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Debris flow pulse activity driven by rock collapse events and associated hazards

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Debris flows occur in mountainous areas when sediment supply, precipitation and sufficient slope exist. In such domains, this process is coupled with surrounding slopes and their erosional activity. It constitutes an erosional link between steep slopes and valley floor, capable of transporting sediments of all sizes. The frequency/intensity distribution of debris flows depends on sediment availability and transport capacity, and follows a power-law.

This event distribution can be altered by extreme events of other processes, like landslide, rockfall, or rock collapse. These massive events can quickly convert huge masses of solid rock into a loose volume with element size ranging from plurimetric boulders down to silts. In glacially affected mountain belts, steep rock faces inherited from past glacial erosion are particularly subjected to rapid and voluminous failures.

Such events induce a positive forcing of the torrential sediment cascade, especially if the rock collapse stops in a steep part of the catchment, i.e. in the initiation zone of debris flows. A sediment pulse is then observed, with frequent and massive debris flow events reaching the valley floor. Torrents originally considered as supply-limited behave in this case as transport-limited ones, until the sediment surplus is exhausted. These pulse events reprezent a hazard to populated areas, and thus need to be better taken into hazard assessment studies, by coupling rock face stability assessment to classical torrential studies.

In this study, similar events from different mountain belts are studied. The importance of such events as precursors of mass sediment transfer events is established and compared to background sediment transfer rates. Implications for mean erosion rates and construction of modern alpine valley trough morphology are discussed.