Inversion analysis of slip distribution of the 2008 Iwate-Miyagi Nairiku earthquake: Possibility of a conjugate fault slip

Yukitoshi Fukahata[1]; Yo Fukushima[1]

[1] DPRI, Kyoto Univ.

On 14 June 2008, the Iwate-Miyagi Nairiku earthquake struck northeast Japan, where active seismicity has been observed under east-west compressional stress fields. According to the Japan Meteorological Agency, the magnitude and the hypocenter depth of the earthquake are Mj 7.2 and 8 km, respectively. The earthquake is considered to have occurred on a west dipping reverse fault with a roughly north-south strike. The earthquake caused significant surface displacements, which were detected by PALSAR, a Synthetic Aperture Radar (SAR) onboard the Advanced Land Observing Satellite (ALOS) employed by JAXA.

Several pairs of PALSAR images are available to measure the coseismic displacements. SAR Interferometry (InSAR) data is useful to obtain crustal displacements in the region where coseismic deformation is not so large (less than 1 m). On the other hand, we can obtain range and azimuth offset data by the pixel matching method in the region where the coseismic deformation is large.

We inverted the obtained SAR interferometric and pixel matching data to estimate slip distribution on the fault. Here, we neglected postseismic deformation. Since the precise location and direction of the fault are not well known, the inverse problem is non-linear. If the fault surface is assumed to be a flat plane, however, the non-linearity is weak. Hence, following the method of Fukahata & Wright (2008), we resolved the weak non-linearity based on ABIC (Akaike's Bayesian Information Criterion). We first estimated slip distribution by assuming a pure dip slip for simplicity, since it has been reported that the dip slip component is dominant. Then, the optimal fault geometry was estimated at dip 26; and strike 203; with the location passing through (140.90E, 38.97N). The maximum slip is more than 8 m and most slips concentrate at shallow depths (less than 4 km). The azimuth offset data suggest the existence of right lateral slip components. So, we next estimated slip distribution without fixing the rake. Again, a large slip area with the maximum slip of about 8 m concentrated in the shallow region was obtained.

However, such a large slip within the shallow region is contradict to the existing common sense; i.e., in the above case, the strain is more than 10 to the power of -3. So, we examined the case of a conjugate fault slip, considering that we could see significant difference of crustal displacement to the east of Mt. Kurikoma. In the conjugate fault mode, we confirmed that the residual mean squares are significantly reduced. We will further examine the validity of the result statistically.