A Global Multi-component Information System for Seismic Risk reduction

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*Bossu Remy[1]、Roussel Frederic[1]、Steed Robert[1]、Landès Matthieu[1]
*Remy Bossu[1], Frederic Roussel[1], Robert Steed[1], Matthieu Landès[1]

1. Euro-Mediterranean Seismological Centre
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Over the last 20 years, the Internet and more recently social media have revolutionized the way rapid earthquake information is broadcasted to the public. The European Mediterranean Seismological Centre (EMSC), one of the top global earthquake information centers, has been embracing these new technologies to develop a multicomponent information system for providing rapid information for eyewitnesses of global earthquakes. At the intersection between seismology, citizen science, and digital communication, its aim is twofold: to offer timely, appropriate information in regions where an earthquake is felt and to collect high numbers of eyewitnesses' direct and indirect observations about the degree of shaking being felt and possible damage incurred.

The information system comprises websites, a Twitter and a Telegram quakebot and a smartphone application. There are 3 key elements in the empirically developed strategy: relevance of provided information for potentially distressed eyewitnesses, rapidity and easiness to understand of key messages.

The relevance of the information is achieved by focusing on felt earthquakes, regardless their magnitude, the ones only detected by seismic monitoring networks being valuable uniquely to seismologists. Felt earthquakes are not identified through seismic data, but by the footprint left on Internet and social media by eyewitnesses looking for information immediately after the tremor. In practice, we independently monitor in real-time three variables: the number of tweets (i.e. messages published on Twitter) containing the keyword "earthquake" in various languages, the number of visitors on our websites, and the number of people launching our LastQuake app. Internet and social media act as the digital nervous system of our Planet and we detect the pulse generated by the online reaction to ground shaking.

These pulses of earthquake-related-activity lead to what is named crowdsourced detections which are typically within 15 to 90 s of earthquake occurrence and precede in the vast majority of cases traditional seismic locations. Crowdsourced detections are automatically published on the different component of the information system and eyewitnesses are invited to confirm them by sharing their felt experience. This proves to be an efficient engagement strategy working in all seismically active region of the world. Felt reports are collected through a set of cartoons depicting the different shaking level of the EMS 98 macroseismic scale rather than an online questionnaire. Visual communication is also exploited to provide timely geo-targeted safety tips to limit inappropriate behaviors in the minutes following an earthquake.

This talk presents the overall strategy and performances of the developed information system and illustrates how felt reports and eyewitnesses' digital footprints can improve rapid situation awareness of global earthquakes and rapid public information at little cost. In turn, we advocate that improved situation

awareness and timely geo-targeted safety tips contribute to global seismic risk reduction. Finally, we will explore the automatic fusion of crowdsourced and seismic data to fasten seismic locations and magnitude estimates.

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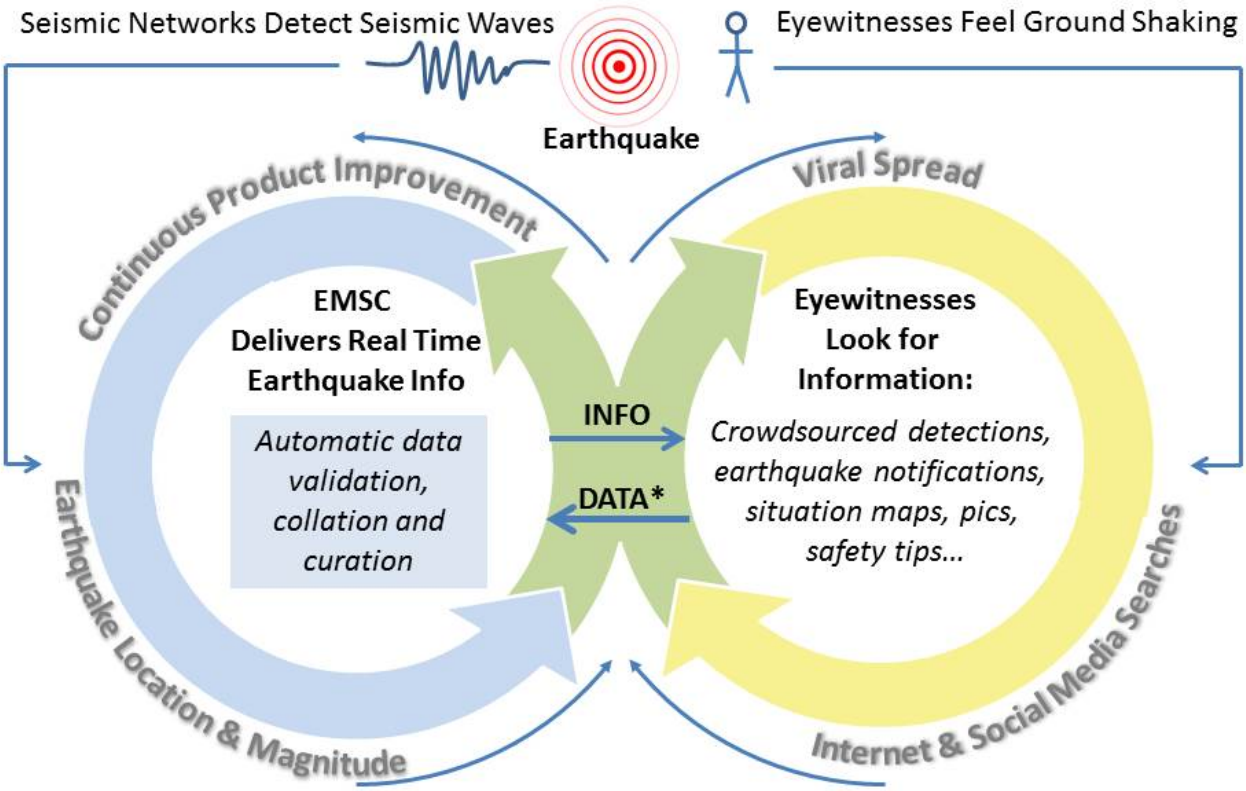

Schematic view illustrating how EMSC uses eyewitness observations to rapidly collect data and offer timely information to users. When an earthquake strikes, it is picked-up by, on the one hand, seismic networks which determine the earthquake's location and magnitude (left) and on the other hand, by people who may experience the tremors and turn to internet searches and other online sources for information (social networks, blogs etc).

The EMSC information system includes websites, a smartphone application and a twitter quakebot, all of which act at the interface between the two feedback loops shown. These three channels collect data from eyewitnesses, automatically curate, analyse and collate them, integrating them with sesmic derived information. The system then produces publicly accessible and timely information, which, in turn, attracts more eyewitnesses and, subsequently generates more data. This facilitates the continuous development and improvement of EMSC's products based on ongoing user feedback and observed effectiveness.

