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Consideration of the Method to Estimate the Radiated Seismic Energy from Regional Seismic Waveforms

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The total released strain energy during an earthquake is divided into frictional energy, fracture energy, and radiated seismic energy. In these 3 components, we can estimate only the radiated seismic energy directly from the seismic waveform, and that characterizes the dynamic source property. There are large variations of radiated seismic energy from previous energy estimate studies, although it is difficult to estimate it due to the contribution from a wide frequency spectrum. One of the probable factors of this variation is focal mechanism dependence of radiated seismic energy from teleseismic waveforms (e.g., Choy and Boatwright, 1995; Convers and Newman, 2011). However, there are 2 additional questions from these studies. 1. These results were obtained only from P wave energy assuming a ratio between P wave energy and S wave energy. Teleseimic S waves often overlap with other phases, and attenuate more strongly than P waves, so it is difficult to measure the S-wave energy directly. The ratio of P to S radiated energy is not well known. 2. The focal mechanism dependence has been shown only for large earthquakes (Mw >6), it seems that this characteristic has not been observed for small and moderate earthquakes.

For the purpose of investigating these questions, we need to estimate and compare the radiated seismic energies correctly from several different phases. As an example, we focus on a moderate earthquake (June 14, 2008 at 12:27, Mw 4.9 from F-net) that occurred just after 2008 Iwate-Miyagi Nairiku earthquake. In this study we estimate the radiated seismic energy from regional P waves, S waves, and S wave coda using an empirical Green's function (EGF) method. The regional waveform data are recorded at stations of Hi-net. Firstly, using cross correlation, we select an EGF event that is highly correlated with the target event. Secondly, we deconvolve the seismograms in frequency domain with a multitaper method (Prieto et al., 2009), and check the waveform in time domain. Thirdly, we fit the obtained spectrum to an omega square model (Brune, 1970, 1971) to estimate the corner frequency. In addition, we try to vary the value of the power for the high-frequency fall-off. Finally, we calculate the radiated seismic energy using these spectra.

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Keywords: Seismic radiated energy, Moderate earthquake