New method for Earthquake Early Warning System available for Magnitude 8-class earthquakes

Irikura, K. (Aichi Institute of Technology <irikura@geor.or.jp>)
Kurahashi, S. (Aichi Institute of Technology)
Masaki, K. (Aichi Institute of Technology)

The Earthquake Early Warning (EEW) system developed by the Japan Metrological Agency (JMA) has provided warning and prediction information during disastrous earthquakes such as the 2009 Suruga-wan earthquake (M_{jma} 6.5), the Iwate-Miyagi-Nairiku earthquake (M_{jma} 7.2) and so on since October 1, 2007. The warning information were successfully issued almost in time for areas further than 30 km. However, the system has still some problems to solve. One is that the warning is not in time for disastrous areas with seismic intensity of more than 6-lower during inland crustal-earthquakes. The other is that seismic intensity might be underestimated in some part for great large earthquakes with magnitude 8-class.

Above all, it is a matter of grave concern whether the EEW is available for great large earthquakes such as Nankai-trough earthquakes with high probability of occurrence. The problem for the magnitude 8-class earthquakes comes from the assumption of a point source for estimating seismic magnitude and then seismic intensity based on the attenuation-distance relations. Ground motions are not generated from a point but source area especially for large earthquakes. In this study, we try to obtain range of the rupture area of large earthquake from observed records using the attenuation relation of maximum motions of P wave motions.

The attenuation relation of maximum acceleration (PGA) and maximum velocity (PGV) of S wave motions has a certain saturation near the fault distance as well known. The range of this saturation might be related to a diameter of the rupture area of the large earthquake. We find that the attenuation relation of maximum acceleration (PGA) and maximum velocity (PGV) of P wave motions also has a certain saturation near the fault distance as well as the S wave motions using 2004 Chuetsu earthquake (Mw6.6), 2007 Noto-hanto earthquake(Mw6.7) and 2008 Iwate-Miyagi Nairiku earthquake(Mw6.9). For the EEW system, the PGAs of vertical components of P wave are best because the saturation of the PGAs appears earlier than that of the PGVs. The saturation level of the P waves' PGAs is about 150 gals, independent of seismic magnitude.

Further, we examined the attenuation relations of the P waves' PGAs for the 1999 Chi-chi earthquake (Mw 7.6) and the 2008 Wenchuan earthquake (Mw 7.9). We find that the P waves' PGAs for such great large earthquakes have also a certain saturation level as well, as long as all portions of vertical components before the main S wave motions are used. The saturation level is also about 150 gals. We can obtain seismic magnitude from the diameter of the saturation area of the P waves' PGAs. Moreover, the information about the saturation area is useful for estimating the seismic intensity distribution considering area source.