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Near-field earthquake shaking generated by kinematic rupture simulations in the Istanbul area

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Physics-based synthetic scenarios are becoming increasingly popular in engineering seismology as reliable input to seismic hazard studies. Numerical simulations allow: (a) overcoming the difficulties posed by the paucity of near-field strong-motion data in the calibration datasets of empirical ground-motion prediction equations (GMPEs); (b) improving our understanding of source-dominated ground-motion phenomena; and c) optimising engineering definition of long-period ground motions. In spite of (a), the feasibility of a synthetic scenario to provide a realistic representation of the severity of seismic shaking is generally measured by the comparison of the results of the numerical simulations with empirical GMPEs. Large deviations of the synthetic peak motions and response spectra from the +/-1 sigma bounds of the chosen GMPEs result often into skepticism and concern about the soundness of the adopted synthetic predictive tools. With this background, we selectively present here the results obtained by scrutinising a near-field synthetic waveform dataset based on about 50 kinematic rupture models in the moment magnitude range 7.0 <= MW <= 7.4 relevant for seismic hazard assessment in the municipal area of Istanbul, Turkey. We focus on analysing the variation of peak ground-shaking parameters and response spectral ordinates (for vibration period T > 0.75 s) as a function of selected source parameters in addition to source-to-site path terms. Our goals are to investigate alternative functional forms for near-field ground-motion prediction based on the synthetic data and to critically revise the current approaches to validating numerical simulations based on the comparison with existing empirical GMPEs.