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A detailed study of the initiation process of a small (Mw4.4) normal fault earthquake in the middle lower crust

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Our knowledge about the physics behind the initiation process of large or small earthquakes remains limited. The current understanding of this process suggests that an earthquake occurs when increasing stress causes a pre-existing fault to fail suddenly (e.g. Dieterich 1992). Models such as the pre-slip instability growth or the triggered cascade of events have been proposed in order to theoretically explain this preparation stage (Dodge and Beroza, 1996; Ellsworth and Bullut, 2018; Bouchon et al., 2011). However, the mechanisms behind this process are still unknown. This debate is mainly due to the lack of direct observations of the subsurface shear stress evolution at the area of interest before and after an earthquake.

Considering that the shear stress evolves through time until the moment of failure, indirect observations of this change might be available but hidden inside the continuous seismic data. In this work, we analyze in detail the evolution of the seismic activity of a small (Mw 4.4) normal fault earthquake which occurred in Central Italy on 7th November 2019 at the middle lower crust (16 km depth). We first analyze the available continuous data using the Fast Matched Filter (Beauc\'e et al., 2017). Then, every new detected event is spatially localized with respect to the other events through the Double Difference algorithm (DD). As a result, we obtain the spatio-temporal evolution of the foreshock and aftershock sequences of that event.

The results from this analysis shed light on the patterns that the shear-stress spatio-temporal evolution follows before and after a given event. Therefore, we expect that this study will contribute to improve our understanding of the physics behind the earthquake initiation process.