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An Attempt of Predicting the Macroseismic Intensity from Early Radiated Energy for On-site Earthquake Early Warning in Italy

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Earthquake Early Warning System (EEWS) are effective tools for the risk mitigation in active seismic regions. Recently we conducted a feasibility study and a performance analysis of a nation-wide EEWS for Italy considering the accelerometric network RAN (Rete Accelerometrica Nazionale) and the EEW software platform PRESTo (http://www.prestoews.org). Focusing on a regional EEW approach and using recordings of moderate earthquakes occurred during the last ten years, such study showed that reliable estimations in terms of magnitude and epicentral localization are already available at the instant of the PRESTo's first alert, that is to say within 3-4 seconds after the first P-wave arrival. On the other hand, given the RAN's density of stations over the Italian territory, a regional EEWS approach would result in a blind zone of 25-30 km in average. The seismic risk mitigation in these areas can be pursued by: 1) decreasing the blind-zone dimension by increasing the network density, 2) integrating the regional EEWS with on-site systems. Current P-wave based onsite systems rely on the contemporary measurements of the peak displacement / period parameter, based on which the alert is issues as predefined thresholds are overcome (e.g. Zollo et al., 2010). In the present study we explore the use of the Squared Velocity Integral measured on a short P-wave time window (IV2-P) as parameter for an on-site EEW methodology based on the prediction of potential damage/perceived shaking at recording sites as expressed by the Macroseismic Intensity (IM). In order to calibrate the empirical relationships between IV2-P and S-waves ground motion parameters, we exploited a large data set of about four thousands RAN accelerometric recordings related to the largest earthquakes (Ml>4) occurred in Italy in the period 1997-2013, and made freely available by the ITalian ACcelerometric Archive, ITACA 2.0. In addition to peak ground velocity (PGV) it has been shown that the Housner Intensity (IH) is very effective as a measure of the building structural damage caused by seismic events with. Therefore, we have parameterized a new relationship between IV2-P and IM. The validity of the new IV2-P vs IM relationship has been assessed using the strong motion recordings of the INGV Strong Motion Data and of the DPC 'Osservatorio Sismico delle Strutture' databases. We also analyzed the recordings of the Mw 6 May 29th 2012 Emilia Earthquake (Italy) by comparing the predicted intensities with the observed ones after a macroseismic survey. Our results indicate that IV2-P can become a key parameter for the design of on-site EEWS capable of proving real-time prediction of the intensity at target sites. Furthermore, real-time intensity maps derived by our procedure would be valuable pieces of information for assisting the Civil Protection to act immediately according with the severity of the situation.