Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SSS28-P18 Room:Convention Hall Time:May 24 17:15-18:30

New back-projection method to use depth phases' information

NAKAO, Atsushi[1*], YAGI, Yuji[1]

[1]Life and Env. Sci., Univ. Tsukuba

The Back-projection method has been applied to large, shallow earthquakes since success in imaging the 2004 Sumatra-Andaman earthquake (Ishii et al., 2005). Many researchers have analyzed the 2011 Tohoku-Oki earthquake by the back-projection method and detected huge seismic energy radiation from around the hypocenter and Ojika Peninsula (0-90 sec) and southward movement of the wave source (90-160 sec). On the other hand, the conventional back-projection method could not resolve rupture propagation pattern in early stage of mega-thrust earthquake detected by probable waveform inversion (e.g. Yagi and Fukahata, 2011). It seems difficult to discuss the mechanisms of some large, shallow earthquakes using the conventional back-projection method.

In the conventional back-projection method of tele-seimsic P-waves, overall observed waveforms are interpreted as direct P-wave and are projected to the seismic source region. Therefore, in case of analysis of shallow thrust faults, huge reflected phases (e.g. sP) should contaminate the rupture image. In this study, we propose new method to project cross-correlating functions between theoretical Green's functions and observed waveforms to the seismic source region. Using the new method, the source grids radiating waves would be detected more robustly and less affected by depth phases.

We applied the new method to the Tohoku-Oki earthquake waveforms recorded on 88 broadband stations of FDSN and GSN. The conventional method and the new method are carried out upon the same condition, and it is revealed that wave sources detected by the new method are smaller in time and depth than those by the conventional method. Resolution in depth progresses because depth phases specify depth of rupture areas. Moreover, radiated energy function by the conventional method is 10-20 seconds later compare to that by the new method, and the projected energy peak by the conventional back-projection (50-100 sec) swerves to near Ojika Peninsula. The results suggest that the conventional method projects not only P but also sP. Indeed, the rupture image with the new method is well consistent with the slip model proposed by Yagi and Fukahata (2011), especially early episode (0-50 sec) of mega-thrust earthquake.The new method seems to overcome weakness of the conventional back-projection method and provides rupture process more objective and higher-resolution. This hopeful method will be applied to verify the validity of slip models obtained by other methods.

Keywords: back-projection, rupture process, depth phase, the 2011 Tohoku-Oki earthquake, cross correlation