



Contrasting mass-wasting activity in two debris flow-dominated catchments of the Venosta Valley/Vinschgau (Italy): 1945-2014

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Debris flows are the most common mass movements within alpine mountainous catchments and main responsible process for sediment delivery from headwaters to streams. Often the delivered unsorted material accumulates as debris-flow lobes on the large debris-flow fans occurring at the outlet of secondary valleys or where the slope becomes less steep. These mass-wasting events are remarkable hazardous process concerning infrastructure and people, especially if villages are located on such fans. Therefore monitoring and analysis of the debris-flow activity is essential in order to mitigate the risk.

This study presents the results of a multi-temporal analysis of the debris flow activity and the evolution of the colluvial sediment sources over the last 70 years. Two high-altitude watersheds, close to each other in the Venosta valley (Eastern Italian Alps), were geomorphologically characterized and the transport regimes were identified. The larger basin is Cengles Creek (10.7 km²) and the smaller watershed is Plaies Creek (3.6 km²). The analysis has been carried out using historical aerial photos and digital analogues as well as through geomorphological, sedimentological and hydrological fieldwork. Our results consist of the identification of different geomorphological features and debris-flow activity patterns within the two basins.

The Cengles basin is characterized by a diffuse layer of permafrost, a hanging valley floor where alluvial processes predominate and considerable vegetation. Within this catchment the debris-flow activity has been quite stable over the last seven decades, with peak activities related to exceptional events, for example in 1999. On the other hand, the Plaies watershed possesses diffuse steep slopes, virtually no vegetation and a large glacier at its headwaters; also there the mass-wasting activity shows a stable trend with an only exceptional peak, linked to the occurrence of a large event in August 2012.

The processes in the catchment area combines zones with colluvial transport regimes with areas in which fluvial transport prevails, whereas Plaies is essentially dominated by mass-wasting processes strongly controlled by the dynamics of the overhanging Ortler Glacier. Further, Cengles is a supply-limited system, since there the occurrence of debris flows is strongly controlled by in-channel sediment evacuation and recharge cycles that interact with the overcoming of variable hydrometeorological thresholds. In contrast, Plaies is a transport-limited resulting from the almost unlimited availability of loose, mainly glacial material that can be mobilized. The debris-flow activity in Plaies is strongly controlled by a combination of hydrometeorological forcing and glacier dynamics.

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