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Lowering the threshold of centroid moment tensor estimation by implementing probabilistic shrinking box, source-specific station term method

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The lower the magnitude of a seismic event, the more challenging the estimation of its centroid moment tensor. The difficulties arise from the reduced signal-to-noise ratio at lower frequencies where a good match between observed and modelled seismograms can be achieved. At higher frequencies, modelling suffers heavily from incomplete knowledge of earth structure and much higher computational demands.
First order effects of the mismodelling are time delays and amplitude deviations between observed and synthetic seismograms. These effects are often compensated for in single-event moment tensor inversion methods, but usually to the price of introducing biases to the absolute locations and mechanisms retrieved.
For the problem of earthquake location, it has been shown that the shrinking box source-specific station term (SSST) method is a powerful technique to improve relative and absolute location accuracy in large sets of seismic events. In this work we extend this technique to the problem of moment tensor estimation, where not only time corrections, but also frequency dependent amplitude and phase corrections are desired. Because of the often large uncertainties and trade-offs in centroid moment tensor estimates, we reformulate the SSST method in a probabilistic way and make use of a new centroid moment tensor optimization scheme capable of imaging the associated uncertainties.
The obtained source-specific, amplitude and phase dependent station corrections are a valuable resource to improve more advanced source inversion techniques, like finite fault inversion or rupture tracking. We propose to routinely calculate and update these on a global scale and provide them to the seismological community as a service.