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Earthquake Source Mechanism and Uncertainty Analysis Using a Multi-Objective Optimisation Approach

Reliable source mechanism estimates for small-to-medium sized seismic sources are important for monitoring compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT). For sources located in regions where there are no dense local networks of seismic stations, often there are only a small number of stations recording surface and body wave signals with high signal-to-noise ratios. To obtain reliable estimates of the source mechanism by inversion of the observed data, it is an advantage if multiple data types can be used in the inversion. We demonstrate how a multi-objective optimisation approach can be used to jointly invert different seismic data types recorded at a range of distances to estimate source mechanisms for sources located in Asia. The data used include teleseismic body-wave observations, three-component broadband waveform data recorded at near-regional distance stations, and surface wave amplitude spectra. Uncertainties from each individual inversion can also be combined to estimate upper and lower bounds on the best-fit source mechanism. The good fit of the synthetic seismograms to the observed seismograms for many of the sources analysed here, indicates that the method is useful for source identification.

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