THE CARTOGRAPHY IN SEISMIC HAZARD ASSESSMENT AND COMMUNICATION: THE CASE STUDY OF THE 2012 PO PLAIN EARTHQUAKE (NORTHERN ITALY)

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Extended Abstract

Communication on seismic hazard is essential to protect people and infrastructure from devastating disasters due to extreme events and to develop a social risk preparedness culture. Whereas the predisposing factors and the impact of earthquakes have a spatial dimension, the cartographic representation is a relevant tool for seismic hazard assessment and communication, potentially able to reach a differentiate and widened public. In this contribution, the use of cartography and geographical information system are discussed within hazard and risk communication approaches. Despite cartographic information allow to visualize and to synthesize the complexity of variables related to seismic hazard, in general, their interpretations and the knowledge exchange between scientific community and civil population still remain often difficult. This paper aims to trace the evolution and development of seismic risk cartography related to the area struck by the 2012 seismic swarm in the Po Plain (Fig.1) that caused 27 deaths, over 400 persons injuried, the evacuation of 14,000 people and considerable damages to the cultural heritage and to the regional economic activities.

Fig. 1 – Epicentral area of the 2012 seismic swarm in the Po Plain (northern Italy)

The Po Plain seismic sequence has been analyzed from various viewpoints (seismological, seismotectonic, geomorphological, historical etc.) as shown by many articles and among them, worthy of note is Anzidei et al. (2012). In detail, two main shocks occurred on 20/05/2012 (ML = 5.9, focal depth: 6.3 km) at the boundary of the Modena and Ferrara provinces and on 29/05/2012 (ML = 5.8, focal depth: 10.5 km), about 12 km west of the first epicenter. Moreover this seismic swarm has consisted of another five M>5 quakes till to 3/06/2012 and more than 2500 aftershocks of lower magnitude during almost one year.

The earthquake sequence, was related to the thrust front activity of buried Apennine north verging faulted folds formed by three arcs under the Plio-Quaternary sediments (known as Ferrara folds). In particular, the most relevant geological effect caused by the two stronger earthquakes was the 10-15 cm of uplift of the epicentral area, detected by the InSAR interferometry, corresponding to the the most external structures of Ferrara Folds. At a detailed scale several hundreds of earthquake-induced environmental effects (EEE), mainly of the geological/geomorphological type, scattered all over the epicentral area, were detected. They mainly consisted of soil liquefaction phenomena, ground ruptures and sand boils. Some artificial canals showed uplifting, bulging and cracks of the bottom and fractures and soil slips on the banks. Also hydrogeological anomalies, such as strong water-table fluctuations, emission of hot water from ground cracks and water wells, have been recorded.

By the comparison of the location of the EEE with the Geomorphological Map of the Po Plain (Castiglioni et al., 1997) appear that the coseismic effects were aligned and concentrated on crevasse splay and along the courses of abandoned riverbeds (at ground level or as levees) mainly characterized by the presence of superficial sandy texture. This aspect highlights the importance and the role of the geomorphological maps for seismic hazard assessment of alluvial plain areas.

As concern macroseismic intensity maps, generally implemented at small scale, a macroseismic intensity field based on the ESI scale (Guerrieri & Vittori, 2007), which considers the characteristics and size of EEE, was depicted (cfr. Anzidei *et al*., 2012). Comparing the ESI local intensity values with the macroseismic intensity evaluations map (MCS, Galli *et al*., 2012), based on the pattern of buildings damage, it is clear that the epicentral intensity evaluations are comparable and EEE can be a better tool for local intensity assessment, as they are independent of the type of construction, but are governed directly by the geological/geomorphological site conditions. For these reasons, a macroseismic intensity field that integrates ESI and MCS intensity evaluations represents a better tool for characterizing the 2012 event in the framework of the seismic-hazard assessment.

The seismic hazard and risk cartography edited by different institutions (e.g. the seismic Emilia Romagna Microzonation maps) have been developed through the implementation of large scale maps also including the EEE and the lithology of the subsoil. A doctoral research focused on the implementation of an homogeneous inventory of EEE by combining and merging the multiple existing databases in one single georeferenced database in GIS environment that will be published with an open source mapping interface is underway (Lanfredi Sofia, in progress). A series of sheets, directly linked to the location of coseismic effects spatial distribution are created in order to communicate information through exhaustive descriptions of the different types of effects and the associated cartography and mapping and photographic documentation.

In spite of the unpredictability of earthquakes the population has given credit to various groundless alarms on the basis of gas emission, bubbling water and ground fractures (Bertacchini et al, 2014). On May 2014 the Emilia-Romagna Region established a working group of experts that throughout a dedicated website they communicate correct information on particular geological phenomena that are observed and usually misunderstood by the civilians. To avoid the spreading of wrong convictions on particular surface phenomena, it appears fundamental to describe and explain, to the general public, the particular phenomena and locate them in the geological framework. The role of communication is essential in order to enhance awareness on seismic hazard and environmental effects comprehension among civil society.

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