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Characterization of rockslide dynamics by the joint analysis of airborne LiDAR and stereo-photogrammetric point clouds.

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The catchment of Sanières is located on the South-facing slope of the Barcelonnette basin (South French Alps). This region is known to be highly prone to gravitational processes including large landslides and debris-flows. In early August 2013, a large rockslide event occurred in the lower part of the catchment. During several days, a large amount of debris have been mobilised along a 300m length cliff. Deposits have reached and filled the torrential channel downslope. Several field observations carried out in the following weeks have shown the progressive opening of fissures along the main scarp. Today, large volumes of unstable debris are still available on the slope. Local stakeholders are now expecting the formation of a debris-dam in the channel which could lead to a debris flow in case of failure. Since the rockslide cannot be stabilized, it is necessary to monitor the site in order to track the evolution of the sliding processes for hazard assessment purposes. This work is focused on the use of remote sensing techniques (terrestrial photogrammetry, LiDAR) to detect and quantify spatial and temporal distribution of materials on the slope. Dataset includes ground-based and aerial optical images acquired through several field surveys together with an airborne LiDAR points clouds. The Structure From Motion (SFM) technique is used to generate multi-date high-resolution digital elevation models (HRDEMs) in order to quantify volumes changes. Images correlation technique is used to estimate displacements at the surface from images acquired continuously by a fixed camera mounted on the opposite slope and facing the rockslide.
The analysis of the terrestrial point clouds indicates two types of dynamics: (i) surficial transport of debris (boulders, tree trunks) which can be identified on daily observations, and (ii) a global deformation of the rockslope along several slip surfaces. The progressive development of the main scarp with velocity of a few cm.month-1 is also monitored. The analysis of an airborne LiDAR point cloud allows to characterize the main discontinuities and the possibility of movement of the global deformation. Finally, an indicator of activity of the slope is proposed from the time serie analysis. The possibility of extension of the rockslide is discussed.