Proposal of frequnecy-dependent magnitude and its effectiveness in earthquake early warning

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Estimating the system response before an arrival of strong motion is a key issue for engineers who plan to design automatic control systems by EEW. For that purpose, we proposed frequency-dependent magnitude (M_{freq}(f)) that can provide a rapid estimate of the response spectra at an arbitrary site, which is dependent on the shaking intensity magnitude (MI) [Horiuchi and Yamamoto, 2005]. M_{freq}(f) is calculated from the observed response spectra by using a regression relation that takes into account geometrical spreading, Q attenuation, and the station corrections. To check the effectiveness of M_{freq}(f), we calculated M_{freq}(f) for 163 earthquakes and compared estimated and observed response spectra at certain frequencies (0.25, 0.5, 1.0, 2.0, 4.0, 8.0 Hz) for 14626 stations. The result shows that averaged errors are relatively small (0.23-0.33 (rms) in log scale). The best estimate (at 2Hz) has almost same accuracy as the estimate of shaking intensity obtained by MI. It is clear that M_{freq}(f) is an effective parameter to provides accurate response spectra, which is independent of source characteristics, for EEW users.