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A New Ground Motion Logic Tree for Seismic Hazard in Europe: Insights from New Data and Changing Perspectives on Uncertainty

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Assessment of seismic hazard is a fundamental requirement to understand the potential risk that earthquakes pose to society. As the socioeconomic consequences of damaging earthquakes can reach far beyond the regions directly affected by the shaking itself, the assessment of hazard risk cannot necessarily be limited to a single region or nation. The 2013 European Seismic Hazard model (ESHM2013) represented a significant advance toward the aim of multi-national seismic hazard assessment for the Euro-Mediterranean region, incorporating new information on seismicity, active faults and tectonics, as well as a careful selection of ground motion prediction equations (GMPEs) within a logic framework for the analysis of epistemic uncertainty. More than five years hence, a new pan-European probabilistic seismic hazard assessment (PSHA) is now underway within the Horizon 2020 SERA project to update the ESHM2013, offering the opportunity to reflect upon and revise the models of ground motion and their associated epistemic uncertainties across Europe.

The construction of a new ground motion logic tree in the SERA project is motivated by several key developments in the field of ground motion modelling and seismic hazard assessment. One of the most important of these is the Engineering Strong Motion (ESM) database and flatfile (http://esm.mi.ingv.it), which greatly expands the number of strong motion records and their geographical coverage in Europe. This expanded dataset reveals greater spatial variability in ground motion scaling and attenuation than has previously been assumed within tectonically similar regions. Furthermore, the addition of records from Greece and Romania facilitate a quantitative assessment of the fit of strong motion data from subduction and other deep source earthquakes to published models, allowing us to make inferences on their suitability for PSHA in Europe.

It is not only the growth of data that prompts this reconsideration. Lessons from recent national and regional seismic hazard assessments, as well as scientific issues emerging from recent ground motion modelling projects such as the Next Generation Attenuation (NGA) West 2 and NGA East, highlight changing perspectives on the nature of epistemic uncertainty, both at a site-specific and regional scale. In addition, the need for the new European seismic hazard models to fulfill the requirements for an analysis of risk to residential and industrial buildings in Europe means that it is important to address new challenges, such as the development of models in the Fourier domain or the estimation of site amplification at regional scale and the influence of basins and topography in this process. These challenges, and more, demonstrate the needs and opportunities for future research in ground motion to guide the next generation of seismic hazard in Europe.