



FACING TOMORROW'S CHALLENGES: USGS SCIENCE IN THE DECADE 2007–2017

Climate Variability and Change

In 2007, the U.S. Geological Survey (USGS) developed a science strategy outlining the major natural science issues facing the Nation in the next decade. The science strategy consists of six science directions of critical importance, focusing on areas where natural science can make a substantial contribution to the well-being of the Nation and the world. This fact sheet focuses on climate variability and change and how USGS research can strengthen the Nation with information needed to meet the challenges of the 21st century.

Importance of Climate-Change Research to the Nation

Climate influences every aspect of life on Earth, affecting human health and well-being, water and energy resources, agriculture, forests and natural landscapes, air quality, and sea levels. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report of 2007 summarizes overwhelming evidence that global warming, due to human activities since 1750, is unequivocal. In addition to increases in global average air and ocean temperatures, observations find widespread melting of

snow and ice; rising sea levels; widespread changes in precipitation amounts, ocean salinity, and wind patterns; and increasing occurrences of extreme weather, including droughts, heavy precipitation, heat waves, and intensity of tropical cyclones. Objective and interdisciplinary science is needed to understand more clearly the complexity of global climate issues. The science will play an essential role during the next decade in helping communities and land and resource managers understand local and regional implications, anticipate effects, prepare for changes, and reduce the risks of decisionmaking in a changing climate.

Why Action Is Needed Now

Climate variability and warming over the past century have already had measurable effects on ecosystems, societies, economies, and health. Climate change contributes to sea-level rise and to the frequency and intensity of wildfires, floods, crop failures, and outbreaks of disease and insect damage. Even though average precipitation is increasing as the climate warms, changes in the amount, timing, and distribution of rain, snow, and runoff are challenging the ability to manage the Nation's water supply. Projected changes in temperature and precipitation patterns in response to increasing greenhouse gas emissions throughout the 21st century are expected to intensify the effects on species, ecosystems, societies, economies, and health in many areas of the world.

During the next decade, the United States and other nations need to develop scientifically rigorous response strategies in anticipation of climatic events that are directional and increasingly variable.



The Coxe Glacier in Harriman Fjord, Prince William Sound, Alaska, has been retreating for more than 100 years. Glaciers are sensitive to changes in local and regional climate; USGS data show that 98 percent of the glaciers in Alaska that terminate at an elevation below 1,000 meters are retreating, thinning, or stagnating. Changes in the cryosphere (Earth's frozen regions) may reduce water supply in mountainous areas and ultimately cause an increase in global sea level. USGS documentation of these processes with both remote sensing and surface techniques will continue to be essential in helping scientists understand and forecast the impacts of climate change. (Photograph by Steven Schwarzbach, U.S. Geological Survey, 2000)

How the USGS Can Help

The USGS occupies a strong and unique role in the climate-change science community and contributes directly to the U.S. Climate Change Science Program (CCSP). USGS is recognized for its research and monitoring efforts in the fields of hydrology, climate history, land-use and land-cover change, wildlife health, ecosystem science, and carbon and other geochemical and nutrient cycles. The USGS contributes directly to the CCSP's intellectual framework of whole-system understanding of global change, including the interrelationships among climate change, ecological systems, and human activities. USGS long-term data sets, together with a breadth of multidisciplinary scientific expertise—spanning geology, biology, hydrology, geography, and remote sensing—enable the delivery of integrated information, predictive scenarios, and technological

tools for managing the Nation's water, land, plant and animal populations more effectively.

With its long-term observational networks, extensive databases, and diverse scientific expertise, the USGS can provide the broad perspective needed to expand understanding of current climate variability, climate change, and their effects on the Nation's resources and economy. The USGS is working with local, State, and Federal partners to understand past climate variability and deliver credible future forecasts of climate-change effects on land, water, ecological and biological resources. DOI partners and other land and resource managers will benefit from its wealth of data, predictive models, and decision-support capabilities as they face the challenge of adapting to, or mitigating the risks of, climate change on ecosystems, biota, land and water resources, and communities across the Nation and around the world.



Tents dot the Greenland landscape at a research camp in July 2006. Scientists from many organizations, including the USGS/NSF National Ice Core Laboratory, are working on the National Science Foundation's West Antarctic Ice Sheet Divide Project to collect deep ice cores in central West Antarctica during 2007–09. The cores provide information on past temperature, precipitation, atmospheric gas composition, and volcanic eruptions that helps researchers better understand the changing climate. (Photograph by Brian Bencivengo, U.S. Geological Survey.)

USGS Science Can Meet the Challenge

The USGS is ready to take action by:

- Creating, expanding, and modernizing existing USGS networks for long-term observations of physical and biological resources that directly and indirectly respond to climate.
- Integrating and disseminating information from multiagency monitoring networks that collect information on climate-change effects across public lands.
- Evaluating and reporting regularly on the Nation's environmental and natural-resource condition and response to climate change, emphasizing what is known and what is uncertain about effects on the Nation's land, water, and ecosystems and their biota.
- Researching interactions between climate and physical, chemical, and biological forces that influence the structure and functioning of ecosystems and the goods and services they provide.
- Continuing and expanding hydroclimatological research to understand how climate and hydrology interact to affect floods and droughts, seasonal snowpacks, and water quality and freshwater supplies.
- Reconstructing past climate history and climate-related ecological, biological, and physical responses to better understand patterns of natural variability, changes currently taking place, and future scenarios.
- Studying, interpreting, and communicating the linkages between climate and the major biogeochemical cycles in soil, vegetation, freshwater, and oceans.
- Refining, applying, and interpreting watershed and ecosystem process models to assist the Nation's natural resource managers to adapt to climate change and develop adaptation and mitigation methodologies that can be used by resource managers to minimize the effects of climate change on the Nation's land, water, ecosystems, and biological populations.

A Vision For the Future

USGS scientists use long-term observational data and records to interpret consequences of climate variability and change to the Nation's biological populations, ecosystems, and land and water resources; provide expert, interdisciplinary advice on risks to infrastructure, human safety, and environment; and make regional and national assessments of critical resource interdependencies that are widely used by policymakers, natural resource managers, and the public.

For Additional Information

U.S. Geological Survey, 2007, Facing Tomorrow's Challenges—U.S. Geological Survey Science in the Decade 2007–2017: Available online at <http://pubs.er.usgs.gov/usgspubs/cir/cir1309>

Also, visit the USGS home page at <http://www.usgs.gov/>