

Sedimentary connection between rock glaciers and torrential channels: definition, inventory and quantification from a test area in the south-western Swiss Alps

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Permafrost creep is an important sediment transfer process in periglacial alpine hillslopes (Delaloye et al. 2010). Rock glaciers are the visible expression of mountain permafrost creep (Delaloye 2004). Large volumes of rock debris originating from headwalls, moraines and weathering deposits are slowly transported within rock glaciers from their rooting zone to their fronts. In the Alps, most rock glaciers can be considered as sediment traps, because the sediment output at their margin is usually limited (Gärtner-Roer 2012). However, cases of rock glacier supplying torrential channels with sediments have been documented (e.g. Lugon and Stoffel 2010, Delaloye et al. 2013). Such rock glaciers can act as a sediment source for the triggering of gravitational processes propagating further downstream. Moreover, in such configuration the amount of sediment available is not a finite volume but is gradually renewed or increased as the rock glacier advances. These cases are therefore very specific, especially in the perspective of natural hazards assessment and mitigation. However, in the Alps very little is known about such type of rock glaciers. In addition, the sediment transfer rates between the fronts of the rock glaciers and the torrents are often not known.

In this context, our study aims at (i) defining better the configurations in which a sedimentary connection exists between rock glaciers and torrential channels, (ii) localizing the cases of active rock glaciers connected to the torrential network and (iii) estimating approximate sediment transfer rates between the fronts and the torrential gullies.

For that purpose, an inventory method for the classification of torrential catchments based on the analysis of aerial images and the computation of connectivity indexes have been developed. In addition, sediment transfer rates were estimated taking into account the geometry of the frontal areas and the velocity rates of the rock glaciers derived from DInSAR data. In order to validate these estimations, the resulting sediment transfer rates are compared to transfer rates calculated from repeated terrestrial LiDAR surveys on selected study cases.

This contribution presents results from the application of this methodology in a test study area in the south-western Swiss Alps. The methodology reveals itself suitable to identify rock glaciers connected to the torrential network. For each of the detected rock glaciers, an estimation of the sediment yield is proposed. The transfer rates range from tens of cubic meters per year for some slow moving and/or partially connected landforms, to several thousands of cubic meters per year.

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