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Review

Sensitivity of the strong ground motion time histories to a finite source model: A case study for the January 12, 2010 Haiti earthquake (M_w=7.0)

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ABSTRACT

We analyze the waveforms generated by the January 12, 2010 Haiti earthquake (M_w=7.0) for its source characteristics. A 60 to 25 km source model is retrieved by the Kikuchi and Kanamori finite source inversion technique that uses broadband teleseismic body wave records. The derived rupture model points out unilateral rupture propagation commenced at the eastern side of the fault plane where the major seismic moment release occurred. The rupture front propagated westward and terminated at a site where the largest aftershocks occurred. Our estimates yield a seismic moment of M_o=8.17 × 10^{19} N m released on a 60 km-long fault plane. A patch at the eastern side of the ruptured fault plane inferred as a region of maximum moment release.

We also simulated the strong ground motion time histories recorded during the earthquake using the modified version of the stochastic modeling technique (FINSIM). In this technique, the finite-fault plane is subdivided into subfaults, and each element is assigned a stochastic ω^2 spectrum. In the modified version, a time axes for time differences between wave onsets at different seismic stations is added, and the stimulation and propagation of the compressional waves is considered. The optimal size of subfaults is selected as a function of the earthquake magnitude. The ground motion waveforms recorded at the nearest station to the epicenter (SDDR) are used in the comparisons. We tested two models: one with a fault plane size from 60 to 25 km, and a second model with a fault plane size of 35–25 km. A good agreement is found between time histories, response spectra of the simulated and the observed data using the model with a fault plane size of 60–25 km. In addition, peak ground acceleration (PGA) distribution obtained by modified version of FINSIM is compared with PGA distribution obtained by USGS ShakeMap for Port-au-Prince and circumferences.

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