Slip distributions of short-term slow slip events in the northern Kii Peninsula based on NIED Hi-net tilt measurements

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In the southwest Japan subduction zone, short-term slow slip events (SSEs) with nonvolcanic tremor (Episodic Tremor and Slip: ETS, Rogers and Dragert, 2003) which last for several days to weeks occur repeatedly. Because the short-term SSEs occur at the downdip extension of a megathrust earthquake rupture zone, the SSEs are one of the key factors for stress buildup processes of the megathrust earthquakes (e.g., Obara and Kato, 2016)[h1] . Therefore, detailed slip distributions of short-term SSEs are important for understanding the strain accumulation and release at the ETS zone. In the northern Kii Peninsula, short-term SSEs have been detected by[h2] previous studies, but their fault motions have been modeled with uniform slip on a rectangular fault (e.g., Hirose and Obara, 2006).[h3] This may introduce a bias in the estimation of amount of slip.
Here we apply an inversion method which can express a spatial slip distribution to tilt step measurements in the northern Kii Peninsula and estimate detailed slip distributions of nine[h4] short-term SSEs from November 2004 to October 2009. We also discuss the classification of the short-term SSE source areas[h5] by analyzing multiple short-term SSEs in the northern Kii Peninsula.
We used time-series records of a high-sensitivity accelerometer (tiltmeter) installed at NIED Hi-net stations located in the Kii Peninsula and Tokai areas. We applied the BAYTAP-G (Tamura et al., 1991) program together with atmospheric pressure records observed at the Tsu Local Meteorological Observatory to the tilt records in order to remove tidal components and an atmospheric pressure response. We measured a tilt change (tilt step) due to an SSE after detrending. Although tilt steps of the analyzed SSEs have already been determined in previous studies (e.g., Hirose and Obara, 2006; Sekine et al, 2010), we redetermined them from the original tilt records to improve station coverage for an SSE and to obtain a more reliable tilt step dataset. We estimated a slip distribution that explains the tilt step dataset for an SSE by a conventional inversion method by Hirose and Kimura (submitted).
As a result, a spatial slip distribution for a short-term SSE in the northern Kii Peninsula is estimated based on tilt records for the first time. The estimated moment magnitudes of the nine SSEs range from 5.5 to 6.1. The obtained tilt steps, and main locations and magnitudes of the estimated slip are basically consistent with the previous studies (e.g., Hirose and Obara, 2006). A comparison of these slip distributions shows that the slip areas are roughly classified to two groups: one is that the center of a slip distribution is located mainly onshore (corresponding to the Shima Peninsula part of the tremor belt), and the other is that that is located offshore in the Ise Bay area (corresponding to the Ise Bay part of the tremor belt). This suggests that there are two “SSE patch” regions where SSEs of the similar size repeatedly occur on the plate interface.
Longer study period and more comprehensive detection of short-term SSEsmay improve our understandings of the relationship between recurrence intervals and magnitudes of SSEs, and the strain accumulation and release processes in the northern Kii Peninsula.

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