USGS Climate and Land Use Change Science

The USGS undertakes scientific research, monitoring, remote sensing, modeling, synthesis, and forecasting to better understand the effects of climate and land use change on the Nation's resources. The results provide a scientific foundation informing decision-making by natural resource managers and policymakers.

The USGS climate and land use change programs also contribute to and coordinate with national and international scientific activities including the thirteen-agency U.S. Global Change Research Program and the Intergovernmental Panel on Climate Change.

The Science Strategy

In 2013, USGS published a climate and land use change science strategy summarizing science goals for the next decade.

Goal 1— Improve understanding of past global changes

Goal 2— Improve understanding and prediction of the global carbon cycle

Goal 3— Improve understanding of biogeochemical cycles and their coupled interactions

Goal 4— Improve understanding of land use and land cover change rates, causes, and consequences

Goal 5— Improve understanding and predictions of changes in hydrologic processes, droughts, floods, and water availability under changing land use and climate

Goal 6— Improve understanding and prediction of coastal response to sea-level rise, climatic change and human development

Goal 7— Improve understanding and prediction of biological responses to global change

Following are several examples of how these goals are integrated into the priorities of the USGS climate and land use change programs.

Monitoring change in glacial mass balance, South Cascades glacier, Washington State. Research on how glaciers respond to climate change helps scientists understand and forecast effects on water supplies, ecosystems, and global sea level.

Landsat 8 launched in February 2013. For over forty years, Landsat satellites have provided the authoritative global-scale record of changes to the land surface. Since the Department of the Interior's first-of-its-kind free data policy in 2008, Landsat data have sparked new scientific advances and resource management uses.

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USGS Climate and Land Use Change Science Programs

Documenting Change on the Earth's Surface

The USGS **Land Remote Sensing Program** provides high-quality data from the Landsat satellites and other remote-sensing instruments flown on aerial and space-borne platforms. The program's comprehensive record of change to the land surface is relied on by scientists and by environmental and economic decision makers. The program has prioritized a set of Landsat-based analyses that will improve applications used by natural resource managers, provide consistent long-term indicators of global change, and contribute to the international and interagency climate monitoring community's initiative to better document specific measurements such as snow cover, permafrost, forest condition, land cover, biomass, surface water extent, and fire disturbance. In addition, the program supports innovation in remote sensing data collection and science, such as the use of unmanned aerial systems to make time-critical observations during events such as fires and floods.

Modeling the Impacts of Change

The USGS **Land Change Science Program** studies the rates, causes, and consequences of land change, and incorporates this understanding into risk, vulnerability, and decision support models. A priority is the assessment of current and potential biological sequestration of carbon in vegetation and soils. This assessment integrates biogeochemical models and future climate scenarios with Landsat-derived land use and land cover data to improve the understanding of greenhouse gas fluxes in ecosystems. A related priority is the development of decision support tools enabling land managers to ask "what if" questions about the impacts of land management activities on carbon stocks and sequestration capacity, and on other ecosystem services such as biodiversity and water provisioning.

Understanding the Earth's Response to Climate and Land Use Change

The USGS **Climate Research and Development Program** integrates research from multiple scientific disciplines to improve understanding of the effects of climate variability and change over a range of temporal and spatial scales. This research includes examination of the causes and patterns of drought and flooding, using a combination of instrumental records, reconstruction of past climates based on geological records, and climate modeling. The program also conducts research on the response of terrestrial and marine ecosystems to climate change on annual to millennial timescales, in habitats ranging from the mountainous western U.S. to Arctic sea ice. For example, the program is studying the patterns, causes, and impacts of sea level rise, using geologic records of past sea level, measurements and modeling of glacier change, and ecological studies of coastal response to sea level rise.

Support for Resource Management Decisions

The USGS **National Climate Change and Wildlife Science Center** and eight regional Department of the Interior **Climate Science Centers** provide usable scientific answers to questions identified by regional natural and cultural resource managers. One of the highest priorities is the need to identify climate change impacts on fish and wildlife species. An example is the development of an integrated ecosystem model to forecast climate and land use change impacts on Alaskan wildfire, habitat, hydrology, and permafrost, which will support species and land management decisionmaking. To complement the production of needed climate and ecological science, the Climate Science Centers have also prioritized working with social and decision scientists to provide scientific results that are directly usable by resource managers.

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