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Monitoring landslide in Badong, China with multi-track Sentinel-1 InSAR: With emphasis on improving temporal resolution and accuracy

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Landslide is one of the most common and serious geo-hazards in China, which is characterized by increasing frequency, random distribution, strong concealment and complicated causes. It is of great importance to monitor the ground deformation associated with landslide. Interferometric synthetic aperture radar (InSAR) has great potential in this field due to its advantages of all-day, all-weather, spatial continuous, high precision and contact free. Especially with the launch of the Sentinal-1 satellites, a great amount of SAR images can be globally provided for free. This provides us a good opportunity to improve the practicability of InSAR in monitoring landslides.

In this paper, InSAR technique is employed to monitor the landslide hazard occurred in the Badong area, Hubei province, China. The study area is located in the middle section of the Three Gorges of the Yangtze River. The annual precipitation ranges from 1100 mm to 1900 mm, concentrating during April and September. Due to the complicated geologic setting and water level change in the reservoir, Badong is one of most vulnerable area to the landslide hazard. Total of 26 Sentinel-1 images acquired by two adjacent tracks are employed to investigate the landslide in Badong during June 2015 and July 2016. In order to improve the temporal resolution and accuracy of the estimated deformation time series, an improved small baseline (SBAS) algorithm is proposed in the study by integrating the multi-track InSAR measurements. Since the InSAR measurement is the projection of the actual three-dimensional (3-D) deformation onto the line-of-sight (LOS) direction, different LOS directions corresponds to different track InSAR measurements. This discrepancy is considered in the improved SBAS algorithm by exploiting the surface-parallel flow assumption for the landslide deformations. The results reveal up to 1.5 cm/year deformation rate for the Badong landslide. Both of he temporal resolution and accuracy of the deformations derived from multi-track InSAR are increased compared to those from single-track InSAR.