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Improved estimation of seismic energy radiation from deep low-frequency tremor

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Deep low-frequency tremor occurs associated with slow slip event on the subducting plate interface at the downdip part of the megathrust seismogenic zone. Studying these phenomena is considered to play an important role to understand the mechanism of the megathrust earthquake. Until now, spatio-temporal distribution of tremor has been well investigated to get a whole picture of tremor activity. In this paper, we proposed a method for assessing energy radiation of tremor more quantitatively.

The Hybrid Method (HM) [Maeda and Obara, 2009] is a technique which determines epicenter and seismic energy of tremor simultaneously by using relative arrival time and amplitude distribution of the tremor envelope. To avoid false event detection, the " HM selected catalog " constructed with a threshold of a high Variance Reduction (VR>90) has been used for tremor study. However, when tremor activity is very high, envelope correlation between stations is relatively poor because of complicated waveforms. Then the VR generally becomes low and some parts of tremor during the active stage are not included in the HM selected catalog [Takeda et al., 2014]. Therefore, in order to investigate the energy release of tremor activity precisely, we have to re-evaluate it by using the waveform data.

Here, we developed a method for estimation of tremor energy by using measurement of tremor duration time from envelope waveform and the HM catalog. We started to search the duration around an origin time of tremor in the HM selected catalog. Then we determined the tremor duration when the amplitude is higher than noise level at each station simultaneously. At each tremor duration, we determined epicenter using centroid location of hypocenters of HM selected catalog within corresponding time and determined energy radiation by summing up of energy of tremor epicenters with VR of larger than 60.

As a result, we found characteristic spatial distribution of energy. It has been already known that there are two peaks of the number of tremors in the dip direction [Obara et al., 2010]. In this study, we found that high-energy region is distributed in the shallower part of the source area of tremor along the strike of the subducting Philippine Sea plate. This biased distribution of high-energy radiation suggests that the shallower part is more brittle in the brittle-ductile transition zone where tremor occurs. This brittle part may radiate higher seismic energy when shear slip occurs. This research will lead to quantitative assessment of the role of tremor in the stress relaxation process in the subduction zone.

Keywords: tremor, Nankai trough, slow earthquake