

Earthquake early warning in the United States

Professor Richard Allen, Seismological Laboratory, UC Berkeley – April 2009

Earthquake early warning is the rapid detection of an earthquake when it begins, assessment of the likely ground shaking hazard, and warning to people and infrastructure in harms way.

The amount of warning time is mostly dependent on the distance from the earthquake epicenter and typically ranges from a few seconds to tens of seconds.

There is currently no publically available warning system in the United States.

The accuracy and warning time is maximized using a regional seismic network that can detect an earthquake on seismometers close to the epicenter and transmit the warning ahead of ground shaking.

The maximum amount of warning time for earthquakes in California is about 1 minute. Using a regional seismic network this would be possible for an earthquake nucleating at the northern end of the San Andreas Fault and rupturing towards the San Francisco Bay Area, or an event nucleating near the Salton Trough and rupturing north toward Los Angeles.

An early warning system will provide minimal or no warning time at the epicenter.

Single station methods use a single seismometer to provide warning at the location of the seismometer. Using a single station means that data does not need to be telemetered (as it does for a regional seismic network), however, using only one station to trigger on an earthquake is more prone to false alarms.

The only country with a publically available nationwide earthquake early warning system is Japan. The Japan Meteorological Agency uses a regional seismic network of about 1000 stations across the country to detect earthquakes and issue warnings. Mexico City and Istanbul also have warning systems.

The California Integrated Seismic Network (CISN.org) is currently testing three earthquake early warning algorithms using the realtime seismic networks across the state. This project is a collaboration between UC Berkeley, Caltech, the University of Southern California and the U.S. Geological Survey. The test is designed to evaluate the accuracy and timeliness of earthquake location and magnitude estimates and does not include providing warnings to users.

All three algorithms are currently running statewide in California detecting earthquakes and assessing the hazard on a daily basis. The “ElarmS” algorithm (ElarmS.org) detected the [October 30, 2007 M5.4 earthquake](#) beneath San Jose and accurately assessed the distribution of ground shaking before it was felt in San Francisco. The “onsite” method detected the Chino Hills earthquake in LA and the “Virtual Seismologist” has accurately detected 54 $M \geq 3$ earthquakes.

There is no reason why we could not have a publically available earthquake early warning system in the United States. All that is required is development of the technology to provide warning to the public and investment in the seismic infrastructure to rapidly detect earthquakes.

For more information contact Richard Allen: <http://seismo.berkeley.edu/~rallen>