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Broadband Ground Motions Simulations for M≥6.0 Earthquakes in the 2016/2017 Central Italy Seismic Sequence through a 1D Frequency-Wavenumber Approach: a Velocity Models Sensitivity Analysis

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The Central Italy area close to the town of Amatrice was hit by a seismic sequence that started with a Mw 6.2 mainshock and lasted more than 1 year, with the highest event being the Mw 6.5 earthquake in Norcia. Reliable prediction of ground motion is difficult due to the limited data available particularly in the near-source; for this reason, we need realistic simulations of near-source broadband ground motion for seismic hazard assessment. Such simulations should be accurate and computationally efficient. In this work, we performed physics-based simulations to investigate ground motion variability for the Amatrice and Norcia earthquakes. Using the Frequency-Wavenumber (FK) technique we generated broadband ground motion time histories up to 10 Hz for both earthquakes. We exploited accurate source rupture models and various sets of Green's functions generated with 1D velocity models obtained by slightly modifying the 1D velocity model of the Central Apennine Area proposed by Hermann et al. (2011). First, we employed the Graves and Pitarka (2016) technique to generate kinematic rupture models. Then, FK Green's functions are computed using the propagator matrix method proposed by Zhu and Rivera (2002). Using the RotD50 SA goodness of fit (GoF) between the recorded and simulated ground motion, we conducted 1D velocity model sensitivity analysis. Overall, the simulated time histories match well the recorded ground motion. We found that the 1D velocity model of the Central Apennine Area, modified for the inclusion of thin near-surface sedimentary layers, performed better than the other 1D velocity models considered in the GOF analysis. Our ground motion simulations suggest that the FK-based simulation approach can effectively reproduce the recorded ground motion in the frequency range of 0-10 Hz. Consequently, this approach holds promise for the seismic hazard assessment in Central Italy, enabling significant computer time savings compared to more complex methodologies that involve 3D wave propagation modeling.