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Retrogressive landslide monitoring by TLS: precursory displacements and final collapse. Case study at Val Canaria (Ticino, Switzerland)

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In this paper we show the application of ground based LIDAR technique for the monitoring and characterization of a landslide that occurred the 27 of October of 2009 in Val Canaria (Ticino, Southern Swiss Alps). The study area corresponds to a retrogressive landslide active since 90's decade, which main scarp has been continuously reactivated. Locally, the study area is affected by Deep Seated Gravitational Slope Deformation (DSGSD).

Due to its frequent post-failure activity, this area was chosen as an experimental test site and was periodically monitored with a Terrestrial Laser Scanner (TLS). In this case study, a TLS ILRIS-3D model (Optech) was used. First data acquisition was carried out in 2006 for the identification of 3D morphology of the study area. New data acquisitions during 2007/2010 period provide useful information on 3D displacements of the slope and the detection of centimetric to decimetric scale changes (e.g. rockfall detachment and accumulation, pre-failure deformation, etc.). The differential displacements and rotations at certain parts of the slope were mainly assessed using the Roto-Translation matrix technique (Montserrat and Crosetto, 2008; Oppikofer et al, 2008).

The volume of the 2009 slide was calculated in the source and in the deposition area (365.000 and 400.000 m3, respectively), showing a swell factor of 10%. Rockall activity was also monitored during the period of study, being remarkable the failure of two rockfalls with a mobilized volume of thousand of cubic meters each. These rockfalls were located at the toe of the unstable area and may be linked with the occurrence of the main slide: the datasets acquired after rockfalls occurrence revealed displacement in the upper part of the slope with a maximum value of 100 cm (period 2007-2009). These displacements were identified as a sign of precursory behaviour, as is discussed by different authors (Rosser et al., 2007; Oppikofer et al, 2008; Abellán et al., 2009). The lower part of the slope (scree deposits) is characterized by active accumulation and transportation processes, being maximum displacement of the boulders of 100 cm during the period of study.

The use of TLS to detect centimetric pre-failure deformations proved useful at this natural slope. Further research should be focused on the detection of precursory displacements under different conditions, i.e., for different lithologies, in different pilot study areas, with variable ranges, and characterized by different failure mechanisms.