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Investigating a rock instability. Exemple of the "Bornes du Diable" cliff, Switzerland

Martin Franz, Clément Michoud, Maria Güell Pons, Andrea Pedrazzini, and Michel Jaboyedoff
Université de Lausanne, Institute of geomatics and risk analysis, Geosciences, Switzerland (martin.franz@unil.ch)

The « Bornes du Diable » cliff is located in the Val de Bagnes in south western Valais. In September 2008, a block of about 2000 m3 has fallen down causing damages to a small alpine road. This event shows the potential instability of the whole cliff which represents a larger volume. Indeed it measures 160 m high and about 100 m width. Several back-cracks are visible hundred meters back to the actual crest. The road, the reservoir of Mauvoisin and the related dam could be reached by the rockfalls. The goal of this study is to characterize the structural settings and to quantify the previous displacements that occurred in the area in order to assess the present day stability.

Structural, geomorphological and geomechanical characterization have been carried by field investigations and completed by orthophotos and digital elevation model analysis.
The unstable area was scanned in fall 2009 using terrestrial laser scanner (TLS) in order to have a very detailed topography and to perform a structural analysis using the home made software Coltop3D. Differential GPS campaign was initiated in July 2009 and will be continued for the next years to assess the potential movement affecting the entire area. Moreover, a photogrammetric analysis of two aerial photographs of 1979 and 2000 is performed to identify if previous movements occurred in the area. The potential unstable volume is estimated performing the Sloping Local Base Level method and geometrical analysis. Finally a model is performed with the UDEC™ and FLAC® softwares. The movement, the discontinuity sets, the rockfall mechanisms and the triggering factors are analyzed to define the deep structures and the mechanisms of a potential complete collapse.

The preliminary results indicate an important rock fracturing in the area of the instability. The persistence schistosity and the highly weathered rock surface indicating a fair-poor rock mass quality. TLS point cloud analysis using Coltop3D highlights six discontinuity sets. A map of the phenomena highlights new and old cracks, superficial landslides, rockfalls, and two debris flows channels.
Similar results have been found by field analysis. Those evidences indicate the existence of a major instability which is located in a suspected Deep-seated Gravitational Slope Deformation mapped within a previous study.