Effects of assumed earthquakes in the presumed source region on the Tokai earthquake

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It has been known that large interplate earthquakes occurd repeatedly at an interval of 90 to 150 years along the Nankai-Suruga Trough where the Philippine Sea plate subducts beneath the Eurasian plate. Kuroki et al. (2002) presented a three-dimensional simulation model with a rate- and state- dependent friction law (Dieterich, 1979; Ruina, 1983) for plate subduction in the Tokai region. Kuroki et al. (2004) estimated effects of nearby large earthquakes on the occurrence time of the Tokai earthquake. It is suggested that the 1891 Nobi earthquake delays the occurrence of the Tokai earthquake, while the 1923 Kanto and the 1944 Tonankai earthquakes advance it. We examine the sense and degree of the effects ot the moderate earthquakes in the presumed souece region on the occurrence time of the Tokai earthquake, and show whether and how much the stress perturbation produced by the nearby earthquakes strengthens or weakens the stress accumulated in the coupling region.

We examine the occurrence time of the Tokai earthquake by evaluating effects of stress perturbation on the basis of a three-dimensional simulation model developed by Kuroki et al. (2004). The time cycle of the interplate earthquakes is adjusted to be about 150 years by determining the value of model parameters on the plate boundary. We assume that a curved Philippine Sea plate is embedded within a uniform elastic half-space, and a frictional force acts on the interface according to a rate and state dependent friction law (Dieterich, 1979; Ruina, 1983). The plate interface in the model region is determined by the hypocentral distribution of micro-earthquakes in the slab. The curved plate interface in the model region is divided into 2421 triangular cells and each cell effects to each other. We calculate interaction of cells by Green function and integrate time by Runge-Kutta method. We assume the relative plate velocity is 4cm/year (Sono et al., 1993).

The parameters of the earthquakes in the presumed source region are determined to agree with the parameters of the past earthquakes to reflect the stress field in the region. To evaluate influence of the earthquake in the presumed source region on the occurrence time of the Tokai earthquake quantitatively, we add shear stress and velocity fields produced by the nearby earthquake to the stress and velocity fields on the plate interface in the model region at different occurrence times of several cases.

We performed numerical simulations for some faults. The occurrence time of the earthquake in the presumed source region is 1, 3, 5, 10, 20 and 50 years before the Tokai earthquake. The earthquakes occur at the location from N34.75 degree E137.75 degree to N35.25 degree E138.25 degree. The results suggest the earthquakes occurred near the nucleation-zone of the Tokai earthquake have large effects on its occurrence time. We investigated the effect of the depth variation of the earthquakes in the presumed source region with the depth range from 10 to 20km. The results suggest the earthquakes more close to the plate boundary have larger effects on the occurrence time of the Tokai earthquake.

We also investigated the effect of the magnitude of the earthquake at the range from M=5.0 to M=6.5. We find that the influence is large when the earthquakes with M greater than 6.0 occur just near the initiating part of the Tokai earthquake. Especially the earthquake with M=6.5 caused the Tokai earthquake soon after its occurrence. But the earthquake with M=6.0 have a little influence on the occurrence time of the Tokai earthquake.