Approach to monitoring ground deformation using InSAR time series analysis all over Japan

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GSI (Geospatial Information Authority Japan) has been monitoring ground deformation all over Japan with ALOS-2 data by applying two-pass Differential Synthetic Aperture Radar Interferometry (D-InSAR) method. The two-pass D-InSAR method is a procedure to extract deformation that occurred between two observations from two radar images obtained from two observations. The two-pass D-InSAR method is susceptible to errors due to tropospheric disturbances, ionospheric disturbances, and change of the ground surface such as vegetation, which can be obstacles in detecting small ground deformations. Tropospheric disturbances and ionospheric disturbances may be reduced by Ray-tracing algorithm using numerical weather prediction model data (Kobayashi et al., 2014) and Split-Spectrum method (Gomba et al., 2016), respectively. However, it is still a challenging task to detect the ground deformation less than several centimeters with two-pass D-InSAR method.
Recently, InSAR time series analysis has been developed where a number of images are processed and statistically analyzed to extract deformations with enhanced accuracies. Persistent Scatter Interferometry method (PSI method) and Small Baseline Subset algorithm method (SBAS method) are typical examples of InSAR time series analysis. GSI has been developed the InSAR time series analysis system (GSITSA) which includes PSI method and SBAS method (Kobayashi et al., 2018). Kobayashi et al., (2018) compared the result of InSAR time series analysis with levering data of same period in subsidence area and showed that with InSAR time series analysis one could detect ground deformation with a velocity of 1 cm / year or less. Thus ground deformation detection capability of InSAR time series analysis is better than that of the two-pass D-InSAR method, and the analysis should be useful for monitoring ground deformation all over Japan more accurately. Furthermore, with Advanced Land Observing Stellite-4 (ALOS-4) that is planned for launch in the 2020 fiscal year, the observation frequency will be increased by five-fold compared to that of ALOS-2, and the InSAR time series analysis should be more applicable.
With this background, we investigated the characteristics of PSI method and SBAS method using GSITSA for consideration of introducing InSAR time series analysis into our future strategy for ground deformation monitoring. In this study, we conducted InSAR time series analysis with ALOS-2 data for Niigata Plain and Tsugaru Plain as examples of land subsidence area, and Mt. Kirishima (Mt. Iwoyama) and Mt. Usu as examples of active volcano area, respectively. In InSAR time series analysis, we were able to detect similar ground deformation in the areas where ground deformation were detected by the two-pass D-InSAR method. In addition, we were able to detect some ground deformation of about 1 cm per year that could not be detected with the two-pass D-InSAR method.
In this presentation, we will show the results of comparison between PSI method and SBAS method, and discuss the optimal analysis strategy focusing on spatial scale and vegetation.
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