USGS
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The Global Seismographic Network

The U.S. Geological Survey's National Earthquake Information Center reports on more than 30,000 earthquakes a year worldwide, automatically detecting, locating, and characterizing events, providing alerts, maps of strong ground shaking, and impact estimates of potential fatalities and losses. These rapid earthquake information products, which enable the prompt mobilization of emergency resources by all levels of government and humanitarian organizations, depend on the high-quality seismic stations that make up the Global Seismographic Network.

The Global Seismographic Network (GSN) is a permanent, digital network of more than 150 modern stations in over 80 countries, from the South Pole to Siberia and from the Pacific basin to the southern tip of Africa. At the core of the GSN, are the very broadband, high-dynamic range seismometers that measure the vibrations of the Earth. These instruments are extremely sensitive over a wide range of frequencies and are capable of detecting the response of the Earth to the motions of the Sun and the Moon with periods of thousands of seconds, as well as the strong shaking near large earthquakes with periods less than a tenth of a second, with high fidelity.

In many cases, these seismometers are combined with other sensors, such as microbarographs, anemometers, magnetometers, and Global Positioning System receivers, to form geophysical observatories. Advanced systems for data acquisition and communications transmit continuous digital data from the stations to collection points in the U.S.

The GSN was formed in 1986 as a partnership involving the U.S. Geological Survey (USGS), the National Science Foundation (NSF), and the Incorporated Research Institutions for Seismology (IRIS, a university consortium) and serves as a multi-use scientific facility and societal resource for monitoring, research, and education. All GSN data are freely and openly available to the public and scientists around the world from the IRIS Data Management Center.

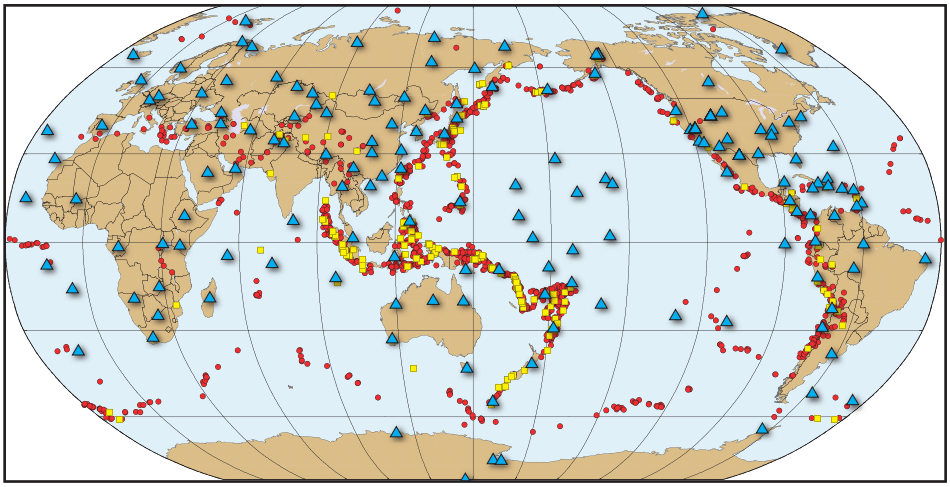
Monitoring Earthquakes and Other Seismic Events

Monitoring earthquakes around the world is essential to the mission of the USGS to deliver rapid information on damaging events and to assess earthquake hazards and risks, particularly because earthquakes outside the boundaries of the United States may endanger U.S. assets and citizens overseas and create destabilizing impacts abroad requiring humanitarian assistance. Nearly all GSN stations transmit data in near-real-time, contributing to USGS rapid earthquake information products such as alerts, Web pages, ShakeMaps, and Prompt Assessment of Global Earthquakes for Response (PAGER) loss estimates. For example, GSN data enabled the USGS National Earthquake Information Center (NEIC) to provide within 30 minutes a projection of the impact of the devastating 2010 Haiti earthquake.

The GSN also plays a major role in the operations of the National Oceanic and Atmospheric Administration (NOAA) Tsunami Warning Centers in Hawaii and Alaska. GSN data are used by the Warning Centers to issue tsunami alerts in all ocean basins of the world within a few minutes of the occurrence of a tsunamigenic earthquake. Foreign governments also rely on GSN data for their earthquake and tsunami monitoring systems. In addition, more than 50 stations of the GSN are part of the International Monitoring System of the Comprehensive Test Ban Treaty Organization (CTBTO) and contribute to nuclear test monitoring and treaty verification.

Applications to Research

GSN data acquired during the last 25 years have facilitated many advances in studies of Earth structure, earthquake science, and other geophysics research For example, GSN data have contributed to new understanding of the Earth's lowermost



Global Seismographic Network stations (triangles) are shown against a backdrop of large earthquakes from 2000–2010 (red circles—magnitude 6–6.9, yellow squares—magnitude 7 and larger earthquakes).

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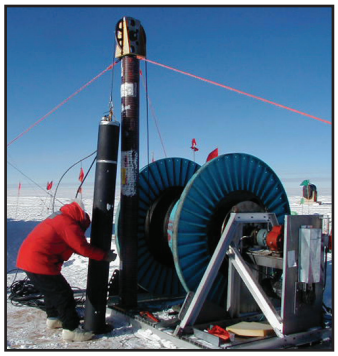

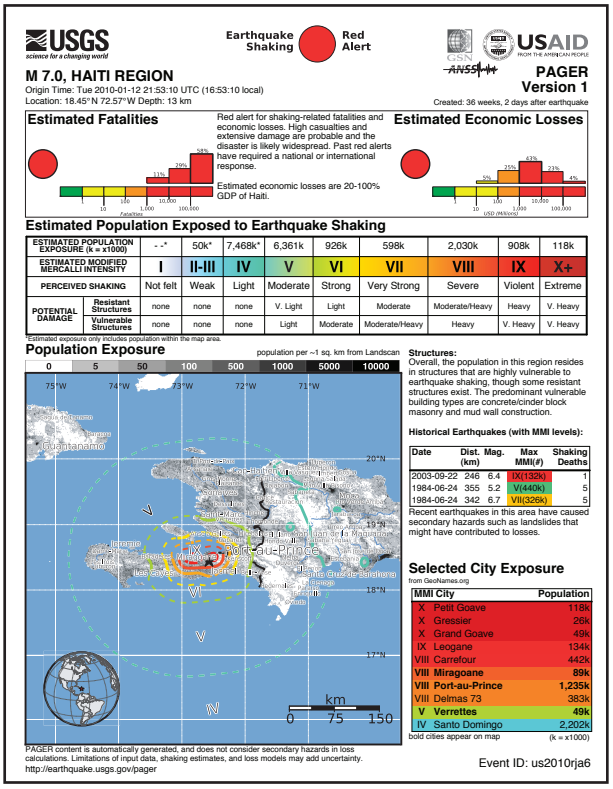

Under the auspices of the USGS and its partners, today's Global Seismographic Network supports the Nation's security, earthquake disaster response, and scientific research needs.

The PAGER provides fatality and economic loss impact estimates following significant earthquakes worldwide. These estimates are generally available within 30 minutes and are updated as more information becomes available. Rapid estimates include the number of people and names of cities exposed to each shaking intensity level as well as the likely ranges of fatalities and economic losses.

The GSN is coordinated with international efforts through the Federation of Digital Seismograph Networks.

The planned lifetime of the completed network is 30 years, but with continued improvements and equipment enhancements, the network should operate indefinitely. The GSN is currently being upgraded and standardized with "state-of-the-art" digital data acquisition systems. USGS allocated $4.7 million of its American Recovery and Reinvestment Act (ARRA) funding to these upgrades, and NSF also devoted $5 million of ARRA-enabled funds to the effort. Together, these allocations and ongoing support will allow the completion of the current GSN modernization effort over the next few years.

Over the past half century, multipurpose seismic monitoring of the Earth has evolved into the world's leading system for detecting, analyzing, and reporting on earthquakes and other events that create seismic signals.

As one of the four federal agency partners in the congressionally authorized National Earthquake Hazard Reduction Program (NEHRP), the USGS is responsible for monitoring seismic activity, assessing earthquake risks, evaluating earthquake predictions, and conducting research to characterize and identify earthquake hazards. The Incorporated Research Institutions for Seismology (IRIS) is a university consortium sponsored by the NSF, a partner in NEHRP. IRIS is dedicated to the operation of scientific facilities for the acquisition, management, and distribution of freely available seismic data. The USGS, NSF, and IRIS are dedicated to providing high-quality seismological data for hazards reduction and research.

—Lind S. Gee and William S. Leith

mantle and core, including the discovery of the fine structure in the inner core, maps of mantle strain that reveal details of mantle deformation, observations of "slow earthquakes," some of which may be ice quakes associated with movement of glaciers, and insight on the processes that govern how earthquake ruptures start and stop. GSN data have also improved the plate-tectonic framework for understanding earthquake hazards by providing better earthquake locations, more accurate models of fault slip, and other earthquake source parameters.

Partnerships, Funding, and Operations

Initially, the GSN was developed on the footprint of earlier global networks, including the Worldwide Standardized Seismograph Network and the International Deployment of Accelerometers. The principal network operators of the GSN are the USGS Albuquerque Seismological Laboratory (ASL) and the Cecil and Ida Green Institute of Geophysics and Planetary Physics, Scripps Institution of Oceanography, University of California at San Diego (UCSD), which is funded by the NSF through IRIS. The network is installed and maintained in cooperation with many international partners, who, in most cases, provide facilities to shelter the instruments and personnel to oversee the security and operation of each station. ASL and UCSD personnel track station and communication system performance, train station operators, provide routine and emergency service visits, and perform data quality control.

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