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CHARACTERISING EARTHQUAKE CLUSTERING AND PRECURSORY PATTERNS IN NORTH-EASTERN ITALY

A reliable characterization of the properties of earthquakes occurrence, including possible pre-earthquake processes in a specified region, requires their rigorous formalization and testing. Nowadays Italy represents the only region of moderate seismic activity where rigorous prospective testing of seismicity patterns at the intermediate-term middle-range scale is ongoing since more than a decade. Specifically, two independent algorithms, namely CN and M8S, which are based on general concepts of pattern recognition are simultaneously applied and permit to deal with multiple sets of seismic precursors to issue robust predictions in the areas under monitoring. These two methods make use of detectable inverse cascade of seismic process to allow for a diagnosis of the periods of time when a strong earthquake is likely to occur inside a given region. The results from experimental testing, regularly updated every two months since 2003, eventually permit a routine validation of the forecasting results at the intermediate space-time scale.

The reduction of uncertainties about location (where) and time (when) a strong earthquake has to be expected requires the use of additional information, which may be eventually provided by different observables (e.g. GPS, gravity, geochemical and other geophysical evidences), other methods (e.g. PI), as well as by relatively lower magnitude seismicity data from high quality local catalogs. The possibilities for an integrated analysis of different data are exemplified, focusing on the North-Eastern part of Italy. 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.

In addition, 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 for 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. 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 cutoff. 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.