Site Effective Earthquake Early Warning Outreach

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The earthquake early warning (EEW) concept is getting increasingly prevalent and somewhat replacing the expectation for earthquake prediction. An extensive real-time monitoring and EEW system installed in a wide region can detect an earthquake within seconds, and immediately issue alerts to affected areas through public media. On-site EEW systems developed for specific facilities may also detect an event and enable the facilities to take necessary actions before strong hits. Having timely warnings come accurate, EEWs can mitigate economy losses and save many lives. However, there are issues regarding EEWs provided by a big network and on-site monitoring systems that specialists in seismology know clearly, for which the general public has to be educated.
A big EEW system estimates seismic intensities using a conventional ground motion prediction equation (GMPE) as a function of distance that are not always in agreement with observed intensities. The actual intensity distributions in felt earthquakes show short-wavelength variation. The frequency band in which seismic intensities are determined is from about 0.5 to 10 Hz, and thus the response of subsurface structure is significant in the estimation. The ground motion at a specific site should be evaluated not only by a GMPE and a site amplification factor, but also accounting for the incident azimuth of incoming seismic waves. We have some exploratory studies to illustrate the local subsurface effects using data recorded by the dense network of strong motion instruments (with a station interval of less than 1.5 km) in Yokohama City. We used several small earthquakes of a similar magnitude (M~4.5) that are located at an epicentral distance of ~60 km from the network and provide different incident azimuths of incoming waves to the network. The observed ground motions at the stations show variations among the events reflecting 3D structural effects along the propagation paths. We also show the variation of amplification from a borehole to the surface using Kik-net data, and suggest that on-site calibrations are necessary for better intensity estimates. Should an earthquake occur directly beneath a crowded metropolitan area, e.g. Tokyo, the warning time is very short and cannot be extended by increasing the station density of a big network.

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