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Bedload dynamics in the rapidly changing paraglacial zone of a high alpine catchment

Clemens Hiller[1,2], Kay Helfricht[1], Gabriele Schwaizer[3], Severin Hohensinner[4], Kerstin Wegner[5], Florian Haas[5], and Stefan Achleitner[2]

[1]Institute for Interdisciplinary Mountain Research, Austrian Academy of Sciences, Innsbruck, Austria (kay.helfricht@oeaw.ac.at)

[2]Unit of Hydraulic Engineering, Department of Infrastructure, University of Innsbruck, Austria (clemens.hiller@uibk.ac.at)

[3]Environmental Earth Observation IT GmbH, Innsbruck, Austria (gabriele.schwaizer@enveo.at)

[4]Institute of Hydrobiology and Aquatic Ecosystem Management, University of Natural Resources and Life Sciences, Vienna, Austria (severin.hohensinner@boku.ac.at)

[5]Chair of Physical Geography, Catholic University of Eichstätt-Ingolstadt, Germany (florian.haas@ku.de)

High mountain environments have been confronted with rising temperatures and geomorphological changes over the past 150 years, with the considerable retreat of glaciers constituting one of the most pronounced impacts in the Alps. Concurrent degradation of permafrost in headwalls exposed from the downwasting ice and in periglacial hillslopes alongside glaciers causes increasing sediment flux onto glacier surfaces. The accumulation of supraglacial debris at the current glacier tongue promotes water-storage in debris-covered ice bodies and is assessed as an important source of sediment in the proglacial zone, since a close connection to the fluvial channel network can be assumed. The evolution of mountain streams, the degree of connectivity and conditional sedimentation-erosion effects significantly determine the dynamics in a generally unstable paraglacial landscape in which retreating glaciers provide high stream discharges while sediment is widely unconsolidated.

In the recent scientific debate, the anticipated progressive shift from supply-limitation (fluvial transport overcapacity) to transport-limitation (abundance of sediment) in high alpine catchment areas is discussed. Thus, this study intends to contribute by investigating the connection of coarse sediment including supraglacial debris from the proglacial transition zone to downstream fluvial transport. Key aspect is the feedback between increasing debris cover and a shifting runoff regime due to a changing composition of glacier melt, snow melt and heavy rainfall events. In that respect, the focus will be on the dynamics of bedload transport and the proglacial coarse sediment budget.

This study is part of the Hidden.Ice project and conducts in-depth monitoring of the connectivity, runoff measurements and geomorphological surveys at the LTER site Jamtalferner, Silvretta Range, Austria. Hydraulic modelling of the potential transport capacity supported by bedload trap measurements, the analysis of grain size distribution in the proglacial area and sediment volume changes calculated from UAV-based photogrammetry are aimed at raising knowledge on

hydrological and geomorphological dynamics.