



USGS SCIENCE IN THE DECADE 2007–2017

Facing Tomorrow's Challenges—An Overview

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 is an overview of the science strategy and describes how USGS research can strengthen the Nation with information needed to meet the challenges of the 21st century.

A Science Strategy for the Future

To be responsive to evolving national and global priorities, the U.S. Geological Survey (USGS) must periodically review its science goals and optimize its strategic directions. This fact sheet is an overview of a new, comprehensive science strategy outlining the goals and priorities of the USGS for the next decade.

The development of a new USGS science strategy for 2007–2017 comes at a time of global trends and rapidly evolving societal needs that pose critical natural-science challenges. First, the emergence of a global economy affects the demand for all resources. The world's natural resources, and the materials produced from those resources, are being used on a scale that is modifying the terrestrial, marine, and atmospheric environments upon which human civilization depends. The use of, competition for, and natural threats to resources on the global scale will affect the Nation's ability to sustain its economy, safeguard its national security, maintain its quality of life, and protect its natural environment.

Second, the last decade has witnessed the emergence of a new model for managing Federal lands—ecosystem-based management. By understanding the status of the Nation's natural resources, their interrelations and changes with time, and their resilience to future natural and human-caused threats, decisionmakers will be able to ensure the security of the Nation, promote the vitality of its economy, protect the health of its envi-

ronment, and maintain the well-being of its citizens.

Third, the U.S. Climate Change Science Program predicts that the next few decades will bring rapid changes in the Nation's and the Earth's environment. Land and resource managers will need to understand the local and regional implications of climate change as well as anticipate and prepare for its impacts to reduce the potential for disaster.

Finally, the natural environment continues to pose risks to society in the form of volcanoes, earthquakes, wildfires, floods, droughts, invasive species, natural and anthropogenic toxins, and animal-borne diseases that affect humans. Some of these hazards may be magnified by changing climate and will be increased

by the movement of the Nation's population to coastal, earthquake-prone, and wildfire-prone areas. Understanding these risks, better defining their probabilities, and forecasting their effect on the status and future of society are essential for a resilient and prosperous United States.

The USGS response to these national priorities and global trends requires a science strategy that builds on existing strengths and partnerships. It also demands the innovation made possible by integrating the full breadth and depth of USGS capabilities to undertake comprehensive and integrated studies that examine the Earth as a system in which biosphere, hydrosphere, lithosphere, and atmosphere are interrelated.

The new USGS science strategy consists of six science directions, which are summarized on the inside pages. This strategy will be implemented at a time when the Nation can benefit greatly by using natural-science information in its decisionmaking. The USGS is well positioned to address the challenge of providing this information. It is the Nation's

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USGS scientists use an airboat to measure the cross section of the Toutle River in Washington State. Accurate, up-to-date measurements are needed to calculate streamflow, develop computer models of surface-water flow, and predict the potential for flooding. Photograph by Pat Pringle, U.S. Geological Survey.

Understanding Ecosystems and Predicting Ecosystem Change: Ensuring the Nation's Economic and Environmental Future



In collaboration with others, the USGS reports on the state of the Nation's terrestrial, freshwater, and coastal/marine ecosystems and studies the causes and consequences of ecological change, monitors and provides methods for protecting and managing the biological and physical components and processes of ecosystems, and interprets for policymakers how current and future rates of change will affect natural resources and society. The USGS works in collaboration with others to understand the distribution, interactions, condition, and conservation requirements of organisms in an ecosystem context and predicts changes to biodiversity resulting from land-cover change, climate change, and other impacts to ecosystems. Through research, the USGS and its partners will advance understanding of ecosystem structure, function, patterns and processes and will develop new products, including standardized national maps of U.S. ecosystems. These and other products will help communities and managers make informed decisions that take into account ecosystem health and sustainability. (See U.S. Geological Survey Fact Sheet 2007-3107, available at <http://pubs.usgs.gov/fs/2007/3107/>)

Climate Variability and Change: Clarifying the Record and Assessing Consequences



USGS scientists will meet the pressing needs of the Federal government, policy-makers, and resource managers for state-of-the-science information and predictive understanding of climate change and its effects by studying the interactions among climate, earth surface processes, and ecosystems across space and time. To answer questions about how the world is changing, the USGS will expand its already strong research and monitoring initiatives in the science of carbon, nitrogen, and water cycles, hydroclimatic and ecosystem effects of climate change, and land-cover and land-use change and will apply the knowledge gained to understanding potential future states and processes. Expanded and modernized USGS observation networks of land, water, and biological resources will be crucial to rigorous analyses of future responses to climate change. The USGS will provide robust predictive and empirical tools for managers to test adaptive strategies, reduce risk, and increase the potential for hydrologic and ecologic systems to be self-sustaining, resilient, and adaptable to climate change and related disturbances. (See U.S. Geological Survey Fact Sheet 2007-3108, available at <http://pubs.usgs.gov/fs/2007/3108/>)

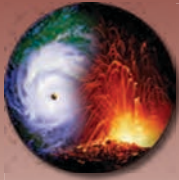
Energy and Minerals for America's Future: Providing a Scientific Foundation for Resource Security, Environmental Health, Economic Vitality, and Land Management



USGS energy and minerals resource research will be broadened to contribute more comprehensively to discourse and decisions about future natural resource security, environmental effects of resource use, the economic vitality of the Nation, and management of natural resources on U.S. Department of the Interior, Federal, and other lands. A wide-ranging, multidisciplinary approach is used to understand and evaluate how the complex life cycle of occurrence, formation processes, extraction methods, use, and waste products of energy and mineral resources influence, or are influenced by, landscape, hydrology, climate, ecosystems, and human health. Cumulative knowledge, long-term data, and new understanding of resource origin and assessment methodologies will improve the reliability and accuracy of national and global assessments and information products, especially as the energy mix evolves and new requirements for rare and scarce materials used by the Nation emerge. (See U.S. Geological Survey Fact Sheet 2007-3109, available at <http://pubs.usgs.gov/fs/2007/3109/>)

Seney National Wildlife Refuge, Michigan. Photograph obtained from U.S. Fish and Wildlife Digital Library system by John and Karen Hollingsworth.

A National Hazards, Risk, and Resilience Assessment Program: Ensuring the Long-Term Health and Wealth of the Nation



The USGS collects accurate and timely information from modern earth observation networks, assesses areas at risk from natural hazards, and conducts focused research to improve hazard predictions. In addition, the USGS works actively with the Nation's communities to assess the vulnerability of cities and ecosystems and to ensure that science is effectively applied to reduce losses. The USGS will develop a national risk-monitoring program, built on a robust underpinning of hazard assessment and research, to visualize and provide perspectives at multiple scales of vulnerability and resilience to adverse land change and hazards. Accurate observations, focused research, and timely communications will safeguard people and property and keep natural hazards from becoming natural disasters. (See U.S. Geological Survey Fact Sheet 2007-3110, available at <http://pubs.usgs.gov/fs/2007/3110/>)

The Role of Environment and Wildlife in Human Health: A System that Identifies Environmental Risk to Public Health in America



The USGS can contribute substantially to public health decisionmaking. The USGS monitors wildlife, is at the forefront of identifying wild-animal disease reservoirs, and maintains critical knowledge about wild-animal disease transmission to humans, drinking-water contaminants, air-dust-soil-sediment-rock contaminants, pathogens in recreational water, and the use of wild animals as sentinels of human health. To employ this expertise in support of the Nation's health needs, the USGS will fully integrate its massive data holdings and environmental science expertise to produce a national database and atlas of geology- and ecology-derived diseases and toxicants. Once this atlas is in place, the USGS will partner with allied health science agencies to support spatially related health research. (See U.S. Geological Survey Fact Sheet 2007-3111, available at <http://pubs.usgs.gov/fs/2007/3111/>)

A Water Census of the United States: Quantifying, Forecasting, and Securing Freshwater for America's Future



The USGS will develop a Water Census of the United States to inform the public and decisionmakers about (1) the status of its freshwater resources and how they are changing; (2) a more precise determination of water use for meeting future human, environmental, and wildlife needs; (3) how freshwater availability is related to natural storage and movement of water, as well as engineered systems, water use, and related transfers; (4) how to identify water sources, not commonly thought to be a resource, that might provide freshwater for human and environmental needs; and (5) forecasts of likely outcomes for water availability, water quality, and aquatic-ecosystem health caused by changes in land use and land cover, natural and engineered infrastructure, water use, and climate. (See U.S. Geological Survey Fact Sheet 2007-3112, available at <http://pubs.usgs.gov/fs/2007/3112/>)



A wildfire destroyed this home near San Bernardino, California, in October 2003. Photograph by Kevin Galvin, Federal Emergency Management Agency.

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and the world's leading natural science and information agency. Its workforce of nearly 9,000 scientists and support staff, distributed in about 400 locations, collects and interprets data from tens of thousands of biologic, geologic, and hydrologic sampling sites throughout the Nation. These efforts, combined with extensive remote-sensing capabilities, allow the USGS to map and understand Earth processes and changes.

The USGS maintains a broad scope of research activities and long-term data sets, such as:

- information relating to natural hazards, including earthquakes, tsunamis, volcanoes, landslides, and coastal erosion; energy and mineral resources; and geologic processes that affect the Nation's land and coasts;
- real-time flood data and information on the quality and quantity of surface- and ground-water resources;
- information critical to animal health, identifying and dealing with invasive species, biologic species management, and ecosystems; and
- geospatial data, topographic maps, and satellite images critical to emergency response, homeland security, land-use planning, and resource management.

The six science directions that compose the new USGS science strategy were chosen to address the societal issues that represent major challenges for the Nation's future. These science directions are critically important, will require

the best of the organization to fulfill, and will provide the information needed to solve the challenges facing the Nation in the coming decade. Throughout its history, the USGS, with its reputation for providing objective, scientifically rigorous information with a nonregulatory perspective, has contributed substantially to the national well-being in all these areas. The implementation of this science strategy over the next decade will strengthen and enhance this tradition of science in service to the Nation.

USGS Science Can Meet the Challenge

The impact of humans on the planet has expanded to the extent that we live today in what some have called the "Anthropocene"—a new geologic epoch in which humankind has emerged as a globally important force capable of reshaping the face of the planet. The ability of humanity to use an understanding of human-induced changes on Earth's environment to help guide the use of the Earth toward positive outcomes is embodied in the term "sustainability." This concept of sustainability symbolizes a desire not only to document the human use of the Earth but also to determine what it ought to be.

As the only integrated natural resources research bureau in the Federal Government, the USGS can play a substantial role in helping the economy remain strong, the environment remain healthy, and the quality of life in the United States remain high now and into the future. This role is larger than the traditional one of providing expertise in mapping, geology, water, and

biology. Major national issues of costly natural disasters, air and water quality, energy and materials needs, newly emerging diseases, invasive species, climate change, and even immigration form a web of linked dependencies among environment, societies, and economies. The USGS must transform its approaches to problem solving not only to address the issues of today but also to prepare for those of tomorrow. The questions are broad, the stakes are high, and the potential is there. No other organization in the Nation has the breadth of multidisciplinary scientific expertise, the extensive national on-the-ground presence, and the wealth of biologic, geographic, geologic, and hydrologic monitoring capabilities and existing data at all scales, from microscopic to global.

The management of the Nation's land, water, and ecosystem resources typically requires weighing tradeoffs among multiple criteria concerning multiple resources. The importance of identifying and understanding critical interdependencies is especially acute in decisions that require anticipating the interactive effects of changes in climate and changes in human resource management. In the not-too-distant future, a scientist will access a comprehensive array of biologic, geographic, geologic, and hydrologic data from past measurements and those being made in real time, use the data for models that describe the present state of the Nation, use high-resolution projections of future climatic states to understand how the situation will change, and provide this information to decisionmakers and the broader public in the forms most suited to their needs. The future holds unprecedented opportunities for USGS science to improve the economic and environmental health and prosperity of people and communities across the Nation and around the world. The USGS looks forward to meeting the challenges of the 21st century.

For Additional Information

U.S. Geological Survey, 2007, Facing tomorrow's challenges—U.S. Geological Survey science in the decade 2007-2017: U.S. Geological Survey Circular 1309, 69 p., available at <http://pubs.usgs.gov/circ/2007/1309/>

