Geologic Landscape and Coastal Assessments Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Earth Surface Dynamics	**12,327**	**+745**	[(1)]**+2,450**	**15,522**	**+3,195**
National Cooperative Geologic Mapping	19,781	+457	+7,500	27,738	+7,957
Coastal and Marine Geology	33,327	+602	0	33,929	+602
Total Requirements $000	65,435	+1,804	+9,950	77,189	+11,754

[1] See Program Change section for details on Place-based Studies (+$500), DOI Science Priorities (+$1,950)

Earth Surface Dynamics

Current Program Highlights

Global Change

The USGS Earth Surface Dynamics Program helps scientists to understand, model, and forecast on sub-continental and regional scales the response of the land surface and ecosystems to climate and land use changes. The landforms and ecosystems of the earth's surface undergo constant and profound changes. The pace and direction of these changes are determined by complex interactions among climate change, natural disturbances, and human activities (such as deforestation, agriculture, and urban sprawl). The earth's surface does not exist in a static, unchanging condition interrupted only by the actions of humans, but instead is a dynamic system of which humans are a part.

The USGS provides scientific support for the land stewardship responsibilities of the Nation by addressing resource management issues related to the impacts of climate variability and land use on ecosystems, the landscape, and resources. Priority is given to improving the utility of global change research to natural resource managers, through an increased emphasis on monitoring, modeling and forecasting the impacts of change on landscapes and ecosystems. Support for research on long-term climate history is decreasing accordingly.

The USGS works closely with other participating federal agencies to coordinate research under the auspices of the U.S. Global Change Research Program. There is an increasing emphasis on the human dimensions of environmental change, including understanding the sensitivity of regional systems to human activities and land use and the impacts of global and regional environmental change on human health. Emphasis is also placed on understanding the impact of climate change and land use on the carbon cycle and carbon sequestration in soils and sediments. In the lower Mississippi Basin, field-based measurements and modeling research will be enhanced to better describe the role of land-use change and associated erosion, sedimentation and biological processes on carbon storage and nutrient cycles in wetlands and riparian areas.

Great Lakes Mapping Coalition Project

In FY 2000 the USGS and the State Geological Surveys of Illinois, Indiana, Michigan, and Ohio began the pilot phase of a new partnership project to meet the increasing need for three-dimensional geologic maps of the extensive glacial deposits that blanket the upper Midwest. These maps will provide a foundation for making economic and environmental decisions related to water, land, and other natural resources. Pilot studies focus on a rapidly urbanizing area northwest of Chicago, a geologically complex region in southwestern Michigan, a region of coastal lake Erie affected by erosion in Ohio, and ground water protection issues in northeastern Indiana.

Studies Conducted Within A Specific Geographic Area

Sound restoration and management decisions depend on the availability of objective, high quality information that integrates science from a broad range of disciplines. These place-based studies investigations bring together scientific teams of geologists, hydrologists, biologists, and cartographers to solve the complex, multifaceted environmental. Results of the work helps resource and environmental managers understand historical ecosystem changes, design monitoring programs for restoration and management, and elucidate the relations between parts of the environment.

This integrated information is critically important to reduce the ultimate costs of restoration and resource management. The costs of physical environmental alterations are large, but not compared to the costs of ill-planned, misinformed actions that are ineffective. The scientific information provided helps to ensure that future plans have realistic expectations for restoration, water control structures are optimally designed and managed, and managers have the tools to predict outcomes of possible restoration actions.

Extensive restoration and management actions are underway in several nationally-important regions of the country. The south Florida restoration is expected to cost $11 billion to $15 billion, and will be based in part on predictions from models that were funded in part through work by USGS. In San Francisco Bay, multimillion-dollar modifications of wetlands and the water management system require multidisciplinary scientific information that has been developed over the years by USGS. In Chesapeake Bay, USGS information on nutrient and sediment loading into Chesapeake Bay has helped the Bay Program better plan restoration goals and actions related to land use management. In Platte River, scientific information will help determine the most effective means of restoring the habitats of millions of migratory birds that rely on the river environment. In the Salton Sea, greater Yellowstone and Mojave Desert, management and restoration also require a targeted scientific base to avoid costly mistakes as management changes are implemented.

Recent Accomplishments

Geologic controls on invasive species -- USGS scientists are working to understand the conditions of cheatgrass (*Bromus tectorum*) invasion into native shrublands and grasslands on the central Colorado Plateau, Utah. Recent discoveries have revealed landscape-scale links between cheatgrass footholds and climate, soil texture, soil composition, and geomorphic features. Combined with new theories about plant-nutrient requirements and uptake mechanisms for native and non-native species in the region, these discoveries support new understanding about how geologic processes influence ecosystem processes and health.

Continued monitoring of climate and nutrient inputs from wind-blown dust derived from distant sources will help achieve goals of alerting land managers to potential future invasion and ultimately identifying possible ways to halt continued damage to the ecosystem.

Understanding Interactions between Climatic and Vegetation Changes -- USGS scientists, working with academic colleagues, published quantitative data and illustrations on the relations between present-day climate and the geographic distributions of more than 400 major native trees and shrubs in North America. These data are being used by U.S. and international scientists to model potential future changes in vegetation patterns, including the potential roles of invasive species in future ecosystems of North America. The USGS data on modern climate-vegetation relations are also being used: 1) with paleobotanical data to provide detailed quantitative reconstructions of past climate fluctuations in North America, 2) to improve the depiction of vegetation surface models, and 3) to 'validate' modeled simulations of past climatic conditions by comparing simulated past vegetation patterns with the observed paleobotanical record.

Temperature History of Greenland and Antarctica -- USGS scientists, working with academic and international cooperators and the National Science Foundation, have obtained highly-precise temperature profiles of ice-sheets in Greenland and Antarctica (bore-hole paleothermometry). These data are being used to revise estimates of temperature changes on these ice sheets over the past few tens of thousands of years. The USGS studies indicate that polar ice sheet temperatures during the last glacial period were much colder than previously thought, and that polar climates changed synchronously between Greenland and parts of Antarctica. These results have strong implications for understanding past global climates and our ability to accurately model patterns of future climate change.

Improved Access to Information Aids Florida Resource Managers -- The South Florida Information Access (SOFIA) Internet site has made significant enhancements to the accessibility of USGS information in South Florida. The site enables managers and the general public to find data, metadata, descriptions of research, fact sheets, and information contacts. The site hosts the interagency presentations made at the South Florida Restoration Science Forum. Viewers can search for information by topic, investigator, title or click on a map to see all of the activities in a given area. Descriptions of synthesis projects provide an overview of specific topics, such as sediment and salinity in Florida Bay, and aquatic cycling of mercury. An automated demonstration steps through the components of the database. The Internet address is http://sofia.usgs.gov.

Models Aid Restoration Planning -- The successful restoration of south Florida rests on the availability of tools to predict accurately the effects of water management. Key predictive capability will be provided by USGS ecological and hydrological models. These models are also supported by the National Park Service (Critical Ecosystem Studies Initiative) and the Corps of Engineers.

Hydrologic Modeling -- Results from the Southern Inland Coastal Systems (SICS) Model are causing major changes in hydrologists' understanding of how water flow through the mangrove zone north of Florida Bay. Understanding the flowpaths of water entering coastal bays is important because US Army Corps of Engineers (COE) and other members of the Ecosystem Restoration Task Force are attempting to reconstruct the historical conditions by rectifying water flow through the Everglades into Florida Bay. Drainage in the southern Everglades, a vast network of interconnecting sloughs, has never been well documented. When planning began, vegetation patterns appeared to indicate that water flowed predominantly through Taylor Slough

and into Florida Bay at Taylor Creek. USGS modeling and data indicate that much of the water entering Taylor Slough actually flows southeast into Joe Bay then into Trout Creek, which empties into a different part of Florida Bay than Taylor Creek. The USGS model uses an integrated suite of scientific information including highly accurate elevation data, complex tidal stream flow measurements, studies of the effects of wind vegetation and evapotranspiration, and relations between surfacewater and groundwater. This information will help the COE accurately target its flow structures and management of water to maintain the appropriate distribution of salinity in Florida Bay.

Ecological Modeling -- The Corps of Engineers used the set of ecological models known as ATLSS, (Across Trophic Level System Simulation) in the Restudy to evaluate hydrologic scenarios for their effects on critical species. ATLSS is one of the most sophisticated ecological models of its kind that incorporates an unusually high degree of realism. Working models for wading birds (based on white ibis), white tailed deer, fish, American alligators, hydrology, and endangered species such as the Florida panther, wood stork, Cape Sable Seaside Sparrow and Snail Kite have been developed and are being refined for more detailed analysis. These models and links with predictive hydrologic models will be completed by FY2000. Additional components on estuarine species such as fish (underway), mangrove vegetation (planned), will be completed by FY 2001-2. ATLSS will continue to be used to aid monitoring, planning and ongoing management of the system http://atlss.org/.

Mercury Studies Provide Key Information For Predictive Models -- Resource managers of South Florida have long known that they had severe problems with methylmercury contamination of fish and wildlife. The State has issued many fish consumption advisories. They also knew that methyl mercury problems were particularly acute in certain parts of the Everglades and that changing the geochemical characteristics of the wetland was likely to influence methylmercury production. What they did not know was whether it would increase or decrease the risk. A team of scientists from USGS, state government, and academia, have provided the research findings that have enabled the EPA to model mercury dynamics in this complex system. The results of the model has allowed the South Florida Water Management District to move forward with its plans to purchase lands to construct Stormwater Treatment Areas without fear of creating "methylmercury factories."

Evaluating The Threat Of Mercury Contamination From Hydraulic Mining Debris -- More than a billion cubic meters of contaminated riverine sediment has flowed out of the foothills of the Sierra Nevada since the hydraulic gold mining days of the 1800s. As much as 10,000 tons of mercury, used to extract gold, was released to rivers during extraction of gold. Much of the contaminated sediment was initially covered over with cleaner sediments, but those sediments are now slowly eroding away. A USGS 3-D model of the distribution of mercury-contaminated hydraulic mining debris for the entire North Bay reveals that more than 400 million cubic meters, approximately one-third of the total volume of hydraulic mining debris, was deposited in North San Francisco Bay during the hydraulic mining period. Sediment coring has revealed mercury concentrations greater than 0.3 mg/g, significantly more than the reported background level of 0.1 mg/g. This model predicts that, more than 100 years later, about half of the hydraulic mining debris originally deposited in the North San Francisco Bay still remains there. Because of ongoing natural erosion of bottom sediments, much of the mercury-contaminated debris is presently at or near the surface of the bay floor, thus facilitating the transfer of mercury to overlying water and biota.