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Activity assesment of a corrected alpine torrential stream : from granulometry to historical records

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Torrential processes are amongst the most rapid and dangerous natural phenomenons encountered in alpine regions. Their activity can be continuous and this process can be described by a power law (intensity relative to frequency). However, some torrential streams deal with a pulse process ; big events separeted by very calm periods. The Saint-Barthélémy stream falls into that category. Situated in canton Valais (Switzerland), it drains a catchment of 12.5 km^2, composed of three geological units (basements and flysch capped by the Morcles helvetic nappe) with quaternary deposits. It created one of the biggest torrential cone of the Alps ($\sim$130*10^6 m^3). The frequency of these pulse events can be estimated at once every century. The last crisis (1926 – 1930, $>$10^6 m^3 transported in total) was followed by an intense campaign of mitigation, consisting mainly of check dams, which are today all filled with sediments.

The aim of this study is to understand the dynamics of the catchment and to use historic activity to assess the current danger. Using high-resolution DEMs and the local sloping base level method, the volume of sediments behind the check dams, and thus the sediment productivity, can be calculated. The volumes obtained are then compared with those calculated by comparing photogrametric-generated DEMs, which also helps localize the active regions. The length profiles of the river network indicate the degree of activity in relation to erosion and geology. Finally, the dominant transport process is identified using field observations (forms, deposition patterns, local slope) and granulometric distribution of the transported elements (ø $<$ 20mm). By removing the artificially accumulated volumes, the 1926 channel conditions can be reconstructed. This allows to calibrate physically-based runout models on the 1926 debris flows, reconstructed using historic sources. Once compared and affined, the obtained parameters are then applied on the current channel, to test the effectiveness of filled dams as protection against debris flows.

In conclusion, although the filled dams do not play their original rentention role anymore, the results show that their protection against high intensity debris flow is strong. This new function has to be taken into account in the future mitigation campaigns.