EGU21-10805
https://doi.org/10.5194/egusphere-egu21-10805
EGU General Assembly 2021

Development of debris cover and changes in fluvial sediments at Eastern Alpine glaciers

Kay Helfricht[1], Clemens Hiller[1,2], Severin Hohensinner[3], Gabriele Schwaizer[4], Florian Haas[5], Andrea Fischer[1], 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

[3]Institute of Hydrobiology and Aquatic Ecosystem Management, University of Natural Resources and Life Sciences, Austria

[4]Environmental Earth Observation IT GmbH, Austria

[5]Chair of Physical Geography, Catholic University of Eichstätt-Ingolstadt, Germany

High mountain environments showed substantial geomorphological changes forced by rising temperatures over the past 150 years. Glacier retreat is the most visible manifestation of climate change in alpine areas and has a significant impact on glacier land systems, high mountain runoff and, thus, on sediment transport in headwaters. Downwasting glaciers face an increase debris cover due to sediment flux onto glacier surfaces and melt out of englacial debris. Continuous debris transport from the glacier to the glacier forefield enhances its sediment available for being mobilized in case of higher or extreme runoff events.

The presented results arise from the Hidden.Ice project, which serves to investigate the hydrological impact of supraglacial debris deposits in the transition zone from glacier ice to the proglacial area. A detailed study focusses on the debris connectivity to bed load transport at the LTER site Jamtalferner (Silvretta mountains, Austria) and the evolution of the debris cover on glaciers in Austria.

A first spatio-temporal analysis of the long-term land cover evolution along the river channel from historical maps and remote sensing data shows increasing shares of fluvial sediments to about 12% of the area deglaciated after the LIA glacier maximum until the 1920s. However, the ongoing exposure of additional sediment plains is compensated by sediment export and covering of former stream banks by vegetation at decadal scale. Vegetation developed on up to 20% of the area in a 50 m buffer around the present glacier stream. This complementary documentation increases our knowledge on the temporal evolution of the sediment-rich proglacial zone evolved with glacier retreat.

To tackle the present interaction of the debris-covered glacier tongue with the runoff, the connectivity of supraglacial debris to bed load transport is estimated based on multi-annual and sub-seasonal high-resolution surface information. The underlying point cloud analysis employs Structure-from-Motion photogrammetry from UAV surveys and airborne laser scanning

acquisitions. The deposition and renewed movement of debris in the glacier forefield is calculated from sediment volume changes. Strong variations in the stream position suggest high connectivity of the entire proglacial sediment body to bed load transport, and considerable shifts of the main channel have been documented from year to year. Multi-spectral analysis of Landsat and Sentinel-2 optical satellite data time series from 1985 to 2020 show the development of debris cover on glaciers in the study region with increasing relative share of total glacier area over the past decades.