An interpretation of surface displacements associated with the 2008 Iwate-Miyagi Nairiku Earthquake detected by ALOS/PALSAR

Youichiro Takada*, Tomokazu Kobayashi, Masato Furuya, Makoto Murakami

Department of Natural History Sciences, Hokkaido University

*Now at Japan Agency for Marine-Earth Science and Technology (JAMSTEC, ytakada@jamstec.go.jp,)

Applying interferometric SAR (InSAR) analysis to the 2008 Iwate-Miyagi Nairiku earthquake, we detected notable ground displacements of several tens of centimeters to about 1.2 m that extend further south of the epicentral area. We explained the InSAR data by constructing a fault model consisting of four WNW dipping and one ESE dipping reverse faults. The five faults are named F1 through F5 from north to south. To fill the lack of InSAR data in the hypocentral area, we applied a pixel matching technique to the intensity images, which shows a shortening in range offsets by as much as ~2 m along a narrow zone stretching along the eastern foot of Mt. Kurikoma, indicating a localized uplift. We also found remarkable contrasts in the range offsets around the low coherence area equivalent to a very large displacement gradient to the WNW of the hypocentral area as well as ESE. We conclude that the main faulting occurred on the WNW dipping reverse faults, but that the overall geometry of the fault system is quite complex including at least one conjugate faulting, as also supported by the hypocentral distribution of aftershocks given by JMA.

To improve the fault model, we compare it with precisely determined hypocenter data provided by GIMNE (Group for the aftershock observations of the Iwate-Miyagi Nairiku Earthquake). Overall, our fault models locate around the upper-most part of the hypocenter distribution. For the northernmost part, the hypocenters indicate a fault plane ranging from ~2km to ~10km depth, wider than the fault F1. For the mid-part (eastern flank of the Mt. Kurikoma), the hypocenters clearly indicate both east and west dipping faults. The east dipping fault continues from west of Mt. Kurikoma to the east of the surface ruptures discovered by field surveys. This implies that F3, which is an east dipping fault determined from large gaps in the range offsets, could brunch from another east dipping fault. The fault F4 is consistent with the west dipping hypocenters, but east dipping hypocenters also exist. For the southern-most part, many shallow earthquakes occurred in a region stretching in the NNE-SSW direction, which is not fully covered by F5.

As demonstrated by InSAR analysis for the 1996 Onikobe earthquake swarm (Takada and Furuya, 2009), the 2008 Iwate-Miyagi Nairiku Earthquake also requires a complex fault system, possibly due to highly fractured structure with many buried calderas created by past volcanic activities.

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