Geologic Landscape and Coastal Assessments Subactivity

Program	1999 Estimate	Uncontrol. & Related Chgs	Program Redirect	Program Changes	FY 2000 Budget Request	Change from 1999
Earth Surface Dynamics	**13,555**	**306**	**-4,036**	**0**	**9,825**	**-3,730**
National Cooperative Geologic Mapping	22,546	566	-3,231	1,500	21,381	-1,165
Coastal and Marine Geology	37,990	744	-6,339	-2,900	29,495	-8,495
Total Requirements $000	74,091	1,616	-13,606	-1,400	60,701	-13,390

Note: The Program Redirect column reflects the redirection of funds to the Integrated Science, Science Support, and Facilities activities.

Earth Surface Dynamics

Current Program Highlights

Knowledge about changes to the Earth's surface and the underlying processes that induce them has enormous impact on how society responds to these changes and, ultimately, the cost of responding to change. Strategies to mitigate the effects of natural hazards, the extraction and flow of mineral and material resources, the restoration of ecosystems, and other critical problems need to be based on a clear understanding of the causes of changes in and to our landscape. With this understanding, human activities can be directed toward working with natural processes to the extent possible (at acceptable cost to society) and away from activities in conflict with natural processes (which incur maximum costs).

A comprehensive understanding of two fundamental issues is essential for making optimal decisions among competing uses of natural resources: (1) The ability to discriminate between natural processes, such as climate variability and ecosystems evolution, and human-induced processes at work on or near the Earth's surface that modify and mold our world, change the environment, and the landscape. Information on ecological variability in the natural state is fundamental to selection of restoration alternatives. (2) The importance of understanding, quantitatively, the wide array of surficial cycles and processes, the rates of surface modifications, and the factors that control these rates of change.

Climate variability on regional, continental, and global scales and the attendant change in habitats, ecosystems, and environments is inevitable. The activities of humans can potentially both enhance and reduce the effect of those changes. Ultimately those changes to the Earth's surface are linked inextricably with population growth, economic growth, and quality of life issues. A comprehensive understanding of the dynamism of the Earth's surface is essential if

the Nation is to enjoy, rather than endure, life through the next century. The program seeks to be responsive to needs of DOI resource management bureaus, while still providing important data and information to the congressionally mandated U.S. Global Change Research Program. This USGS effort contributes to the U.S. Global Change Research Program, a coordinated national research program established in 1990. The USGS conducts research in climate history, surface processes, and the effects of change on the Earth's surface. USGS climate history studies are directed toward understanding the rates and magnitudes of natural changes in climate and determining how those changes have affected land-surface processes in the past. The studies contribute to understanding likely future climate variability and climate change and help develop and evaluate models that project the regional-scale response of the environment to changing climate. Through research on global change and climate history, the USGS provides earth science information needed to develop National policies concerning changes in global environmental assets such as productive lands and oceans, water resources, and ecological systems.

USGS process research focuses on the role of terrestrial and coastal processes on geologic and historical time scales. Carbon plays a major role in these processes and research on the carbon cycle is an important component of this effort. Terrestrial environments such as large river basins store a significant fraction of the world's carbon. USGS has begun a major effort to understand the interactive effects of land use, erosion, sedimentation, and soil development on carbon storage and nutrient cycling in the effect in the Mississippi River basin.

A broadly integrated science strategy has been developed to help policy makers and land managers understand and cope with ecosystem changes caused by both natural and human induced stresses and influences (e.g., periods of drought, changes in land use). The science strategy, presented in USGS Circular 1153, evaluates past and potential future ecological and environmental changes on regional scales, utilizing an ecosystem model that links global climate models to regional climate, watershed, vegetation, and hydrologic models. The hierarchy of models reflects the cascade of ecosystem responses from the global climate system to regional and local systems and processes. Quantification of the interactions of climate, hydrology, vegetation, and fire frequency allow managers to better assess the landscape responses and interactions to changes in the natural environment and management policy.

Recent Accomplishments

Carbon Sequestration in Lakes, Reservoirs, and Wetlands — Scientists can perhaps best contribute to the policy debate over carbon emissions by better defining carbon sources and sinks in the past, present, and future. Toward that goal, the USGS, in collaboration with the University of Minnesota, analyzed carbon burial in freshwater systems and concluded that lakes, reservoirs, and wetlands serve as vast sinks for carbon, removing three times as much carbon from the atmosphere annually than do all the oceans. This is particularly remarkable since lakes, reservoirs, and northern wetlands together cover less than 2 percent of the Earth's surface. This high rate of carbon sequestration is the result of the relatively high carbon content of the sediment and the high rate of sedimentation in these basins. Human activities have significantly enhanced this carbon sink as a result of land use and agricultural practices

which have historically increased erosion and sedimentation and at the same time enhanced eutrophication and production of organic matter in many of these wetlands.

Monitoring Impact of Climate and Land Use — In 1998, increased emphasis was placed on monitoring the effects of climate variations and land use on processes that affect ecosystems and the landscape. Collaborative research in this area is being conducted with several Geologic programs, in collaboration with other USGS divisions and land-management agencies. Data from these studies, coupled with information from climate history and surficial geological studies, provide the basis for new modeling efforts that explore the potential impacts of future climate changes on federal lands in the Southwest and Alaska. Specific aspects associated with this effort include: (1) working with USGS biologists to develop a geomorphic model for the invasion of cheat grass of concern to DOI land management agencies, (2) determining the causes of large-scale wind erosion in the Southwest deserts, and tracking major dust storms from their source regions to the sites of deposition, (3) working with USGS biologists and the NPS to investigate eolian deposits, soil fertility, and habitat vulnerability in National Parks on the Colorado Plateau, (4) working with USGS hydrologists and geographers to understand the roles of climate and land use in the formation of arroyos in the Southwest, and (5) understanding and modeling vegetation change, with the objective of portraying the potential impacts of future climate change on ecosystems of the western United States.

Understanding Changes in Watersheds and Lakes — USGS scientists are working with researchers from the Utah Geological Survey, Kansas State University, Utah State University, the University of Utah, Northern Arizona University, and the University of Minnesota to understand the effects of climatic variability and land use on watersheds and lakes in northwestern Utah and adjacent areas of Wyoming and Idaho. This region is both the southwest quadrant of the “Greater Yellowstone Ecosystem” and the boundary of the rapidly growing urban areas along the Wasatch Front in Utah. The quantity and quality of available water here is important for the sometimes-competing interests of ecosystems, agriculture, tourism, and urban growth. Initial research indicates that Great Salt Lake and Bear Lake have both experienced periods of both higher-than-historic and lower-than-historic levels during the last several thousand years. Rising waters of Great Salt Lake threatened the infrastructure of the greater Salt Lake City metropolitan area in the 1980s, and much larger lake rises occurred during the Holocene. Conversely, periods of drought (such as those that occurred in this region in the 1960s) threaten agriculture, urban water supplies, and ecosystems. In addition, the exposure of saline lake beds during droughts can create dust-hazards with associated impacts on air quality and human health. Understanding the role of climate variability and land use in these changes will aid future land use management decision making.

Assessing the Impacts of Climate Variability and Change on the Nation’s Resources — The USGS is a major supporter of the "U.S. National Assessment: The Potential Consequences of Climate Variability and Change," in conjunction with the U.S. Global Change Research Program. The assessment is applying research findings to help understand the potential impacts, both detrimental and beneficial, that global change may have on the environment, society, and the economy. The USGS has responsibility for assessing four regions (Rocky Mountains and Great Basin, Alaska, Southwest, and Hawaii and Pacific Islands) as well as the Nation’s water sector. Regional assessments are being conducted as a public-private partnership by leading academic institutions in each region. Workshops have

been held to scope key issues and information needs in each region. The assessment will link research by scientists to specific needs of a broad spectrum of stakeholders and will provide planners, managers, organizations, and the public with the information needed to increase resilience to climate variability and cope with climate change. The National Assessment will be completed in 1999, with an in-depth analysis and synthesis of the regional information.

Monitoring Glaciers - Sensitive Indicators of Change — Global change predictions indicate that warming trends will be strongly amplified in the Polar Regions. Glaciers are particularly sensitive indicators of climate change. The USGS and NASA are collaborating on analysis of satellite images and experimental geodetic airborne and satellite laser altimetry surveys of glaciers in order to detect changes in area and surface elevation. Landsat images from the mid-1970s are being used to establish a comprehensive global baseline of glacier area. An 11-volume Atlas of Glaciers of the world is being produced, utilizing remotely sensed data to construct and analyze long-term fluctuations of glaciers from a regional and global perspective. The Glaciers of South America volume was completed in 1998, and the Glaciers of North America volume is near completion. In addition, Landsat images (mid-1970s and late 1980s/early 1990s) and radar images (late 1990s) of Antarctica are providing critical information about changes in the floating ice margin of Antarctica and about the flux of ice discharging from the continent. The first in a series of coastal change maps of Antarctica was completed in 1998. These monitoring activities are providing critical early evidence of global climate change.