Interseismic coupling-based earthquake and tsunami scenarios for the Nankai Trough

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Translating seismotectonic research to plausible earthquake scenarios is key to managing risk in tectonically active regions. Space geodetic observations of crustal motion have enabled the assessment of spatiotemporal variation in interseismic coupling, a measure of frictional locking on a fault interface that causes stress buildup between earthquakes. Theoretical modeling and investigations of recent subduction zone earthquakes show that spatial distributions of interseismic coupling and coseismic rupture are correlated. However, the utility of contemporary coupling in guiding construction of rupture scenarios has not been evaluated on the world’s most hazardous faults. Here we demonstrate methods for scaling coupling to slip to create rupture models for southwestern Japan’s Nankai Trough, where 1,300 years of historical records document megathrust earthquakes occurring every 100-200 years, and a magnitude 8-9 earthquake is likely to occur in the next few decades. Results show that coupling-based models produce distributions of ground surface deformation and tsunami inundation that are similar to historical and geologic records of the largest known Nankai earthquake in C.E. 1707 and to an independent, quasi-dynamic rupture model. Notably, these models and records all support focused subsidence around western Shikoku that makes the region particularly vulnerable to flooding. Results imply that contemporary coupling mirrors the slip distribution of a full-margin, 1707-type rupture, and GPS measurements of surface motion are connected with the trough’s physical characteristics.

Keywords: Nankai Trough, Interseismic coupling, Tsunami simulation

