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Modeling of great earthquake generation cycle and estimation of the ocean bottom deformation in the Nankai subduction zone

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SUMMARY

Great interplate earthquakes had occurred intermittently along the Nankai subduction zone, southwest Japan. Along this subduction zone, it has been considered that there are at least two fault segments. In the eastern segment, great earthquakes had occurred earlier than in the western segment. The time intervals between the events in the two segments changed significantly from less than one hour to a few years. Further, the recurrence interval of events in each segment also varied from less than 100 years to more than 200 years. Although the time interval of the events changed so significantly, we qualitatively reproduced the variation patterns of the last three pairs of events in the numerical simulations for earthquake generation cycles with a rate- and state-dependent friction law. In the model, heterogeneous frictional properties were assumed based on the structure surveys in this area. Among some heterogeneous frictional properties, friction around the segmentation boundary is the most sensitive to the simulated rupture patterns. The boundary behaved as a barrier for the eastern event and then became an asperity of the western event. During the time interval between the two events, afterslip of the eastern event propagated from east to west through the segmentation boundary. In this model, how the afterslip accelerates or decelerates is critical for the time interval between the two events. Thus, we evaluated the surface deformation (actually the ocean bottom deformation) and examined whether the afterslip variation can be detected by ocean bottom pressure gauges which are planning to be deployed in the segmentation boundary area within several years. The results showed that more than 20 centimeters uplift occurred prior to the western event. The amplitude of this variation is larger than the noise level (several centimeters) of pressure gauges in the eastern segment. Since the time interval between the east and west events is important information for disaster mitigation, we are developing the monitoring and data assimilation system for the spatio-temporal variation of the plate boundary slip in the source area of the events using the data from ocean bottom cable networks and GPS on land.