Study on the relationship between SAR-based digital elevation models and water vapor contents and surface deformation

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Synthetic Aperture Radar (SAR) Interferometry (InSAR) is a powerful tool in radar remote sensing. However, due to the unavoidable inherent limits of the SAR mechanism, there are different challenges to be tackled based on the user’s aim of use. Common issues that have been discussed in the application of topography mapping are temporal decorrelation, surface deformation, atmospheric disturbance, and phase unwrapping problems. These difficulties expose the quality of the final DEM products under high risks, depending on the selection of InSAR image pairs and the environment of area of interest. In this research, we are aiming at investigating the relationship between the SAR-based digital elevation model (DEM) and the related factors which contribute to the error budget. This research will allow InSAR technique users to obtain a better understanding of the severity of errors that were induced by the factors. Furthermore, by knowing which factor degrades the InSAR-generated DEMs the most, one could accordingly apply appropriate methods to reduce the error.

In this research, eight pairs of Sentinel-1A images are used. They are characterized by a 12-day temporal baseline and over 90 meters of perpendicular baseline. The conventional InSAR processing workflow is conducted in each pair. In the post-processing stage, phase gradient removal is applied in order to mitigate unwrapping problems. Surface deformation and water vapor variation are chosen as two factors that introduce errors in InSAR DEM. GPS data are collected to obtain deformation information, and atmospheric water vapor data are collected by weather prediction models. Finally, the multiple linear regression analysis is applied in order to find out the relationship between SAR-based DEM and the selected factors.