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An approach to improve the accuracy of ice flow rate measurement of Antarctic ice sheet using DInSAR method

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Differential Interferometric Synthetic Aperture Radar (DInSAR) is an effective tool to measure the flow rate of slow flowing ice streams on Antarctic ice sheet with high resolution. Since few studies had been made on accuracy estimate of the ice flow measurement using DInSAR method, it is an important subject to discuss the displacements and their changes.

We use Digital Elevation Model (DEM) at two times in the estimating ice flow rate by DInSAR. At first, we use it to remove topographic fringes from InSAR images. And then, it is used to project obtained displacements along Line-Of-Sight (LOS) direction to the actual flow direction. ASTER-GDEM widely-used for InSAR processing of the data of polar region has a lot of errors especially in the inland ice sheet area. Thus the errors yield irregular flow rates and directions. Therefore, quality of DEM has a substantial influence on the ice flow rate measurement.

In this study, we tried to improve estimate accuracy of ice flow rate estimated by DInSAR method by applying a newly created DEM (hereinafter referred to as PRISM-DEM), and compared PRISM-DEM and ASTER-GDEM. Since it is not likely that crustal displacement occurs on outcrops in Antarctica during the recurrence period (in the case of ALOS: 46days), the observed displacements on outcrops are considered to be caused by errors contained in DInSAR images. Therefore, we used the displacements on outcrops as an indicator of error evaluation.

The study area is around Skallen, 90km south from Syowa Station, in the southern part of Soya Coast, East Antarctica. For making DInSAR images, we used ALOS/PALSAR data of 13 pairs (Path633, Row 5710-5720), observed 2007/11/23-2011/1/16. PRISM-DEM covering PALSAR area was created from stereo disparity of nadir and backward images of ALOS/PRISM (Observation date: 2009/1/18, Path187, Row (nadir)5020-5030, (backward)5075-5085).

The number of irregular values of actual ice flow rate was reduced by applying PRISM-DEM compared with that by applying ASTER-GDEM. Additionally, an averaged displacement of approximately 0.74cm was obtained by applying PRISM-DEM over outcrop area, while an averaged displacement of approximately 1.65 cm was observed by applying ASTER-GDEM.

It is concluded that the accuracy of the ice flow rate measurement and errors contained in DInSAR images can be improved by using PRISM-DEM. In this presentation, we will show the results of the estimated flow rate of ice streams, and discuss the accuracy validation of PRISM-DEM.

Keywords: DInSAR, Antarctic Ice Sheet, ice flow rate, DEM