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Twelve-Year Landslide Risk Assessment in Villa de Independencia, Bolivia, with Sentinel-1 and ALOS-1/2 InSAR Observations

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Monitoring of slow landslide movement on a local scale with Interferometric Synthetic Aperture Radar (InSAR) observations can provide long-term deformation information and assist in identifying failure triggers. We combined three different tracks of satellite radar images spanning 12 years from ALOS-1 PALSAR-1, ALOS-2 PALSAR-2, and Sentinel-1 to assess the evolution of a landslide in Bolivia where the village of Independencia lies at the slope foot. For ALOS-1 PALSAR, SAR data was acquired on 15 dates during the period from 28 February 2007 to 11 March 2011 in ascending mode. For ALOS-2 PALSAR-2, eight acquisitions between 07 October 2015 and 29 November 2017 were available in ascending mode. The low temporal resolution of ALOS images makes the detection of deforming signal difficult though the L-band data captures more coherent pixels on vegetation areas than C-band. Sentinel-1 data with a minimum time interval of six days from 16 October 2014 to 08 September 2019 (144 images) is collected and processed to recover the dynamic behaviour of the landslide movement.

To explore the sensitivity of different InSAR time series analysis methods on revealing the deformation pattern of the landslide, we respectively used Persistent Scatterer Interferometry (PSI), Small Baseline Subset (SBAS) algorithm and Distributed Scatterer Interferometry (DSI) based on phase eigenvalue-decomposition to process the mentioned multiple satellite radar observations. Overlapping valid pixels from these three methods share similar temporal evolution while SBAS and DSI trace more measurement points than PSI in spatial distribution. Preliminary results show that the village central exhibits extremely slow movements (≤ 10 mm/yr) with seasonal oscillation. The north edge of the village in the middle of the landslide body retains stable until 2018. Deformation time series after early 2018 perform an acceleration from about 5 mm/yr to 15 mm/yr. Such acceleration may result from artificial irrigation activities, precipitation or internal landslide reactivation, and we expect to collect more ground evidence to interpret the acceleration. To conclude, the failure risk of this landslide is relatively higher since 2018 and is more noteworthy than before.