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Rapid earthquake loss assessment after damaging earthquakes

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ABSTRACT

This article summarizes the work done over the last decades regarding the development of new approaches and setting up of new applications for earthquake rapid response systems that function to estimate earthquake losses in quasi-real time after an earthquake. After a critical discussion of relevant earthquake loss estimation methodologies, the essential features and characteristics of the available loss estimation software are summarized. Currently operating near-real-time loss estimation tools can be classified under two main categories depending on the size of area they cover: global and local systems. For the global or regional near-real-time loss estimation systems: GDACS, WAPMERR, PAGER, and NERIES-ELER methodologies are presented together with their loss estimations for the 2009 Abruzzo (L'Aquila) earthquake in Italy. Examples are provided for the local rapid earthquake loss estimation systems, including the Taiwan Earthquake Rapid Reporting System, Real-time Earthquake Assessment Disaster System in Yokohama, Real Time Earthquake Disaster Mitigation System of the Tokyo Gas Co., and Istanbul Earthquake Rapid Response System.

1. Introduction

As illustrated in Fig. 1 [1], management of earthquake risks is a process that involves pre-, co-, and post-seismic phases. Earthquake Early Warning (EEW) systems are involved in the co-seismic phase. These involve the generation of real time ground motion estimation maps as products of real-time seismology and/or generation of alarm signals directly from on-line instrumental data. The rapid response systems take part immediately after the earthquake and provide assessment of the distribution of ground shaking intensity (shake maps) or physical damage and casualties (loss maps). These maps can serve to direct the search and rescue teams to the areas most needed and assist civil protection authorities in emergency actions. This study will critically review the existing earthquake rapid response systems that serve to produce earthquake loss information (casualties, and building, lifeline, and facility damages) immediately after an earthquake.

Potential impact of large earthquakes on urban societies can be reduced by timely and correct action after a disastrous earthquake. Modern technology permits measurements of strong ground shaking in near-real time for urban areas exposed to earthquake risk. Assessments of the distribution of strong ground motion, building damage, and casualties can be made within a few minutes after an earthquake. The ground motion measurement and data processing systems designed to provide this information are called earthquake rapid response systems.

Reduction of casualties in urban areas immediately following an earthquake can be improved if the location and severity of damages can be rapidly assessed by the information from rapid response systems. Emergency management centers of both public and private sectors with functions in the immediate post-earthquake period (i.e. SAR, fire, and emergency medical deployments) can allocate and prioritize resources to minimize loss of life. Emergency response capabilities can be significantly improved to reduce casualties and facilitate evacuations by permitting rapid and effective deployment of emergency operations. The rapid response data should possibly be linked with incident command and standard emergency management systems to increase effectiveness.

Ground motion data related with power transmission facilities, gas and oil lines, and transportation systems (especially fast trains) allow for rapid assessment of possible damages to avoid secondary risks. Water, wastewater, and gas utilities can locate the sites of possible leakage of hazardous materials and broken pipes. Prevention of gas-related damage in the event of an earthquake requires understanding of damage to pipeline networks and prompt shut-off of gas supply in regions of serious damage.

Available near-real-time loss estimation tools can be classified under two main categories depending on the size of area they cover: (1) global systems and (2) local systems.

For the global or regional near-real-time loss estimation efforts, GDACS—Global Disaster Alert and Coordination System

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