

New Methodologies Applied to Seismic Hazard Assessment in Southern Calabria (Italy)

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Abstract

Although it is generally recognized that the M7+ 1783 and 1908 Calabria earthquakes were caused by normal faults rupturing the upper crust of the southern Calabria-Peloritani area, no consensus exists on seismogenic source location and orientation. A recent high-resolution low-altitude aeromagnetic survey of southern Calabria and Messina straits suggested that the sources of the 1783 and 1908 earthquakes are en echelon faults belonging to the same NW dipping normal fault system straddling the whole southern Calabria.

The application of a newly developed physics-based earthquake simulator to the active fault system modeled by the data obtained from the aeromagnetic survey and other recent geological studies has allowed the production of catalogs lasting 100,000 years and containing more than 25,000 events of magnitudes ≥ 4.0 . The algorithm on which this simulator is based is constrained by several physical elements as: (a) an average slip rate due to tectonic loading for every single segment in the investigated fault system, (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 segment are allowed to expand into neighboring segments, if they are separated by a given maximum range of distance.

The application of our simulation algorithm to Calabria region provides typical features in time, space and magnitude behaviour of the seismicity, which can be compared with those of the real observations. These features include long-term pseudo-periodicity and clustering of strong

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

Lastly, as an example of a possible use of synthetic catalogs, an attenuation law has been 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. These maps can be compared with the existing hazard maps that are presently used in the national seismic building regulations.