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Towards physics-based finite-fault Monte Carlo PSHA for Southwest Iceland based on a new fault system model

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Throughout history, damaging earthquakes have repeatedly struck in Southwest Iceland, the country's most populated and seismically active region. There, the interplate earthquakes do not occur on sinistral strike-slip faults parallel to the plate margin, but instead on a dense array of near-vertical dextral faults striking perpendicular to the plate margin. This "bookshelf" faulting has not explicitly been accounted for in probabilistic seismic hazard assessment (PSHA). Instead, incomplete earthquake catalogues and simplistic seismic sources have been used in past PSHA that have used conventional methods. Recently however, a new and physics-based 3D fault system model of the Southwest Iceland transform zone has been proposed that effectively explains the observed Icelandic earthquake catalogues. The model moreover allows the systematic spatial variation of fault slip-rates to be modeled by discrete subzonation of the fault system and the equivalent parameters of seismic activity (M_{max}, *a*- and *b*-values). Through random realizations of fault locations as postulated by the new model, we have simulated multiple finite-fault earthquake catalogues for the entire bookshelf system for earthquakes ranging from magnitude 4 to 7. This in fact allows us to apply conventional PSHA but instead of using e.g. seismic point sources distributed over a designated seismic source areas, the seismic activity of which is predicted by limited historical catalogues, the synthetic finite-fault catalogues are time-independent and embody fully the first two key elements of PSHA, the seismic source locations along with their activity rates. Using multiple empirical hybrid Bayesian ground motion models (GMMs) that recently have been proposed for Southwest Iceland we have predicted the amplitudes (peak ground accelerations and pseudo-acceleration spectral response) from each synthetic finite-fault earthquake on a grid of hypothetical stations. This enables us to carry out a Monte Carlo PSHA that is based on a physical earthquake fault system model. We present the provisional PSHA results for Southwest Iceland and compare them to other relevant efforts, the Icelandic National Annex to Eurocode 8 and the ESHM20, but most importantly to those of a parallel study that carries out a physics-based PSHA based on synthetic ground motion time histories (on the same hypothetical network) from kinematic earthquake rupture modeling (on the same finite-fault earthquake catalogues) implemented in the CyberShake framework adapted to the Southwest Iceland tectonic situation and earthquake source scaling.