3D physics-based numerical simulations: advantages and current limitations of a new frontier to earthquake ground motion prediction. The Istanbul case study.

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Abstract In this paper, an overview is presented to motivate the use of 3D physics-based numerical simulations of seismic wave propagation to support enhanced Probabilistic Seismic Hazard Assessment. With reference to the case study of Istanbul, we introduce the activities required to construct a numerical model of the surface geology and topography and to determine the input conditions to trigger future earthquakes in a physically sound way. Owing to the intrinsic frequency limitations of the numerical simulations, a post-processing technique to produce realistic broadband waveforms is introduced, allowing to correlate short-period to long-period spectral ordinates from an Artificial Neural Network. Finally, the results obtained in Istanbul from numerous physics-based ground motion scenarios of M7+ earthquakes allow us to throw light on the potential added value to PSHA of the 3D numerical simulations. Namely, to provide locally constrained probabilistic distributions of ground motion intensity measures, matching the actual footprint of a large earthquake in the specific area under study.