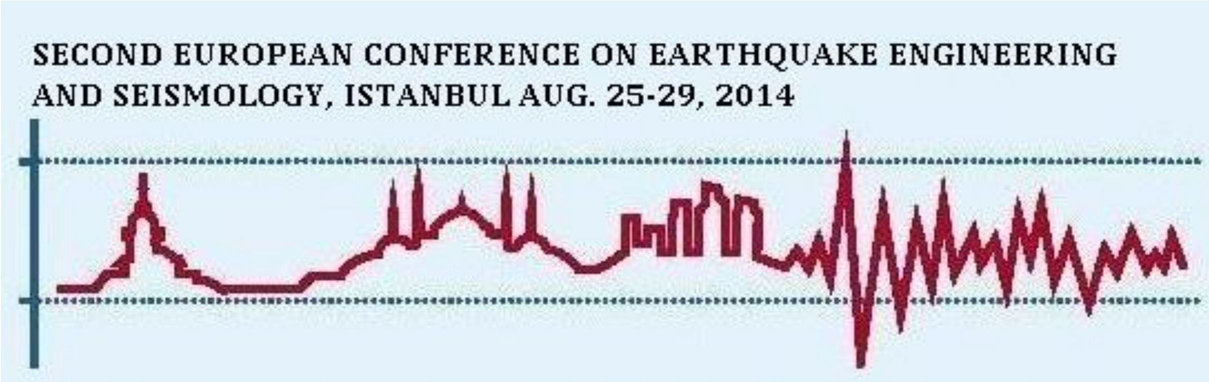

DATA DRIVEN PROBABILISTIC SEISMIC HAZARD ASSESSMENT: A COMPARATIVE STUDY OF TURKEY AND SWITZERLAND

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Much to the disappointment of the general public, seismologists have been unable to predict earthquakes. One of the scientific endeavours pursued to compensate for this frustration is the development of probabilistic seismic hazard assessment (PSHA) models that aim to provide long term hazard estimates and improve seismic design provisions. The simplest method to account for the worst case is the deterministic approach where one aggregates individual contributions from well defined scenario earthquakes. The PSHA method was introduced to account for the uncertainties involved in the determination of such scenarios [*Cornell*, 1968]. However in many cases the application of PSHA involves a great deal of deterministic choices and judgements. Most of these are regarding the specification of the seismic source zones considered in the models. It is well established that different expert opinions in seismic zonation give rise to great differences in the obtained results [*Barbano et al.*, 1989; *Reiter*, 1990; *Bommer*, 2002]. In recent years there have been continuing efforts to harmonize and standardize PSHA through regional and global collaborations. Nevertheless interpretation of the obtained results remains problematic due to different expert choices used in each region. For instance the recently finalized project for Seismic Hazard Harmonization in Europe (SHARE) reports similar hazard levels for Basel, Switzerland (which has not experienced a M5 or greater event for the last 300 years) and Sariyer, Istanbul (www.efehr.org).

In this study we address the issue of seismic source zonation; we present an objective data driven method that explores the optimal spatial segmentations with respect to the likelihood of the Gutenberg-Richter's law [*Kamer and Hiemer*, 2014]. The method incorporates a non-arbitrary partitioning scheme based on Voronoi tessellation, which allows for the optimal partitioning of space using a minimum number of free parameters. By random placement of an increasing number of Voronoi cells we are able to explore the whole solution space in terms of model complexity. An overall likelihood for each model is obtained by estimating the b-values in all Voronoi regions and calculating its joint likelihood using Aki's formula [*Aki*, 1965]. Accounting for the number of free parameters we then calculate the Bayesian Information Criterion (BIC) [*Schwarz*, 1978] for all realizations and rank them accordingly.

For the purpose of PSHA we generate multiple synthetic catalogues from the top ranking zonation models by generating frequency magnitude distributions based on each zone's b-value and sampling the spatial distribution of the observed events. The generated catalogues are combined to facilitate long term hazard assessment. Next we incorporate a Monte-Carlo approach by simulating a ground motion distribution for each event in the catalogue. For this purpose we use the ELER software developed within the EU-FP6 NERIES project [*Erdik et al.*, 2010]. This allows us to incorporate advanced aspects of ground motion calculations (such as automatic fault assignment, rupture length estimation, site specific amplifications and a variety of ground motion predictions) easily.

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In order to present a comparative investigation of how the subjective seismic zonation practices affect the resulting hazard maps we apply the proposed data-driven Monte-Carlo approach to the seismicity of Turkey and Switzerland. For this purpose we use the SHARE European Earthquake Catalogue that has been compiled through the extensive collaboration of European experts [*Giardini et al.*, 2013]. We present our results in terms of peak horizontal ground motion accelerations with 10% probability of exceedance in 50 years.

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