Geophysical Research Abstracts, Vol. 9, 05591, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05591

Heterogeneous dynamic rupture modeling for strong ground motion simulation

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For strong ground motion simulation due to a finite fault, a kinematic source model (rupture behavior fixed a priori) is usually adopted. This study instead proposes to introduce dynamic source simulation (rupture behavior physically controlled by stress-friction conditions) based on our first attempt (Aochi and Doulgas, BEE, 4(3), 211-229, 2006). According to the multi-scale simulations of Ide and Aochi (JGR, 110, B11303, 2005), spatial heterogeneity is introduced randomly in fracture energy. This leads to very heterogeneous rupture behavior in terms of rupture directivity and direction and slip time functions. In particular, unlike in usual dynamic rupture simulations, all the ruptures begin on an infinitesimal area (no nucleation) and end naturally due to the energy balance around the rupture front (no artificial barrier). Therefore, the location and timing of high-frequency seismic wave radiation can be significantly different from usual dynamic rupture simulation. This difference is important for efficient evaluation of strong motions from different earthquake scenarios. Near-field wave propagation is simulated using a finite difference method and synthetic seismograms are compared with empirical ground-motion models.