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A complete BIEM-FDM-FEM simulation of an earthquake scenario - dynamic rupture process, seismic wave propagation and site effects

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We demonstrate a hybrid simulation of the complete process of an earthquake (dynamic rupture propagation, seismic wave propagation and site effects). First a boundary integral equation method (BIEM) is adopted to model the dynamic rupture process because of its flexibility for treating nonplanar faults. A finite difference method (FDM) is then chosen to compute the seismic wave propagation because of its portability. Finally a finite element method (FEM) is used to calculate the effect of the site because of its power in modelling complex nonlinear materials. The preliminary simulation is carried out for an earthquake of about magnitude 6 (rupture area 12x8km) within a region of 40x40x20km and characterized for a near-field site of 300x300x60m. The validity of the numerical simulation is also discussed by the comparing the results with published empirical relationships derived from real strong ground motion data. Such a numerical approach for the complete dynamic process constitutes a very powerful and useful tool for seismic risk assessment and scenario predictions at the regional scale.