Basic study for developing of the Earthquake Early Warning for great earthquakes -case of ground motions in large earthquakes-

Susumu Kurahashi[1]; Kojiro Irikura[2]; Kazuaki Masaki[3]

[1] Eng, AIT; [2] Aichi Inst. Tech.; [3] Dept. of Civil Engineering, Aichi Inst. of Tech.

http://dprec.aitech.ac.jp/aisite/

Introduction

The information from the Earthquake Early Warning (EEW) system in Japan provides the coordinate of the starting point, the origin time and the magnitude of target earthquakes. The seismic intensity at each site is calculated by using an attenuation relation and site amplification at each site from the magnitude and hypocentral distance obtained from the EEW. However, in large earthquakes, the calculated seismic intensity might be underestimated in comparison with the observed one. Because the large earthquakes have the wide rupture area, the distances from the earthquake rupture area to observed sites are different from the hypocentral distances assuming a point source. In the Tokai area, the calculated seismic intensity might be about one or two scales smaller than observed one as long as the Tonankai earthquake would occur off Shionomisaki. It is effective to estimate the rupture extension of the large earthquake from real-time observed records close to the rupture area to prevent underestimation of the seismic intensity in the Tokai area. In this study, we try to obtain it from observed records of large crustal earthquakes using the attenuation relations of acceleration and velocity records in near-source areas.

Attenuation relations in near-source areas for ground motions from large crustal earthquakes

Attenuation relations of maximum acceleration of S-waves are saturated near the fault distance, as well-known in the NGA reports in US (e.g. Abrahamson and Silver, 2008). The horizontal ranges of the above saturation relate to the extension of the rupture of large earthquakes. Figure.1 shows the attenuation relation peak ground acceleration (PGA) of P-waves and S-waves and peak ground velocity (PGV) of S-waves with the shortest distances to the rupture area at sites for the 2004 Chuetsu earthquake (Mw6.6) and the 2008 Iwate-Miyagi nairiku earthquake (Mw6.9). The PGA and PGV include the site effect of each site. The P waves and S waves mentioned above mean vertical motions of the P waves' part and horizontal motions of the S waves' part. The PGA of P-waves as well as that of S-waves from each earthquake seems to be saturated within the distance of about 20 km to the rupture area. Therefore, we can provide the information about the rupture extension before the arrival of the S-waves. We find the PGV also is saturated as well as the PGA at station close to rupture area. The PGA and PGV close to rupture area in the Iwate-Miyagi Nairiku earthquake are almost the same as those in the Chuetsu earthquake. Further, we need to study magnitude dependence of the saturation levels collecting observed records from other large earthquakes with different magnitudes.

Conclusion

The PGA of P-waves and S-waves are saturated in the attenuation relations near the rupture areas. If we combine the information about the location, the origin time and the magnitude of earthquakes from the EEW with the real-time observed records of P-waves near the rupture areas, it is possible to estimate the rupture extension from the saturation level of the attenuation relation as a function of magnitude. Further study should be required to obtain the absolute saturation levels dependent on magnitude removing local site effects due to near surface geology from observed data.