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Statistical study of the space-time variations of the seismic activity

R. Console (1), M. Murru (1) and G. Falcone (1,2)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy

(2) University of Messina, Messina, Italy

(console@ingv.it)

The algorithm developed provides the users with quantitative estimates of the probability of occurrence of new earthquakes on specific areas of the target territory. The algorithm avails of the earthquake data detected by the Italian National seismic network. The software adopted for the estimation of the space-temporal seismic hazard is based on epidemic models of the ETAS type (Epidemic Type Aftershock Sequence). In this models each event can be either inducing another earthquake or induced by a previous one. The expected seismicity rate in any particular point of the target area for a given threshold can be determined through the contribution of all the previous events using a kernel function that involves: magnitude, distance and time of occurrence of every previous events. The magnitude distribution assumed follows the Gutenberg-Richter law. The parameters used by the software have undergone a first phase of training using the INGV data set to obtain a maximum likelihood estimate of the parameters. The time span for training goes from July 1987 to December 2005 for M$\geq$2.4 earthquakes. Since January 2006 the procedure described above has been tested on a dedicated server. The goal is to determine the occurrence probability of new moderate to large size events detected in real time by the INGV seismic monitoring center. The results are displayed as time-dependent maps showing every 5 minutes both the expected rate density of M$\geq$4.0 earthquakes overall Italy, given as events/day/km^2, and the probability of ground motion larger than 0.01 g in areas of the size of 100 x 100 km in the next 24 hours, around the zone of maximum expected rate density. In order

to verify the results of the predictions, we have used the statistical method of the ROC (Relative Operative Characteristics) known also as Molchan diagram. This method is also used to assess the meteorological forecasts. In essence it addresses the capability of the model to predict or to generate false alarms. The results obtained in this study show that the ETAS model is capable to obtain predictions some hundreds of times more accurate than a purely random model.