Static Coulomb Failure Function and Aftershocks of 1995 Kobe Earthquake

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Static Coulomb failure function (CFF) describes stress change on a specified fault plane which is caused by external tectonic events such as large earthquakes. Since mid-1990s, the CFF hypothesis has been widely used to explain elements of seismicity, especially the spatial distribution of aftershocks of large events. Statistical verification on this hypothesis, however, has not been widely attempted to date.

When CFF hypothesis is applied to aftershocks, it is common to assume parameters of the target fault and to compare spatial pattern of CFF values and the aftershock distribution. Since CFF values depend on the orientation and the slip direction of target faults, it is an oversimplification to apply one fault parameter to the entire aftershocks, as variation of aftershock mechanisms has been widely and commonly observed.

In this study, we evaluate how successful static CFF hypothesis would be for aftershocks of 1995 Kobe (Hyogo-gen-nanbu) earthquake and test whether this success is statistically significant. We use aftershock mechanisms of Katao et al. [1997] to evaluate CFF for each aftershock to evaluate control of CFF on each event. When we use geodetic source model of Hashimoto et al. [1996], the static CFF takes positive values on either of two nodal planes for more than 70 % of aftershocks, which is in agreement of Sugihara and Zhao [1999]. On the other hand, when we choose same number of events randomly from a statistically modeled regional seismicity, we find that the static CFF takes positive values on either of two nodal planes for more than 70 % of the target events often occurs. This implies that 70%, apparently a high number, is not statistically high enough to conclude the effective control by static CFF, or our statistical tests do not confirm that these aftershocks are selectively excited events by the main shock.

Our results imply that we need to reconsider the hypothesis that aftershock activity can be explained and predicted by simple static CFF.