Variation in earthquake generation cycles due to interaction between multiple segments or asperities

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Recent seismic and geodetic observation reveal that an isolated asperity surrounded by stable sliding area causes almost identical earthquake with almost constant recurrence interval (Matsuzawa et al., 2002). On the other hand, if there are two or three asperities, earthquake recurrence interval and size significantly change. For example, two major asperities ruptured in the 1968 Tokachi-oki earthquake. After 26 years of this event, one of the asperity ruptured in the 1994 Sanriku-oki earthquake (Nagai et al., 2001). The slip amount at the asperity for the latter event is smaller than that for the former event. Another example can be seen along the Nankai trough. There are three major segments; Tokai, Tonankai and Nankai. The great earthquakes occurred on these segments within a few years interval each other. Recurrence interval is from about 100 to 200 years for each segment (Ishibashi, 2002).

We have revealed that the variation in recurrence interval and size can be reproduced by numerical simulation of earthquake generation cycles based on asperity model with laboratory derived fault constitutive law. The slip amount for each asperity/segment basically depends on the time interval from the last event (namely, slip-predictable). Additionally, slip amount becomes small when an asperity ruptures but neighboring ones do not. On the other hand, variation in recurrence interval depends on many factors, such as stressing rate on the asperity, their strength recovery process, and so on. The stressing rate depends on space-time distribution of seismic and aseismic slip around the asperities/segments. Strength recovery process depends on fault constitutive law and its parameter values. We will show the mechanisms for some regions, such as Nankai trough, Japan trench and Kuril trench.