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Active faults, regional seismotectonic zonation and seismic hazard assessment in central Italy. A multidisciplinary approach.

B. Pace (1), L. Peruzza (2), G. Lavecchia (1), **P. Boncio** (1) and F. Visini (1)

(1) GeoSis-Lab, Earth Science Dep., University of Chieti-Pescara, Chieti, Italy (b.pace@unich.it), (2) OGS Istituto Nazionale di Oceanografia e Geofisica Sperimentale, Sgonico (TS), Italy.

A multidisciplinary approach, using geological, seismological, geophysical and thermo-mechanical information, is useful to better understand the relationships between faults and earthquakes in space and time, with major advances in the science of probabilistic seismic hazard analysis. We defined a seismogenic model for central Italy based on 3 layers of seismogenic sources and we computed the relative seismic hazard maps. 1) The first layer consists of individual structures liable to generate major earthquakes (M>=5.5). Starting from active faults (normal faults in this case) mapped at surface using earthquake geology studies, we defined 3D seismogenic structures by integrating surface geology data with all the data suitable for constraining the down-dip length, the seismogenic layer thickness as well as the first-order segmentation pattern of the active faults (earthquake data, geophysical explorations, rheology and structural geology). The map projection of the 3D seismogenic fault is called "seismogenic box". The energetic parameters and seismicity rates associated with an individual source are based on the geometry and kinematics of the fault; the recurrence model is controlled by the earthquakes-source association and, when possible, we defined the occurrence time of the last major event for time-dependent seismic hazard considerations. 2) The second layer consists of seismotectonic provinces, that are relatively large zones of homogeneous seismotectonic features. Seismotectonic provinces are used in order to model all the relevant historical and instrumental earthquakes (4.5<M=<6) which cannot be correlated to known structures. 3) The last layer is the background seismicity, given by the instrumental seismicity of the last two decades. Using a sliding window selection of events, we defined a model of regular adjacent cells of variable a and b values of G-R relation. The seismic hazard computations used firstly this layered model in a traditional probabilistic scheme. Then, using a simplified time-dependent hypothesis only for individual sources, the conditional probability of occurrence of characteristic earthquakes for each source by Brownian passage time distributions is computed. Adopting equivalent fictitious seismicity rates, we obtained maps referring to the next 50 years by using traditional codes. We concluded that the use of geological inputs is essential in cases of incomplete historical records and/or in slowly deforming areas (such as Italy), and that the methodology and results obtained here are useful for seismic risk reduction strategies.