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Robustness of Epistemic Uncertainties in Regional Ground Motion Models

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Regional seismic hazard models are community efforts, spanning few years (i.e. three to five years) aiming to develop homogeneous models, both in terms of datasets and methods. A regional model, built upon the most recent data, fully harmonized and using state-of-the art methods becomes the reference for the region. Thus, the seismic hazard estimates must be robust and stable for several years. However, ground motion models are likely to be updated more often due to new development of GMPEs (http://www.gmpe.org.uk/). Also, new strong motion data might facilitate data-driven testing, selection of predictive models and help reducing the epistemic uncertainties.

This contribution reports on the robustness of the epistemic uncertainties models in the 2013 European Seismic Hazard Assessment (ESHM13). The ESHM13 adopted a logic tree approach to account the epistemic uncertainty built upon elicitation of expert judgment and data-driven testing. Ground motion logic trees have the advantage of explicitly including alternative ground motion predictive equations (GMPEs) representing the epistemic uncertainties. Nevertheless, several acceptable approaches can be used to quantify and propagate epistemic uncertainties i.e. Monte Carlo simulation and a “backbone” approach. Monte Carlo simulations are particularly efficient when sampling the entire distribution of input parameters. Albeit efficient, a Monte Carlo technique might be non-unique and non-replicable. “Backbone” or a “central” approach defines a ground motion prediction equation (GMPE) representative to the intrinsic epistemic uncertainties in ground motions over all magnitudes and distances of interest.

Sensitivity analyses are performed to quantify the effects of different models of epistemic uncertainty (i.e. Monte Carlo and “backbone”). The results are presented in terms of hazard curves and uniform hazard spectra for various sites located in low, moderate and high seismically active regions.

Furthermore, the impact of the newly developed GMPEs is also discussed. Given that most of the GMPEs selected and used in the ESHM13 were developed between 2003 and 2010, it might be time to consider the impact of the newly available GMPEs (e.g. the 2014 updates of the Next Generation Attenuation (NGA) Models). Thus, this investigation might provide an answer to update the ground motion characteristic models of ESHM13.