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QuakeUp: an advanced platform for the Earthquake Early Warning

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Here we propose an advanced platform for Earthquake Early Warning, able to provide a real-time mapping of the Potential Damage Zone (PDZ), e.g. the epicentral area where the peak ground velocity is expected to exceed the damaging or strong shaking levels, with no assumption about the earthquake rupture extent and spatial variability of ground motion. The system processes the 3-component, real-time ground acceleration and velocity data streams at each station. For stations providing high quality data, the characteristic P-wave period (τc) and the P-wave displacement, velocity and acceleration amplitudes (Pd, Pv and Pa) are jointly measured on a progressively expanded P-wave time window. The evolutionary estimate of these parameters at stations around the source allows predicting the geometry and extent of PDZ, but also of the lower shaking intensity regions at larger epicentral distances. This is done by correlating the measured P-wave amplitude with the Peak Ground Velocity (PGV) and Instrumental Intensity (IMM) and by interpolating the measured and predicted P-wave amplitude at a dense spatial grid, including the nodes of the accelerometer/velocimeter array deployed in the earthquake source area.
We tested the methodology by a retrospective analysis of three scenario cases: the 2008, Mw 6.8 Iwate–Miyagi Nairiku earthquake, the 2011, M 9.0 Tohoku-Oki event and the 2016, Mw 6.5 central-Italy earthquake. We found that, depending of the network density and spatial source coverage, this method naturally accounts for effects related to the earthquake rupture extent (e.g. source directivity) and spatial variability of strong ground motion related to crustal wave propagation and site amplification.