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A combined fault- and catalog-based hazard assessment for Central Zagros, Iran

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The Zagros mountains is a tectonically active Arabian-Eurasian plate convergence zone. The convergence direction changes along the strike of the belt, results in oblique faulting in the North-Western Zagros (NWZ) and the prevalence of pure reverse faulting in the South-Eastern Zagros (SEZ). The two regions undergo different convergence rates, (4 ± 2 mm yr −1) in NWZ and (9 ± 2 mm yr −1) in SEZ. These differences is partially accommodated by right-lateral strike-slip faulting throughout the Central Zagros (CZ), resulting in catastrophic earthquakes like 1972 Mw = 6.7 Qir and 1934 Mw = 6.3 Kazerun. This study presents the Probabilistic Seismic Hazard Assessment (PSHA) for the CZ region by integrating fault sources and seismological data. The seismological catalog data consists of 6504 events (2.5 < Mw < 6.7) during 1925-2020 and was compiled from the International Seismological Center (ISC) and the Iranian Seismological Center (IRSC). The faults with the history of Mw > 5.5 or geometrical potential of producing such an event were modeled. A Truncated Gutenberg–Richter (TGR) Magnitude-Frequency Distribution (MFD) for a range of magnitudes (5.5 < Mw < Mmax) is evaluated by processing the geometrical parameters and slip rate of each fault source using the FiSH code. The Mmax is computed for each source by combining various Mmax estimates based on the faults geometry and observed Mmax if it is available. The catalog data was modeled as a grid source. A unique set of seismic activity rate parameters (for Mw > 4) in each grid is obtained by applying a modified smoothed seismicity approach. More precisely, a penalized likelihood-based methodwas utilized for the spatial estimation of the b-values, and a weighted smoothing method was implemented to calculate the spatial distribution of the a-values. The catalog events with Mw > 5.5 were excluded to avoid duplicated hazard estimation (modified earthquake catalog). Compiling the source models, the hazard computations were performed using the OpenQuake Engine. The Peak Ground Acceleration (PGA) is computed for the Probability Of Exceedance (POE) of 10% over 50 years for distributed seismicity obtained by the full catalog, and an aggregated model of active faults and distributed seismicity with the modified earthquake catalog. The distributed model produces an approximately uniform PGA with a maximum value of 0.185 g over CZ, while the aggregated model accents the PGA in the vicinity of the faults the maximum of 0.319 g observed around the Kazerun fault. The results show the competence of aggregating fault-based and distributed seismicity hazard assessments for applying comprehensive PSHA studies.