Triggering and Coulomb stress interaction of Successive large earthquakes.

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The present study assesses static coulomb stress change (ΔCFF) hypothesis for triggering of successive large earthquakes which are defined as earthquake sequences occurring close to the target earthquake both in space and time; and are not attributed to the aftershock activity. A wide range of various case studies support ΔCFF hypothesis for earthquake triggering process based on mainshock-aftershock or aftershocks –mainshock sequences. But, there are few studies that systematically give attentions on the effect of ΔCFF triggering mechanisms for the large earthquakes occurring beyond the aftershock zone. In the present study, we investigate how often the successive large earthquakes occur and assess the ΔCFF hypothesis to them that occurred beyond the aftershock zone.

We use data from the Global Centroid Moment Tensor catalog for the period of 1976 to 2016. The earthquakes with magnitude larger than 6 occurred at the depth less than or equal to 70 km are analyzed. We counted the number of successive earthquakes by substituting various ranges of horizontal distance *(D)* and time interval (*ta)* between the earthquakes. To examine whether or not the large earthquakes occur randomly, the results are compared with simulations in which the successive large earthquakes are set to randomly occur in time. The results show that the observed large earthquakes with magnitude >=7 are triggered beyond 1000 km, 400 km and 300 km for *ta* of 14, 180 and 365 days, respectively. As the horizontal distance increases and/or interval time increases, the occurrence probability decreases and approaches to the normal condition in which the occurrence time intervals of large earthquakes obey a Poisson distribution.

We further calculate ΔCFF on both nodal planes for each pair event in each cluster, using Coulomb3.3 program (USGS). The ΔCFF assessed in this study only include the effects of individual source event that first occurred in a cluster, thus any secondary triggering or cascading is not accounted. The results show that, at triggering distance, the Coulomb Index (CI, number of event which experienced positive ΔCFF in one of the fault plane) is between 40% and 77%. Up to the triggering distance, the changes of ΔCFF becomes too small. This behavior supports the random occurrence process of successive large earthquakes up to some large distance.

Our results suggest that ΔCFF alone seems inefficient to trigger successive large earthquakes. It is necessary to take into account for other uncounted processes such as slower deformation processes due to visco-elastic behavior in crust and mantle, and the ambient stress field due to plate tectonic motion process.

Keywords: Successive large earthquakes, Triggering, Static stress change, Coulomb Index

