Geophysical Research Abstracts
Vol. 15, EGU2013-4065, 2013
EGU General Assembly 2013

Kinematic inversion of the 2008 Mw7 Iwate-Miyagi (Japan) earthquake by two independent methods: Sensitivity and resolution analysis

Frantisek Gallovic (1), Antonella Cirella (2), Vladimir Plicka (1), and Alessio Piatanesi (2)

(1) Charles University in Prague, Faculty of Mathematics and Physics, Department of Geophysics, Prague, Czech Republic, (2) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy

On 14 June 2008, UTC 23:43, the border of Iwate and Miyagi prefectures was hit by an Mw7 reverse-fault type crustal earthquake. The event is known to have the largest ground acceleration observed to date ($\sim$4g), which was recorded at station IWTH25. We analyze observed strong motion data with the objective to image the event rupture process and the associated uncertainties. Two different slip inversion approaches are used, the difference between the two methods being only in the parameterization of the source model. To minimize mismodeling of the propagation effects we use crustal model obtained by full waveform inversion of aftershock records in the frequency range between 0.05-0.3 Hz.

In the first method, based on linear formulation, the parameters are represented by samples of slip velocity functions along the (finely discretized) fault in a time window spanning the whole rupture duration. Such a source description is very general with no prior constraint on the nucleation point, rupture velocity, shape of the velocity function. Thus the inversion could resolve very general (unexpected) features of the rupture evolution, such as multiple rupturing, rupture-propagation reversals, etc. On the other hand, due to the relatively large number of model parameters, the inversion result is highly non-unique, with possibility of obtaining a biased solution.

The second method is a non-linear global inversion technique, where each point on the fault can slip only once, following a prescribed functional form of the source time function. We invert simultaneously for peak slip velocity, slip angle, rise time and rupture time by allowing a given range of variability for each kinematic model parameter. For this reason, unlike to the linear inversion approach, the rupture process needs a smaller number of parameters to be retrieved, and is more constrained with a proper control on the allowed range of parameter values.

In order to test the resolution and reliability of the retrieved models, we present a thorough analysis of the performance of the two inversion approaches. In fact, depending on the inversion strategy and the intrinsic 'non-uniqueness' of the inverse problem, the final slip maps and distribution of rupture onset times are generally different, sometimes even incompatible with each other. Great emphasis is devoted to the uncertainty estimate of both techniques. Thus we do not compare only the best fitting models, but their 'compatibility' in terms of the uncertainty limits.