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Broadband strong motion simulation coupling K-2 kinematic source model with empirical Green's functions: application to the 2009 L'Aquila earthquake

Sergio Del Gaudio (1,2), Mathieu Causse (3), and Gaetano Festa (1)

(1) University of Naples Federico II, Naples, Italy (sergio.delgaudio@unina.it), (2) AMRA scarl, Naples, Italy, (3) ISTerre, Université Joseph Fourier, IFSTTAR, Grenoble, France

We perform "blind" broadband ground-motion simulations using empirical Green's functions (EGF) summed up according to a k-2 kinematic source model. Source parameters (roughness degree of slip heterogeneity, nucleation point, rupture velocity) are defined as a priori random variables, so as to compute the expected median and variability of the ground-motion. The method is used to predict ground-motion of the 2009 L'Aquila earthquake (M_w = 6.3), one of the best recorded events in Europe. A large database of aftershocks is available, providing a large number of potential EGFs. Moreover the main shock and the aftershocks have been recorded at various distances from the epicenter, and hence simulations have been performed both in near-field and far-field conditions.

We first selected aftershocks in the magnitude range 3.5 – 3.7, located approximately on the fault plane of the main shock, with a similar focal mechanism and with a high signal to noise ratio (> 3) in the frequency range of interest (0.2 Hz to 20 Hz). All these aftershocks ($\sim$15) can be considered as "good" candidates for EGF ground-motion prediction. We then analyze how the choice of the EGF affect the simulation results. We also show that the use of several EGF distributed over the fault plane significantly improves the results in comparison to predictions performed using a single EGF, especially for the near source stations. Finally we analyze how different degree of a priori knowledge on the source parameters (fixed low frequency slip distribution, roughness degree of slip heterogeneity, rupture velocity, nucleation point) may affect the simulations. Comparison between synthetics and real data are shown in terms of Fourier amplitude spectra and response spectra.