Geophysical Research Abstracts
Vol. 20, EGU2018-14543, 2018
EGU General Assembly 2018

What can We Learn from Higher Order Moments of the Moment Tensor?

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Higher Order Moments can potentially give first order information about the finiteness properties of a distribution. One way to describe earthquakes is to represent them as distribution of moment tensor densities in space and time. Higher order moments of the moment tensor can be used to describe the spatial and temporal lengths of an earthquake. Although higher order moments have been utilized many times in previous studies, there are no studies that consider the resolution of the method by applying it to waveforms generated from synthetic earthquakes where the source is known. In order to accomplish this, in this study, we compare waveforms from various finite-fault earthquake scenarios with those estimated from the higher order moment expansion of the moment tensor. Comparison of the waveforms show that the width of the body waves can be better estimated from higher order moments in comparison to the point source approximation in the frequency range that is close to the corner frequency of the earthquake. We analyze the sensitivity of the waveforms to unilateral and bilateral rupture, as well as other physical parameters such as fault length, total duration and rupture velocity. We finally discuss possible schemes for inverting for the higher order parameters which can be used for rapid estimation of fault length, width and rupture duration. (Acknowledgement: This work was supported by the Scientific and Technological Research Council of Turkey (TÜBİTAK), Grant No: 114Y052)