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Real-time estimation of energy magnitude for EEW purposes

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Although the radiated seismic energy ES represents a small portion of the total energy budget involved in the earthquake rupture process, it is an important physical parameter linked to the dynamic characteristics and stress release during the an earthquake rupture. The rapid and reliable estimation of ES provides important information on the dynamic properties of the ongoing rupture process (i.e. apparent stress, seismic Moment Rate function). For such reasons in the past years seismological laboratories developed procedures for the computation of the energy magnitude (ME, see, e.g., Choy and Boatwright, 1995). As a complement to the moment magnitude (MW), we used ME that better characterize the earthquake radiation in the same frequency range of most civil infrastructures, and therefore is better correlated to the potential structural damage in the epicentral area.
In an earthquake early warning (EEW) procedure the integral of the squared velocity measured over P-wave windows (IV2-P) is here used as a proxy for ES to provide a direct insight into the physics of the earthquake rupture (Festa et al., 2008).

In this work, a new network based P-wave EEW strategy for the real-time estimation of ES released during an ongoing earthquake is presented. The approach we propose exploits the IV2-P parameter and aims to characterize in real-time the earthquake size in terms of ME. Our method is calibrated using a database of Italian earthquake recordings.
The performance of the method is evaluated comparing its results with the teleseismic measurements of ME realized according to the procedure proposed by Di Giacomo et al. (2010) for 8 earthquakes of the L'Aquila, 2009 and the Emilia, 2012 seismic sequences. Finally, a test of the procedure has been performed considering two Japanese earthquakes with similar MW (i.e. $\sim$7), but different teleseismic ME.

References

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