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The finite source properties of intermediate and deep earthquakes

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We recently developed a body-wave source inversion technique, which allows to retrieve the moment tensor and the source time function of intermediate and deep earthquakes from teleseismic broadband records possibly including different phases: P, S, pP, etc. Using a simulated annealing algorithm, we align in time the set of waveforms, determine a common source time function and recover a collection of observed station amplitudes. In a second stage, these amplitudes projected back to the focal sphere, are used in a formal inversion process to estimate the moment tensor under three different constraint schemes :unconstrained, pure deviatoric and double couple. In the original version of the method, the spatial extent of the source was not taken into consideration. The apparent source time functions, although quite coherent in general, often present systematic variations from station to station. These variations carry information about the spatial finiteness of the source. Here, following the approach developed by McGuire [2004], we complete the above mentioned technique with a third step aimed to constrain the spatial finiteness of the source. After aligning and scaling the apparent source time functions, we calculate their first and second order temporal moments and use them as secondary observables to constrain a simple rupture kinematic model represented by the second order spatial moments of the slip distribution. In practice, besides the moment tensor and the average source time function, we can estimate the rupture length, duration and direction of propagation. We apply this technique to several events from the period 1990-2005 for which independent studies are available in the literature.