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On-site earthquake early warning strategy for Italy

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An Earthquake Early-Warning System (EEWS) is a real-time seismic monitoring infrastructure that has the capability to provide warnings to target cities before the arrival of the strongest shaking waves. Two different approaches are usually proposed for the acquisition lay-outs of EEWS: the regional (or network-based),method where a dense seismic network is deployed around the earthquake epicenter, and the on-site system, where sensors are installed in proximity of the target site to protect. In the two cases, a different lead-time (e.g. the time available for risk mitigation actions) is expected depending on the distance from the source, with the onsite method more advantageous for targets located at small distances from the source.

In a recent paper, Picozzi et al. (2015) performed a feasibility study for a nationwide, regional EEW method based upon the Italian strong motion network (RAN) owned and operated by the Italian Department of Civil Protection (DPC) (Gorini et al., 2010) and using the EEW software platform PRESTo. The application of PRESTo to a set of M 4-6 earthquake data occurred in Italy during the last 10 yrs, showed that the regional EEW method cannot provide timely warnings within a distance of about 25 km to 30 km from the epicenters , using P-wave data from the closest 3 stations (Picozzi et al., 2015).
In this paper we want to address the issue of whether the on-site or the regional approaches is the best strategy to mitigate the earthquake damage in real-time for Italy.
For this purpose, we developed two different on-site EEW approaches and evaluated their performance at national scale. The first approach is called “SAVE” (On-Site Alert Levels), and is a P-wave based early warning system that measures in real-time two parameters: the initial Peak Displacement (Pd) and the average period (τc, Kanamori 2005) over time windows of 1, 2 and 3 seconds after the P-phase arrival. In output the system provides the predicted ground shaking intensity at the monitored site, the alert level (e.g. Zollo et al., 2010), and a qualitative classification of earthquake magnitude and the source-to-receiver distance.
An alternative, on-site methodology for EEWS is based on the continuous-time analysis of the P-wave amplitude along the whole seismogram. The key elements are the real-time, continuous measurement of three peak amplitude parameters (acceleration, velocity and displacement) and which are combined to define a dimensionless proxy parameter allowing to predict the ensuing peak ground velocity (PGV) and Instrumental Intensity (Imm). The alert is issued as soon as the empirical combination exceeds a given threshold.
Here we apply both methodologies to a data set of Italian earthquakes, with magnitude ranging between 3.8 and 6 and evaluate the performance of the systems, in terms of correct warning, lead-times and blind zones. A comparison between the proposed on-site systems and the results for the regional configuration (Picozzi et al., 2015) is also provided.

References

Gorini et al. (2010)
Picozzi et al. (2015)
Zollo et al.(1010)