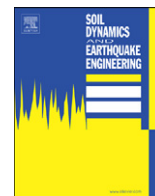




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# Earthquake early warning as a tool for improving society's resilience and crisis response

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## ABSTRACT

Increasing vulnerability of metropolitan areas to earthquake and the very low probability level at which short term earthquake forecasting is possible make earthquake early warning methods (EEW) the main viable alternative for effective risk reduction in cities. Preventive actions, such as retrofitting and building and the diffusion of construction codes, are of course essential. They are not sufficient. A substantial proportion of the population in areas of higher earthquake hazard still reside in buildings that do not meet modern earthquake resistant standards, and cannot currently be strengthened in an economically viable manner. As demonstrated in Japan EEW has the potential of significantly contributing to reduce individual vulnerability of urban population to earthquakes. Future research on EEW should be focused on its implementation to protect lifelines, infrastructures and strategic buildings, and it should include training of administrators and people who can fully exploit the technological advantages offered by EEW systems. In particular it should foresee extensive cost-benefit analysis for each potential application, the identification and solution of legal problems (such as liability in the event of false or missed alarms), education and training, both for mitigation and response, as well as detection and processing within 1 s of the first seismic wave arrivals. Further objectives include the development of people-centred EEW, specialized IT and decision making support systems, integration of sensors, communications and decision making systems, integration into programs of eco-sustainable development, and integration with other EW systems (all hazard systems).

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## 1. Introduction

The rapid and continuous increase of population is making cities, especially mega-cities, hotspots of global risk change. The urban explosion takes place predominantly in the developing world, where the population of large cities doubles every 15 years, while that of informal settlements doubles every 7 years. It is expected that around 420 million people will reside in cities with a population of 2 million or greater by 2015. 350 million of them will be in developing countries. Even in continents, like Europe, where the increase of population is far less dramatic, the high level of industrialisation and the fast growing networking of infrastructures, lifelines and economies increase the level of risk of metropolitan areas, still making them hotspots of risk change (see f.i., [1,2,7]). Hence, the developing world faces increasing urban risk that would lead to greater loss of human life, while in Europe and other developed countries the urban risk's

increase is mainly bound to increasing financial and infrastructure losses. A further aspect to be considered is that, as a result of globalisation (economic and social) and the resulting greater integration of economic partners, the area affected by a natural catastrophic event is nowadays much wider than that physically struck by the event.

The importance of Early Warning (EW) for risk reduction has been highlighted in a number of international documents at various governmental levels. Within the context of the United Nations, EW was emphasised within the Hyogo Framework for Action, where it was identified as one of the five priorities for action. In addition, a report requested by the then UN Secretary General, Kofi Annan, provides a global assessment of the EW capabilities, gaps and opportunities, while three international conferences dealing with EW, all under the auspices of the United Nations, have continued to emphasise the importance and necessity of EW systems (see [2,3]).

Earthquake Early Warning cannot reduce hazard, but it can decrease vulnerability and exposure. Therefore it can contribute to reduce the negative consequences of earthquakes. An effective Earthquake Early Warning raises many scientific and technical

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