Detecting and Monitoring of slow-moving post-earthquake landslide by InSAR technology in Jiuzhaigou area

On 8th August 2017, a magnitude Mw 6.5 earthquake occurred in the County of Jiuzhaigou in Sichuan Province, China (USGS, https://earthquake.usgs.gov/). Because of its high magnitude and shallow epicenter, the earthquake caused grave casualties and property losses. Furthermore, the earthquake triggered numerous secondary mountain disasters such as rockfall and landslide. Shortly after the Jiuzhaigou earthquake, some studies had assessed the number, distribution and other characteristics of the coseismic landslides based on pre- and post-event remote sensing data. However, slow-moving post-earthquake landslides don't show visible change at short notice and are often neglected by the common change detection method. These slow-moving landslides will pose a long-term potential threat to people's life and property. Therefore, a detailed monitoring of the slow-moving landslides is crucial to post-earthquake recovery and reconstruction.

Synthetic aperture radar interferometry (InSAR) technology, which has large ground coverage and high spatial resolution, has great advantages for geological disaster observation under all weather conditions. It has been utilized in ground surface deformation measuring of landslide for disaster detection and assessment. In this research, we adopt an optimized strategy that combines D-InSAR technique with SBAS InSAR to accurately detect and monitor the slow-moving post-earthquake landslides in Jiuzhaigou area. Firstly, we carry out a quick detection across wide area using differential InSAR (DInSAR) technique with 6 ALOS-2 PALSAR-2 ascending images. To retrieve the temporal evolution of these landslides, a detailed monitoring of specific landslides is carried out using the short baseline subset InSAR (SBAS-InSAR) during the period from 2007 to 2019. Combining with other multi-source data (including field investigation, LiDAR and optical image), we perform an in-depth analysis of the impact of the 2017 Jiuzhaigou earthquake on slow-moving post-earthquake landslides.

The results show that there are 16 slow-moving post-earthquake landslides which can be detected by InSAR analyses in Jiuzhaigou area, including 8 landslides close to residential areas. These landslides are mainly distributed in the NE plate (active plate), and the slide directions mainly are east (including 9 landslides) and southeast (include 5 landslides). Secondly, we found that the earthquake's impact on the slow-moving landslides can mainly be classified into three categories: (a) accelerating the active historical landslides that were already sliding before the earthquake; (b) reactivating the stable historical landslides which were undisturbed before the earthquake; (c) directly triggering the landslides that had stable geological environment before the earthquake. For each case, we demonstrate some case studies of landslide affected by the earthquake, and perform a detailed analysis combining with multi-source data.