Estimation of velocity distribution of Shirase Glacier derived from SAR data obtained by ERS-1/2 tandem mission

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Shirase Glacier is one of the fastest flowing ice stream in Antarctica flowing into the southernmost of Lutzow-Holm Bay in Dronning Maud Land, East Antarctica. It is important to clarify the spatial flow rate distribution with a high resolution to investigate causes of the fast flow and the temporal flow rate changes. In order to make a high resolution flow velocity map, we apply a usual interferometric Synthetic Aperture Radar (InSAR) technique to the obtained data. However, since flowing velocity of the ice stream is greater than 2 km/year (Nakamura et al., 2007, Aoyama et al., 2016), it is difficult to estimate the flow velocity by applying an InSAR technique to the ordinal repeat cycle SAR mission data.

Tandem mission by European Satellite of Remote sensing (ERS)-1/2 was conducted in 1996 and 1999. In this tandem mission, ERS-2 had flown after ERS-1 in the same orbit with an interval of one day, and many InSAR pairs with one day temporal baseline were obtained through the mission.

We successfully obtained two SAR interferograms over Shirase Glacier using this tandem mission InSAR pairs acquired at 1996/06/02-1996/06/03 and 1999/11/14-1999/11/15. We estimated surface displacements along range direction (direction of radar illumination) by applying differential InSAR (DInSAR) with a TanDEM-X 90m DEM (Rizzoli et al., 2017) to remove topographic phase. We also estimated displacements along azimuth direction (direction perpendicular to range direction) by applying a split beam interferometry (SBI) (Bechor and Zebker, 2006) technique to the two InSAR pairs. By combining the range and azimuth displacements, spatial flow velocity distributions can be derived with a high resolution.

In the presentation, we will show two dimensional flow velocity maps with a resolution of approximately 20 m at the two periods and discuss spatial and temporal velocity changes. We will also compare the obtained flow velocity with those by in-situ GNSS measurements in the glacier.

Keywords: Shirase Glacier, flow velocity map, ERS-1/2 tandem mission, DInSAR, SBI

