Spatio-temporal evolution of long- and short-term slow slip events in the Tokai region, central Japan estimated from a very dense GNSS network, during 1997-2017

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We analyzed Global Navigation Satellite System (GNSS) data from 1997 to 2017 for the Tokai region of tne Nankai subduction zone, in order to investigate long- and short-term slow slip events (SSEs) on the subduction interface. The GIPSY-OASIS II software (version 6.1) was used to estimate daily coordinates of continuous GNSS stations operated by GSI and temporary GNSS stations operated by JUNCO (the Japanese University Consortium for GPS Research). It is well known that GNSS time series have many systematic signals and noises that do not result from SSEs. They include, for example, seasonal variations, co- and post-seismic deformation of the 2004 southeast off Kii Peninsula earthquakes (M_j 7.1/7.4), the 2008 Ibaraki-ken-oki earthquake (M_j 7.0), the 2008 Fukushima-ken-oki earthquake (M_j 6.9), the 2010 Fukushima-ken-oki earthquake (M_j 6.7), and the 2011 Tohoku-oki earthquake (M_w 9.0), and crustal deformation of volcanic activity on the northern Izu Islands in 2000. After removing them, we applied a modified Network Inversion Filter (NIF) [Fukuda et al., 2008] to estimate daily slip and slip rate on the subduction plate interface. Our results showed a long-term SSE from 2000 to 2005 involved two slip phases/subevents. The slip peak of the first phase was estimated at a depth of 20 km from the end of 2000 to the end of 2001. Another long-term slow slip with slower slip rates was estimated around this slip peak from 2013 to 2015. The slip peak of the second phase estimated at a depth of 30 km from the end of 2002 to the beginning of 2005. The slip area of the second phase was extended/migrated to the down-dip tremor area, and the recurrence period of tremor became short during this period. Our results show spatio-temporal distribution for not only those long-term SSEs in 2000-2005 and 2013-2015, but also short-term SSEs (M_w <6.1). The maximum estimated daily slip rates for short-term SSEs are an order of magnitude larger than those of the long-term SSE, and peak slip for short-term SSEs migrates along strike with LFTs synchronously.

Keywords: slow slip event, Tokai region, GNSS

