Temporal evolution of fault coupling associated with the occurrence of slow slip events in central Japan

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Abstract

Although interseismic coupling has often been considered to be stationary in time, there is increasing evidence that fault locking can vary both spatially and temporally during the interseismic period. The detection of transient slip behavior in the proximity of locked regions, such as slow slip events or decadal-scale uncoupling events, suggest in fact that the notion of a characteristic interseismic coupling distribution might not be appropriate.
This study focuses on interseismic deformation rates in the southeastern part of the Kantō area in Japan. This region lies at junction of two subduction zones, leading to a particularly complicated tectonic setting. On the Eastern side, the Pacific plate subducts under the Okhotsk Plate at the Japan Trench, while the Sagami Trough to the south evidences the subduction of the Philippine Sea Plate under the Okhotsk Plate. The Philippine Sea Plate interface has hosted M8 megathrust earthquakes in the vicinity of Tokyo metropolitan area, such as the 1923 Great Kantō earthquake. Studies of interseismic deformation rates [Sagiya, (2004); Nishimura et al. (2007)] have shown that these megathrust events are consistent with the presence of a strongly locked asperity on the western extent of the Philippine Sea Plate interface at depths above 15-20km. Meanwhile, offshore the Bōsō Peninsula, i.e. on the eastern side of the interface, recurrent slow slip events have been detected in 1996, 2002, 2007, 2011, 2013-2014, and 2018. These events of magnitude 6.4–6.7 last between 14 to 43 days and are associated to transient slip located at the downdip transition between the locked region and the deep freely creeping zone [e.g. Fukuda, (2018), Hirose et al., (2012, 2014)].
In this study, we analyze deformation rates from GEONET GPS measurements at stations in the southern Kantō region. We estimate horizontal and vertical interseismic rates at different inter-SSE periods from 1996 to 2011. We notice changes in the linear trend, between inter-SSE periods for both horizontal and vertical components, which may be associated to changes in fault coupling. Deformation rates are then inverted to produce coupling maps at the considered inter-SSE periods. We finally investigate possible relationships between the characteristics of the slow slip events and the inferred changes in interseismic fault coupling.

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