

Simulation of Great Earthquakes along the Nankai Trough: An Attempt at Simulation of Heterogeneous Slip Deficit Rate Distribution and Slip Distributions of the Showa Tonankai / Nankai Earthquakes

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1. Introduction

Recently, Yokota et al. [2016, Nature] and Nishimura et al. [2016, AGU] estimated heterogeneous slip deficit rate distributions on the plate boundary along the Nankai trough using both land based GNSS and offshore GPS/A data. We intend to simulate not only the heterogeneous slip deficit rate distribution but also slip distributions of the Showa Tonankai / Nankai earthquakes relatively well known [Baba & Cummins, 2005, GRL] using a three-dimensional earthquake cycle model based on the rate- and state-dependent friction law with heterogeneous frictional parameters on the plate interface along the Nankai trough.

2. Parameter setting

We set frictional parameter $a = 0.005$ in reference to Sawai et al. [2016, GRL]. The seismogenic zones for which $(a-b)$ is negative are within the depth ranging from trough to 30 km. We used larger effective normal stresses (35-60 MPa) at the plate interface off Shikoku and Tokai districts than the 30 MPa we used elsewhere. We set characteristic displacement L in 0.05-0.20 m on slip distributions of the Showa Tonankai / Nankai earthquakes and in 7.5 m on regions corresponding to small slip deficit rate distributions. The plate convergence rate we used was 5.5 cm/y in the western part of the study area, decreasing eastward from the Kii Peninsula to 1.0 cm/y in the eastern part of the study area [Nishimura et al., 2016, AGU].

3. Results

Preliminary results showed that Mw7.9-8.6 great earthquakes occur with recurrence interval of 90-120 years. We found various rupture patterns as follows, 1: stop off Omaezaki (Hoei eq. type), 2: whole (Ansei Tokai eq. type), and 3: stop off Lake Hamana (Showa Tonankai eq. type) in eastern area, and 4: whole including Hyuganada (Hoei eq. type), 5: off Shikoku district (Ansei Nankai eq. type), and 6: beneath coast of Shikoku (Showa Nankai eq. type) in western area. Occurrence interval between Tonankai and Nankai earthquakes were 0.7-1.6 years. We also found small slip deficit rate distributions off Kii peninsula and off eastern Shikoku district during interseismic periods. Thus, we could roughly simulate the heterogeneous slip deficit rate distribution and slip distributions of not only the Showa Tonankai / Nankai earthquakes but also other historical earthquakes. However, it is necessary to try parameter tuning further because we could not simulate historical occurrence timing.

Keywords: Nankai trough, Simulation, Slip deficit rate distribution, Showa Tonankai / Nankai Earthquakes