Short-term Seismic Activity. Next Earthquake Time-magnitude Distributions. Application to Vrancea, Romania

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The mean recurrence time theory for regular earthquakes is briefly reviewed, as well as Omori’s law for the seismic activity accompanying main seismic shocks. It is shown how the Gutenberg-Richter magnitude distribution, the corresponding logarithmic distribution and the cumulative recurrence law can be employed to characterize a particular seismic activity and region. The California model introduced recently for short-term prediction is analyzed (Gerstenberger et al, Nature, 435 328 (2005)), with emphasis on its statistical character and time-decreasing sequences of clustering earthquakes described by Omori’s law. A different approach to short-term earthquake prediction is put forward herein, based on statistical analysis of the time-magnitude distributions of the next earthquake. The method makes use of the general n-point correlation functions in statistical analysis. The next-earthquake model is applied to 1999 earthquakes recorded in Vrancea over the last 30 years with (moment) magnitude higher than M > 3. It is shown that the short-time Vrancea seismic activity is characterized by time-decreasing distributions of the next earthquake, possibly with a long tail extinguishing slowly in time, described by Omori-type power laws, as expected. The short-term Vrancea seismic activity exhibits a correlation time of roughly 20-25 days for the next earthquake, and a similar size correlation for magnitudes M < 4-5. The null hypothesis is investigated for these distributions, and the confidence level is estimated to cca 77% for magnitudes M<4. Unfortunately, the poor statistics prevents a confident prediction for stronger earthquakes, but data are given for Vrancea earthquakes with magnitude up to M>7.

Preliminary European Seismic Hazard Assessment: Application of Hybrid Zoneless Approach

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A first unified seismic hazard map for Europe and the Mediterranean has been published in 1999 in the framework of GSHAP and updated in 2003 within the SESAME project. Making advantage of this expertise, we have established a new generation hazard map by considering an up-to-date earthquake catalogue and ground motion models and applying to the hybrid zoneless approach we have developed. To establish a hazard map according to this approach, the treatment of the earthquake occurrence probability follows the standard zoneless approach (Woo, 1996), which considers a bandwidth function as a smoothing Kernel in the neighboring region of earthquakes. The actual depth of each earthquake is included, rather than using the same hypocentral depth for all of the earthquakes as is the procedure of the standard zoneless approach. Because of seismic density differences in different parts of Europe, large-scale zones based solely on the large-scale geological architecture are introduced and a different bandwidth function for each zone is given. We also consider a different catalogue completeness time for each zone since the source parameters of seismicity we used are acquired from different seismic catalogues. In order to realistically represent the attenuation behavior, different ground motion models are introduced for different regions. In comparison with hazard assessment imparted by GSHAP, our results show, as not otherwise expected, in general similar locations of hazard peaks. While, e.g. in approximate central Europe, Greece, Albania, southern Italy, northern Algeria, and the Vrancea region, the level if the computed seismic hazard is very similar. For the other areas, lower hazard is obtained. Because of the minor model assumptions for the hybrid zoneless approach, it provides a suitable basis for application to automatically performed seismic hazard assessment in regular time steps accounting for updated earthquake catalogue in the future.