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A new release of the SURE database of earthquake surface ruptures suited to Fault Displacement Hazard Analysis

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Fault displacement hazard assessment is based on empirical relationships derived from data of historical surface rupturing earthquakes. This approach is used for land use planning, sizing of lifelines or major sensitive infrastructures located in the proximity of active faults. These relationships provide the probability of occurrence of surface rupture and predict the amount of displacement, both for the main ruptures (principal) and for distributed ones appearing beyond.

Following the first version of the global database SURE 1.0 (Baize et al., 2019), we are continuing the effort to compile observations from well-documented historical and recent surface faulting events in order to feed and improve empirical relationships. The new SURE2.0 global database consolidates the previous version SURE 1.0 data, rejecting some poorly constrained cases, reviewing some cases already in, and adding well-documented new ones (e.g. Ridgecrest sequence, USA, 2019). In total, the SURE 2.0 database has 46 earthquakes, including 15 normal fault cases, 16 reverse fault cases and 15 strike-slip cases from 1872 to 2019. The magnitude range is from M4.9 to 7.9, with ruptures from 5 to 300 km long.

SURE 2.0 provides the geometric location and attribute information of rupture segments in a GIS environment and a spreadsheet reports the amplitude and characteristics of deformation, including data sources and its eventual geometric refinement during analysis. In this new version, we completed an essential task to derive attenuation relationships, by classifying each rupture segment and each slip measurement point, using a ranking scheme based on the pattern and amplitude of the observed rupture traces, and considering the structural context and the long-term geomorphology. This distinguishes the principal rupture (class 1), which is the main surface expression of the source of the earthquake. Typically, in the siting study, this class is assigned to the identified active fault. Class 2 features (distributed ruptures) are characterized by shorter lengths and smaller displacements that appear randomly close and around the main rupture. We introduced the distributed main fracture category (class 1.5), which corresponds to the relatively long minor fractures recognized on cumulative structures secondary to the main fault. Class 3 represents triggered slip evidences on remote active faults, clearly not connected with the

earthquake causative fault (sympathetic ruptures).

As was done with reverse fault cases (Nurminen et al., 2020), this new SURE 2.0 version will be used to derive probabilities associated with the rupture distribution during any type of earthquake.