Detailed Spatial Slip Distribution for Short-term Slow Slip Events along the Nankai Subduction Zone, Southwest Japan

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Short-term slow slip events (S-SSEs) with a duration of days to weeks have intensively occurred at the transition zone at depths of ~ 35 km along the Nankai subduction zone, southwest Japan. Because crustal deformation due to a single S-SSE is small, the source fault has been often represented as a single planar uniform slip model, resulting to little constraint on the spatial heterogeneity in amount of slip. Here, to comprehensively investigate the detailed cumulative spatial distribution of S-SSEs in the whole Nankai subduction, we adopted a stacking approach of GNSS data by referencing low-frequency earthquakes which are assumed to be accompanied by S-SSEs. We have successfully extracted cumulative displacements due to a series of S-SSEs occurred from 2004 to 2009, showing coherent signals that are almost opposite to the direction of plate subduction. Then, we inverted these surface displacements to fault slip along the plate interface. The estimated slip indicates significant slip patches laterally elongated along the transition zone at the depths of ~30–35 km, and small patches on the shallow portion of ~15 km depth in eastern Shikoku and Tokai as well as in western Shikoku inferred by Kano et al. (2019). The two shallow patches locate on the downdip edge of the coseismic slip area in 1946 Nankai earthquake, while the Tokai small slip is located on the shallower side of the anticipated source area of the magnitude 8 class earthquake. In addition, the large slip patches of S-SSEs are possibly complementary to the spatially dense low-frequency earthquake areas; the number of low-frequency earthquakes is low in major slow-slip areas. This spatial dependence of fault slip style even within the transition zone provides new insights of generation mechanism of slow earthquakes.

Keywords: slow slip events, Nankai subduction zone, low-frequency earthquakes

