CALIFORNIA EARTHQUAKE EARLY WARNING SYSTEM – STATUS AND FUTURE DIRECTION

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Abstract

The demonstration earthquake early warning system, developed by the USGS, UC Berkeley, Caltech, ETH, and the University of Washington, named ShakeAlert, functioned well for the South Napa earthquake of August 24, 2014. The first ShakeAlert was generated by the ElarmS algorithm (Kuyuk et al., 2014) 5.1 sec after the origin time of the earthquake, and 3.3 sec after the P-wave arrived at the closest station 6.5 km from the epicenter. The initial alert was based on P-wave triggers from four stations, had an estimated magnitude of 5.7. The warning was received at the UC Berkeley Seismological Laboratory 5 seconds before the S-wave and about 10 sec prior to the onset of the strongest shaking. ShakeAlert beta-testers across the San Francisco Bay Area received the alert simultaneously including the San Francisco 911 center with 8 sec warning, and the BART train system. BART has implemented an automated train-stopping system that was activated (though no trains were running at 3:20 in the morning).

With the available network geometry and communications, the blind zone of the ElarmS alert had a radius of 16 km. The four stations that contributed to the first ElarmS alert all provide 1 second data packets, but the latency in transmitting data to the processing center ranged from 0.27 to 2.62 seconds. If all the stations provide data in 0.27 seconds, then the alert would have been available 2.3 sec sooner and the blind zone would be reduced to about 8 km. This would also mean that the city of Napa would have received about 1 second of warning. Overall the magnitude estimate and event location were stable from the initial alert onwards. The magnitude estimate did first increase to 5.8 and then dip to 5.4 2.6 sec after the initial alert, stayed at that level for 2 sec, and then returned to 5.7. The final magnitude estimate was 6.0 consistent with the ANSS catalog. In addition to the ElarmS contribution to the ShakeAlert, the Onsite algorithm also contributed with an initial alert 10.9 s after the earthquake origin time.