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Water vapor data assimilation for the atmospheric correction of D-InSAR products:Case study over Mts. Baekdu and Datun

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Since Zebket et al. (1986) developed Interferometric SAR (InSAR) technique, it has been widely accepted that InSAR is a useful tool for generating topographic products. Differential InSAR was further applied to trace surface deformation through the InSAR technique. Even so, the limitation of such remote sensing method is that the small surface deformation was not distinguishable from errors without highly accurate correction procedure. Thus, the biggest issue of D-InSAR for deformation monitoring issues such as the volcanic activity is the suppressing of error components. Especially, the water vapor anomaly is the crucial elements hiding the real surface deformation in D-InSAR analysis. Therefore, few interferogram stacking approaches have been developed for regulating the error components. The difficulty of such interferogram stacking technique is that it is necessary to process a large number of SAR image sequence. Normally, it is questionable whether enough InSAR pairs are always available over target areas. For the compensation of such problem, the water vapor correction method employing the high resolution water vapor map extracted from satellite image products such as MODIS and/ MERIS was developed (Li et al., 2003). However, over the high altitude target area, the cloud free MODIS and MERIS which enable to extract stable water vapor map is usually not expected. Therefore, we developed the 1km resolution water vapor fields construction method combining the MERIS, MODIS and the numerical weather forecasting model such as Weather Research and Forecasting (WRF). Considering the high accuracy of MERIS water vapor products, it was employed as the reference fields to integrate the other water vapor sources. A four-dimensional interpolation of MODIS and WRF measurements referencing MERIS water vapor values produced the phase correction model and were re-projected upto the SAR image pair based on acquisition time. As a result, the interferograms in multi-pass InSAR campaign could be corrected.

The test areas are two potential volcanoes, including Mt. Baekdu in Korea and Mt. Datun in Taiwan. Although the recent reports of crust activities have revealed that the Eastern Asian volcanoes are in dormant status, the two volcanoes have been the main focus of interests as they are very close to high population area. Therefore a monitoring for extracting correct deformation is critical. To the end the SAR data were proposed for the volcano monitoring task. However, in spite of several D-InSAR monitoring, the stratification water vapor and the erroneous base DTMs make it impossible to correctly observe true deformation. In this study, ENVISAT image sequences with error corrected D-InSAR technique were interpreted to detect the potential land deformation. As a result, small land deformations that might be interpreted as the influence caused at the stage of magmatic intrusion was identified in Mt. Baekdu. The whole D-InSAR processing was conducted over Mt. Datun again and the results were verified using the GPS data sets. Even if those are not genuine volcanic activities, continuous D-InSAR monitoring employing new SAR assets and the stable atmospheric correction are highly recommended to reduce the potential risks considering the reliable D-InSAR observation accuracy.