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The resolving power of kinematic source inversions: a blind test

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Finite-source inversion for the earthquake rupture process have shown that slip is heterogeneous at all scales, as illustrated in a large database of source-rupture models (www.seismo.ethz.ch/srcmod). Such kinematic inversions, using near-fault data, but also teleseismic recordings and constraints from geodetic measurements, allow to retrieve the spatio-temporal evolution of slip on the fault plane (final displacement, rupture timing, slip rate / rise time which depend on the selected source time function). Accurate images of the spatio-temporal rupture process are also indispensible for moving from kinematic source characterizations to reliable models of the dynamic fracture process.

A number of techniques have been developed in the past to carry out such source inversions, with an apparent increase in estimated rupture complexity which also reflects the increasing amount and quality of near-fault strong-motion data. However, the resolution, reliability and quality of these finite-source rupture models still remains an open question, which is expecially apparent in the differences for multiple slip models obtained for a single earthquake by different research teams. The large intra-event variability, manifested in different, sometimes even incompatible slip maps for the same earthquake, results from particular choices in the inversion method (fault parametrization, minimum search alogrithm and fitness function) and data selection/processing. While this intra-event variability is to some extent expected and understood, it has never been quantified and critically assessed.

We therefore construct a blind test inversion exercise in which several research groups attempt to derive a kinematic rupture model from synthetic seismograms calculated

for an input model unknown to the source modelers. During several stages of this blind test, we increase the complexity of the input model while also detioriating the "data quality" by adding random noise to the synthetic seismograms. The major aim of this study is to compare different source-imaging techniques, to understand their strengths and weaknesses and to check the processing of data. While this blind test exercise was started initially within the framework of the EU-SPICE project (Seismic wave Propagation and Imaging in Complex media - a European project), it is open to other interested researchers.

In this presentation, we will report on results for the first set of inversions for a rather simple input rupture model (variable slip, constant rupture velocity, constant rise time for a simple slip-rate function). Inverse models are compared statistically in order to investigate their degree of (dis-)similarity quantitatively, and recommendations for future work will be provided.