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# Dynamic rupture of anticipated Nankai-Tonankai earthquakes using plate coupling rates on the subduction interface

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Hazardous earthquake ruptures along the Nankai-Tonankai subduction zone are expected in the following decades. Therefore, it is important to evaluate in advance potential strong ground motions and tsunamis that could be generated by these earthquakes. To do this, we proposed a methodology to integrate different stages in the earthquake cycle and by assimilating observed geophysical data we can provide reliable scenarios.

Fukuyama et al. (2009, BSSA) presented some spontaneous rupture scenarios at the subducting plate boundary of the 2003 Tokachi-Oki earthquake using the 3D geometry of the plate interface constructed Hashimoto et al. (2004, PAGEOPH). Hok et al. (2009, SSJ meeting) presented the spontaneous rupture propagation for the Nankai earthquake based on the Hashimoto et al. (2009, SSJ meeting)'s slip deficit rate estimation. Here, we basically follow these studies; we extend the simulation region including the Tonankai area and discuss the interaction between the segments.

In our simulation, the constitutive relation such as breakdown strength and slip-weakening distance (Dc) at each fault element become free parameters and may vary over the plate interface. We introduced simple assumptions for the constitutive parameters. We assume that the slip deficit accumulated since the previous earthquakes (1944 Tonankai and 1946 Nankai earthquakes) will be released completely by the next earthquake. Static strength can be constant all over the fault, or can follow the initial stress heterogeneity. The whole seismogenic area can be divided into several segments, having different parameter distribution.

We tested these hypotheses that lead to various rupture scenarios. For instance, considering homogeneous static strength, and initiation of the rupture in the Kii peninsula area (where the 194 4 and 1946 earthquakes initiated), we show that the Dc value in this intersegment area is a critical parameter, which controls the final size of the earthquakes. When Dc is taken the same on the intersegment as on the Nankai and Tonankai segments, then the rupture propagates bilaterally and the complete Tonankai-Nankai area breaks within a single event. When Dc inside the intersegment area is twice as large as that outside, we obtain unilateral ruptures that break either the Tonankai or the Nankai segment only, depending on which side of the intersegment the rupture is initiated at. After this two-earthquake sequence scenario, similar as the 1940s sequence, the whole Nankai-Tonankai area has been broken and unloaded. In our model, the intersegment between the Tonankai and the Nankai segment is a rather weak barrier, and its efficiency to stop the rupture depends strongly on the fact that the rupture initiated close to it. We also computed ruptures that initiate at the western edge of the Nankai segment, or at the eastern edge of the Tonankai segment. In the former case, the intersegment zone broke, and the complete Nankai-Tonankai area was broken in the same earthquake.

We showed that a smooth barrier, where Dc is large Dc, located between Nankai and Tonankai segments can lead to a sequential rupture of the plate boundary, provided that the rupture initiates close to the intersegment area. This is no longer true if the rupture starts on the Nankai segment, far from the intersegment area, leading to a single giant rupture event.

Keywords: rupture dynamics, Nankai earthquake, Tonankai earthquake, earthquake rupture, earthquake hazards