Fault approach in PSHA – a question of how to best represent knowledge and uncertainties

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Including faults in probabilistic seismic hazard assessment tends to increase the degree of uncertainty in the results due to the intrinsically uncertain nature of the fault data. This is especially the case in the low to moderate seismicity regions of Europe, where slow slipping faults are difficult to characterize. In order to better understand the key parameters that control the uncertainty in the fault-related hazard computations, we propose to build analytic tools that provide a clear link between the different components of the fault-related hazard computations and their impact on the results. This will allow identifying the important parameters that need to be better constrained in order to reduce the resulting uncertainty in hazard and also provide a more hazard-oriented strategy for collecting relevant fault parameters in the field. The tool will be illustrated through the example of a West Corinth rift fault-model. Recent work performed in the gulf has shown the complexity of the normal faulting system that is accommodating the extensional deformation of the rift. A logic-tree approach is proposed to account for this complexity and the multiplicity of scientifically defendable interpretations. At the nodes of the logic tree, different options that could be considered at each step of the fault-related seismic hazard will be considered.

The first nodes represent the uncertainty in the geometries of the faults and their slip rates, which can derive from different data and methodologies. The subsequent node explores, for a given geometry/slip rate of faults, different earthquake rupture scenarios that may occur in the complex network of faults. The idea is to allow the possibility of several fault segments to break together in a single rupture scenario. To build these multiple-fault-segment scenarios, we consider that faults will break alone and produce earthquakes of small magnitude or break together to generate stronger ones. The ratio between simple ruptures and multi-segments ruptures is fixed following a given magnitude-frequency distribution (Gutenberg-Richter or Young-Coppersmith).Other fault parameters such as the Maximum magnitude (defined according to different Scaling-Relationships), the slip-rate, the b value of the MFD of faults, the shear modulus μ and the threshold magnitude (Mt) of earthquakes considered on-fault are also explored. The final node represents an exhaustive set of ground motion prediction equations chosen in order to be compatible with the region. Finally, the expected probability of exceeding a given ground motion level is computed at each sites using OpenQuake.

Results will be discussed for a few specific localities of the West Corinth rift.Using our analytic tools we can show that hazard uncertainty is controlled mainly by GMPE, because of the very short source-to-site distances (less than 10 km) involved but also by the choice of Mt and of rupture scenario. By comparing our results with the results of the SHARE project, we will illustrate how the level of detail considered in a fault model increases considerably the level of hazard and the associated range of uncertainty.