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Improving Seismic Hazard Assessment in Southeast Spain through CyberShake: A Physics-Based Approach

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The Eastern Betic Shear Zone (EBSZ) experiences slow seismic deformation that leads to relatively low seismicity rates. Due to this, historical records underscore the substantial impact that earthquakes have had on local communities. The dearth of comprehensive data on moderate to large seismic events in this area, limits the accurate generation of seismic hazard and risk maps, posing a significant challenge for seismic risk planning. A way to address these limitations is leveraging physics-based earthquake simulations in the Southeast Iberian Peninsula. These simulations first require integrating paleoseismic data, models of fault distribution –such as the Quaternary-Active Faults Database of Iberia, seismic source characterizations and historical seismic catalogs, to construct an Earthquake Rupture Forecast (ERF), where likelihood of each fault rupture is weighted by an occurrence probability. Our study focuses on developing physics-based rupture scenarios and shake maps using CyberShake. CyberShake is designed to perform physics-based probabilistic seismic hazard assessments (PB-PSHA) by simulating a vast set of synthetic ground-motion time histories from kinematic rupture scenarios on the ERF three-dimensional finite-fault array. Originally tailored for PB-PSHA studies in Southern California by the SCEC (Southern California Earthquake Center); this research represents the first CyberShake application for Southeast Spain. The resulting shake maps represent an alternative basis for updating regional probabilistic seismic hazard maps and also could support crucial decision-making processes following a local earthquake, offering valuable insights for effective response strategies.