nehrp SeismicWaves
How the National Earthquake Hazards Reduction Program Is Advancing Earthquake Safety
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ShakeMap and ShakeCast

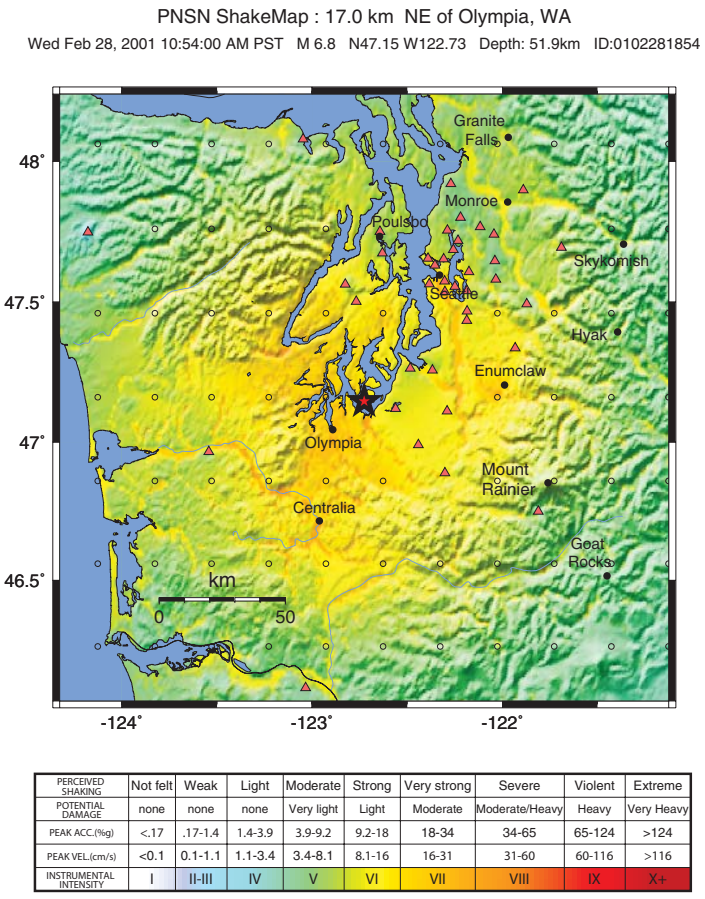
Revolutionizing Informatics for Earthquake Response

In the immediate aftermath of a damaging earthquake, lives and property may hang in the balance as emergency personnel assess and respond to the disaster. The ShakeMap and ShakeCast systems can tell responders where they are most likely to be needed, and tell them quickly—within minutes of an earthquake.

ShakeMap and ShakeCast (short for ShakeMap Broadcast) are complementary software systems developed by the United States Geological Survey (USGS), one of the agencies participating in NEHRP. ShakeMap originated in the late 1990s and expanded as a key product of the Advanced National Seismic System (ANSS), the nationwide network of monitoring stations that detect, measure, and record seismic events. ShakeMap systems receive and process ANSS data in regions of high seismic activity. When a moderate to large earthquake occurs, ShakeMap automatically generates maps and data files that document various measures of ground shaking. The most popular of these products is the instrumental intensity ShakeMap, which uses color coding to depict the severity of earthquake shaking.

USGS and its regional seismic network partners now operate ShakeMap systems in Alaska, Southern California, Northern California, Nevada, the Pacific Northwest, and Utah. Before these systems were established, responders typically received just two pieces of data from monitoring networks following earthquakes: the magnitude and location (epicenter) of the quake. Although helpful, this information has limited utility for targeting and prioritizing response efforts. This is because the shaking at a particular location is influenced not just by how far it is from the epicenter or how strong the earthquake is at its source. It is also affected by rock and soil conditions at the site and by the structure of the Earth's crust between there and the source. As the ShakeMap shown here illustrates, shaking can be stronger in some locations than in areas closer to the epicenter.

By mapping ground motions in near real time, ShakeMap can help responders to quickly assess the scope of an event, determine which areas are likely to have sustained more or less damage, and mobilize and target appropriate resources. In addition to earthquake response, ShakeMap is also being used for structural engineering analyses, for seismological research, and for developing earthquake scenarios, which provide ShakeMap products—produced using estimated ground motions—for potential future earthquakes. ShakeMap scenario data are widely used in conjunction with earthquake loss-estimation software, such as the Hazards U.S. (HAZUS) software developed by the Federal Emergency Management Agency (FEMA, a NEHRP agency), for guiding disaster planning and associated training exercises.



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Instrumental intensity ShakeMap for magnitude 6.8 earthquake near Olympia, WA, 2/28/01; epicenter is starred. Source: USGS

ShakeMap's central role, however, is in enhancing situational awareness among responders, enabling them to better target, prioritize, and expedite a range of activities, from medical treatment, firefighting, and emergency feeding and sheltering to damage and safety assessment, utility and lifeline restoration, loss estimation, and public information services. The public agencies, utilities, and media organizations that carry out these activities are the critical ShakeMap users that ShakeCast was created to assist.

Anyone can access current and past ShakeMap output on the USGS ShakeMap Web pages (http://earthquake.usgs.gov/shakemap). ShakeCast, however, automates this access. Organizations with ShakeCast software can automatically download desired ShakeMap products as soon as they are generated, 24-7. The ShakeCast system can automatically connect to a user's database of critical facility or lifeline locations, report on shaking levels and the likelihood of damage at each location, and notify specified personnel when preset shaking or damage thresholds are met. ShakeCast can also feed ShakeMap data to other user applications, such as loss-estimation or geographic-information systems.

The ShakeCast system first became available in 2004. USGS plans to release a major system upgrade, ShakeCast Version 2.0, later this year. The system has been developed by USGS with support through a grant from the California Department of Transportation (Caltrans). A few of the organizations that have or soon will become ShakeCast users include FEMA, the U.S. Department of Veterans Affairs (VA), Caltrans, Pacific Gas and Electric Company, and the Los Angeles Unified School District (LAUSD).

With responsibility for more than 25,000 bridges and overpasses, Caltrans exemplifies critical users' needs for ShakeCast. The VA will use the system to monitor earthquake impacts at its hospitals nationwide. ShakeCast is expected to help the LAUSD, which maintains about 13,000 buildings at more than 700 sites, not only in identifying and prioritizing response efforts for buildings likely to have been damaged, but also in locating undamaged structures that can serve as emergency shelters for the Red Cross.

More information about ShakeCast is available at http://earthquake.usgs.gov/shakecast.