The U.S. Geological Survey Recent Highlights—*Hazards*

U.S. Department of the Interior

U.S. Geological Survey

Introduction

Hazards are unpreventable natural events, such as earthquakes, floods, landslides, volcanic eruptions, and wildfires. The U.S.Geological Survey (USGS) works to understand these hazards and to prevent or reduce suffering and economic loss from them. With the addition of the Biological Resources Division, the new USGS now deals with outbreaks of disease in wildlife populations as well. We document where and how natural hazards have occurred and devise better ways of monitoring these awesome processes. We also develop models to project where the most vulnerable areas are, in order to assist Federal, State, and local officials in their disaster relief and mitigation planning.

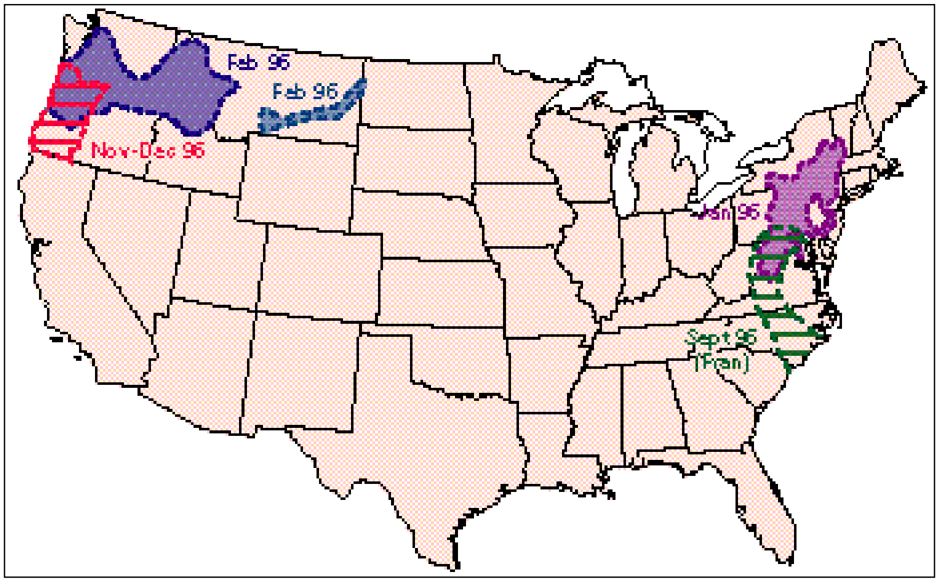

Figure 1. General areas of major flooding, January-December 1996.

USGS Response to Hazard Events of 1996

In fiscal year 1996, many different parts of the United States were struck by natural hazards. The events highlighted here, including floods, landslides, a hurricane, and an outbreak of avian botulism, show the range of USGS responses to hazard events. In some cases, the individual event was not national in scale. Hazards always strike locally; however: it is our vulnerability to hazards and their enormous economic and social consequences that make them a national problem.

Floods

In 1996, severe weather produced major floods in several parts of the country (fig. 1). Wherever flooding occurs, the USGS, as the Nation's leading source of water resources information, provides flood data to other Federal agencies, such as the National Weather Service (NWS) and the U.S. Army Corps of Engineers (COE), as well as to State and local emergency response agencies. Real-time river stage and discharge data are transmitted by satellite telemetry from more than 4,200 USGS stream gaging stations; these data enable the emergency response agencies to issue flood forecasts and evacuation orders to downstream communities, to monitor bridges and roads, and to effectively manage flood-control reservoirs to mitigate the impact of flooding.

In January 1996, heavy snowfall followed by a sudden thaw and heavy rain caused floods along rivers from New York through Pennsylvania to Virginia, producing water levels not seen since Hurricane Agnes (June 1972) on most major rivers in Pennsylvania and on the Potomac. The rain and melted snow, sometimes jammed with ice, caused two dozen deaths and required more than 100,000 people to evacuate their homes in subfreezing weather. Ice blocks carried by the floodwaters exacerbated the damage done to buildings, bridges, and dams. The cost in Pennsylvania alone was estimated at more than $1 billion, with every county in the State experiencing some damage. In spite of extremely hazardous conditions, the stream gaging network remained functional, and USGS field crews worked around the clock to provide a continuous flow of critical data to officials charged with managing both national and local responses to the flood emergency.

The following month (February 1996), during severe storms in the Pacific Northwest, real-time information from more than 150 stream gaging stations in Oregon and Washington was relayed by telemetry to the NWS, allowing highly accurate flood forecasting and effective flood management over a period of months. During the worst weather, in February 1996, these data enabled the COE to manage reservoir levels so as to prevent the flooding of downtown Portland. The storms caused many millions of dollars in damage, but the COE estimates that holding river levels below the top of the levee at Portland prevented $2.7 billion in additional damage. In November and December 1996, early winter storms brought renewed flooding to the Pacific Northwest, so once again the USGS is providing essential real-time data needed by decision makers as they plan their emergency response and recovery operations.

Landslide Hazards Across the Country

In June 1995, torrential rainfall along the Blue Ridge in central Virginia produced hundreds of fast-moving debris flows, which caused extensive property and crop damage and one fatality. The total cost from debris flows and flooding was over $100 million for the 12-county area affected. Followup reports by the USGS documented the extent of the debris flows, advised the public how and when to be alert for debris flows during heavy rainstorms, and provided a summary report, with mitigation recommendations, all in collaboration with the Federal Emergency Management Agency (FEMA). In February 1996, on the other side of the country, heavy rain and snowmelt caused widespread damage from flooding and landslides, inflicting total costs estimated at $800 million dollars to the States of Oregon, Idaho, and Washington. USGS landslide specialists were again called in to perform a regional reconnaissance of the extent and nature of the landslides. As in Virginia, they have contracted with FEMA to provide complete documentation of the distribution of landslides and an assessment of the ongoing hazard to the area from storm-triggered landslides, in an effort to mitigate the effects of future storms.

USGS landslide experts have also successfully forecast ground failure. In May 1996, scientists provided advance warning to officials of Pitkin County, Colo., that the Aspen Country Day School, near Aspen, Colo., was at risk from debris flows that might descend from a landslide developing 1,200 feet uphill from the school. Classes were moved, so that when debris flows, triggered by rapid snowmelt, did hit the school a few days later, no one was injured, even though school buildings and grounds were damaged.

Figure 2. Rockfall below Glacier Point, Yosemite. Upper arrow shows source of rockfall; lower arrow points to the roof of the Happy Isles Nature Center, which is approximately 100 feet long.

Not all ground failure events are related to storms. A very different, and spectacular, ground failure occurred at Yosemite National Park in July 1996, when more than 70,000 cubic yards of rock spalled off the upper part of the granite cliffs below Glacier Point. The slabs fell over 2,000 feet to the floor in the main valley of this heavily visited national park, killing one man and injuring several other people. The airblast created as the rock slabs hit the ground felled trees for a distance of 1,500 feet from the base of the cliff, as shown in figure 2. Much of the rock was pulverized as it hit, plastering the nearby landscape, and stripping the bark from trees 300 feet out from the impact site. USGS scientists responded quickly to document this unique rock fall and airblast phenomenon before the evidence was erased by wind and weather, and they are working with the National Park Service to develop mitigation strategies for the future.

USGS landslide activities emphasize rapid, postevent documentation and analysis of ground failure events, because so much of the evidence for landslides, debris flows, or rockfalls is either washed away by later storms, or physically removed as society cleans up after these events. Thorough documentation of the type and extent of ground failures provides an indispensable basis for recommendations on how to mitigate against future ground failure hazards.

Hurricane Fran

On September 5, 1996, Hurricane Fran, a category 3 hurricane with winds of 115 miles per hour, made landfall on the North Carolina coast at Cape Fear, an area that had already been hit by Hurricane Bertha in July. The winds and heavy rain from the storm produced a storm surge greater than 10 feet, which caused extensive flooding at the coast. The storm then moved northward across North Carolina and through Virginia to West Virginia, producing torrential rains and subsequent heavy flooding all along its track, as far north as the Potomac

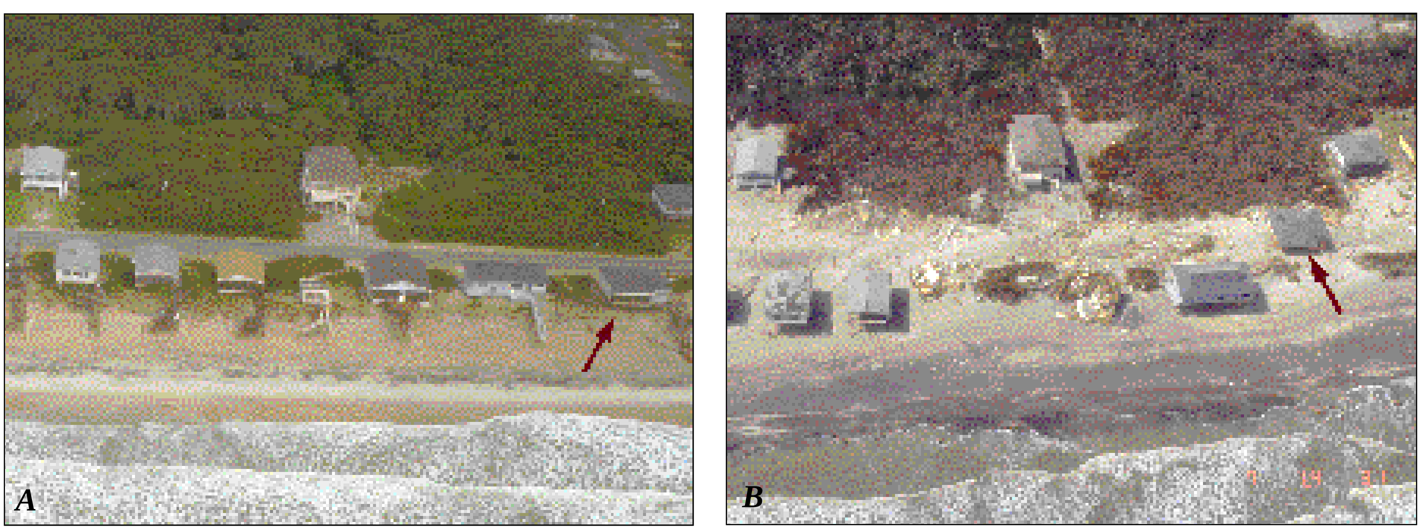

Figure 3. Coastal damage at Topsail Beach, N.C., ***A***, after Hurricane Bertha, a category 2 storm, and ***B***, after Hurricane Fran, a category 3 storm.

basin. USGS scientists responded both to the coastal damage and to the flooding over the whole area affected. Damage from Hurricane Fran, both at the coast and inland, was $5.1 billion for North Carolina alone.

On September 7-8, the USGS flew an aerial survey of the coast north of Cape Fear, using oblique video and 35-mm photography, to document the extent of coastal erosion and dune overwash along the North Carolina coast. As with landslides, rapid response is essential to completely document the impact of coastal storms, to map the area affected, and to understand the processes involved for purposes of hazard mitigation. Figure 3 shows the difference in damage caused by Hurricane Bertha (a category 2 storm) and by Hurricane Fran (a category 3 storm).

Flooding caused by Hurricane Fran extended over at least three States (North Carolina, Virginia, and West Virginia, see fig. 1), with peak water levels at the 50- to 500-year recurrence intervals over much of the area. In addition to monitoring the record water levels and advising Federal and local agencies on flooding hazards, USGS scientists documented the major degradation in river water quality that resulted from increased runoff and sediment load. This information is critical for the many communities that take their water supply directly from rivers affected by flooding.

Avian Botulism Outbreak at the Salton Sea

Eruptions of wildlife diseases affect human society as well as wild animal populations. Some diseases can be passed from wildlife populations to humans and domestic livestock, affecting society very directly. Other impacts include the loss of recreational opportunities, losses to commercial fisheries, and the cost of disease control activities. An outbreak of wildlife disease is often sudden and can be catastrophic, at least to local populations.

A major outbreak of avian botulism killed unprecedented numbers of pelicans at the Salton Sea in California during the summer of 1996. Public health activities were assisted when USGS disease investigations disclosed a potential human health hazard associated with a simultaneous die-off in the fish population. In addition to helping guide the disease control efforts of the U.S. Fish and Wildlife Service, USGS scientists organized a meeting of representatives of agriculture, wildlife conservation, water resources agencies, and other parties that depend on the Sea for their activities, to develop consensus views on diseases in the Salton Sea wildlife population and on to decide how to deal with the problems created by disease outbreaks

Improvements in Hazards Monitoring, Mapping, and Mitigation Planning

Volcanic Ash Monitoring in the Aleutians

Encounters between jet aircraft and volcanic ash clouds that are erupted explosively into the atmosphere pose a serious hazard: lives are endangered if jet engines cut out during flight, and the aircraft, both military and commercial, can be extensively damaged, even at low levels of exposure to ash. The USGS has led the effort to build awareness of this hazard worldwide, in part because many of our air routes in the Pacific Northwest and over the northern Pacific Ocean fly near or over the volcanoes of the Cascades and Aleutian Islands.

In fiscal year 1996, the USGS received funds through the Federal Aviation Administration (FAA) to extend our volcano monitoring network in the Aleutians. The work was done in the summer of 1996 by personnel of the Alaskan Volcano Observatory (AVO), which is a cooperative effort of the USGS, the University of Alaska, and the State of Alaska. Instruments were deployed at Pavlof, Akutan, Makushin, and Dutton, the most active of the Alaskan volcanoes not already being monitored (see fig. 4 for the location of these volcanoes).

One of the four, Pavlof, began erupting in mid-September, and the new instruments are relaying information on that eruption to AVO, which sends the data to the National Weather Service (NWS) and the FAA. The NWS tracks ash clouds from Pavlof in satellite images and sends those results to the FAA. The FAA in turn uses data from both the USGS and the NWS to keep pilots and air traffic controllers informed of the level of volcanic activity. So far, the activity at Pavlof has required only minor rerouting of air traffic. The new equipment, by giving positive assurance that this response is adequate, has saved the airlines and their customers time, money, and worry.

Enhanced volcano monitoring benefits the local communities in the Aleutians as well as the airline industry. In March 1996, when intense seismic swarms shook Akutan Volcano, scientists from AVO rushed equipment to Akutan to

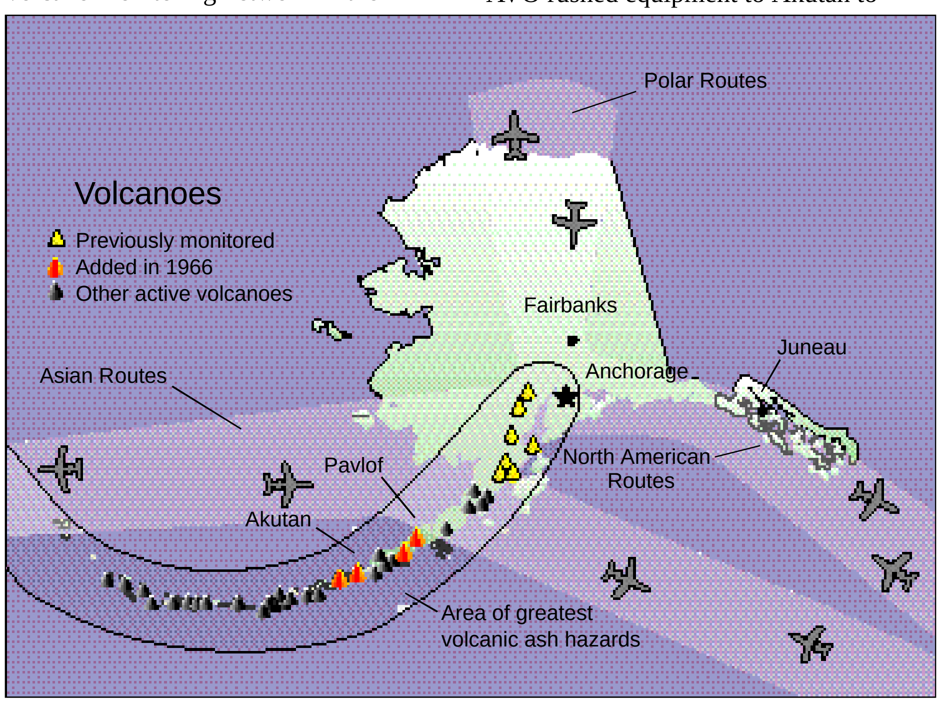

Figure 4. Volcanoes and air traffic routes in Alaska.

monitor the earthquakes. Data were

relayed to Anchorage and Fairbanks to be analyzed by AVO seismologists. Their results, together with assessments made by AVO scientists on the ground at Akutan, made it possible to reassure the 1,000 people on the island that an eruption was unlikely and evacuation would not be necessary. The local fishing industry (valued at $10 million per month) could continue uninterrupted.

National Seismic Hazard Maps

In 1996, the USGS completed and released a new series of national shaking-hazard maps, which show the severity of expected shaking of the ground in response to earthquakes for a particular probability level. The ground-shaking maps thus refine our knowledge of what the risk of earthquake damage is, not just for well-known seismically active areas such as California, but for the entire Nation. Figure 5 shows levels of ground shaking (expressed as a percentage of the acceleration of gravity) that have a 1-in-10 chance of being exceeded in a 50-year period. These maps, which are available in print and on the Web, are some of our most frequently requested products.

The USGS ground-shaking maps are being put to immediate use by the Building Seismic Safety Council (BSSC) as it updates seismic-risk maps for the Nation. The new BSSC risk maps will be issued in 1997, in cooperation with the USGS and FEMA, when the BSSC publishes its recommended seismic regulations for building codes throughout the country. The maps and codes are used by architects, engineers, and land use planners to plan for realistic earthquake risk levels.

High-Resolution Aeromagnetic Survey Results for the San Francisco Bay Region

Recently the USGS conducted a new high-resolution aeromagnetic survey of the San Francisco Bay area, both onshore and offshore to the west of San Francisco. This survey, which mapped subtle variations in the local magnetic field, gives us a better picture of the location and detailed structure of major faults in the Bay area. The first important result is that the part of the San Andreas fault that produced the 1906 earthquake is more complex and 2 miles closer to San Francisco than previously thought (see fig. 6). Such knowledge enhances our understanding of this past major earthquake and helps us prepare the area for future events.

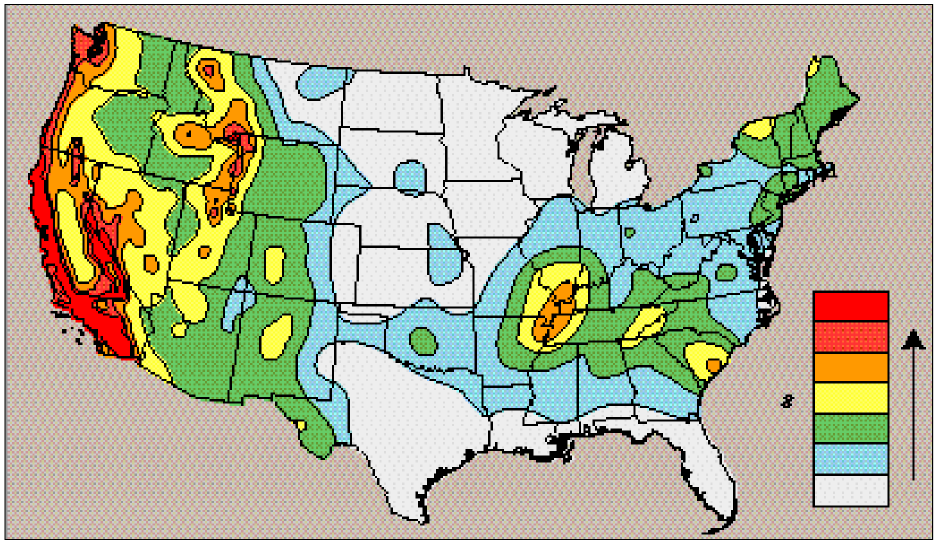

Figure 5. Shaking hazard map for the 48 contiguous States, showing levels of horizontal shaking that have a 1-in-10 chance of being exceeded in a 50-year period.

Another part of the survey, intended to assess the potential hazard that the inferred San Bruno fault posed to the new Bay Area Rapid Transit (BART) extension between Colma and San Francisco, produced a most unexpected result: no evidence was found that the San Bruno fault extends into the area where the rail line is to be built. This surprising but welcome result freed planners from having to consider and plan for a seismic threat to BART from that source.

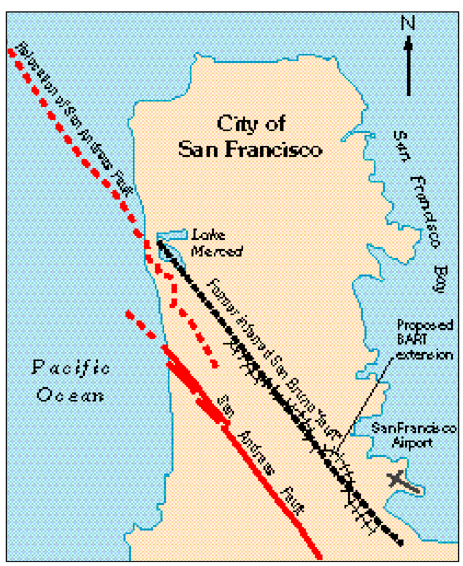

Figure 6. San Francisco Bay area, showing revised location of the San Andreas fault and the location of the formerly inferred San Bruno fault.

Information

For information on these and other USGS products and services, call 1-800-USA-MAPS, fax 703-648-5548, or e-mail: esicmail@usgs.gov.

Receive information from the EARTHFAX fax-on-demand system, which is available 24 hours a day at 703-648-4888.

The address for the USGS home page is <URL: http://www.usgs.gov/>

The address for the Hazards Theme home page is <URL: http://www.usgs.gov/themes/hazard.html>