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Feasibility study of a nation-wide Early Warning System: the application of the EEW software PRESTo on the Italian Strong Motion Network (RAN)

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The past two decades have witnessed a huge progress in the development, implementation and testing of Earthquakes Early Warning Systems (EEWS) worldwide, as the result of a joint effort of the seismological and earthquake engineering communities to set up robust and efficient methodologies for the real-time seismic risk mitigation.
The leading experience of the operational early warning system implemented by the Japan Meteorological Agency showed the effectiveness of a combined onsite and network-based approach to rapidly broadcast the rapid warning after a potential damaging earthquake. At the nation-wide scale, the Japanese system makes use of real-time data streamed by the extremely dense accelerograph array (about 1000 seismic instruments) deployed across Japan.
With more than 750 accelerometric stations installed over all the active seismic zones, target cities and strategic infrastructures, Italy has the potential for a nation-wide early warning system, although the communication network and data sharing must be expanded and improved. A significant number of these stations are nodes of the RAN (Italian Accelerometric Network) managed by the Italian national emergency management department (Dipartimento della Protezione Civile, DPC), whose data are used for emergency response services.
In the framework of the REAKT-Strategies and tools for Real Time Earthquake RisK ReducTion FP7 European project, the AMRA-RISSCLab group is engaged in a feasibility study on the implementation of the EEW software PRESTo earthquake early warning platforms on the Italian accelerometric network (RAN)
PRESTo (PRobabilistic and Evolutionary early warning SysTem) is a highly configurable and easily portable platform for Earthquake Early Warning. The system processes the live accelerometric streams from the stations of a seismic network to promptly provide probabilistic and evolutionary estimates of location and magnitude of detected earthquakes while they are occurring, as well as shaking prediction at the regional scale. Alarm messages containing those parameters can reach target sites before the destructive waves, enabling automatic safety procedures. The earthquake location is obtained by an evolutionary, probabilistic approach that uses information from both triggered and not-yet-triggered stations at each time step. Magnitude estimation is based on a Bayesian approach that uses the peak displacement measured on short 2-4 second windows of P- and S-waves signal. Peak ground motion is estimated at target sites by GMPEs using location and magnitude.
The performance of the potential EW system at the national scale has been investigated through simulated earthquake scenarios using real-data from several M 5-6 earthquakes recorded by the network RAN. Furthermore, a statistical approach has been implemented considering a nation-wide grid of synthetic sources, the same grid which is used to derive the seismic hazard map in Italy. By considering a virtual testing period of 50 years, each grid's node is considered as a seismic source capable of generating a sequence of earthquakes with magnitude varying according the seismogenic zones properties to which it belongs. Then, the EW algorithm, PRESTo, is run on the sequences of synthetic data created for each of the grid's points considering the present-day RAN configuration, and network performance in terms of lead-time, errors in event location and magnitude determination is computed for the tested sources.