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New insights on the features of earthquake clustering in South-Eastern Alps

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A formal detection and systematic analysis of earthquake clusters in South-Eastern Alps is carried out, with the aim to get some new insights on local scale features of seismicity at the transition from Alps to Dinarides. The study is based on a robust data-driven identification of seismic clusters, particularly suitable for small-to-medium magnitude events, for which the standard de-clustering techniques may turn out rather gross approximations.

To characterize the features of seismicity in the area, we take advantage of revised and updated information from local OGS-CRS bulletins, compiled at the National Institute of Oceanography and Experimental Geophysics, Centre of Seismological Research, since 1977. Various techniques are considered to estimate the scaling parameters that characterize the earthquake occurrence in the region, including the b-value and the fractal dimension of epicenters distribution. Specifically, besides the classical Gutenberg-Richter Law, the Unified Scaling Law for Earthquakes, USLE, is applied. To estimate the USLE parameters, the counts of earthquakes are performed in a set of cascading squares (“telescope”), zooming down to the active cells of a regular grid with $1/16° \times 1/16°$ size. The values of the coefficient of magnitude balance (corresponding to the b-value), concentrate in the interval from just above 0.5 to 1.0. The fractal dimension d of the earthquake epicenter locus varies from 0.6 to 1.3. Average robust estimates that characterize the OGS-CRS bulletins, within the outlined area of sufficient completeness, are b = 0.9 and d = 1.1.

Using the updated and revised OGS-CRS data, a statistical method for detection of earthquake clusters, based on nearest-neighbor distances of events in space-time-energy domain, is applied. The method allows decomposing the seismic catalog into background seismicity and individual sequences of earthquake clusters. In order to compute the rescaled space and time distances used by the nearest-neighbor technique, we use the average robust estimates of the USLE parameters for the study region. Results from clusters identification by the nearest-neighbor method turn out quite robust with respect to the time span of the input catalogue, as well as to minimum magnitude cut-off. The identified clusters for the largest events reported in the region since 1977 are well consistent with those reported in earlier studies, which were aimed at detailed manual aftershocks identification. With these results acquired, the main features of seismic clusters are explored, with the aim to identify possible space-time patterns of earthquakes occurrence at the Alps-Dinarides transition and its surroundings.