SSS31-P31　　　　　Room:Convention Hall　　　　　Time:May 21 18:15-19:30

Numerical simulation of Nankai Earthquake, Hyuga-nada Earthquakes, and slow slip events in Bungo Channel

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We numerically simulated cycles for occurrences of seismic and aseismic events in the region from Hyuga-nada to off Shikoku of southwest Japan with the 3D geometry of the Philippine Sea plate. In this study, we model Nankai Earthquake, three large earthquakes in Hyuga-nada, and slow slip events (SSEs) in the Bungo channel using the composite law, which is a type of rate- and state-dependent friction law. We put the seismogenic zone for the Nankai Earthquake from off Kii peninsula to cape Ashizuri. And we set frictional properties at source area of SSE and the Hyuga-nada earthquakes to satisfy a condition of slow slip and unstable slip, respectively.

As a result, these earthquakes and SSEs occur, whose recurrence intervals roughly correspond to observation data. In our simulation, the Nankai Earthquake and the northern Hyuga-nada earthquake mostly occur independently. And once or twice for a thousand years, rupture of the Nankai Earthquake extends to the Hyuga-nada region. When shallow area at off cape Ashizuri is locked, rupture of the Nankai Earthquake does not extend to the westward. Coseismic slip or afterslip frequently occurs after the Nankai Earthquake in the source area of SSE in the Bungo channel. Then, SSEs in the Bungo channel do not occur after the Nankai Earthquakes for a while, and it repeatedly occurs before the next Nankai Earthquake.

By using these results, it is possible to describe the correlation among occurrences of Nankai Earthquake, Hyuga-nada Earthquake, and Bungo channel SSEs. But these phenomena have not been observed in the past. Therefore, it is required to include a discussion of modeling hypothesis and uncertainty of frictional properties.