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Crustal deformation after the Iwate-Miyagi Nairiku earthquake deduced from PS-InSAR time series analysis

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The 2008 Iwate-Miyagi Nairiku (inland) earthquake occurred beneath the border between the Iwate and Miyagi prefectures in northeastern (NE) Japan, within Ou back-bone range (OBR) strain concentration zone [1] at 08:43 JST, 14 June 2008. Its focal mechanism is a reverse fault type with a W-NW to E-SE compressional axis. Ohta et al. [2] suggested that the coseismic fault plane is mainly west dipping based on the kinematic GPS analysis. Iinuma et al. [3] investigated the postseismic deformation deduced from the dense continuous and temporal GPS network. They found that the aseismic slip occurred at the shallower part of the coseismic slip and Dedana fault where did not slip during the mainshock rupture. Furthermore, Ohzono [4] found the long-term postseismic deformation in and around the focal area deduced from the continuous GPS data. She pointed out that this long-term postseismic deformation is caused by viscoelastic relaxation in lower crust or upper mantle. This model explains well the observed GPS data in far field. However, the simple viscoelastic model fail to explain the near field GPS data (e.g. [4, 5]). In this study, we apply InSAR time-series analysis by PS (Persistent Scatterer) method for investigation of long-term postseismic deformation near the focal area.

We applied StaMPS [6, 7] approach to the ALOS/PALSAR data obtained by the JAXA. In order to produce our interferograms, we processed a set of 12 descending orbit SAR images (Track 57, Frame 2830), acquired by the ALOS/PALSAR sensors from July 2008 to October 2010. In particular, SRTM4 Digital Elevation Model of the study area and precise orbital information were used for the interferograms generation. The master data image is acquired in September 3rd, 2009. We assumed the amplitude dispersion index (D_A) is as 0.4 that is threshold value defined by Ferretti et al. [8] to find the PS pixel. The result based on our analysis clearly shows LOS (Line of Sight) change in and around the focal area. We found the clear LOS change in the footwall and hanging wall side of the focal area. In the footwall side, the LOS is extended which may be subsidence or displaced to the westward. It is clear evidence of the viscoelastic relaxation after the mainshock pointed by [4, 5]. The hanging wall side LOS change is characteristic. In the hanging wall side, we found the two large amount LOS shortening regions. It is difficult to explain by the simple viscoelastic relaxation. It may be caused by long-term afterslip near the focal area, which may be triggered by the mainshock. Several scenes, however, might be affected by atmospheric and ionospheric disturbance. We need to reevaluate these effects for more accurate time series analysis.

[1] Miura et al., EPS, 2004, [2] Ohta et al., EPS, 2008, [3] Iinuma et al., GRL, 2009, [4] Ohzono, PhD dissertation, Tohoku Univ., 2009, [5] Ohta et al, JpGU Meeting, 2010, [6] Hooper et al., JGR, 2007, [7] Hooper et al., GRL, 2008, [8] Ferretti et al., IEEE Trans, 2001

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