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Preface to the special issue on Earthquake early warning system and rapid seismic instrumental intensity report

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In the past several years, from May 12, 2008 Wenchuan M_W8.0 earthquake in China to March 11, 2011 off the Pacific coast of Northeastern M_W9.0 earthquake in Japan, the world witnessed catastrophic disasters caused by destructive earthquakes. The earthquake posed a great threat to the development of society and economy, especially in the developing countries such as China. In order to reduce the losses in peoples life and properties in maximum possibilities, there were a lots of technologies had been researched and developed, among them the earthquake early warning system (EEWS) and rapid seismic instrumental intensity report (RSIIP) are the two of the state-of-the-art technologies for the purpose. They may be used to minimize property damage and loss of life and to aid emergency response after a destructive earthquake.

The basic principle of EEWS is simple: strong ground shaking is caused by shear-waves and by the subsequent surface waves which travel at about half the speed of the primary waves and much slower than electromagnetic signals transmitted wireless or by cable. When a suitable seismic network is available, by using the real-time analysis methods of the fast primary wave, a few seconds to a few tens of seconds warning time may be provided to the warning target area before the arrival of strong ground shaking. RSIIP, similar to the ShakeMap of USGS, is a report including seismic instrumental intensity map showing the distribution of ground-motion parameters which are produced automatically within a few minutes to an hour after a large earthquake by using the real-time observed ground motion with the correction of site effect of ground motion and the fault rupture effect in the case of great earthquake.

Even Cooper (1868) proposed the original idea of earthquake early warning in 1868, Japan used on-site P-wave detection/alarm in its Shinkansen high speed railway system in 1964 and first launched the EEWS to public on October 1, 2007, the technology of EEWS is sill far from perfect, there are many problems still need to be solved and it should be researched and improved for the practical use in different area. The papers in this special issue are some advancement in the EEWS and RSIIP based on program of *The Research on EEWS and RSIIP and Its Pilot Application* that is financially supported by National Key Technology R&D Program (Grant No. 2009BAK55B00).

The special issue contains eight papers on the EEWS and RSIIP, basically including the main progress in these two fields in the past several years in China, especially in the Fujian Province. The contents include theory and methods of EEWS and RSIIP and its pilot application, the study on-site correction of ground motion in Fujian area, the fault rupture effect and rapid earthquake losses estimation based on RSIIP. Below is a summary of each paper.

Jin et al. systematically introduce the latest progress of the EEWS in Fujian Province, China, by focusing on continuous earthquake location and its error evaluation, magnitude estimation, reliability-judgment of EEWS information, double-parameter principle used in EEWS information release threshold, real-time estimation of seismic intensity and available time for target areas,

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seismic monitoring network and data sharing platform, EEWS information release and receiving platform, software test platform and test results statistical analysis. Based on the technologies and methods mentioned above, a EEWS had been developed with own intellectual property and suite to seismic network of Fujian province. Finally, some real earthquake cases and simulation of Wenchuan earthquake had been given.

Li et al. inspected and compared the T_{now} method and the four-station continuous location method by using P-wave arrival information of the first four stations of each earthquake in the Catalog of Fujian Seismic Network. It shows that the four-station continuous location method can locate more seismic events than the T_{now} method.

Earthquake magnitude estimation is one of the most important and also the most difficult parts of the EEWS. Jin et al. obtained earthquake magnitude estimation relationships by using the τ_c and P_d methods based on 142 earthquake events and 253 seismic records that were recorded by the KiK-net in Japan, and aftershocks of the large Wenchuan earthquake in Sichuan.

Also Zhang et al. had analyzed the highest potential seismic intensities and the EEWS warning time for each city in Fujian Province based on 71 historical earthquakes in Fujian area. In the case of the seismic network of Fujian Province, each city has several seconds warning time prior to the arrival of the destructive wave.

Kang et al. had developed a new model to simulate high-frequency motions from earthquakes with large rupture dimension. The envelope of high-frequency ground motion from a large earthquake can be expressed as a root-mean-squared combination of envelope functions from smaller earthquakes. The authors use simulated envelopes of ground acceleration to estimate the direction and along-strike length of a rupture. Using the Wenchuan and Chichi earthquake dataset, the examples of this new method were given.

Geomorphological classification is an important factor effect on ground motion, i.e., seismic intensity. Ke et al. had provided Geomorphological classification of the Fujian province, which was done based on remote-sensing imaging, digital elevation maps (DEM), and slope-gradient data acquired by ArcGIS 9.2.

Also, site effect posed a significant affect on ground motion. Zhang et al. had contributed the site category-zoning map of FJ area with the scale of 1:200,000 that is generated according to the site classification standard of “Code for Seismic design of Buildings” of China (GB 50011-2010), on the basis of the interpretation of the high-resolution satellite remote-sensing images, in combination with the data of engineering geological exploration and shear-wave velocity testing. It makes possible to correct site effect of ground motion in Fujian Province.

Finally, an application of RSIIP had been developed by Huang et al. In the case, by combining vulnerability study results from earthquake disaster cases and the building of Fujian Province, the RSIIP was used to realize rapid earthquake loss estimation in an attempt to provide more reliable information for earthquake emergency response and decision support.

From August 2008, while people around country were celebrating the Olympic Game in Beijing, a group of seismologist from the country gathered in Fuzhou City to write the proposal of *The Research on EEWS and RSIIP and Its Pilot Application,* to July 2013, the program had passed the check and accept organized by the Ministry of Science and Technology, many people made great efforts and contributed their talent, toil, and sweat. I would like to extend my sincerely thanks to all participants and supporter of the program, and all the author of this special issue, especially, to the editor of this special issue.