Development of earthquake early warning system in Taiwan

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With the implementation of a real-time strong-motion network by the Central Weather Bureau (CWB), an earthquake early warning (EEW) system has been developed in Taiwan. In order to shorten the earthquake response time, a virtual sub-network method based on the regional early warning approach was utilized at first stage. Since 2001, this EEW system has responded to a total of 225 events with magnitude greater than 4.5 occurred inland or off the coast of Taiwan. The system is capable of issuing an earthquake report within 20 sec of its occurrence with good magnitude estimations for events up to magnitude 6.5. Currently, a P-wave method is adopted by the CWB system. Base on the results from 596 M ≥ 4.0 earthquakes recorded by the real-time strong-motion network, we found that peak displacement amplitudes from initial P waves (P_d) can be used for the identification of M ≥ 6.0 events. Characteristic periods τ_c (Kanamori, 2005; Wu and Kanamori, 2005) and $\tau_p^{\max}$ (Nakamura, 1988; Allen and Kanamori, 2003) of the initial P waves can be used for magnitude determination with an uncertainty less than 0.4. In the future, we expect to achieve a 10-second response time by the EEW system in Taiwan.

The real-time strong-motion network at CWB has been operating for more than 10 years. Taking account of the advancements on instrumentations and communications, CWB planned to improve the capabilities of this network. For seismograph, the 16-bit digital accelerographs will all be replaced by 24-bit instruments to enhance the dynamic range to 144 dB. In the meanwhile, the short-period and broadband seismographs will be joined together for integral data processing. Therefore, not only the strong shakings can be accurately reserved during a strong earthquake, but provides high resolution P wave signals for EEW application. For telemetries, 64K Frame-Relay networks for each station at least are prepared, and the sampling rate is enhanced to 100 Hz. In addition, the high quality borehole seismic stations and a cable-based Ocean Bottom Seismographic (OBS) stations will plan to implement on and off north-eastern Taiwan since 2008. We will further develop the EEW system in response to these new instruments, as well as to any new research ideas.

Currently in Taiwan the rapid earthquake reports issued by the EEW system are not available to the general public, except for experimental purposes by some relevant organizations such as railway administration, rapid transit companies, and disaster prevention agencies etc. Public release of

earthquake early warnings does not produce social benefits in the absence of a comprehensive approach to educating the public on how to respond to the warning messages. However, encouraged by the recent successful examples in the research and application of EEW system in Japan, a joint program to promote the EEW system with the participation of various organizations will proceed in the near future in Taiwan.