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Broadband Ground Motion Simulations of the 23 October 2011 Van (Eastern Turkey) Earthquake

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On October 23, 2011, a Mw 7.1 earthquake occurred in eastern Turkey, close to the towns of Van and Erciş, causing about 600 casualties and a widespread damage. The earthquake ruptured a 60-70 km long NE-SW fault with a thrust mechanism, in agreement with the tectonic stress regime of the region. The mainshock was recorded by several stations of the Turkish and Iranian strong-motion networks providing about 20 three-component recordings within 230 km distance from the epicenter. Due to the sparse station coverage, only few strong-motion records are collected in the epicentral area (i.e. within 50 km from the earthquake fault). Thus, the details of the rupture process and the ground motion distribution in the near-fault, that are essential to investigate and assess the damage caused by the earthquake, remain largely unknown.

In this study, we present preliminary results of broadband (0.1-10Hz) ground motion simulations for the Van earthquake using a hybrid integral-composite source model. The simulations are based on three fault models: (i) the USGS slip distribution calculated from teleseismic records, (ii) our slip distribution calculated from Turkish strong-motion stations, and (iii) our multiple-point source model calculated from the same data as (ii). Models (ii) and (iii), in contrast to (i), were derived independently on the assumed position of the hypocenter. We first attempt to simulate the closest strong motion records in order to calibrate some rupture model parameters that cannot be constrained from alternative studies. The sensitivity of the simulated ground motions to rupture velocity, stress drop and slip distribution over the fault is investigated. Finally, we examine the simulated ground motion distribution in the near-fault area and compare it with empirical ground motion prediction equations and with the observed damage after the earthquake.