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Combining Sentinel (S1/S2) and Ground-based SAR acquisitions to retrieve landslide 3D displacement: application to Pas-de-l'Ours landslide, France

Floriane Provost (1), Alexander Handwerger (2), Jean-Philippe Malet (3), and Clément Hibert (3)

(1) European Space Agency, ESRIN, Frascatti, Italy (floriane.provost@esa.int), (2) Jet Propulsion Laboratory, California Institute of Technology, USA (alexander.handwerger@jpl.nasa.gov), (3) Institut de Physique du Globe de Strasbourg, Ecole et Observatoire des Sciences de la Terre, CNRS/University of Strasbourg, France

The "Pas de l'Ours" landslide, located in the Queyras valley (Southeast France) reactivated in the Spring 2017. The total moving mass is estimated at 17 million cubic meters, with a width of 1 km and a length of 600 m, which makes it currently one of the largest active landslides in the French Alps. In addition to the large deforming mass, numerous rockfalls and mudflows have occurred and have severely damaged the road that is located at the foot of the landslide.

Ground-based instruments including Ground-based radar (GBSAR), GPS, and seismometers have been deployed on-site to monitor the landslide evolution. In addition, we are monitoring the landslide motion using SAR and optical data from the Sentinel-1 (S1) and -2 (S2) satellites. These datasets are processed separately: a) the Sentinel-1 (ascending and descending) data are processed with the InSAR Scientific Computing Environment (ISCE), b) the Sentinel-2 are processed by Multiple-Pair Image Correlation (MPIC) and c) the GBSAR data are processed with IBIS Guardian, a persistent scatterer interferometry algorithm. The analysis of the landslide deformation pattern measured by the different techniques shows that the landslide is undergoing periods of rapid acceleration (> 0.5 m.d^{-1}) and deceleration (m.yr^{-1}).

These complementary datasets are exploited to invert for the 3D surface displacement for a small section of the landslide where all three datasets overlap using a Weighted Least Square (WLS) inversion. The retrieved 3D displacements are compared to GNSS datasets at three different locations. Our work highlights how complementary monitoring techniques can be combined to retrieve the evolution of slope instabilities with various kinematic regimes, and offers a new perspective into the physical processes controlling landslide dynamics.