



Taking the Earth's Pulse

During the past 35 years, scientists have developed a vast network of seismometers that record earthquakes, volcanic eruptions, and nuclear explosions throughout the world. Seismographic data support disaster response, scientific research, and global security. With this network, the United States maintains world leadership in monitoring the greatest natural and technological events that threaten our planet's population.

The Global Seismographic Network

Scientists of the U.S. Geological Survey (USGS) have operated seismographic stations throughout the world for more than 35 years. For the past few years, in cooperation with the Incorporated Research Institutions for Seismology (IRIS—a consortium of more than 90 universities), the USGS has begun to upgrade the system into a state-of-the-art Global Seismographic Network (GSN). The GSN is designed for obtaining high-quality data in digital form that can be readily accessed by data users worldwide. Most data are accessed via computer modems. For some stations, the data are reported to orbiting satellites, and thence to the Internet where information can be viewed using the World Wide Web.

The GSN network design calls for a total of 128 stations located in more than 80 countries on all continents. The GSN dramatically improves the quality, coverage, and quantity of data for earthquake reporting and research—the GSN also monitors nuclear explosions worldwide. At the end of 1996, the GSN consisted of 107 stations, of which the USGS is responsible for 77.

Figure caption: The Global Seismographic Network (GSN), when completed, will include 128 stations. The GSN dramatically improves the quality, coverage, and quantity of data for earthquake reporting and research, and monitoring nuclear explosions worldwide.

Monitoring Earthquakes and Tsunamis

Seismologists at the USGS National Earthquake Information Center (NEIC) in Golden, Colorado, routinely obtain and analyze data from GSN stations within minutes. These data are used to determine the location and magnitude of large seismic events anywhere on Earth. Depth and type of earthquake are determined within about an hour. Such information is in strong demand by scientists and government officials responsible for responding to emergencies and disasters in populated regions.

Economic and security interests of the United States, as well as foreign disaster-response and relief activities, are served by the information provided by the NEIC using the GSN. For example, the NEIC immediately relays information about damaging foreign earthquakes to staffs of U.S. embassies and consulates, the United Nations, and the national and international news media.

The GSN provides the global complement to the U.S. National Seismographic Network (USNSN), which is also operated by the USGS with university partners. The GSN and USNSN stations are similar, and data collection, analysis, and distribution are coordinated by the USGS and IRIS. For large earthquakes in the United States, especially those near the borders or offshore, the extended coverage of the GSN provides critical data for disaster response.

Many of the GSN stations in and around the Pacific basin are now part of a warning system that monitors earthquakes having the possibility of generating tsunamis (seismic sea waves). The Tsunami Hazard Mitigation Implementation Plan, initiated in December 1996, was designed to maximize the efficiency of detecting tsunami threats, issuing warnings, and responding to tsunami damage. The plan relies on several GSN stations and the combined resources of the National Oceanic and Atmospheric Administration (NOAA), the Federal Emergency Management Agency (FEMA), the USGS, and the states of California, Oregon, Washington, Alaska, and Hawaii.

Photo caption: GSN stations are designed for optimum performance in a wide variety of environments. This station near Mt. Newall in Antarctica was installed and operated for the U.S. Air Force by the USGS. The helicopter is delivering propane that will fuel generators that power the station. Data from this station are transmitted to Scott Base, Antarctica; thence worldwide via the Internet.

Earthquake Research

The GSN is an invaluable tool for research on global earthquake hazards, earthquake mechanisms and the geologic processes that cause earthquakes, and on the internal structure, composition, and dynamic processes of the Earth. Seismic waves, recorded after they have traveled thousands of miles through the Earth's interior, bear significant information about the tectonic plates and the mantle and core that underlie them. Researchers use GSN data extensively to construct and revise three-dimensional models of the Earth's interior. These models, in turn, are used to accurately locate earthquakes and large explosions.

GSN data also allow seismologists to understand why earthquakes of similar size differ greatly in their damage potential. These data have shown that the duration of strong shaking near the earthquake epicenter varies significantly for shocks of the same magnitude. This finding allows seismologists using the GSN to project more accurately what the effects of an earthquake are likely to be in the critical response time just after the earthquake has occurred.

Monitoring Nuclear Explosions

GSN data are used to locate, identify, and estimate the yield of under ground nuclear explosions and other explosions, and in research to improve capabilities in these areas. Nonproliferation of nuclear weapons is important to our national security, and the GSN will provide easily available data to help determine the cause of seismic events. Sixty-nine of the existing or planned GSN stations are designated for supporting the International Monitoring System being developed to ensure that countries uphold the recently signed Comprehensive Test Ban Treaty.

GSN logo: National Security Response Disaster Research Scientific

Logo caption: The Global Seismographic Network (GSN) is the world's leading system for monitoring events that create seismic signals. The GSN is a powerful, versatile tool with many applications for disaster response, scientific research, and national security.

Partnerships, Funding, and Operations

The GSN was installed and is maintained in cooperation with many international partners. The process of siting, permitting, and installing GSN stations is nearing completion. The planned lifetime of the completed network is 30 years but, with continual improvements and equipment upgrades, the network should operate indefinitely.

The principal network managers are the USGS Albuquerque Seismological Laboratory (USGS/ASL) and the University of California at San Diego (UCSD), which is funded by the National Science Foundation (NSF) through IRIS. USGS/ASL and UCSD are responsible for monitoring and supporting station operations. Their tasks include training station operators, providing routine and emergency service visits to network stations, quality control, and distributing seismic data.

Under the auspices of the USGS and its cooperators, multipurpose seismic monitoring of the Earth has evolved during 35 years into the world's leading system for monitoring, analyzing, and reporting on all events that create seismic signals. The GSN is a primary example of USGS leadership, expertise, and experience in the long-term operation of a global seismic monitoring program in support of the Nation's security, earthquake disaster response, and scientific research needs.

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