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Fault-based Probabilistic Seismic Hazard Assessment of the Makran Subduction Zone and the Chaman Transform Fault in Pakistan: Emphasis on the Effects of Source Characterization of Megathrust

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Seismic source characterization (SSC) for probabilistic seismic hazard assessment (PSHA) in regions characterized by subduction megathrusts involves a considerable degree of ambiguity due to the complex nature of subducting plates and large seismogenic depths. The lack of detailed geologic, seismic, and geodetic histories increase the uncertainties involved in constraining the parameters of the SSC model. The enigma is further enhanced in the regions where thin skinned accretionary prism faults associated with the subduction zone are actively involved in deformation. In this article, we propose a planar SSC model for seismically active eastern Makran subduction zone, its associated accretionary prism faults, and Chaman transform fault. Developed SSC model is combined with Next Generation Attenuation West2 (Bozorgnia et al., 2014) and BC Hydro (Abrahamson et al., 2016) ground motion models in the PSHA calculations. Sensitivity tests for various ambiguous parameters associated with the SSC model are performed and presented in the form of peak ground accelaration (PGA) maps with 475-year return period. Especially in gently dipping subduction zones such as Makran, the estimated ground motions and their spatial distribution are highly sensitive (changing up to 0.2g) to the selected depth extent and dip amount of the Megathrust interface which defines the maximum rupture width. For short return periods (475) years, gentler and deeper extending interface geometries resulted in lower PGA values towards the trench and higher towards inland along accretionary wedge due to their influence on the rupture dimensions and source-to-site distances. Moreover, alternative magnitude distribution models which influence the activity rates of controlling earthquake scenarios are tested for Makran subduction zone and truncated exponential model resulted in 10-20 percent higher PGA values than composite models for short return periods. According to our selected SSC model, the highest PGA values computed for the region are around 0.75g in the vicinity of Makran megathrust.