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Short-period spectral levels for aftershocks and foreshocks of the 2011 off the Pacific coast of Tohoku earthquake

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We estimate short-period spectral levels of acceleration source spectra for aftershocks and foreshocks of the 2011 off the pacific coast of Tohoku earthquake and previous earthquakes in this region by a spectral inversion method. We use two sets of data, that is, subduction-zone earthquakes off the Pacific coast and normal-faulting crustal earthquakes around the Fukushima coast.

The subduction-zone earthquakes are 10 interplate earthquakes with MJ 6.4 -7.7 and depth less than 60 km from October 2003 to March 28, 2011 and an intraplate earthquake occurred off Miyagi prefecture on April 7, 2011. The short-period spectral level of each earthquake is estimated using Q-value and empirical amplification factors estimated by a spectral inversion method (Satoh and Tatsumi, 2002) and strong motion records at K-NET and KiK-net stations. We also estimate short-period spectral levels of 7 normal-faulting crustal earthquakes with MJ 4.7 -7.0 and one strike slip crustal earthquake with MJ5.0 around the Fukushima coast by a spectral inversion method using K-NET and KiK-net (borehole) records with hypocentral distances less than 60 km. In the spectral inversion, one-dimensional amplification factor for S-wave at FKSH19 (Miyakoji) calculated using inverted soil constants from the seismic bedrock to the surface is used as a restricted condition. Q-value for path is represented as 70f{sub}0.9{/sub} using frequency f.

In a figure we show the relations between the short period spectral level A [dyne-cm/s/s] and the seismic moment M0 [dyne-cm]. The upper is for subduction-zone earthquakes and the lower is for crustal earthquakes. The short period spectral level (1.49e+27dyne-cm/s/s) of the intraplate earthquake occurred off Miyagi prefecture on April 7, 2011 is larger than that of the intraplate earthquake occurred off Miyagi prefecture on May 26, 2003 (MJ7.1). The short period spectral level of the interplate earthquake occurred off Miyagi prefecture on March 9, 2011 (MJ7.3) is a little smaller than that the interplate earthquake occurred off Miyagi prefecture on August 16, 2005(MJ7.1), but has the same scaling as the interplate earthquake occurred off Miyagi prefecture in 1978 (MJ7.4) and corresponds to the average + standard deviation of the empirical relation for interplate earthquakes occurred off the Pacific coast of east Japan derived by Satoh (2010). On the other hand, the short period spectral levels of the interplate earthquake occurred off Iwate prefecture at 15:8 on March 11, 2011(MJ7.4) and the interplate earthquake occurred off Ibaragi prefecture at 15:15 on March 11, 2011(MJ7.7) are 3.35e+26 dyne-cm/s/s and 6.19e+26 dyne-cm/s/s, respectively and lie between the average and the average-standard deviation. The short period spectral levels of the biggest normal-faulting crustal earthquake(MJ7.0) is 7.34e+25 dyne-cm/s/s and corresponds to the average of the empirical relation for strike-slip crustal earthquakes derived by Satoh (2010). The short period spectral levels of the second and the third biggest normal-faulting crustal earthquakes are smaller than the average of the empirical relation for strike-slip crustal earthquakes. This result that short period spectral levels for normal-faulting earthquakes are smaller than those for strike-slip earthquakes is the same result pointed by Satoh(2003) and is consistent with NGA (New Generation Attenuation) relations for response spectra.

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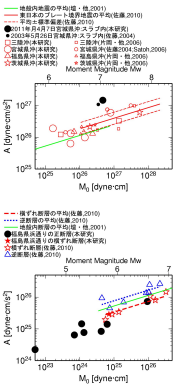

Keywords: hort-period spectral level, the 2011 off the pacific coast of Tohoku earthquake, aftershock, foreshock, subduction-zone earthquake, normal-faulting crustal earthquake