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A Pan-European Representative Ground Motion Model

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Ground motion prediction equations (GMPE) are recognised as a key component of any seismic risk analysis. The consideration of both aleatory and epistemic sources of variability in the ground motion models may have significant influence on the overestimation or underestimation of the final losses. With the increased availability of new developed GMPEs over the past few years, it has been observed that the epistemic uncertainty due the choice between potential GMPEs is not decreasing, even though related knowledge is improving. A common approach to include this source of epistemic uncertainty is to design a logic tree that proposes choices between various GMPEs and associated weights. This approach is not necessarily the best suited for modelling epistemic uncertainty in GMPE. A simple an efficient representative model has been recently proposed by defining three GMPEs, lower, central and upper, to represent epistemic uncertainty. The three representative GMPEs are derived from selected available median models. This three-equation model is equivalent to the use of multiple GMPEs, provided the same range of epistemic uncertainty is sampled.
This representative GMPE approach is tentatively applied to the European context. A selection of available GMPEs based specifically on European ground-motion databases is used. The resulting three-GMPE representative model is then confronted to actual ground motion records, which are selected from the European RESORCE Strong Motion Database. The performance of this representative Pan-European model can then be benchmarked with respect to individual GMPEs, by checking the amount of observations that are overestimated or underestimated by the various ground-motion prediction models.
The proposed model enables a complex problem to be represented by a minimum number of branches for single-site hazard analysis and mapping. A preliminary application is carried out for a critical infrastructure risk analysis in the framework of the EU-funded INFRARISK project (European Commission's FP7 programme, Grant Agreement No. 603960)