

## ShakeAlert: Using early warnings for earthquakes in California and the US West Coast

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With funding from the USGS and the Gordon & Betty Moore Foundation, a prototype production system for earthquake early warning, ShakeAlert, is now operating in California. Earthquake early warning (EEW) is the ability to detect an earthquake quickly and provide a few seconds of warning before destructive shaking starts. Alerts from an EEW system can improve resilience if their recipients have developed plans for responding and act on them. We are working with a suite of perspective users from critical industries and institutions throughout California to identify information they require, as well as delivery mechanisms, procedures and products. Our most effective collaboration has been with the Bay Area Rapid Transit District (BART). Since 2012 the BART system has been using EEW information to automatically slow trains. BART receives alerts via the internet and feeds them into the train operating system. In the 2014 South Napa (M6) earthquake, the BART operations center received the EEW alert 8 s before shaking began at their site, 5 s after the earthquake started. The automatic processing worked. Had trains been running at 03:21 local time when the quake occurred, they would have slowed automatically. Other recipients of EEW alerts from California's EEW system include the emergency managers of San Francisco and Los Angeles, the California Office of Emergency Services, UC Berkeley's police department, and other organizations like the LA School District, Google, Amgen and the major power companies in California, PG&E and SoCal Edison. These organizations currently receive the alerts to enhance their situational awareness. We are also supporting their efforts to determine and implement appropriate responses to EEW alerts, and to assess possible uses and especially benefits to themselves and to society. More recently, the ShakeAlert system has begun operating in the Pacific Northwest, where our partners are also reaching out to perspective users. With the recent step to the production prototype system in California, we are encouraging our users to develop and implement automated and personal actions suitable to their applications, as further demonstrations of the benefits of EEW toward enhancing society's resilience.

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