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Complementary distribution of Coseismic slip, Afterslip, and Slow Slip on the Nankai Trough Plate Boundary

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Understanding of mechanical behavior of the plate boundary is a key to estimate future seismic hazard. In the western Nankai Trough subduction zone around Shikoku, southwest Japan, a wide variety of interplate faulting phenomena occur and have been observed and it is a very good test field for such a purpose. The megathrust Nankai earthquake occurred in 1946, followed by a significant afterslip lasting for more than 20 years. Recently, long-term slow slip events have been found to repeat about every 6 years beneath the Bungo Channel along the western coast of Shikoku. In addition, short-term slow slip events accompanied by deep low frequency tremors occur almost every 6 months beneath the northern Shikoku. Such a diversity of faulting phenomena may be attributed to the heterogeneous distribution of frictional properties on the plate interface. In order to investigate spatial relationship among these various phenomena, we analyze conventional leveling data as well as recent GPS data using the same geodetic inversion code and the same plate boundary configuration model. We estimate slip distribution during the coseismic (1929-1947), the postseismic (1947-1964), and the slow-slip periods (1997, 2003, 2009-2010). Firstly, it is shown that on the slow-slip patch, plate interface is almost completely locked during the inter-slow-slip periods and accumulated slip deficit is released during the slow slip events. Therefore a small-scale earthquake cycle exists at the slow slip patch. The slow slip patch is located in the depth range of 20-30km, where the afterslip of the 1946 earthquake took place. However, the afterslip did not overlap the slow slip patch. This result may indicate there is some factor other than the depth or the temperature that controls the frictional properties on the plate interface. The dip angle and the amount of oceanic sediments are such candidates. On the other hand, another interpretation may be possible. Since the stress accumulated on the slow slip patch is almost totally released during every slow slip events, there might be no stress to be released after 1946.