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More power to kinematic earthquake source inversions: With new tools from mismodelling to uncertainties

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The notorious discrepancies among finite fault slip inversion results have attracted much attention over the last years. In consequence, much effort has been put into methods to improve the robustness of such inversions and to quantify uncertainties on results. The techniques exploited include controlling the smoothness of the inferred slip distribution, reducing dimensionality of parameter-space, propagation of observational errors through Bayesian inference, Monte-Carlo modelling and bootstrapping.

The difficulties in earthquake finite source parameter estimation arise from three distinct origins: (1) observational errors, (2) the (in)ability of the earthquake source model to represent nature, and (3) mismodelling of synthetic seismograms. While observational errors can often be formally included in the source parameter estimation process, the latter two are much harder to to handle. Appropriateness of the source model (2) is hard to achieve because more realistic models require more model parameters and quickly lead to underdetermined systems. Mismodelling of synthetic seismograms (3) has not been investigated much, probably because the technical effort to deal with it is usually high (because forward modelling may have to be repeated for many earth model variations).

In this presentation, we will show that freely available precomputed Green's functions for ensembles of different earth models will make such investigations feasible for routine practice. We will illustrate this with a synthetic test case of a regional kinematic source parameter optimization.

The presented work is closely related with the development of a new open source Python toolbox for the handling of precomputed Green's functions and for synthetic seismogram generation (http://emolch.github.io/pyrocko/gf). Ultimately, we would like to launch a community driven open access Green's function sharing platform and web services for synthetic seismogram and test scenario generation (http://kinherd.org/).