Geophysical Research Abstracts
Vol. 16, EGU2014-2711, 2014
EGU General Assembly 2014

The key role of eyewitnesses in rapid earthquake impact assessment

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Uncertainties in rapid earthquake impact models are intrinsically large even when excluding potential indirect losses (fires, landslides, tsunami…). The reason is that they are based on several factors which are themselves difficult to constrain, such as the geographical distribution of shaking intensity, building type inventory and vulnerability functions.

The difficulties can be illustrated by two boundary cases. For moderate (around M6) earthquakes, the size of potential damage zone and the epicentral location uncertainty share comparable dimension of about 10-15km. When such an earthquake strikes close to an urban area, like in 1999, in Athens (M5.9), earthquake location uncertainties alone can lead to dramatically different impact scenario. Furthermore, for moderate magnitude, the overall impact is often controlled by individual accidents, like in 2002 in Molise, Italy (M5.7), in Bingol, Turkey (M6.4) in 2003 or in Christchurch, New Zealand (M6.3) where respectively 23 out of 30, 84 out of 176 and 115 out of 185 of the causalities perished in a single building failure. Contrastingly, for major earthquakes (M>7), the point source approximation is not valid anymore, and impact assessment requires knowing exactly where the seismic rupture took place, whether it was unilateral, bilateral etc.… and this information is not readily available directly after the earthquake's occurrence.

In-situ observations of actual impact provided by eyewitnesses can dramatically reduce impact models uncertainties. We will present the overall strategy developed at the EMSC which comprises of crowdsourcing and flashsourcing techniques, the development of citizen operated seismic networks, and the use of social networks to engage with eyewitnesses within minutes of an earthquake occurrence. For instance, testimonies are collected through online questionnaires available in 32 languages and automatically processed in maps of effects. Geo-located pictures are collected and then published after validation. Quake Catcher Networks (QCN) where a cheap USB MEMS motion sensors transform a PC in a seismic station are being deployed in Thessaloniki and Patras (Greece) in collaboration with Stanford University and the USGS. Flashsourcing is also used which is the analysis in real time of traffic surges observed on EMSC's earthquake information website; these surges are caused by the natural convergence of eyewitnesses who rush to the Internet to investigate the cause of the shaking that they have just felt. Within 5 minutes and independently of any seismic data, this detects felt earthquakes, maps the felt area and can detect the presence of damage. We will also explain the roles of social networks in optimising data collection and how citizen involvement has changed our earthquake information services.