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A possible scenario for earlier occurrence of the next Nankai earthquake due to triggering by an earthquake at Hyuga-nada, off southwest Japan

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Several recent large-scale earthquakes including the 2011 Tohoku earthquake (Mw 9.0) in northeastern Japan and the 2014 Iquique earthquake (Mw 8.1) in northern Chile were associated with foreshock activities (Mw > 6). The detailed mechanisms between these large earthquakes and the preceding smaller earthquakes are still unknown; however, to plan for disaster mitigation against the anticipated great Nankai Trough earthquakes, in this study, possible scenarios after Mw 7-class earthquakes that frequently occur near the focal region of the Nankai Trough are examined through quasi-dynamic modeling of seismic cycles. By assuming that simulated Nankai Trough earthquakes recur as two alternative earthquakes with variations in magnitudes (Mw 8.7–8.4) and recurrence intervals (178–143 years), we systematically examine the effect of the occurrence timing of the Mw 7 Hyuga-nada earthquake on the western extension of the source region of Nankai Trough earthquakes on the assumed Nankai Trough seismic cycles.

We find that in the latter half of a seismic cycle preceding a large Nankai Trough earthquake, an immature Nankai earthquake tends to be triggered within several years after the occurrence of a Hyuga-nada earthquake, then Tokai (Tonankai) earthquakes occur with maximum time lags of several years. The combined magnitudes of the triggered Nankai and subsequent Tokai (Tonankai) earthquakes become gradually larger with later occurrence of the Hyuga-nada earthquake, while the rupture timings between the Nankai and Tokai (Tonankai) earthquakes become smaller. The triggered occurrence of an immature Nankai Trough earthquake could delay the expected larger Nankai Trough earthquake to the next seismic cycle. Our results indicate that triggering can explain the variety and complexity of historical Nankai Trough earthquakes. Moreover, for the next anticipated event, countermeasures should include the possibility of a triggered occurrence of a Nankai Trough earthquake by an Mw 7 Hyuga-nada earthquake.