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Quantifying permafrost degradation using combined stable isotopes (2H and 18O) and anthropogenic 129I isotope chemistry in rock-glacier meltwaters

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Rock glaciers are very prominent features of alpine permafrost that potentially contain important water resources in alpine regions. In the European Alps, where glaciers are diminishing under the rising temperatures, the importance of underground ice stored in permafrost bodies is on the rise. In this respect, rock glaciers receive increasing attention, as their distinct surface morphology and creeping movement attests to significant ice-contents below their active layer. How much of this ice is melting during warm summers and how these melting processes affect the hydrological cycle of alpine rivers is largely unknown.
Our study uses a hydro-chemical approach to estimate the fraction of total discharge contributed by rock-glacier meltwaters in the Kaiserbergtal valley, located in the crystalline Ötztaler Alps, Austria. The upper Kaiserbergtal valley has a surface area of ∼3 km2 and hosts several active rock glaciers in elevations above 2500 m a.s.l., but is devoid of any glacier ice. Here we installed two gauging stations to monitor discharge, one located close to the terminus of the largest rock glacier, a second station further downstream that receives discharges from the entire catchment. In addition, we collected monthly water samples from rain, lakes, snow, glacier ice (adjacent catchment), and rock glacier discharge throughout the summer of 2018 in order to determine their stable isotope signatures δ18O and δ2H, as well as the anthropogenic isotope 129I.