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A sanity check for earthquake recurrence models used in PSHA of slow deforming regions: the case of SW Iberia

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Probabilistic Seismic Hazard Assessment (PSHA) is the most common tool used to decide on the acceptable seismic risk and corresponding mitigation measures. One key component of these studies is the earthquake generation model comprising the definition of source zones and recurrence relationships. Slow deforming regions are particularly challenging for PSHA since the inferred return period for large earthquakes is longer than the instrumental and historical seismicity records, and the relationship between known or probable active faults and seismicity is uncertain. Therefore, in these areas PSHA results show a large variability that impairs its acceptance by the political decision-makers and the public in general. We propose two consistency tests to address the variability of earthquake generation models found in PSHA studies: i) one rule-of-thumb test where the seismic moment release from the model is converted to an average slip on a typical fault and compared with known plate kinematics or GNSS deformation field; ii) using a neotectonic model, the computed deformation is converted into seismic moment release and to a synthetic earthquake catalogue. We apply these tests to the W and SW Iberia slow deforming region, where two earthquake source areas are investigated: 1) the Lower Tagus Valley, one of the largest seismic risk zones of Portugal; and 2) the offshore SW Iberia area, considered to be the source for the 1st November 1755 event (M~8.7). Our results show that some of the earthquake source models should be regarded as suspicious, given their high/low moment release when compared to the expected values from GNSS observations or neotectonic modelling. In conclusion, PSHA studies in slow deforming regions should include a similar sanity check on their models' evaluation, downgrading the weight of poorly compliant models.