



## **Size dependent initial rupture growth in real earthquakes**

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When a seismic rupture starts, the process may evolve into multiple ways, generating different size earthquakes. Understanding how seismic fractures initiate and evolve is crucial for Earthquake Early Warning methods, which are grounded on the fast peak ground shaking prediction as a function of distance and earthquake magnitude. Here we demonstrate that small and large earthquake ruptures do not exhibit a common universal behaviour, but they differentiate since their early stage. For past earthquakes of different size, we measure the initial rate of the P-wave peak amplitude, and show that this quantity is correlated to the final event magnitude and it is independent of the recording distance. Our observations support the evidence from laboratory experiments, for an imprinting preparatory phase of natural seismic ruptures, affecting the final earthquake rupture extent. While opening new views on the rupture preparation process, our findings can have significant implications on the effective development of fast and reliable methods for source characterization and ground shaking prediction.