

Smartphone-Based Earthquake Early Warning in Chile

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Chile faces a high seismic hazard with magnitude 7.5+ earthquakes occurring roughly every 1.5 years. Accordingly, Chile has a need for both earthquake early warning and local tsunami early warning. The Chilean Centro Sismológico Nacional (CSN) is in the process of establishing an early warning system with scientific grade instrumentation. In parallel, we are developing and deploying an early warning system in Chile using only smartphones and an inexpensive GNSS add-on to incorporate SBAS corrections. The smartphone uses an Android application to collect data from the smartphone's onboard accelerometer and the GPS chip. The application analyzes and transmits relevant data to a central server where we use the FinDer-BEFORES algorithm to detect earthquakes and produce a real-time joint seismic-geodetic finite-fault distributed slip model (for sufficiently large magnitude earthquakes) or a near-field acceleration-based line source model (for smaller magnitude earthquakes). Accurate ground shaking forecasts could be provided by either earthquake source model, and distributed slip models for larger offshore earthquakes could be used to infer seafloor deformation and thus provide local tsunami warning. Our goal is to build and deploy over 200 smartphone-based monitoring stations this year. Although this project utilizes the smartphone-based sensor as part of a fixed network, this approach could also be implemented in a crowd-sourced manner. In November, 2015, the first 8 sensor units were installed in the region of the 2015 Mw 8.3 Illapel, Chile earthquake. While the early warning system is not yet live, retrospective batch processing of all the data collected from these few sensors shows that our proposed analysis method successfully detects, locates, and estimates the magnitude for two Mw \geq 5.5 earthquakes that have occurred since the sensors were deployed while producing zero false alarms. We expect the system's performance to improve significantly once the sensor network is expanded beyond this nominal initial deployment.

Sample smartphone MEMS seismogram for Feb 10, 2016 Mw 6.3 recorded at Coo3 (86 km from source)

