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Earthquake Early Warning in India Using Data from Low-Cost Sensors as well as Synthesised Data

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Earthquake Early Warning (EEW, a life-saving tool) system in India is in its early stage. In recent time, India set up an EEW system in the central seismic gap (CSG) along the Himalayan Belt, which is highly sensitive to the seismic risk with the potential of strong, major and great earthquakes. Almost 200 low-cost P-Alert sensors have been installed for the same. Despite the functioning of this network for last 4 years, it has not recorded any significant earthquake. In absence of any data from this network, we take advantage of recorded earthquake data from Taiwan and synthesized data to test the functionality of EEW in India. In first phase, 100 stations were installed in Garhwal Himalayas of Himalayan belt. We selected Taiwanese stations in good accordance with the Indian sensor network, to have a best fit in terms of inter station spacing. Finally, the recorded waveforms are passed through Earthworm software using tankplayer module. The system performs very well in terms of earthquake detection, P-wave picking, earthquake magnitude and location (using previously estimated regressions). Pd algorithm has been tested where the peak amplitude of vertical displacement are used for estimating magnitudes using previously regressed empirical relationship data. For the earthquakes located in Himalays close to epicenter of historical earthquakes like Uttarkashi (1991) and Chamoli (1999) earthquake, a good estimate of location, as well as magnitude is observed. The approach based on P_d for estimating magnitude works perfectly as compared to τc approach, which is more sensitive to signal to noise ratio. To make it more region specific, we generated synthetic seismograms from the epicenters of historical Chamoli (1999) and Uttarkashi (1991) earthquakes at EEW stations in India and checked the functionality of EEW. While placing these earthquakes within the instrumentation window, a good approximation of earthquake location and magnitude is obtained by passing these generated waveforms. The parameters used to judge the performance of EEW system included the time taken by the system in issuing warning after the confirmation of the occurrence of damaging earthquake and the lead time (time interval between the issuing of warning and arrival of damaging earthquake ground motion at a particular location). High lead times have been obtained for the plainer regions including thickly populated regions of Gangetic plains, such as, Delhi-National Capital Region (NCR) according to the distance from the epicenter, which are the main target of EEW system.