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Origin of runoff and suspended sediment in a glacierized Alpine catchment

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The spatial and temporal variability of sources of runoff and suspended sediment in high-elevation, glacierized catchments are still poorly explored. In this study we used stable isotopes of water, electrical conductivity (EC) and turbidity as tracers to identify the origin of different waters and of fine sediments contributing to streamflow and suspended sediment transport in the glacierized Sulden/Solda catchment (130 km^2 drainage area, Eastern Italian Alps). The site ranges in elevation between 1112 and 3905 m a.s.l. and includes two major sub-catchments. Rainfall samples were taken from bulk collectors placed along an elevation gradient (905-2585 m a.s.l.). Winter-integrated snowmelt samples were collected from passive capillary samplers installed at different elevations (1600-2825 m a.s.l.), whereas occasional snowmelt samples were taken from dripping snow patches distributed within the central-upper part of the catchment. Ice melt samples were taken in summer from small rivulets on the glacier surface. Samples from the two main streams at different sections, major tributaries and springs at various locations were collected monthly. At the outlet, daily stream water sampling for isotopic analysis was ensured by an automatic sampler. EC, turbidity and water stage were measured every 5 minutes. Meteorological data were measured by two weather stations at 1600 and 2825 m a.s.l.. Manual samples were taken from February to December 2014, whereas automatic measurements at the outlet started in May 2014.
Preliminary results (the isotopic analyses are in progress) showed small seasonal variability of EC in spring water, suggesting a limited role of snowmelt on groundwater recharge. Relatively high and constant values in EC at the catchment outlet were observed until the beginning of the summer, when diurnal fluctuations in streamflow and EC of increasing amplitude reveal increasing contributions of meltwater, peaking in July. The relatively small variability in EC between early and late summer suggests a predominance of snowmelt contributions over ice melt contributions to streamflow, confirming field observations about the greatly above-average snow cover in 2014 that left only a small part of the glacier surface exposed and prone to active melting. Diurnal oscillations in EC were still visible until early November, although with smaller amplitude and slightly higher values with respect to summer, suggesting a possible larger role of glacier meltwater in early fall. Turbidity was more sensitive to rainfall events compared to EC, showing sharp responses during rainy periods in spring and fall, and diurnal cycles during the melting periods. In contrast to EC, turbidity reached its highest values in August and during intense rainfall events. This indicates that both melt water coming from the upper parts of the catchment and direct rainfall erosion of surface near-stream zones played a role on the rapid mobilization of fine sediments and suspended sediment transport in the study catchment.

Keywords: stable isotopes of water; electrical conductivity; turbidity; glacierized catchment