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Effects of fault distance for seismic intensity anticipation using attenuation relation

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Seismic intensity anticipation in Earthquake Early Warning (EEW) of JMA uses attenuation relationship and site amplification factor with hypocentral parameters (origin time, location, and M) determined immediately after detection of seismic wave at only one or a few seismometers near source region. The fault distance, one of a parameter used in attenuation relationship, is length subtracted half of fault length estimated by empirical relationship of M from hypocentral distance. Anticipation error of intensity using the fault distance of this method is generally larger than that of fault distance computed from actual fault model. In this study, we investigate the effect of fault distance for seismic intensity anticipation.
We use 17 inland crustal earthquakes from 1997 to 2008 which have obtained fault model by previous study. These fault models are based on source process inversion analysis by GSI, fault parameters used in Matsusaki et al. (2006) and fault geometries estimated from aftershock distribution. We use observed seismic intensity larger than or equal to 3.5. Mw of JMA CMT solution catalog is used. As site effect, site amplification factor ARV used in JMA EEW is applied. We compare anticipation error with fault distance by JMA EEW to that with fault model. As a result, the anticipation errors with fault model are smaller for 14 earthquakes out of 17. Also, the difference between those anticipation errors of the earthquakes whose hypocenter is located at the edge of the fault is greater than those whose hypocenter is located at the center of the fault.
We estimate anticipation errors depending on strikes by rotating the fault by various degrees around the epicenter with respect to the strike of the fault model. For this analysis, 7 earthquakes, for which the number of the observed seismic intensity is more than 100, are used. At first, for the earthquakes whose epicenter is located at the center of the fault, anticipation errors of strike slip fault have peak at the rotation angles of 90 and 270 degrees, and have minimum values at 0 and 1 80 degrees. For reverse fault, the difference of anticipation error depending on various rotation angles is small. Next, for the earthquakes whose epicenter is located at the edge of the fault, they are all reverse faults, and have great anticipation error away from around 0 degree. With observed seismic intensity becoming large, the difference of anticipation error depending on various rotation angles increases wherever epicenter is.
Based on the above results, it is possible to estimate fault parameter such as strike of fault and approximately rupture direction by processing real time data obtained at a few seismometers near source region. This possibility, however, is based on displacement magnitude. For enhancement of accuracy of anticipation seismic intensity of EEW, it might be valid to use seismic intensity magnitude (Yamamoto et al., 2008). On the other hand, magnitude estimated from acceleration and velocity grows faster than displacement magnitude, but large scatter among stations (Hoshiba et al., 2010). Combination of magnitude estimation from displacement and that from seismic intensity is need for rapid and accurate estimation of fault parameter.

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Keywords: Earthquake Early Warning, seismic intensity anticipation, fault distance