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Detection of short-term slow slip events along Hyuganada and the Sagami trough using GNSS data

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Nishimura et al. (2012) detected tectonic offsets in GNSS time-series using the AIC and fault model estimation of short-term slow slip events (SSEs) on the subducting Philippine Sea plate along the Nankai trough. Here, we report results of detection and estimation of SSEs along Hyuganada and the Sagami trough using their method.

Daily coordinates of 314 GEONET stations in southwestern Japan were used to detect the deformation of SSEs along Hyuganada. We fitted a step function to the filtered daily coordinates to detect displacements in a direction of N135^{o}E which is opposite to the relative plate motion between the Philippine Sea plate and southwestern Japan. The candidate dates of the SSEs are determined if the significant displacements were detected. And three components (i.e., EW, NS, and UD) of the displacement were inverted to estimate a rectangular fault model. We finally recognized SSEs if the observed displacement were well reproduced by the fault model. The same procedure is applied for the analysis of SSEs along the Sagami trough. But we used 327 stations to detect displacements in a direction of N160^{o}E.

In the Hyuganada region, we estimated four M_w 6.0-6.1 SSEs near the border between Oita Prefecture and Miyazaki Prefecture. Number of SSEs in the southern region decreases around Miyazaki Prefecture but increases around the Osumi Peninsula and Tanegashima again. The SSEs near the Oita-Miyazaki border occur at a depth of ˜30 km and those near the Osumi Peninsula occur at a various depth between 10 and 50 km. It is interesting that SSEs with a depth of 30 km and shallower occur there, which have never been detected in the Shikoku region. Some SSEs accompanied with seismic activities along the Hyuganada. We also detected several episodes of SSE-related deformation along the Sagami trough. One of the largest SSEs occurs far east off the Boso Peninsula around April 14, 2007. The estimated moment magnitude ranges between 6.3 and 6.7.

In summary, many SSEs were found along Hyuganada and the Sagami trough, where significant activities of non-volcanic tremors are not observed. We found that some SSEs accompanied with seismic activities but that the others did not. Comparison among analyses for several neighboring regions revealed a problem that some false SSEs were detected by the present method because of a low signal to noise ratio. It is necessary to combine GNSS and strain/tilt data so as to improve the fault model estimation and estimate duration of SSEs.

Keywords: Slow slip event, GNSS, Crustal deformation, Subduction zone, Hyuganada, Sagami Trough