Interplate coupling and slow slip events along the northern margin of the Philippine Sea plate estimated from GNSS data

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Southwest Japan is situated along the northern margin of the Philippine Sea plate. In the subduction zone along the Nankai trough, megathrust earthquakes historically hit southwest Japan with an interval of 100-200 years. Various slow earthquakes including slow slip events (SSEs) and low-frequency tremors have been observed there. A dense geodetic network including onshore GNSS and offshore GPS-A provides a key observation to clarify slow and fast slip and coupling of the Nankai megathrust zone. This presentation focuses on our recent studies of short-term SSEs (S-SSEs, Nishimura et al., 2013; Nishimura, 2014) and interplate coupling (Nishimura, in prep) estimated from the geodetic data.
In order to detect S-SSEs, we analyzed the data of ~800 GEONET GNSS stations along the Nankai Trough and the Ryukyu Trench. More than 390 possible short-term SSEs with M_w 5.6 for 19 years were detected by our analysis and they have a variety of characteristic recurrence intervals, magnitudes, durations and coincidental seismic activities. The detected SSEs concentrate in a depth range of 25-40 km and form the ETS (Episodic Tremor and Slip) zone along the Nankai Trough. The detected S-SSEs extend from the ETS zone toward southwest, and then fade away around the subducted Kyushu-Palau Ridge. Although few shallow (depth 20 km) S-SSEs have been detected along the Nankai Trough, S-SSEs often occur on the shallow plate interface along the Ryukyu Trench. This may be related to the incomplete interplate coupling.
We also estimate back-slip rates expressing interplate coupling as well as inland block rotations from GNSS and GPS-A velocities for a quiet period of crustal activity. Land GNSS data from April 2005 to December 2009 are used to estimate interseismic velocities. GPS-A data from 2004-2012 to 2016 are used after correcting co- and post-seismic displacement of the 2011 M_w 9.0 Tohoku-oki earthquake. The estimated coupling distribution (Figure) shows large heterogeneity in both strike and dip directions. Estimated back-slip rates are the highest off Shikoku and in the Bungo Channel at a depth of 10-30 km and decreases toward east. Back-slip rates off Kii Peninsula show heterogeneous distribution. Epicenters of the 1944 M_w8.0 Tonankai and the 1946 M_w8.3 Nankai earthquakes locate in an area of relatively low back-slip rates. Most S-SSEs occur at the down-dip edge of the transition zone from partial coupling to no coupling except in the Bungo Channel where a high coupling zone extends in a down-dip direction.

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