The Seismicity of the Central Apennines Region Studied by Means of a Physics-Based Earthquake Simulator

Rodolfo Console[1,2], Paola Vannoli[2] and Roberto Carluccio[2]

(1) *Center of Integrated Geomorphology for the Mediterranean Area, CGIAM, Potenza, Italy*

(2) *Istituto Nazionale di Geofisica e Vulcanologia, INGV, Rome, Italy*

Abstract

The application of a physics-based earthquake simulation algorithm to the central Apennines region, where the 24 August 2016 Amatrice earthquake occurred, allowed the compilation of a synthetic seismic catalog lasting 100 ky, and containing more than 500,000 $M \geq 4.0$ events, without the limitations that real catalogs suffer in terms of completeness, homogeneity and time duration.

The algorithm on which this simulator is based is constrained by several physical elements as: (a) an average slip rate for every single fault in the investigated fault systems, (b) the process of rupture growth and termination, leading to a self-organized earthquake magnitude distribution, and (c) interaction between earthquake sources, including small magnitude events. Events nucleated in one fault are allowed to expand into neighboring faults, even belonging to a different fault system, if they are separated by less than a given maximum distance.

The seismogenic model upon which we applied the simulator code, was derived from the DISS 3.2.0 database (http://diss.rm.ingv.it/diss/), selecting all the fault systems that are recognized in the central Apennines region, for a total of 24 fault systems. The application of our simulation algorithm provides typical features in time, space and magnitude behavior of the seismicity, which are comparable with those of real observations. These features include long–term periodicity and

clustering of strong earthquakes, and a realistic earthquake magnitude distribution departing from the linear Gutenberg-Richter distribution in the moderate and higher magnitude range.

The statistical distribution of earthquakes with $M \geq 6.0$ on single faults exhibits a fairly clear pseudo-periodic behavior, with a coefficient of variation *Cv* of the order of 0.3-0.6.

We found in our synthetic catalog a clear trend of long-term acceleration of seismic activity preceding $M \geq 6.0$ earthquakes and quiescence following those earthquakes.

Lastly, as an example of a possible use of synthetic catalogs, an attenuation law was applied to all the events reported in the synthetic catalog for the production of maps showing the exceedence probability of given values of peak acceleration (PGA) on the territory under investigation.