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Source parameters for global seismology: how accurate are CMT-style source inversions?

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The centroid–moment-tensor (CMT) algorithm, introduced by Dziewonski *et al.* (1981), has found wide application: the Global CMT Catalogue contains details of over 35,000 earthquakes, and is routinely used by researchers across the spectrum of geosciences. However, comparatively little attention has been paid to the uncertainties associated with the source parameters: what error-bars should be put on a CMT solution?

We discuss the limitations and possible sources of uncertainty within the CMT algorithm. In particular, we focus on the potential for systematic errors, arising from the use of approximate forward-modelling techniques and low-resolution earth models. By conducting experiments using synthetic data, we are able to map out the misfit function that the CMT algorithm seeks to minimise. We observe that whilst a minimum-misfit solution is typically well-defined, the curvature of the function may be very low—so that in some cases, large perturbations in source parameters result in only small increases in misfit. This implies that these parameters are poorly constrained, and have large uncertainties that should be considered during subsequent analysis.

For any specific seismic event, assessment of source parameter uncertainties requires knowledge of the dataset and detailed inversion strategy used—information that is often lacking when catalogue sources are used. Where the accuracy of source parameters is particularly important, we suggest that users should consider performing their own inversions. However, this may not always be practical; therefore, we show that it is possible to estimate the misfit function curvature using only forward-modelling, and that this allows some assessment of relative uncertainties to be made.

Dziewonski, A., Chou, T.-A. and Woodhouse, J., 1981. Determination of earthquake source parameters from waveform data for studies of global and regional seismicity, *Journal of Geophysical Research*, 86, pp.2825–2852.