Coulomb stress changes on block boundary faults during the megathrust earthquake in southwest Japan

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In the subduction zone, megathrust earthquakes may modulate the shallow crustal seismicity in the overriding plate. Historical documents indicate the frequent occurrence of large shallow crustal earthquakes in the overriding continental plate 50 years before and 10 years after the megathrust earthquakes along the Nankai trough in southwest Japan. We construct a model that can reproduce not only the inland seismic activity but also the geodetic observation by using the relative motion between tectonic blocks and the interplate coupling. The stress sources on the block boundary faults are repeated megathrust earthquakes with a recurrence interval of 100 years and locking at the seismogenic part (i.e., aseismic slip on the downward extensions of a seismogenic part of the block boundary faults). Our model suggests that the apparent friction coefficient may be small considering the historical seismic activity in the San-in area. Although we know neither absolute value of CFS or fault strength in terms of earthquake occurrence, it is reasonable that an earthquake cannot occur as long as delta CFS is below its previous maximum. Therefore, an earthquake can occur only during the period when delta CFS exceeds its previous maximum and we defined this period as ‘the active period’ of inland earthquakes. The active period is shorter as the backslip rate of inland block fault is smaller. In order for our model to explain the past seismic activity, the backslip rate must be much smaller than the relative block motion estimated from recent GNSS observation. In other words, long-term elastic strain accumulation on inland faults should be much smaller than that predicted by the relative block motion to explain the modulation of historical earthquakes.

