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# Characteristics of radiated short-period seismic energy from moderate-to-large inland earthquakes

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It is in 1990s that envelope inversion methods have been developed to study earthquake source processes in shorter period ranges than about 1s (e.g. Gusev et al., 1991; Zeng et al., 1993; Kakehi and Irikura, 1996). Motivated by the occurrence of the 1995 Hyogo-ken Nanbu earthquake, the authors developed an envelope inversion method (Nakahara et al., 1998) to estimate the spatial distribution of short-period seismic energy radiation on earthquake source faults. So far, we have applied the inversion method to more than 10 moderate-to-large earthquakes. Compiling the results, we consider statistical characteristics of short-period seismic energy radiation from the earthquakes especially focusing on inland earthquakes.

We have so far analyzed 6 inland earthquakes: the 1995 Hyogo-ken Nanbu (Kobe) earthquake (Mw6.9), the 1998 Northern Iwate Prefecture earthquake (5.8), the 1999 Chi-Chi, Taiwan, earthquake (7.6), the 2000 Tottori-ken Seibu earthquake (6.6), the 2004 Niigata-ken Chuetsu earthquake (6.6), and the 2008 Iwate-Miyagi Inland earthquake (6.6). We compile the results in terms of 3 items:

1. Scaling law of short-period seismic energy

The logarithm of seismic energy in short period bands (1-2, 2-4, 4-8, and 8-16Hz) is found to be proportional to the moment magnitude. In other words, the short-period seismic energy is proportional to the fault area. The absolute values for 6 inland earthquakes are explained well by the omega-squared model with the short-period spectral level A obtained by Dan et al. (2001). On the contrary, the absolute values for the other plate-boundary type and intra-slab type earthquakes are about 10 times larger than those for the inland earthquakes.

2. Spatial relationship between asperities and short-period sources

We compare relations between locations of asperities estimated by waveform inversions in longer periods and locations of short-period energy radiation obtained by the envelope inversion in shorter periods. The relation is found to be complimentary for 3 earthquakes of the 1998 Iwate, the 1999 Chichi, and the 2000 Tottori. But the relation is complex for the other 3 earthquakes.

3. Statistics of short-period seismic energy radiation

Seismic energy radiation is estimated for each subfault and each period band by the envelope inversion method. Plotting energies from all the subfaults in a descending order, we find that the logarithms of the energies are linearly decrease against the order. This is explained by the two-parameter Weibull distribution. The slope is characterized by the shape-parameter which ranges from 0 and 2 depending on earthquakes and period bands. The shape parameter of 1 corresponds to the exponential distribution and that of smaller than 1 means more heavy-tailed distributions.

Given these results, we need to physically understand the statistical characteristics of short-period seismic energy radiations and to take them into account in predicting strong-ground motions.

Keywords: inland earthquakes, short-period seismic energy, envelope inversion