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Testing probabilistic seismic hazard assessment estimations against accelerometric data in France

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A probabilistic seismic hazard assessment (PSHA) provides exceedance probabilities of ground-motion levels at the site of interest in a given future time window. The PSH calculations rely on several models and assumptions, such as the characterization of seismic sources, the frequency-magnitude distributions, or the ground-motion prediction equations. At all steps there are significant uncertainties. Therefore understanding the impact of the uncertainties of PSH components on the final output of the PSHA is not straightforward. It is essential to look for independent data to try to constrain the PSHA results.

The coherency of PSHA outcomes with respect to observations can be evaluated through statistical techniques. In the present study, we focused on testing PSH models using accelerometric data at rock sites. The methodologies developed will be applied on the historical database as a second step.

Three different sets of PSHA maps established for the French territory in the last decade by different expert groups (MEDD 2002, AFPS 2006, SIGMA 2012) will be considered. Two types of datasets are used to perform the testing: 1) a refined accelerometric dataset from the French Accelerometric Network (RAP) that provides 15 years of recordings; 2) a synthetic dataset inferred from the instrumental LDG earthquake catalogue, extending over 34 yrs, providing complete information for events with ML $\geq$2.5 (combined with a GMPE).

The method we propose is close to the technique introduced by Albarello & D'Amico (2008), as the principle of sampling in space to compensate for short time windows is used. Thanks to a Monte Carlo sampling, the distribution for the number of sites with exceedance to expect (according to the PSHA model) is obtained and compared to the observations. The testing is performed for a wide range of accelerations (and corresponding return periods).

Considering a grid of stations covering France, observations are on average coherent with PSHA estimates of AFPS 2006 (testing performed for 0.033-0.09g). Moreover, the use of the synthetic dataset shows that 15 years are long enough for testing these levels of accelerations. The results for MEDD 2002 are only available for classical return periods of interest in earthquake engineering (TR$\geq$100 yrs). The testing at such long return periods does not permit to reject the model, but does not validate it either (0 exceedance is predicted). Moreover, if reducing the area sampled, by considering only southeast France, the results suggest that the area is too restricted to permit testing, and the testing results led on SIGMA2012 estimates cannot be considered as reliable.

The methodology developed here will be applied on historical intensity data, higher ground-motion levels and longer observation time windows will be tested.