

Modeling slow slip events and low frequency tremors in the Kii Peninsula and Tokai regions

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In the subduction zone of southwest Japan, short-term slow slip events (SSEs) occur at intervals of several months (Obara, 2010). Recently, Obara et al. (2009) located deep low frequency tremors (LFTs) with high resolution and examined the tremor activity in detail. Because LFTs occur with SSEs, we can determine the generation zone of SSEs from the distribution of LFTs. In the present study, we simulate the activity of SSEs by determining the generation zones of SSEs from the hypocenters of LFTs located by Obara et al. (2009). Furthermore, we simulate the activity of LFTs by setting local patches of LFTs based on the hypocenters of LFTs.

In the numerical simulation, we use the same method as that developed by Shibazaki et al. (2010, JGR, in press). We simulate SSEs on a 3D plate interface beneath the Kii Peninsula and Tokai regions by considering a rate- and state-dependent friction law with a small cut-off velocity on an evolution effect. SSE regions are determined as the hypocenters of LFTs are included in these regions. Results of numerical simulation show that SSE generation zones beneath the Kii Peninsula are separated into three segments. Recurrence intervals of SSEs in the northern Kii are approximately 6 months but those in the southern Kii are about 2 months. Recurrence intervals of SSEs in the Tokai region are around 4 months. Our numerical results reproduce well the characteristics of the observed SSE activity.

We also attempt to model LFTs accompanied by short-term SSEs. We consider local circular patches of LFTs in which the critical displacement is small. Distributions of LFT patches are derived based on the observed LFTs locations. We also consider SSE regions that surround LFT patches. First, we simulate LFTs without SSE regions. Moment rate functions are pulse-like and the main moment release is caused by fast LFTs. However, when we consider SSE regions that surround LFT patches, our simulation reproduces fast LFT events during slow SSEs. In actual observations, the moment released by LFT events and very low frequency (VLF) earthquakes are small compared with total moment of SSEs. Therefore, LFTs and VLF earthquakes can be regarded as fast, local ruptures during slow SSEs.

Keywords: slow slip event, low frequency tremor, modeling, Kii Peninsula, Tokai region