10th ACES International Workshop, Awaji Island, September 25-28, 2018

Development of an Inversion Method to Estimate Fault Geometry from Teleseismic Data

Shimizu, K.[1], Yagi, Y.[2], Okuwaki, R.[1], Fukahata, Y.[3]

1. *Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan*
2. *Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan*
3. *Disaster Prevention Research Institute, Kyoto University, Kyoto, Japan*

Teleseismic waveforms contain information on spatiotemporal potency density tensor distribution, which enables us to extract information on the distribution of the slip-rate function of an earthquake as well as the source-fault geometry (i.e., strike and dip configuration) that may change along the fault. The finite fault inversion method is a tool to estimate the distribution of slip-rate function under the assumption of given fault geometry as a single (or multiple) model plane(s). An inappropriate approximation of fault geometry as the model plane tends to distort the solution due to modelling errors. Recently, a formulation that introduced the uncertainty of fault geometry into the data covariance was developed, which made it possible to construct stable slip models especially for near-field geodetic data [Ragon, Sladen & Simons 2018]. In this study, we propose an inversion method accounting for features of Green's function for teleseismic waveforms; they are generally sensitive to assumed fault geometry while being relatively insensitive to an assumed fault location. In this study, we aim to extract information on fault geometry from observed teleseismic waveforms by mitigating modelling errors originated from inaccurate assumption of model fault geometry. We newly developed a finite fault inversion method that represents fault slip by five basis-potency-tensor components, which enables us to estimate focal parameters on the model fault plane. The estimated focal parameters on each subfault are independent of the strike and dip angles of the assumed model plane, which makes it possible to represent the fault geometry. We validated the new method by the application to the 33 teleseismic P-waveforms of the 2013 Balochistan, Pakistan earthquake (M_W 7.7), which has been thought to have occurred along a curved fault. We set a single-flat horizontal model plane that entirely covers the potential source area which was partly identified from the surface displacement after the Balochistan earthquake revealed by the optical satellite images [Avouac et al. 2014; Zinke, Hollingsworth & Dolan 2014].

The estimated spatiotemporal distribution of seismic potency released during the Balochistan earthquake shows that the rupture propagated almost unilaterally southwestward from the epicenter, which is consistent with the spatiotemporal distribution of high-frequency radiation sources tracked by back-projection technique [Avouac et al. 2014; Wang et al. 2016]. The spatiotemporal distribution of the potency tensor solution shows that the focal mechanism at each subfault mainly had a strike-slip component with successive changes of the strike angle of the preferable nodal plane from 205° to 250° as rupture went southwestward from the epicenter. These results show that the Balochistan earthquake was the strike-slip earthquake ruptured along a curved fault. To evaluate the robustness of the developed method, we conduct analyses using different settings of a model plane and confirm that the arbitrariness of model plane geometry does not affect the estimate of potency tensor distribution and fault geometry.