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# Characterization of Earthquake Near-fault Ground Motion Parameters Using an Artificial Neural Network on Synthetic Big Data

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The South Iceland Seismic Zone (SISZ) and Reykjanes Peninsula Oblique Rift (RPOR) in Southwest Iceland together form one of the two major transform zones in the country that have the greatest capacity for the occurrence of destructive earthquakes. Therefore, in these regions, the seismic hazard is highest and performing a probabilistic seismic hazard assessment (PSHA) is vital as the foundation of earthquake resistant building design and seismic risk mitigation. It is well known both from observations as well as physics-based (PB) modeling of earthquake rupture and near-fault ground motion simulations, that the most damaging part of near-fault seismic motion is the velocity pulse, the large-amplitude and long-period pulse-like ground motions found along the fault and away from the ends of strike-slip faults. Such motions cause intense earthquake action primarily on large buildings, such as hydroelectric power plants, dams, powerlines, bridges and pipelines. However, the data is still too limited to enable the reliable calibration of a physically realistic, yet parsimonious, near-fault model that incorporate such effects into empirical ground motions models (GMMs), thereby allowing their incorporation into a formal PSHA. However, in the recent European H2020 ChEESE project, we established a new 3D finite-fault system model for the SISZ-RPOR system that now has facilitated the simulation of finite-fault earthquake catalogues. Moreover, the catalogues have been implemented into the CyberShake platform, the PB earthquake simulator that was adapted to the characteristics of the SISZ-RPOR earthquakes in the ChEESE project. The seismic ground motions of each earthquake in the catalogue have thus been simulated on a dense grid of 594 near-fault stations in Southwest Iceland. The simulation has been carried out on high-performance computing systems of the Barcelona Supercomputing Centre in Spain. Moreover, the hypocentral locations and slip distributions on each synthetic fault have been varied, resulting in approximately 1 million earthquake-station-specific pairs of synthetic low-frequency and high-amplitude near-fault ground motion time histories. In this study, we analyse this dataset using an artificial neural network to reveal its characteristics in terms of amplitudes and the characteristics of near-fault velocity pulses, capturing all key features of such effects. The results will facilitate the incorporation of the near-fault effects into new near-fault and far-field GMMs, that are a key element of conventional PSHA. This will both enable the near-fault PB-PSHA

along with the comparison of PSHA from the synthetic dataset vs. the GMMs. This will usher in a new era of PB-PSHA in Iceland.