# Evolution of a debris flow channel monitored using a 3D terrestrial laser scanner.

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Like numerous torrents in mountainous regions, the Illgraben creek (canton of Wallis, SW Switzerland) produces almost every year several debris flows. The total area of the active catchment is only 4.7 km², but large events ranging from 50'000 to 400'000 m³ are common (Zimmermann 2000). Consequently, the pathway of the main channel often changes suddenly. One single event can for instance fill the whole river bed and dig new several-meters-deep channels somewhere else (Bardou et al. 2003). The quantification of both, the rhythm and the magnitude of these changes, is very important to assess the variability of the bed's cross section and long profile. These parameters are indispensable for numerical modelling, as they should be considered as initial conditions.

To monitor the channel evolution an Optech ILRIS 3D terrestrial laser scanner (LIDAR) was used. LIDAR permits to make a complete high precision 3D model of the channel and its surroundings by scanning it from different view points. The 3D data are treated and interpreted with the software Polyworks from Innovmetric Software Inc. Sequential 3D models allow for the determination of the variation in the bed's cross section and long profile. These data will afterwards be used to quantify the erosion and the deposition in the torrent reaches. To complete the chronological evolution of the landforms, precise digital terrain models, obtained by high resolution photogrammetry based on old aerial photographs, will be used.

A 500 m long section of the Illgraben channel was scanned on 18th of August 2005 and on 7th of April 2006. These two data sets permit identifying the changes of the channel that occurred during the winter season. An upcoming scanning campaign in September 2006 will allow for the determination of the changes during this summer.

Preliminary results show huge variations in the pathway of the Illgraben channel, as well as important vertical and lateral erosion of the river bed. Here we present the results of a river bank on the left (north-western) flank of the channel (Figure 1). For the August 2005 model the scans from 3 viewpoints were superposed, whereas the April 2006 3D image was obtained by combining 5 separate scans. The bank was eroded. The bank got eroded essentially on its left part (up to 6.3 m), where it is hit by the river and the debris flows (Figures 2 and 3). A debris cone has also formed (Figure 3), which suggests that a part of the bank erosion is due to shallow landslides. They probably occur when the river erosion creates an undercut slope.

These geometrical data allow for the monitoring of the alluvial dynamics (i.e. aggradation and degradation) on different time scales and the influence of debris flows occurrence on these changes. Finally, the resistance against erosion of the bed's cross section and long profile will be analysed to assess the variability of these two key parameters. This information may then be used in debris flow simulation.

REFERENCES
Bardou, E., Fournier, F. & Sartori, M. (2003): Paleofloods reconstruction on Illgraben torrent (Switzerland): a need for today frequency estimation. International Workshop on Paleofloods, Historical Data & Climatic Variability: Applications in Flood Risk Assessment, Barcelona.
Zimmermann, M. (2000): Geomorphologische Analyse des Illgraben. Bern, GEO 7 (unpublished).

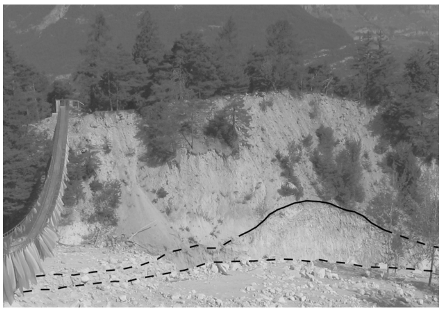

Figure 1. Photograph of the Illgraben's fan (taken in August 2005). The stippled lines show the left and right limits of the debris flow channel. The continuous line delimits the studied river bank.

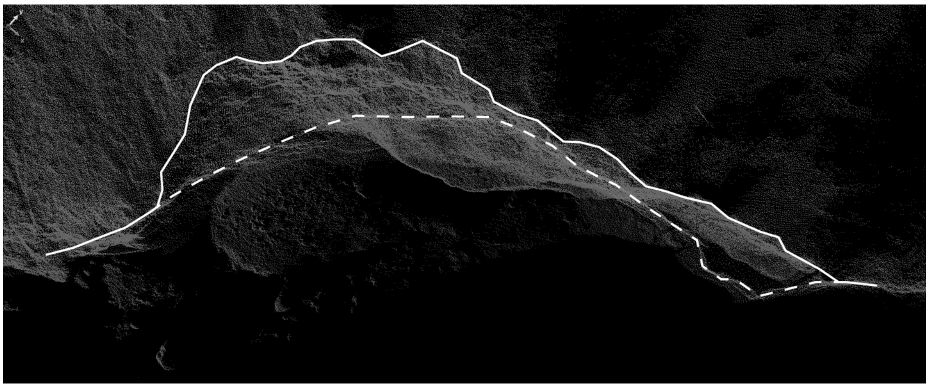

Figure 2. Top view of the 3D laser data of the river bank. The white dashed line shows the upper limit of the bank in August 2005, whilst the continuous line shows the bank's edge in April 2006.

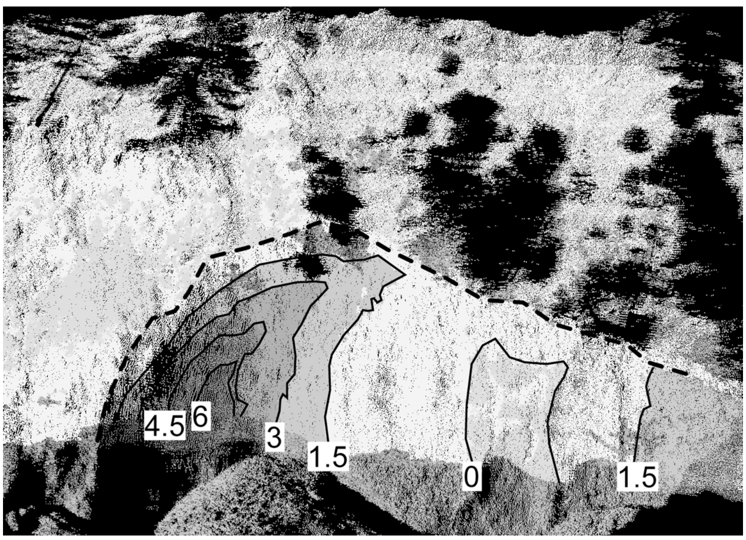


Figure 3. Comparison of the two data sets showing the horizontal differences (gray scale and numbered contour lines) between August 2005 and April 2006.