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Localized water vapor signals detected by ALOS/PALSAR data in Japan

Youhei Kinoshita[1*], Masato Furuya[1]

[1]Natural History Sci., Hokkaido Unoversity

Interferometric Synthetic Aperture Radar (InSAR) phase signals, which can detect surface deformations with high-spatial resolution, are affected by earth's atmosphere like GPS, and thus provide a detailed spatial distribution of precipitable water vapor without any surface deformation signals or other errors. Hanssen et al. (1999) showed the coincidence between water vapor signals detected by InSAR and spatial distributions of rain fall echo detected by a weather radar (WR), and indicated the possibility of InSAR as a water vapor sensor. However, there weren't any studies of InSAR water vapor signals for meteorological applications except in the case shown by Hanssen et al. (1999). In our past presentations, we reported two case studies detecting localized water vapor signal associated with deep convective systems with InSAR (Kinoshita et al., GSJ 2011), and conducted the estimation of the three-dimensional (3D) water vapor distribution and numerical weather simulations for reproducing localized water vapor signals (Kinoshita et al., GSJ 2012). However, there were still few cases detecting localized water vapor signals with InSAR.

For elucidating the mechanism of the behavior of water vapor with InSAR, it is necessary to increase case studies of water vapor detection by InSAR. Here we searched SAR data with the potentiality of containing localized water vapor signals in Japan from ALOS/PALSAR archive data with national composite WR echo data. As a result, we could find a number of such SAR data. It is certain that there are many interferograms that include localized water vapor signals beyond expectation. At the time of submitting this abstract, we generated four InSAR data at Niigata, Kyoto, Saga and Oita using ALOS/PALSAR data with descending orbit, which is regarded as including few ionospheric effects, and then we successively detected localized signals from all these InSAR data near locations of maximum WR rainfall echo. Radar line-of-sight changes of some of these signals reach up to 200 mm which exceed amplitudes of water vapor signals in two cases we reported in the past. Additionally, the SAR data of Niigata was derived during a heavy rain event associated with a cold front, and that InSAR data clearly shows the existence of a number of localized water vapor signals due to convective systems near the front.

At the presentation, we will show detection results of localized water vapor signals in generated interferograms. Additionally, we are planning to report results of the estimation of 3D water vapor distribution and the numerical weather simulation what we will do by the presentation.

Keywords: InSAR, water vapor, weather radar, convective system