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Understanding Low Magnitude Threshold for the Source Parameters Estimation for the Central Apennines.

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Deichmann (2018) recently presented an overview of the theoretical background for ME, ML and Mw, lighting up how different magnitude scales look at the earthquake source and he brought under the light several common misinterpretations concerning the small magnitude events. Previously, he showed as below a certain magnitude the observed corner frequencies remain constant determining a change in the scaling between Ml and Mw, which from 1 becomes 1.5 for small events (Deichmann, 2017). The threshold in magnitude where the scaling between Ml and Mw changes is function of several factors, as density of the network, hypocentral distances, stress-drop, and signal-to-noise ratio, just to mention some of the most important issue.
Aim of this study is to evaluate, in a real seismic monitoring context (e.g., a seismic networks deployed for regional monitoring), how much it is possible to work down in magnitude being able to resolve with high accuracy the source parameters. Furthermore, we present a comparison of different methodologies for studying the source scaling with the aim to highlight the influence of different approaches in source parameters estimation.
Taking advantage of the available high quality data for small events recorded during the Amatrice-Norcia-Visso sequence in Central Apennines, we analyzed pairs (i.e. doublet) of small events (Ml$\leq$3.3) selected to have the same localization, a difference in magnitude $\sim$1 and a high cross correlation on at least 3 stations. For each doublet, we analyzed the pulse duration of P-waves (equivalent to corner frequency) of the two events on different stations and compared each other. For each station and event, we also observed the kappa behavior to see if the pulse duration is influenced by rapid spectral decay at high frequencies and the H/V ratio for the site.
When the pulse width is the same and not influenced by kappa and other site effects, the corner frequency of the two events is the same. Testing various doublets, we try to understand at which magnitude the corner frequency saturates and the 1-to-1 Ml vs. Mw scaling is violated.
Two different techniques, respectively based on GIT and on coda-envelope-based spectral ratios (Mayeda et al. 2007, Walter et al. 2017), are then applied to evaluate source parameters. This is done with the aim of verifying the agreement with the doublets analysis results and between the two methodologies. The level of agreement gives an information about the suitability of these techniques for estimating source parameters of small events recorded by regional networks.