A CENTENNIAL RAINSTORM AND FLOOD EVENT IN LES DIABLERETS (SWISS ALPS)

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On June 25th 2005, a heavy rainstorm poured more than 100 mm rain in 2 hours on the Sex Rouge massive, above the tourist resort of Les Diablerets, in the Swiss Prealps. Peak intensities of 40 to 100 mm/hour have been estimated from radar imagery, leading to a peak discharge in the order of 30-35 m^3/s in Les Diablerets (B+C 2006). This event triggered massive sediment transport by torrents and extensive flooding in the area of the village. This event was followed by a second rainstorm on July 29th, which triggered renewed erosion and reworking of the sediment load. The total volume of mobilized sediments is very difficult to determine, but can be evaluated to more than 10^5 m^3.

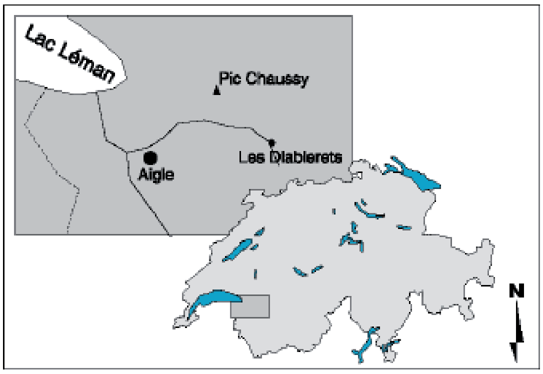

Fig. 1: location of Les Diablerets.

A detailed geomorphological survey shows that the major sediment supply was produced by erosion of scree slopes between 2500 and 2000 m asl. The subsequent debris flows eroded channel banks and sometimes new channels, scratching soil and debris cover down to the bedrock. In one catchment, the Dard glacial cirque, the erosion starts just below the assumed modelled lower permafrost boundary, and permafrost melting has possibly played a role (Lambiel et al. 2008).

Fig. 2: channel incised in a scree slope at 2000 m asl in the upper Grande-Eau catchment.

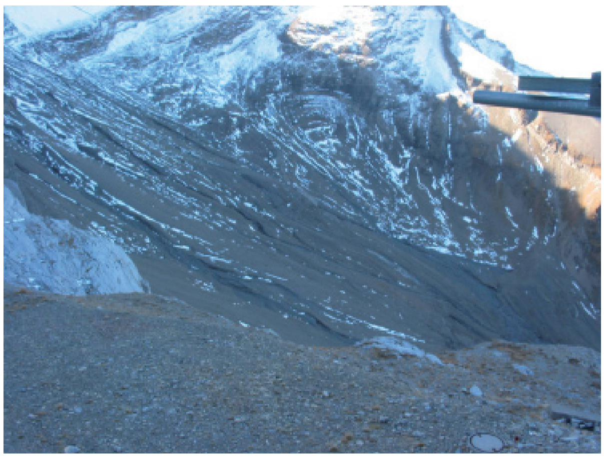

Fig. 3:erosion channels in the Dard cirque, starting below the permafrost limit.

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In the lower reaches, sediments were partly deposited on grassland, and partly transported further down as bedload by the main rivers. The coarse gravel load however was mainly deposited in the river bed, half way between the steep slopes and the village, and the flooding of the flatter zone of the village brought mainly fine sediments.

This event appears to be very similar to a series of historical events that happened between 1851 and 1859, resulting in repeated flooding and massive sediment supply (Schoeneich & Busset 1998). The comparison with the recent event allows a reanalysis of these historical events: a first heavy rainstorm, very similar to the 2005 event, probably destabilized the whole system, triggering erosion in the upper course of the torrents. The subsequent events of 1852, 1853, 1856 and 1859, which brought large amounts of gravel to the lower course, filling the channel and triggering flooding and channel diversions, are probably due more to the reworking and downward transport of the sedimentary wave left by the first event, than to exceptional rainfall.

This illustrates the probable functioning of this torrential system, alternating episodic erosional crisis with massive sediment transport and long periods of “normal” activity. It allows also to predict the evolution of the system in the near future. The main problem to deal with will be the reworking and downward transport of the coarse gravel load through the flat lower course by subsequent spring and rainstorm floods. This migration of the sediment wave is expected to last several years.

The 2005 flood also confirmed the mapping of flood areas, based on hydraulic modelling (B+C 2002). Extensive protection works have been undertaken and are still in progress. The best way to manage the bedload is still under discussion.

This case study shows the role of major events that destabilize the system. It illustrates how historical records can be reinterpreted by comparison with recent events, but also how they can help to predict the system response. The event also reveals the conflictive evolution of land use and flood hazard management, opposed interests that do not find a compromise arrangement even after the extensive flooding of 2005.

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