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Estimating the uncertainty of seismic point source solutions

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A point source is the most basic description of an earthquake. While it is obviously too simplistic for large earthquakes ($\gtrapprox M7.5$), it is still sufficient for intermediate ($M5.5 - M7.5$) earthquakes, especially in sparsely instrumented areas and when large numbers of earthquakes are to be processed automatically. Seismic tomography regularly needs a large number of point source solutions to infer the structure of the Earth.
We present a Bayesian inference of seismic point source parameters, including depth, full moment tensor and the source time function.
A focus of this study is the correct handling of noise in data and modelling error in the forward calculation of seismic waveforms. We show that samplewise misfits like the ℓ^1 or ℓ^2 norm are not suited in presence of strong forward modelling errors and instead propose to use the cross-correlation coefficient CC as a misfit criterion. We further derive a likelihood function for CC to allow for full Bayesian inference. This includes an estimation of the correlation of measurements at different stations.
The result of this study can be used as an novel input for seismic tomography, especially since it allows to estimate the uncertainty of input parameters for tomography, like travel-time or amplitude anomalies.