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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.