forecasting spring and summer water supply in the western United States and for flood forecasting) as well as glacier mass balance; and the physical and chemical variability in riverine and estuarine environments in relation to large-scale atmospheric and oceanic conditions (to discriminate natural from human-induced effects on such systems). It also includes documenting the long-term behavior of hydrologic systems in response to past climatic variations and changes (from decades to hundreds of thousands of years) as well as more recent (decadal) hydrologic trends. The program maintains an active effort to develop improved representations of terrestrial hydrologic processes in general circulation and regional climate models. In broad terms, these activities are aimed at improving statistical and deterministic methods for predicting hydrologic hazards and related environmental conditions on monthly to interannual time scales.

Carbon Cycle

USGS conducts a broad range of carbon cycle research focused on North America, which includes the following activities:

- *Assessment of Carbon Stocks and Soil Attributes*—Determine the spatial distribution of carbon in the terrestrial environment in relation to historical natural and human processes, as a basis for initializing dynamic models of soil carbon.
- *Carbon Sequestration in Sediments*—Study the redeposition of eroded soils and sediments (and their associated organic carbon) which sequesters large quantities of carbon, buried at the base of slopes and in wetlands, riparian areas, and reservoirs.
- *Landscape Dynamics and Vegetation Change*—Examine the long-term dynamics of vegetation change in relation to climate change and variability. A detailed history of vegetation change in the western United States is being constructed. Past changes are used to model vegetation response to climatic variables. This knowledge is applied to forecasting the effects of future climate change on the distribution of vegetation in the western United States.
- *Fate of Carbon in Alaskan Landscapes*—Expand process studies and modeling to better understand the historic and modern interactions among climate, surface temperature and moisture, fire, and terrestrial carbon sequestration. Cold region forests (boreal ecosystems) contain large carbon reserves that are highly susceptible to changes in climate.
- *Exchanges of Greenhouse Gases, Water Vapor, and Heat at the Earth's Surface*—Employ field measurements, remote sensing, and modeling of carbon fluxes to develop estimates of gross primary productivity, respiration, and net ecosystem exchange at flux tower sites, and use remotely sensed data to extrapolate these carbon fluxes to ecoregions.

Cryosphere Dynamics

The Arctic is particularly vulnerable to climate change because of the large temperature changes that occur there and the disruption caused by melting/freezing of ice and permafrost. In addition, the polar regions have the greatest potential for causing abrupt global-scale climate changes through instabilities and feedbacks involving the cryosphere and ocean circulation. USGS research focuses on documenting change in the cryosphere via studies of the thermal state of the permafrost in northern Alaska; mass balance studies of benchmark glaciers in the Pacific Northwest and Alaska; a global assessment of changes in glacier extent; and mapping of changes in ice extent along the coast of Antarctica.

Changes in Ecosystems

USGS ecosystems research focuses on impacts on terrestrial and coastal ecosystems by determining the exposure, sensitivity, and adaptive capacity of natural systems and ecological processes to multiple environmental factors, including climate and other natural and anthropogenic influences. Research provides the scientific knowledge and technologies for conservation, rehabilitation, and management of ecosystems needed by public land management agencies.

Satellite Data Management and Dissemination

USGS operates and continually enhances the capabilities of the Earth Resources Observation System (EROS) Data Center to serve as the National Satellite Land Remote-Sensing Data Archive, by maintaining existing data sets, adding new ones, and converting older data sets from deteriorating media to modern, stable media. This archive supports all research components that investigate the land surface and the ecosystems it supports.

Appendix

Related Research

DOI also sponsors contributing research programs addressing the collection, maintenance, analysis, and interpretation of short- and long-term land, water, biological, and other geological and biological processes and resources through dispersed observing networks; research in land use and land cover, including creation of maps and digital data products; and inventorying and monitoring of biological habitats, resources, and diversity.