Geophysical Research Abstracts
Vol. 13, EGU2011-12502, 2011
EGU General Assembly 2011

Statistical tests for the retrospective detection of space-time clusters of seismic events

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The assumption that "in declustered catalogues, long-term clustering, not periodicity, characterizes the occurrence of all earthquakes" (kagan, 1991) has affected the preferential choice of stochastic models, like self-exciting models, in the studies on seismic hazard, which imply the decrease of the occurrence probability as time elapses since the main shock. Hence the clustering assumption prejudices the forecasting power of the models considered in the most cases; as a matter of fact, one can not expect that any increase of the occurrence probability precedes a forthcoming earthquake in an epidemic model.
The importance of this assumption requires the application of statistical tools to evaluate objectively its coherence with the reality. To this aim we have considered different seismicity levels and areal sizes in the Italian context; then we have drawn data sets from the historical catalog used in the seismic hazard evaluations. On these sets we have performed different statistical tests, in R language, based on the space-time distance between pairs of earthquakes under the null hypothesis of no space-time interaction. In this way we have ascertained whether space-time clustering exists among past events and evaluated its statistical significance. Monte Carlo hypothesis testing can be used to obtain the null distribution and the simulated p-values. Regions characterized by common tectonic features have been examined; preliminary results are presented.