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Quantification of expert knowledge for PSHA using graphical tools

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Probabilistic seismic hazard analysis (PSHA) aims at the generation of quantitative models for the rate of exceedance of seismically generated ground motion parameters. Due to the sparseness of observed ground motion for a particular site of interest, uncertainties of hazard models are usually large and frequentist statistical modeling approaches, which heavily rely on data and thus need big sample sizes for confident results, are only rarely applicable if at all. As an alternative, Bayesian approaches in which expert judgment is expressed as prior (subjective) probabilities over hypotheses which is subsequently updated through observations become more and more popular. In this context, scarce datasets will (only) lead to a domination of the prior probability, the likelihood of the hypothesis, over the observed data. As a consequence in this case, the quality of the results depends strongly on the „quality“ of the expert knowledge.

Regarding the actual quantification of expert knowledge, two different situations arise. The first (continuous) one concerns cases in which expert knowledge is needed to define informative prior probability distributions on the parameters of models, which are then subsequently updated through data (e. g. in the context of ground-motion model testing). The second (discrete) one deals with cases where an expert is directly asked to provide discrete weights expressing his/her degrees-of-beliefs in a set of models (e. g. defining logic tree branch weights). A major challenge for the expert in both cases is to provide estimates which are logically consistent (in the sense of Kolmogorov’s axioms) and to be aware of and to deal with the multitude of heuristics and biases which affect human judgment under uncertainty. Here we present first results of our attempts to design new graphical tools to help experts to coherently quantify their domain knowledge in form of subjective probabilities for seismic hazard analysis and discuss their applicability for the ground-motion part of PSHA.