COMPUTATIONAL PHYSICS

SEM3D: A 3D High-Fidelity Numerical Earthquake Simulator for Broadband (0–10 Hz) Seismic Response Prediction at a Regional Scale

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In this paper, we present SEM3D: a 3D high-fidelity numerical earthquake simulator that is tailored to predict the seismic wave field of complex earthquake scenarios from the fault to the epicenter site. SEM3D solves the wave-propagation problem by means of the spectral element method (SEM). The presented demonstrative test case was a blind Mw6.0 earthquake scenario at the European experimental site located in the sedimentary basin of Argostoli on the island of Kefalonia (Western Greece). A well-constrained geological model, obtained via geophysical inversion studies, and seismological model, given the large database of seismic traces recorded by the newly installed ARGONET network, of the site were considered. The domain of interest covered a region of 44 km × 44 km × 63 km, with the smallest grid size of 130 m × 130 m × 35 m. This allowed us to simulate the ground shaking in its entirety, from the seismic source to the epicenter site within a 0–10 Hz frequency band. Owing to the pseudo-spectral nature of the numerical method and given the high polynomial order (i.e., degree nine), the model featured 1.35·10**10 DOFs (degrees of freedom). The variability of the synthetic wave field generated within the basin is assessed herein, exploring different random realizations of the mean velocity structure and heterogeneous rupture path.