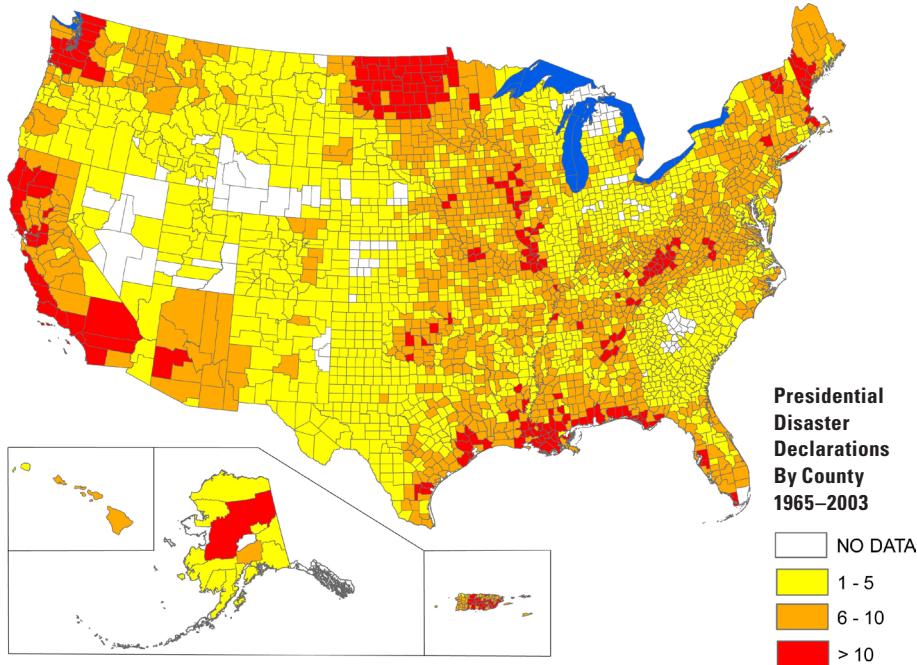




Natural Hazards – A National Threat

USGS Science Helps Build Safer Communities



Presidential Disaster Declarations in the United States and Territories by county from 1965–2003 reflect the broad geographic distribution and human impacts of earthquakes, floods, hurricanes, landslides, tsunamis, volcanoes and wildfires. (Map not to Scale. Source: FEMA)

The USGS Role in Reducing Disaster Losses

In the United States each year, natural hazards cause hundreds of deaths and cost billions of dollars in disaster aid, disruption of commerce, and destruction of homes and critical infrastructure. Although the number of lives lost to natural hazards each year generally has declined, the economic cost of major disaster response and recovery continues to rise. Each decade, property damage from natural hazards events doubles or triples. The United States is second only to Japan in economic damages resulting from natural disasters.

A major goal of the U.S. Geological Survey (USGS) is to reduce the vulnerability of the people and areas most at risk from natural hazards. Working with partners throughout all sectors of society, the USGS provides information, products, and knowledge to help build more resilient communities.

| Natural Hazards Impacts: | USGS Science Seeks to Achieve: |
|---|--|
| <ul style="list-style-type: none"> Earthquakes have the highest potential for causing catastrophic casualties, property damage, and economic disruption. Over 75 percent of declared Federal disasters are related to floods. More than half of the U.S. population lives within 50 miles of a coast. Many of these areas, especially the Atlantic and Gulf coasts, will be in the direct path of future hurricanes. Landslides affect every State, causing \$3.5 billion dollars annually in damages and between 25 and 50 deaths. The United States faces significant tsunami threats to the West Coast, Hawaii, Alaska, and island territories in the Caribbean and the Pacific. The United States has 169 active volcanoes capable of producing a wide range of hazards that threaten people and infrastructure on the ground as well as aircraft in flight. In 2004, wildfires burned more than 8 million acres in 40 States. | <ul style="list-style-type: none"> Rapid earthquake impact assessments delivered to emergency managers Real-time flood inundation mapping to support emergency response Predictions of coastal impacts 48 hours before hurricane landfall Tsunami risk maps for all coastal areas that may be at risk Better predictions of where and when landslides will occur Early detection of volcanic activity to allow maximum response time Real-time wildfire condition information to support rapid firefighting activity Integrated information about multiple hazards to create new products that are useful for reducing loss of life and property from natural hazards. |

The USGS provides scientific research and real-time information to help citizens, emergency managers, and policymakers decide how to react to each hazard and how to safeguard society.

The USGS has the lead Federal responsibility for issuing alerts about earthquakes, volcanic eruptions, and landslides. These effective forecasts and warnings, which are based on the best possible scientific information, are intended to enhance public safety and reduce losses.

Other agencies rely on USGS information to help them fulfill their responsibilities regarding natural hazards. For example, the National Weather Service (NWS) relies on USGS real-time streamflow information for developing forecasts and issuing flood watches and warnings. The NWS also relies on data from USGS-supported seismic networks as a primary input for tsunami warnings.

USGS seismic hazard maps provide information essential to building codes adopted by States and localities nationwide. USGS pre-hurricane forecasts regarding impacts to infrastructure are essential for evacuation and poststorm recovery efforts. USGS notices of volcanic activity are used by the Federal Aviation Administration, NWS, airlines, and the Department of Defense to keep air traffic flowing safely. USGS volcano hazard assessments are used by State and local communities and land managers to guide development in hazardous areas and to develop eruption response and mitigation plans. The USGS and its Federal partners monitor seasonal wildfire danger conditions and provide firefighters with maps of current fire locations, perimeters, and potential spread.

USGS Priorities for Natural Hazard Science

The USGS has made major advances in its ability to assess, monitor, and predict natural hazards. Its current challenge is to turn technical ability into operational capability.

The USGS is focusing on strengthening its science that deals with natural hazards that typically have a sudden onset and can have catastrophic consequences in terms of loss of life and destruction of property—earthquakes, floods, hurricanes, landslides, tsunamis, volcanoes, and wildfires. It brings a broad combination of disciplines—biology, geology, hydrology, geography, and geospatial information technology—to bear on all these hazards. This work is also applicable to more gradual hazards such as drought and the effects of changing climate. The USGS, in collaboration with its partners, can help reduce disaster losses by:

- Issuing more timely and accurate warnings of the severity and locations of hazards when they occur
- Ensuring the availability of hazard predictions and warnings to all those who may be impacted by a natural hazard
- Developing products in formats that are useful to a wide range of users and that can be quickly put into the hands of emergency management personnel to guide their rescue and recovery efforts
- Characterizing natural hazards and their risks
- Installing and operating the monitoring networks necessary to detect and track hazardous phenomena
- Increasing the scientific understanding of why, where, how, and when natural disasters occur and communicating that understanding to affected communities and the Nation.



Hurricane Katrina caused widespread destruction along the Gulf Coast in late summer 2005. (Photo by Mark Wolfe, FEMA)



An eruption cloud ascends from Redoubt Volcano, Alaska, as viewed to the west from the Kenai Peninsula on April 21, 1990. (Photo by R. Clucas)



A 1964 earthquake-generated tsunami left severe damage in Seward, Alaska, and along Prince William Sound. (Photo by the Department of the Interior)



Homes in East Grand Forks, Minn., are submerged following flooding in 1997. (Photo by David Saville, FEMA)

A Vision for the Future

In order to provide science that safeguards society from natural disasters, the USGS must collect accurate and timely information from modern earth observation networks, assess areas at risk from natural hazards, and conduct research targeted at improving hazard predictions.

Collect Information from Earth Observation Hazard Networks

Robust monitoring networks provide the fundamental information needed to accurately predict and characterize hazards as well as information vital to response and recovery efforts. Modernization of earthquake, volcano, and flood monitoring networks in particular are critical to help communities prepare for, respond to, and rebuild following natural hazard events. Future success depends on:

- ✓ Fully deploying the Advanced National Seismic System to improve seismic monitoring of the 26 U.S. urban areas at greatest risk from earthquakes
- ✓ Developing the National Volcano Early Warning System so that the most threatening of the Nation's volcanoes are well monitored with modern, real-time networks
- ✓ Ensuring a stable, core network of USGS-supported streamflow stations for continuity of data critical for flood warnings, drought management, and other uses
- ✓ Expanding the Marsh Surface Elevation Table Network to evaluate the effects of hurricanes on coastal wetlands
- ✓ Systematically acquiring moderate resolution, multi-spectral imaging; temporally repeated National Land Cover Dataset products; and LIDAR to assess and monitor hazards-related landscape changes.

Assess and Characterize Natural Hazards

Characterizing hazards—determining where they are likely to occur and how large they are likely to be—is essential for making decisions about where and how to live and build. Examples include:

- ✓ Evaluating the physical and socio-economic vulnerability of both the built and the natural environment to multiple hazards
- ✓ Creating multi-hazard maps for at-risk urban areas
- ✓ Enhancing LANDFIRE—an inter-agency cooperative assessment of wildfire factors—to project changes in vegetation, fire fuels, and fire characteristics over time
- ✓ Developing streamflow characteristics for all locations in the Nation, including areas without streamgages
- ✓ Assessing vulnerability of hurricane-threatened U.S. coasts to different hurricane types and intensities
- ✓ Determining potential for tsunami generation in U.S. offshore waters
- ✓ Providing high-resolution digital imagery to more accurately characterize hazard susceptibility.



Parts of San Francisco were devastated following a magnitude 7.1 earthquake in October 1989. (Photo by C.E. Meyer, USGS)

Target Research on Hazard Processes and Prediction

Accurate forecasts and predictions are dependent on understanding the physical processes that control the occurrence, distribution, timing, and severity of a hazard. Additional targeted research is needed to make significant advances in hazard prediction:

- ✓ Advancing knowledge of the time-dependence of earthquake processes can enable forecasts that focus on those faults most likely to rupture soon.
- ✓ Forecasting the style and magnitude of volcanic eruptions builds on the current ability to forecast the timing of eruptions.
- ✓ Understanding of landslide processes will form the basis for real-time landslide and debris-flow warning systems.
- ✓ Research on tsunami-generating processes will improve assessments of tsunami hazard potential.
- ✓ Advancing non-contact data collection and real-time estimates of measurement uncertainty could significantly improve flood estimates.
- ✓ An enhanced awareness of the role of wetlands in protecting coastal communities from the ravaging impacts of hurricanes is needed to improve risk assessments.

Early Warning of Hazards

When a hazard looms, advanced warning can make a critical difference in saving lives and protecting property. A primary goal of USGS science is to provide warnings further in advance of the onset of a hazard event. Priorities include:

- ✓ **Earthquakes:** Develop new methodologies that use seismic data telemetry to reduce the response time for earthquake notification, in some cases before shaking begins
- ✓ **Volcanoes:** Provide a five-minute notification of ash-producing volcanic eruptions so that air traffic control centers can provide airline pilots and dispatchers enough lead time to alter flight plans
- ✓ **Landslides and Debris Flows:** Develop and fully deploy debris-flow early warning systems in partnership with the NWS
- ✓ **Flood:** Provide real-time information from USGS streamgages for the NWS and others to use in making forecasts and issuing flood warnings
- ✓ **Forecast Coastal Change Resulting from Hurricanes:** Forecast the expected locations and relative magnitudes of extreme coastal changes 48 hours before hurricane landfall by using hurricane track and intensity forecasts supplied by the National Hurricane Center



An ambulance passes evacuees during a June 2002 wildfire in Colorado. (Photo by Bryan Dahlberg, FEMA)

USGS Multi-Hazards Demonstration Project

The USGS proposes a new project in Southern California to demonstrate how integrating information and products about multiple hazards can help to reduce vulnerability of high-risk communities to natural hazards. The Multi-Hazards Demonstration Project brings the unique research and systems capabilities of the USGS to bear on the complex issues surrounding natural hazards events, especially those that are interrelated such as fire, floods, debris flows, earthquakes, or tsunamis.

Why Southern California?

Southern California has one of the Nation's highest potentials for extreme catastrophic losses due to natural hazards. Estimates of expected losses from these hazards in eight counties of Southern California exceed \$3 billion per year.

This project will expand the use of USGS science through more effective risk communication and better technology. The USGS will engage the local emergency management community in all phases of the project to determine their needs, design projects to fulfill those needs, and deliver relevant products that result in more disaster-resilient communities. Integrated information from modern earth observation networks, targeted research on hazards processes, and comprehensive hazard assessments will lead to better understanding of when, where, and how hazards occur. As a result, predictions will be more timely and accurate, providing the lead time needed to save lives and property.

The USGS is working closely with a number of partners in Southern California, who will help plan and guide the implementation of the USGS Multi-Hazards Demonstration Project. Results expected include:

- ✓ Prototype early warning systems for flash floods and debris flows
- ✓ Integrated hazards maps developed in collaboration with local emergency managers
- ✓ Hazard scenarios to identify vulnerabilities
- ✓ Systems for hazards monitoring and risk assessment
- ✓ Robust/hardened information technology and telecommunications systems to ensure availability of critical information at all times.



In June 2005, these homes in Laguna Beach, Calif., were heavily damaged during landslides triggered by record rainfall. (Photo by the USGS)

For More Information

www.usgs.gov/hazards/