Proposed Time Measurement Model for Earthquake Early Warning Systems

Philip Maechling[1], Maren Boese[2], Georgia Cua[3], Thomas Jordan[1], Thomas Heaton[2], Egill Hauksson[2], Richard Allen[4], Margaret Hellweg[4]

1. Southern California Earthquake Center

2. California Institute of Technology

3. Swiss Seismological Service, ETH Zurich

4. University of California at Berkeley

Performance evaluations of earthquake early warning (EEW) systems measure both seismological parameters (e.g. does the system accurately forecast future ground motions?) and speed of operation (e.g. how long after origin time does the system produce a warning?). While methods for evaluating seismological accuracy are well established, EEW system speed of operation measurements are less standardized. In this poster, we propose a general model for evaluating an EEW system's speed of operation. We call our EEW speed of operation measurement model a timeline-based measurement model. Our timeline-based measurement model defines system performance in terms of system parameters that may optimized such as the amount of time series data needed by EEW algorithm, data transmission delay, algorithm processing delay, and delivery of warnings to user. We have identified two important benefits of our timeline-based EEW system performance measurement model. First, our model identifies which system performance measurements should be collected during EEW operation to support speed of operation analysis. Second, our performance model helps EEW systems evaluate the impact that specific system improvements will have on overall EEW system speed of performance. For example, an EEW system may want to evaluate which of two system upgrades will provide a greater improvement in

their system speed of operation: (a) increasing the density of stations in the network, or (b) introducing faster telemetry at existing sites. If the EEW system performance is expressed using our timeline-based speed of operation model, EEW system designers can quickly evaluate the overall impact on EEW speed of operation if one, or both, of these system improvements is made. Our EEW timeline-based performance measurement system supports both system-wide speed of performance measures (e.g. time to first warning) as well as site-specific performance measurements (e.g. amount of warning before S-wave arrival at a specific site). In this poster, we present our time measurement model and provide examples using data from CISN EEW algorithm performance testing being conducted by the California Integrated Seismic Network and the Southern California Earthquake Center.