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Integrating 3D physics-based earthquake simulations to seismic risk assessment: The case of Bogotá, Colombia.

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The basin beneath the greater metropolitan area of Bogotá, Colombia, consists of soft material deposits with shear wave velocity $V_s \leq 400$ m/s that reach depths up to 425 m. Located on a high plateau in the eastern cordillera of the Colombian Andes, this highly populated urban area is subject to significant seismic hazards from local and regional fault systems. The potential ground motion amplification effects during earthquakes due to the presence of soft soil deposits and the surface and sub-surface topography constitute problems of great importance towards better understanding and estimating the seismic risk of the city. Given the scarcity of seismic data from large magnitude events, and in an effort to advance modern seismic hazard mapping for the region, this study aimed to develop a physics-based framework to generate synthetic ground records that can help to better understand the basin and other amplification effects during strong earthquake shaking in the region, and then to incorporate these effects into the estimation of seismic risk. To this end, a set of simulations were first conducted on Hercules, the wave propagation octree-based finite element simulator developed by the Quake Group at Carnegie Mellon University, to reproduce similar conditions to those observed in Bogotá during past seismic events (e.g., 2008 Quetame Earthquake) and to identify the impacts of hypothetical strong earthquakes scenarios. Then the results from these simulations were then integrated into a new software package for post-processing and assessing the seismic risk in the Bogotá region for different scenarios selected.