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Coupling high resolution 3D point clouds from terrestrial LiDAR with high precision displacement time series from GB-InSAR to understand landslide kinematic: example of the La Perraire instability, Swiss Alps.

Clément Michoud (1,2), François Baillifard (3), Lars Harald Blikra (4), Marc-Henri Derron (1), Michel Jaboyedoff (1), Lene Kristensen (4), Davide Leva (5), Richard Metzger (2), and Carlo Rivolta (5)

(1) Institute of Earth Sciences, University of Lausanne, Switzerland (clement.michoud@unil.ch), (2) Terr@num SRL, Bussigny, Switzerland, (3) Security services, Bagnes Municipality, Switzerland, (4) Åknes/Tafjord Beredskap, Stranda, Norway, (5) Ellegi SRL, Milano, Italy

Terrestrial Laser Scanning and Ground-Based Radar Interferometry have changed our perception and interpretation of slope activities for the last 20 years and are now routinely used for monitoring and even early warning purposes. Terrestrial LiDAR allows indeed to model topography with very high point density, even in steep slopes, and to extract 3D displacements of rock masses by comparing successive datasets. GB-InSAR techniques are able to detect mm displacements over large areas. Nevertheless, both techniques suffer of some limitations. The precision of LiDAR devices actually limits its ability to monitor very slow-moving landslides, as well as by the dam resolution and the particular geometry (in azimuth/range) of GB-InSAR data may complicate their interpretations.

To overcome those limitations, tools were produced to truly combine strong advantages of both techniques, by coupling high resolution geometrical data from terrestrial LiDAR or photogrammetry with high precision displacement time series from GB-InSAR. We thus developed a new exportation module into the processing chain of LiSAmobile (GB-InSAR) devices in order to wrap radar results from their particular geometry on high resolution 3D point clouds with cm mean point spacing. Furthermore, we also added new importation and visualization functionalities into Coltop3D (software for geological interpretations of laser scanning data) to display those results in 3D and even analyzing displacement time series. This new method has also been optimized to create as few and small files as possible and for time processing.

Advantages of coupling terrestrial LiDAR and GB-InSAR data will be illustrated on the La Perraire instability, an active large rockslide involving frequent rockfalls and threatening inhabitant within the Val de Bagnes in the Swiss Alps. This rock mass, monitored by LiDAR and GPS since 2006, is huge enough and long-term movements are big (up to 1.6 m in 6 years) and complex enough to make difficult point cloud comparisons and LiDAR interpretations. Two monitoring campaigns with GB-InSAR devices were later performed and caught mm daily displacements (up to 8 mm in 15 days in September 2011). By coupling both datasets, we were able to clearly identify back scarps, as well as the most active masses within the whole instability, and thus to map limits of the instability and stable parts of the slope. Here the integration and the coupling of ground-based monitoring techniques were necessary to understand the whole landslide kinematic.