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Rapid determination of P-wave-based Energy Magnitude: Insights on source parameter scaling of the 2016 Central Italy earthquake sequence

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In this study, we proposed a novel methodology for the rapid estimation of the earthquake size from the seismic radiated energy. Two relationships have been calibrated using recordings from 29 earthquakes of the 2009 L'Aquila and the 2012 Emilia seismic sequences in Italy. The first relation allows obtaining seismic radiated energy ER estimates using as proxy the time integral of squared P-waves velocities measured over vertical components, including regional attributes for describing the attenuation with distance. The second relation is a regression between the local magnitude and the radiated energy, which allows defining an energy-based local magnitude (MLe) compatible with ML for small earthquakes. We have applied the new procedure to the seismic sequence that struck central Italy in 2016. Scaling relationships involving seismic moment and radiated energy are discussed considering the Mw 6.0 Amatrice, Mw 5.9 Ussita and Mw 6.5 Norcia earthquakes and their ML >4 aftershocks, in total 38 events. The Mw 6.0 Amatrice earthquake presents the highest apparent stress, and the observed differences among the three larger shocks highlight the dynamic heterogeneity with which large earthquakes can occur in central Italy. Differences between MLe and Mw measures allows to identify events characterized by a higher amount of energy transferred to seismic waves, providing important constraints for the real-time evaluation of an earthquake shaking potential.