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Relationship between short-term slow slip event and other slow earthquakes in western Shikoku

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In southwest Japan the Philippine Sea Plate is subducting beneath the continental plate. Dense and high-quality observation networks such as NIED Hi-net have revealed that various types of slow earthquakes have occurred repeatedly on the plate interface. In the case of western Shikoku, simultaneous occurrences of the short-term slow slip event [SSE; Obara et al., 2004] with the magnitude of about 6.0, the nonvolcanic deep tremor [Obara, 2002] and the very low-frequency earthquake [VLFE; Ito et al., 2007] have been observed. These episodes have occurred repeatedly with an interval of about half year [Obara et al., 2004]. For understanding the source physics of these slow earthquakes, it is important to make it clear the relationship of source process among various types of slow earthquakes. Hirose and Obara [2010] applied the time-dependent slip inversion technique to Hi-net tiltmeter data and indicated that slow slip area and tremor activity migrate as a group. In this study, we estimated source models of SSEs in western Shikoku other than those analyzed in Hirose and Obara [2010], and compared them with other types of slow earthquakes such as the tremor in detail.

As an example, we estimated source process of the short-term SSE in October 2009. During this event, some tiltmeters of Hi-net stations observed significant tilt changes, and especially, UWAH and OOZH stations observed tilt changes with 0.1 microradian or larger. We applied the time-dependent slip inversion method to the tilt data of 12 Hi-net stations. Tidal components and the tilt response to atmospheric pressure were removed from tilt data using the BAYTAP-G [Tamura et al., 1999].

The estimated total moment magnitude and maximum slip value were 6.0 and 2.6 cm, respectively. Large slip area extended along the strike of the slab and the depth of the area ranged from 30 to 35 km. A complex migration of slip area during this event was detected by our analysis. Slip began in a narrow area, about 20 km x 20 km, beneath KWBH station. Then slip area migrated to the eastern part of the fault. Finally, large slip area went back to the west and reached at Bungo Channel.

We compared the obtained source process of the short-term SSE with the tremor activity [Obara et al., 2009]. The large slip area during the SSE was in good agreement with the tremor activity area. Moreover, the tremor activity area also migrated in almost the same way as the slip area of the SSE. Especially, the increase in the slip rate occurred at the same time and area as the increase in the tremor activity.

For future work, we analyze the detailed relationship between short-term SSEs and other slow earthquakes including tremors and the 2003 long-term SSE in Bungo Channel.

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