Seismic Hazard Mapping inside the Project SIGMA

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The Project SIGMA (Sistema Integrato di sensori in ambiente cloud per la Gestione Multirischio Avanzata) arises from the fields of Information and Communications Technologies (ICT) and advanced applications for the control, monitoring and management of high-risk processes of natural and social origin. SIGMA is a multilevel architecture whose main aim is the acquisition, integration and processing of heterogeneous data from different sources (seismic, volcanic, meteorologic, hydric, pluvial, car traffic, marine traffic, and so on) to manage and elaborate risk mitigation strategies which are important for the emergency management planning. Within the several experimental activities included in the project, there is the designing and realization of a prototype of application platform specialized to provide the operating procedures and software to the public administrations and the industrial companies, for constantly monitoring both the anthropic and natural phenomena in Sicily. In this framework, of course, the seismic risk analysis plays a very important role since Sicily is one of the Italian regions with high seismic risk.

Seismic risk assessment may be approached in two different ways: i) as average seismic risk of the buildings and facilities in question during the period considered, combining the vulnerability of different building types and the seismic hazard for the site, which are then expressed in terms of the effects of the events derived from an earthquake catalogue that exceed a specified threshold during a given period; ii) as estimated damage of the buildings and the critical facilities using a scenario input described in terms of the source parameters of the hypocenter as location, magnitude, and so on.

Here we deal with the hazard calculation through the code CRISIS (Ordaz, Aguilar and Arboleda) and with the code PROSCEN (PRObabilistic SCENario, [Rotondi and Zonno, 2010]) to obtain earthquake scenario to be used in the latter approach. Indeed, an earthquake scenario is a planning tool that helps decision makers to visualize the specific impact of an earthquake based on the scientific knowledge. An earthquake scenario creates a picture that the members of community can recognize and, at the same time, improves the communication between the scientific, emergency management and policy communities to seismic risk reduction.

In particular, CRISIS computes seismic hazard using a probabilistic approach that consider as input parameters the earthquake occurrence probabilities, attenuation characteristics and geographical distribution of earthquakes in the studied area. The hazard results are given in terms of probabilities of exceeding a given peak ground motion in different time frames. More in detail, the area under study is first divided into seismic sources; then, within a seismic source an independent earthquake-occurrence process takes place. Thus, for each seismic source, earthquake occurrence probabilities are estimated by means of statistical analysis of earthquake catalogs. Conversely, PROSCEN estimates the seismic scenarios by adopting a probabilistic approach based on the Bayesian statistics [Rotondi and Zonno, 2004] and modelling the attenuation of the macroseismic intensity both in the case of point source (isotropic model) and linear source (anisotropic model). The code needs just two input parameters to generate the earthquake scenario, that is the location and the epicentral intensity (together with the fault geometry for the anisotropic model) of the given earthquake. The scenario results are plotted on grid maps representing the intensity that can be exceeded with a fixed probability. This representation can easily find application in seismic monitoring of an area, since can be used to produce real-time shake-maps in intensity based on the earthquake parameters calculated automatically from the instrumental recording and location routines.

References

Rotondi R., Zonno G., (2004). *Bayesian analysis of a probabilistic distribution for local intensity attenuation.* Annals of Geophysics, 47, 1521-1540.

Rotondi R., Zonno G., (2010). *Guidelines to use the software PROSCEN.* Open Archives Earth-prints Repository, INGV, Reports. http://hdl.handle.net/2122/6726.