

Time-series surface displacements in Taiwan using Sentinel-1 wide-swath SAR data

*Shoki Hiranaka¹, Kazuya Ishitsuka¹, Weiren Lin¹

1. Kyoto University

Grasp of surface deformation is important for understanding groundwater activity, exploitation of natural resources and monitoring calculation of the strain. In 2014, the satellite, Sentinel-1, launched by ESA. It has IWS mode which can monitor wide area, about 250 km swath with high resolution. Sentinel-1 is superior to the former satellites so it can grasp surface deformation in more detail.

In my study, I focus on Taiwan island. In Taiwan, the main cause of surface deformation is plate tectonics and massive groundwater pumping. Taiwan is one of the most active tectonic regions in the world and earthquakes frequently occurs like Japan. And recently, groundwater pumping has been a growing concern in western Taiwan. It causes land subsidence due to dropping groundwater level. In my study, I revealed the recent deformation in Taiwan island using SAR data from Sentinel-1 with IWS mode and divided two main cause, plate and groundwater activities. And then, compared with previous researches which used Envisat satellites, I evaluated the effectiveness of my study.

In this study, we process 62 SAR data of ascending orbit from Sentinel-1 between October 2017 and October 2019. We use 115 results from InSAR analysis to generate time series based on the SBAS method. Baseline of all interferograms is less than 200 m. Then, using time series surface deformation, we estimate short-term seasonal deformation and long-term deformation. Specifically, we project time series result like least-squares to sine and linear function.

In the time series result, over 3 cm/year displacement is estimated at one point in the western Taiwan and two in the eastern Taiwan. Seasonal result reveals that seasonal deformation is large in the western but no seasonality is found in the eastern. This means groundwater activity is variable in the western Taiwan. According to Huang et al. (2016), the region faces the anthropogenic groundwater pumping. And in the eastern area, there are no effect of groundwater activity so we think tectonics activity causes deformation.

Because of judgement of validity of these results, we compare some previous research (Huang et al.,2016; Su et al.,2017) using time series analysis. There are same trends of deformation between them and also the same trend with previous research about seasonality (Huang et al., 2016). This means that Sentinel-1 wide-swath SAR data in my research is effectiveness.

Keywords: Sentinel-1, InSAR time-series analysis, Taiwan