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Exploring the uncertainties of the fault source parameters in the Alboran Sea for seismic hazard using earthquake rate modelling tools

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The Alboran Sea is one of the most seismically regions of Western Europe, accommodating an important part of the current NW-SE convergence between the African and Eurasian plates (4-5 mm/yr). Despite the Alboran Sea is considered as a region of relatively low tectonic deformation and diffuse seismicity, the major faults within have been responsible of large earthquakes (I_{EMS}>IX) since historical times (e.g., 1522 Almería, 1790 Oran, 1804 Alboran, 1910 Adra or 2016 Al-Idrissi earthquakes). One of the main issues for the characterization of the seismic hazard in the Alboran Sea, common to many low-deformation regions, lies in accurately constraining the seismic parameters that define fault activity and their behavior (i.e., slip rates, earthquake recurrence and multi-fault rupture capability, among others). This issue is further aggravated by the fact that these faults are mostly located offshore, making their investigation more challenging. As a result, most faults in the Alboran Sea have poor slip and activity rate estimates, while their capability to interact and rupture in complex rupture patterns has not been explored yet. In this study, we compute several models of earthquake rupture rates for the Alboran Sea with the SHERIFS code and using a systematic parameter exploration tree to determine the parameters of each model. We base the exploration tree on the slip rate and multi-fault rupture scenarios, allowing us to investigate the epistemic uncertainty linked to these parameters. To check the feasibility of the computed earthquake rates of each model, we compare them with the observed seismicity rates in the region. As a result, this enables us to identify which parameter combinations best match the recorded seismicity, prioritizing those that perform better for the hazard assessment. In addition, these optimal values might be used as indicators for further studies focused on better constraining the fault parameters in some faults, as well as for preliminary fault-based seismic hazard assessments. By extension, the limitations of the modelling in terms of slip rate budget distribution and fault rupture scenarios can also be used to determine which areas should be

prioritized for further research. We expect that the results of our work enhance discussion among researchers working in the area and motivate further investigations into fault dynamics.