Preliminary Analysis of Airborne SAR Interferomery Using Pi-SAR-L2 Data

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1. Introduction

Synthetic-aperture radar (SAR) is a powerful tool for volcano monitoring that enables all-weather non-contact remote sensing covering wide area on the globe. Space born SAR like PalSAR2 onboard ALOS2 already becomes a standard method for volcanology, whereas airborne interferometric SAR remains at an experimental stage for a long time, owing to many obstacles coming from difficulties to keep flight trajectories of paired observations close enough to each other. Recent progress in airborne SAR technology, the capability of the instrument is improving. Here process Pi-SAR-L2 data to evaluate the technological possibility of L-band airborne SAR interferometory.

2 Interferometry of .Pi-SAR-L2 data and Results

Pi-SAR-L2 is equipped with a precise INS-GPS hybrid type navigation system so that high level trajectory control is achievable. In reality, a perfect identical routing of the flight is still difficult because of unpredictable aeronautical conditions during the flight. As a result, the distribution of the phase of the interferogram suffers from phase undulations caused by the entangled nature of the geometric configuration of the trajectories. An appropriate removal of those phase undulation caused by the complexity of the wake is the key factor for an effective detection of crustal deformation information. Here we try a relatively simple approach based on surface fitting for the removal of this unwanted phase undulations. As a test target area we selected Sakurajima region where a magmatic intrusion event took place in August, 2015 and crustal deformation is already confirmed by ALOS2 InSAR and GNSS analyses. The Pi-SAR-L2 data were granted by JAXA. For interferometric analysis we used RINC (ver. 0.36) software developed by Dr. Taku Ozawa at NIED. We processed a pair acquired on 2013/9/13 and 2014/8/7 spanning over a period when no crustal deformation was detected. We obtained initial interferogram by simple differentiation of two data sets (SLC) following a standard process of RINC software. At this stage the phase distribution is a mixture of several components coming from different origins, such as incompatibility of repeating trajectories, topography, propagation medium inhomogeneity and crustal deformation on the ground surface. For the detection of crustal deformation, we at least have to remove phase undulation caused by the incompatible trajectories. In this study we removed this undulation using a simple surface fitting technology. As a first step we found the entire interferogram can be devided into 3 parts separated by 2 range lines across which phase continuity is lost. Because in each of the patches we confirmed that the phase change is smooth, we carried out surface fitting assuming quadratic function for each patch separately. Then we subtracted the best fit surface component from the original interferogram. As the next step we also subtracted the best fit component proportional to ground undulation. We applied these processes separately for each of 3 patches of the original interferogram and finally we combined all the results. We found that the distribution of remaining phase is within +/- half wave length range which corresponds to about +/- 6 cm. This indicates the possibility of the air-borne interferometry for the detection of crustal deformation similar to the 2015 intrusion event beneath Sakurajima.

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Keywords: Crustal Deformation, Volcanology, Remote Sensing, Airborne SAR

