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Modeling instantaneous dynamic triggering in a 3–D fault system: the case of an early and remote aftershock in the June 2000 South Iceland seismic sequence

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We present a seismogenic model in which the target fault is not an isolated physical system, but it is subjected to external perturbations of stress arising from a causative fault.

As an application, we consider the spatio-temporal stress redistribution following the M_S = 6.6 June 17, 2000 mainshock, occurred in the South Iceland Seismic Zone. We analyze the triggered response of the Hvalhnúkur fault, which is located at remote distance (nearly 64 Km) from the causative fault and fails 26 s after the mainshock. We consider a truly 3-D, fully dynamic in the whole range of slip rate, spontaneous problem, accounting for crustal stratification and rheological heterogeneities. We solve the fundamental elasto–dynamic equation by means of a Finite Difference method and accounting for different constitutive laws, either rate- and state-dependent and non-linear slip-dependent governing laws. We compare our numerical results with those obtained in a previous study, where a point-like model of the 26 fault was considered, and we show the key differences existing between a mass–spring model and an extended fault model.

Our results show that the triggering time and the dynamics of the 26 s fault depend on the assumed constitutive law and pre-stress. We also demonstrate the importance of the coupling of the normal component of the stress perturbation to the shear ones, reinforcing the meaning of the Coulomb Failure Function. The hypocenter location, its failure time and the seismic moment are in general agreement with observational constraints.