Aftershock activity of the 1994 Northridge earthquake (Mw 6.7) and static and dynamic stress changes

Takeshi Kimura[1]; Aitaro Kato[2]; Takashi Miyatake[1]; Satoshi Ide[3]

[1] ERI, Univ. of Tokyo; [2] ERI, Univ. Tokyo; [3] Dept. EPS, Univ. of Tokyo

After an earthquake occurred, increase of seismicity has been observed in the near and far field, which is called earthquake triggering. It is important to study the environment in which earthquakes are triggered and factors which influence earthquake triggering in order to understand the earthquake rupture mechanism. In this study, I examine the effect of dynamic and static Delta CFF (Coulomb Failure Function) on the aftershock activity of the 1994 Northridge earthquake (Mw 6.7) by comparing a spatial distribution of seismicity rate changes with the distribution of maximum values of dynamic Delta CFF and that of static Delta CFF.

We use an earthquake catalog relocated by Shearer et al. (2005). We calculate Delta CFF using forth-order finite difference method (FDM) with a 3-D staggered-grid. The grid interval and time increment are 0.25 km and 0.01 sec., respectively. We use a kinematic source model estimated by Wald et al. (1996). We translate the fault plane to conform the rupture nucleation point to the hypocenter of Shearer's catalog. We calculate Delta CFF in a semi-infinite homogeneous medium and temporal stress changes are low-pass filtered at 1 Hz. We calculate Delta CFF for thrust faulting on fault planes same as and perpendicular to that of the main shock. Delta CFF is calculated at grids whose interval is 0.5 km and we choose larger value of the values calculated for above two fault geometries.

First we study Delta CFF-frequency distribution. Maximum value of dynamic Delta CFF-frequency diagrams for 3 month and 1 year aftershocks show that these aftershocks concentrated in the area with larger positive maximum values of dynamic Delta CFF than background seismicity. In the case of static Delta CFF, the aftershocks also concentrated in the area with larger values of static Delta CFF.

Next, We divide a volume around the fault plane of the main shock into small meshes and characterize the seismicity rate changes associated with the main shock using the beta-statistic (Matthews and Reassenberg, 1988). We compare the beta-statistics with maximum values of dynamic Delta CFF and static Delta CFF. The beta-statistic correlate with the maximum value of dynamic Delta CFF. We need to examine the effect of the period of analyzed aftershock activity and mesh size on the beta-statistic.