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Dynamic stress changes due to a dipping fault in which the rupture propagates along strike direction

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After the 1992 Landers, 1999 Hector Mine and 2001 Denali earthquakes, some researchers observed increases in seismicity rates in many areas far from epicenters. Many researches indicate that static stress changes due to large earthquakes influence following seismicity rate changes in the near filed. However, in the far field, static stress changes have little effect on seismicity because their amplitudes are too small to trigger earthquakes in the far field. Alternatively, dynamic stress changes accompanied by seismic waves, which attenuate less than static stress changes, must trigger earthquakes in the far field. If dynamic stress changes trigger earthquakes in the far field, they should affect aftershock activity in the near field, and some researchers evaluated effects of dynamic stress changes by comparing a distribution of maximum values of dynamic stress changes with aftershock activity. However, most of them studied on strike slip events whose rupture propagates mainly along the strike direction, such as the 1992 Landers earthquake. On the other hand, events on normal and reverse faults have been rarely studied, and even the relationship between the spatio-temporal variation of dynamic stress changes and rupture process on the master fault is not understood clearly.

Kimura and Miyatake (2006) investigated the relationship between characteristics of spatio-temporal distribution of dynamic stress changes and the rupture process of pure dip slip in which the rupture propagates mainly along the strike of the fault. This article provided following conclusions:

1. The spatial distribution of dynamic changes of Coulomb Failure Function (delta CFF) in the near field has four separate parts according to the sign of the normal stress changes.
2. Dynamic delta CFF is amplified by rupture directivity.
3. When the rupture reaches the edge of the fault, a large amplitude stopping phase is emitted from the fault edge.

However, Kimura and Miyatake (2006) calculated dynamic stress changes in an infinite homogeneous elastic medium, and effects of the free surface on dynamic stress changes were not taken into account. In this study, we calculate the dynamic stress changes due to a simple rectangular fault within a half-infinite homogeneous elastic medium, and compare results with the case of infinite homogeneous elastic homogeneous medium, strike slip fault, and static stress changes.

We use the forth-order finite difference method (FDM) with a 3-D staggered-grid to calculate the dynamic stress changes. The slip-weakening law with constant values of Dc and static stress drop on the master fault is assumed as a boundary condition. The rupture propagates circularly from the rupture starting point at a fixed velocity of 80 percents of the S-wave velocity. As a result in the case of a reverse fault whose dip is 45 degrees, the first characteristic mentioned above can not be seen due to waves reflected at the free surface. However, the area to the rupture propagating direction has larger values of delta CFF than that around the rupture starting point due to the rupture directivity effect and stopping phase. As our future works, we calculate dynamic stress changes due to a simple normal fault, and evaluate the difference between the dynamic stress changes due to a reverse fault and that due to a normal fault.