SENSITIVITY ANALYSIS OF COULOMB STRESS CHANGE DUE TO VARIABILITY IN MAINSHOCK SOURCE MODELS AND RECEIVING FAULT PARAMETERS: A CASE STUDY USING THE 2003 MW 6.5 BAM EARTHQUAKE

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The Coulomb stress change has been widely employed to interpret mainshock-mainshock and mainshock-aftershock triggering (Cakir et al., 2003), (Tsukuda, 1991). This quantitative index is computed based on Coulomb failure criterion and is a function of fault parameters including the source and receiver fault geometries, the friction coefficient on the receiver fault, Skempton's coefficient of the host rock, and the magnitude and direction of the maximum principle stress of the regional stress field (King et al., 1994). Thus, for the robust determination of the Coulomb stress change, the sensitivity of the Coulomb stress change to these model parameters should be assessed. The scope of this research is to investigate the effect of geometrical and physical input parameters in Coulomb stress change calculations on the basis of elastic dislocation theory (Okada, 85, 92). Different variables are involved in these processes; some of them perform more accurately than others. In this paper we investigate the sensitivity of the Coulomb stress change to the fault model parameters for the 2003 Mw = 6.5 Bam earthquake. Bam fault parameters were gathered from different sources (Jónsson et al., 2004), (Motagh et al., 2006), (Talebian et al., 2004). Table 1 shows selected Bam fault parameters used as reference fault for sensitivity analysis.

Table 1. Bam fault parameters used for sensitivity analysis

length (km)	width (km)	locking depth (km)	dip (deg.)	slip (m)	Lame coefficients (GPa)
20	8	9.3	90	2	30

To do sensitivity analysis, we considered areas with maximum and minimum Coulomb stress changes. Then we changed reference fault parameters to see its effect on evaluated Coulomb stress change (Table 2). High differences among evaluated Coulomb stress change show more sensitivity.

Table 2. Applied changes on reference fault parameters to do sensitivity analysis

length (km)	width (km)	locking depth (km)	dip (deg.)	slip (m)	Lame coefficients (GPa)
10	4	5	70	1	20
15	6	7	80	1.5	25
20	8	9.3	90	2	30
25	10	11	60	2.5	35
30	12	13	50	30	40

Our results indicate that for this case the Coulomb stress change is the most sensitive to the uncertainty in the dip angle of the receiver fault, while the influences of the uncertainties in the slip model of the source fault, the strike, and rake angles of the receiver fault, and the friction and Skempton's coefficient can not be neglected. Coulomb stress change is most sensitive to the regional stress direction, because the regional stress direction affects directly the optimum rupture planes. Secondly, Coulomb stress change is modestly sensitive to the effective friction, because the friction determines the weight of normal stress in Coulomb stress change calculation. At last, our results show that Coulomb stress change is insensitive to the regional stress amplitude, because the amplitude of Coulomb stress change is much smaller than that of regional stress field (Table 3).

Table 3. Coulomb stress change sensitivity to input parameters, sensitivity decreases from top to bottom

Parameter
Regional stress field direction
Dip angle
Slip of fault (dislocation)
Strike angle
Rake angle
Skempton's coefficient
Friction coefficient

Accordingly, it is crucial to perform a realistic estimate of the uncertainty in the Coulomb stress change. By performing such calculation, future Coulomb stress analyses such as stress triggering of earthquake sequence and the likelihoods of potential earthquakes could be based on more robust Coulomb stress change maps.

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