Earthquake Early Warning in the Context of Developing the USGS Advanced National Seismic System

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Earthquake early warning systems, already successfully deployed in Japan, Taiwan, Mexico, and other nations, can detect an earthquake in progress and provide notice seconds to tens of seconds prior to actual ground shaking. To explore the use of earthquake early warning in the United States, methods are being tested in California using the California Integrated Seismic Network (CISN), an integral part of the USGS Advanced National Seismic System (ANSS), through which the USGS aims to broadly improve earthquake monitoring and reporting in the United States. The CISN early warning project is a collaboration among the USGS, the California Institute of Technology, the University of California-Berkeley, the Swiss Seismological Service, and the Southern California Earthquake Center. Funding for the CISN is provided by both the USGS and the State of California. Tests on several California earthquakes in the past two years have demonstrated that strong shaking can be detected and analyzed within seconds (reported by others at this workshop).

Our goals are to identify improvements to the existing monitoring networks needed to support reliable earthquake warnings, and to better understand how a warning system could be used in California and elsewhere to improve safety and reduce losses. Before building a prototype system, we need to better understand and demonstrate quantitatively: 1) expected warning times for various network configurations; 2) the frequency of false alarms and missed warnings; 3) capital costs of building the network, and its operational costs; 4) the types of users of an early warning service and their needs (so as to determine the most useful products); 6) the economic benefits of the proposed system (e.g., benefit/cost ratio); 7) the technological limitations of the current CISN networks to provide warnings (e.g., hardware, software communications).

Some of the above questions are being addressed in the CISN study (warning times, network limitations, false-and missed alarm frequency), and we can address others by evaluating the systems deployed and operating elsewhere. For example, simply by replacing high-latency digitizers we can significantly decrease warning times, and we are consequently planning for a major upgrade of the CISN network for this purpose. A critical next step is to work with specific users to provide actionable warning information.