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Investigation of intensity magnitude estimates for improving an earthquake early warning system

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The rapid determination of earthquake location and magnitude are key parameters in an earthquake early warning system. These (and other) parameters are estimated by automated systems that perform real-time analyses of the seismic waveform data recorded by the dense seismic arrays in Japan. In particular, a new source parameter, called Mi, is used to determine the seismic intensity magnitude, which can be estimated from the P-wave data recorded during the early stages of fault rupture for larger earthquakes M $>$ 6.5. Therefore, a real-time warning can be especially beneficial in mitigating the damages from a large subduction zone earthquake. We find the use of Mi can result in a significant improvement in both the speed and reduction of uncertainty in the predicted shaking from the damaging S-waves when compared to estimates derived from earthquake magnitude. However, we are also finding systematic differences between shaking intensity magnitude and moment magnitude that are related to hypocentral distances, the locations and/or type of earthquakes and site effects.

We examined 18,250 Mi data, and found that difference from Mw becomes large with epicentral distance. Mi is larger than Mw by about 1.0 at 400km epicentral distance. Efforts are underway to understand and provide a correction factor that will help to reduce this discrepancy and therefore provide a more reliably estimate of the expected shaking intensity. A better understanding of the important site corrections is relevant not only to applications in a real-time warning system but also will help to improve the reliability of seismic shake maps that are used to access the damages from large earthquakes.

Keywords: earthquake early warning system, intensity magnitude, EEW