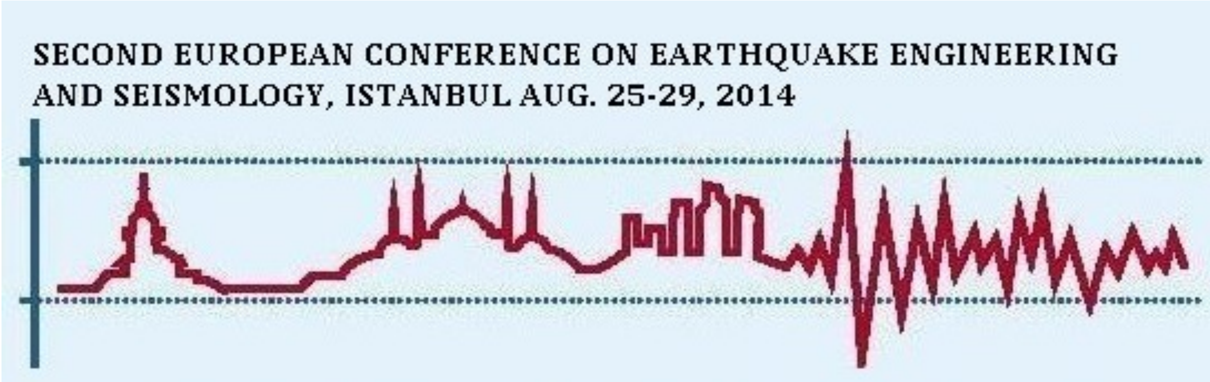

THE 2013 EUROPEAN SEISMIC HAZARD MODEL: INSIGHTS AND PERSPECTIVES

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Probabilistic seismic hazard assessment (PSHA) aims to characterize the best available knowledge on seismic hazard of a study area, ideally taking into account all sources of uncertainty. The EC-FP7 funded project "Seismic Hazard Harmonization for Europe (SHARE)" generated a time-independent community-based hazard model with the particular objective to provide a harmonized hazard model overcoming national boundaries that was released as the 2013 European Seismic Hazard Model (ESHM13, Woessner et al., 2014) for the European region and Turkey. The ESHM13 includes results for ground motion parameters spanning from spectral ordinates of the Peak Ground Acceleration (PGA) to 10s and annual exceedance probabilities from one-in-ten to one-in-ten thousand years. To date, SHARE is the first completed regional program contributing its model to the Global Earthquake Model (GEM) initiative. SHARE scientists delivered a complete set of harmonized seismic hazard results and quantified the associated uncertainty. The ESHM13 serves as reference model for the update of Eurocode 8 due to the strong collaboration with the earthquake engineering community and thus for future safety assessment of private and public buildings and critical infrastructures. As an example, Figure 1 shows the 10% exceedance probability within 50 years for PGA. However, the current results do not replace the existing national design regulations and seismic provisions, which should be obeyed for today's design and construction of buildings.

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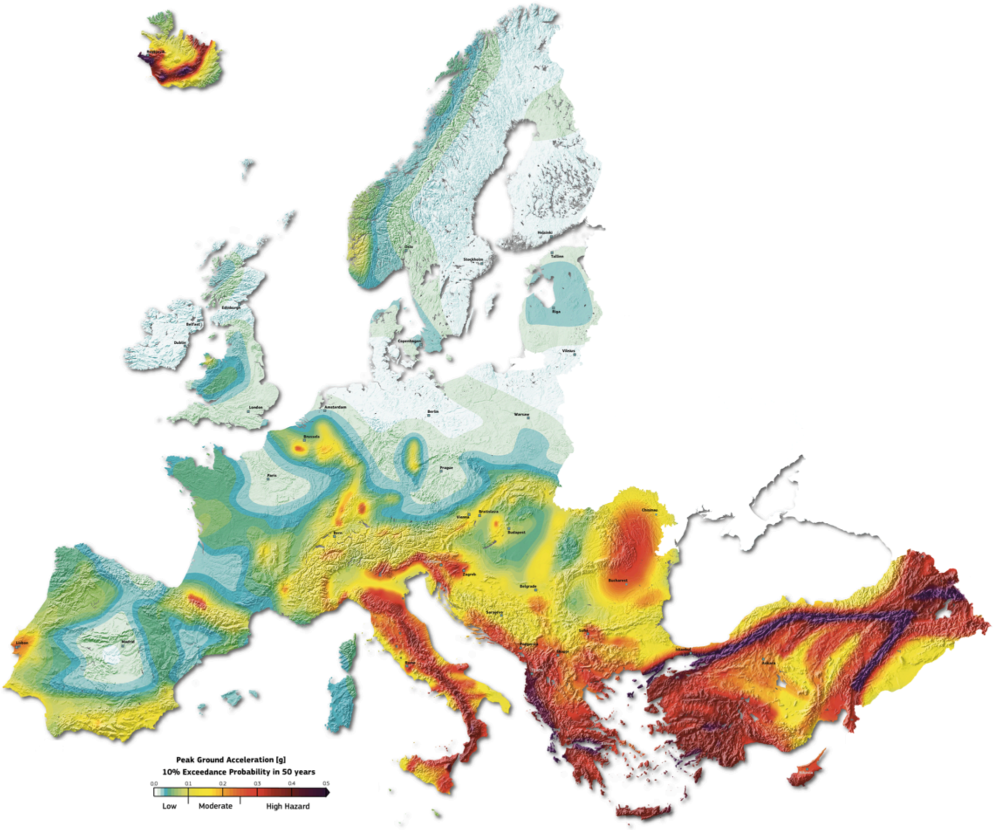

Figure 1: European Seismic Hazard Map displaying the 10% exceedance probability in 50 years for peak ground acceleration in units of g. Cold colors indicate comparatively low hazard areas (PGA $\leq$ 0.1g), yellow to orange indicate moderate hazard values (0.1<PGA$\leq$0.25g) and red colors indicate high hazard areas (PGA $\geq$ 0.25g).

The ESHM13 model accounts for uncertainties, whether aleatory or epistemic, via a logic tree. Following the generic assumption of time-independent hazard models, earthquakes are modeled to occur independently. The entire earthquake source model has been derived from newly compiled datasets (Giardini et al. 2013). Each of the three earthquake source models describes the annual occurrence rate of future earthquakes including their spatial, depth and frequency-magnitude distribution as well as the style of faulting. These models are developed from past moderate to large earthquakes, as documented by their damaging effects through history and since around 1980 with modern instrumental seismic networks, all combined in a single SHARE European Earthquake Catalog (SHEEC) (Grünthal and Wahlström 2012; Stucchi et al. 2012), from fault sources and subduction zone models, all included in the new European Database of Seismogenic Faults (Basili et al. 2013)and from deformation rates of the Earth's crust. Epistemic uncertainties within the seismic source-model are represented by three earthquake source models including a traditional area source model, a model that characterizes fault sources, and an approach that combines kernel-smoothing for seismicity and fault source moment release. Activity rates and maximum magnitudes in the source models are treated as epistemic uncertainties. For practical implementation and computational purposes, some of the epistemic uncertainties in the source model (i.e. dip and strike angles) are treated as aleatory, and a mean seismicity model is considered.
Epistemic uncertainties for ground motions are considered by multiple Ground Motion Prediction Equations (GMPEs) for each tectonic setting and are treated as being correlated. Ground motion prediction equations relate earthquake source characteristics to the ground shaking at a site. The procedure to select the smallest comprehensive set of GMPEs that captures the center, body and range of the possible ground motions, to calibrate to the available strong motion data set and to decide on the final logic-tree weighting, is described in (Delavaud et al. 2012). The major improvement in the project was to combine a predefined expert elicitation process and objective data testing in an iterative procedure. The ultimately selected fourteen empirical relations span various functional forms to

characterize the expected ground motions, their median values and related probability distributions, and depend on magnitude, distance to the source, depth, and style of faulting. The final weights in the logic-tree are backed with sensitivity analyses.

In the presentation, we will outline the general procedures implemented to generate the ESHM13. We show how we used the logic-tree approach to consider the alternative models and how, based on the degree-of-belief in the models, we defined the weights of the single branches. This contribution features results and sensitivity analysis of the entire European hazard model and selected sites.

Data, results and print material including an A0 poster are accessible online at http://www.efehr.org, the portal of the European Facility for Earthquake Hazard and Risk and the project website (www.share-eu.org).

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