

Did early snow melt and permafrost occurrence favoured the triggering of the « torrent de Lourtier » debris flow in June 2003 (Val de Bagnes, Valais) ?

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Mid June 2003 a heavy local thunderstorm provoked a debris flow in the « torrent de Lourtier » on the western slope of the Bec-des-Rosses (3222 m a.s.l.). The debris flow reached a relatively large magnitude for this torrent. It diffusely started from the uppermost part of the catchment (2800 - 3000 m a.s.l.) in a blocky section (talus slope). The debris flow crossed the settlement of Lourtier (1100 m a.s.l.) where it reached the Drance River. Fortunately, no damage was caused.

Despite debris flows are frequent in the torrent de Lourtier, an event such as in 2003 appears to be rather rare. Survey carried out in 2002 in the watershed showed that no debris flow was recently initiated from the upper

part of the catchment (Bardou et al., submitted). Indeed, the triggering zone of recent debris flows was located in the median part (at about 2000 m a.s.l.). Only old deposits covered by vegetation were observable upward. The 2003 debris flow started from a permafrost area (Lambiel 1999) quite early in the season for such an elevation. Beside the intensity of the thunderstorm, what could have been the influence of both the snow melt pattern and the frozen state of the ground on the debris flow triggering?

Pictures taken a few days after the event, show that the starting zone was already almost free of snow at that time. Such a situation seems not to have been exceptional, but frequently occurred later in the summer (e.g.

Delaloye 2004) as for example three weeks later in 2004. The Figure 1 depicts this difference in snow cover between end of June 2003 and end of June 2004. It is hypothesized that the absence of snow in 2003 did increase a rapid runoff.

During winter and early spring, the temperature in a perennially frozen scree is lower than 0°C (e.g. Delaloye 2004). When melt water percolates in the cold ground in late spring, it freezes and fills up at least one part of the porosity creating a quasi impermeable layer near the surface (no direct information is available, but analogies with other sites can be done). At the time of the 2003 event, the scree slope was certainly still frozen a few (tens of) centimetres beneath the surface : the superficial runoff could have been favoured by the frozen state of the ground. Later in the summer season, the thaw depth is larger (up to several meters) contributing to retain a greater quantity of water in case of heavy rainfall event.

Mid June 2003, a thunderstorm harshly hit the Bec-des-Rosses area. It is nevertheless supposed that both the absence of snow cover and the frozen state of ground in the initiation area of the debris flow were aggravating factors. This assumption required obviously to be discussed and supported by field observations still to be performed. It opens questions as : would the debris flow triggered if the same thunderstorm happened mid June 2004 when the snow was still present or in autumn when the thaw depth in the ground (active layer) is the largest ? There is no definitive answer but in any case, the question of the relation-

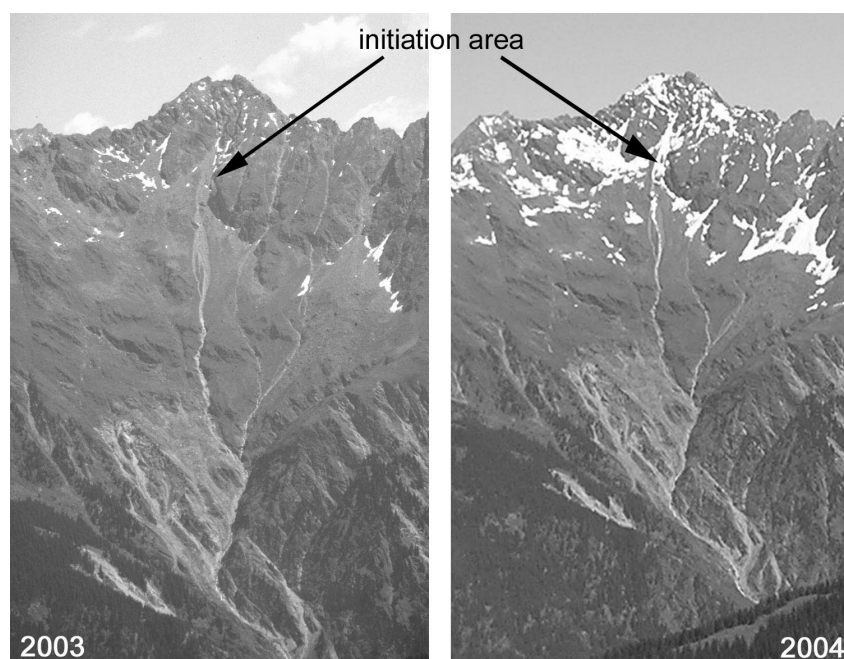


Figure 1 View of the catchment at end of June for both the year 2003 and 2004. There is a clear difference in snow cover in the zone of the initiation area.

ships between soil temperature, snow and erosion, although poorly studied (e.g. Haupt 1967, Gatto et al. 2001, Bardou & Delaloye, submitted), is already highlighted.

References

- Bardou, E., Delaloye, R. submitted: Effects of ground freezing and snow avalanche deposits on debris flow in an alpine environments. Submitted to NHES.
- Bardou, E., Pfeiffer, H.-R., Boivin, P. submitted: Compared properties of debris flow deposits and parent materials: Implications for debris flow study. Submitted to *Sedimentology*.
- Delaloye R. 2004: Contribution à l'étude du pergélisol de montagne en zone marginale. Thèse n°1441. Fac. Sci. Univ. Fribourg. *GeoFocus* 10, 240 pp.
- Gatto, L.W., Halvorson, J.J., McCool, D.K. and Palazzo, A.J. 2001: Effects of freeze-thaw cycling on soil erosion. In: H. R.S. and W.W. Doe III (Editors), *Landscape erosion and evolution modeling*. Kluwer Academic/Plenum Publisher, New York, pp. 29-55.
- Haupt, H.F. 1967: Infiltration, overland flow, and soil movement on frozen and snow-covered plots. *Water Resource Research*, 3(1): 145-161.
- Lambiel, C. 1999: Inventaire des glaciers rocheux entre le Val de Bagnes et le Val d'Hérémence (Valais). Mémoire de licence, Institut de Géographie, Univ. Lausanne, 2 vol. (non publié).