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Modelling earthquake sources using the second-order moments of earthquake space-time distributions

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Robust seismic source characterizations are key to understand fault mechanics, active tectonics processes and seismic hazard. Typically, a source representation beyond a point source is required for such applications. Finite fault, distributed slip models can give a very detailed picture of the source process, but they can also be very non-unique; e.g., different studies can produce very different slip maps for the same event. On the other hand, the determination of second-order moments of earthquakes can be more stable and robust. We present a method for the estimation of fault spatial dimensions, rupture duration and velocity from the non-linear inversion of seismic records. The technique is based on the second-order moments of earthquake space-time distributions and is applied to a synthetic, realistic finite fault using theoretical seismograms computed using both 1D and 3D Earth models. We use this test to evaluate the impact of using 3D Earth structure in the determination of source parameters. We finally apply the inversion method to a real case example and we compare the results with previous studies.