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Seismic clusters analysis in North-Eastern Italy by the nearest-neighbor approach

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The main features of earthquake clusters in the Friuli Venezia Giulia Region (North Eastern Italy) are explored, with the aim to get some new insights on local scale patterns of seismicity in the area. The study is based on a systematic analysis of robustly and uniformly detected seismic clusters of small-to-medium magnitude events, as opposed to selected clusters analyzed in earlier studies.
To characterize the features of seismicity for FVG, we take advantage of updated information from local OGS bulletins, compiled at the National Institute of Oceanography and Experimental Geophysics, Centre of Seismological Research, since 1977. A preliminary reappraisal of the earthquake bulletins is carried out, in order to identify possible missing events and to remove spurious records (e.g. duplicates and explosions). The area of sufficient completeness is outlined; for this purpose, different techniques are applied, including a comparative analysis with global ISC data, which are available in the region for large and moderate size earthquakes. Various techniques are considered to estimate the average 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.
Using the updated and revised OGS data, a new formal method for detection of earthquake clusters, based on nearest-neighbor distances of events in space-time-energy domain, is applied. The bimodality of the distribution, which characterizes the earthquake nearest-neighbor distances, is used to decompose the seismic catalog into sequences of individual clusters and background seismicity. Accordingly, the method allows for a data-driven identification of main shocks (first event with the largest magnitude in the cluster), foreshocks and aftershocks.
Average robust estimates of the USLE parameters (particularly, b-value and fractal dimension) are assessed for the whole study region and are considered to compute the rescaled space (R) and rescaled time (T) distances used by the nearest-neighbor technique. Stability tests are carried out with respect to the time span of the input catalogue, as well as to minimum magnitude cutoff. Results from clusters identification by the nearest-neighbour method turn out quite robust and well consistent with earlier studies, which were aimed at detailed manual aftershocks identification for the largest events reported in the region since 1977.