

# Inferring permafrost degradation on Murtèl Rock Glacier with hydrological investigations

Seraina Noemi Tschan

Master thesis in Geography (Dynamics in Glaciology and Geomorphology)

Natural long-term water reservoirs at the surface such as glaciers, ice packs and perennial snow patches are decreasing due to rising air temperatures. This may lead to drastic consequences in terms of water supply for people living in arid and semi-arid regions. However, rivers in the dry and warm season are not only fed by thawing of surface ice or snow but also by permafrost ground ice degradation. Rock glaciers, witnesses to permafrost presence, are more resilient to climate change than other ice reservoirs. The debris mantle insulates and cools the ice-rich rock glacier core and results in slow, delayed ice melt. Nevertheless, the role of permafrost as a water reservoir is often neglected since permafrost hydrology is not fully understood.

This Master's thesis shows at Murtèl rock glacier (Engadine, eastern Swiss Alps) that a shift in water origin in the discharge during summer can be distinguished by using hydrological measurements such as electrical conductivity and isotopic composition of the water. In addition, it illustrates that during the cold and wet summer 2021 no permafrost degradation took place. However, in warm summers permafrost ice melt can bridge the discharge after snowmelt season during late summer dry periods.

During summer 2021 there is a clear shift of the water origin from snowmelt via rainwater to mineralized water. The electrical conductivity increases steadily over summer, indicating the transition from weakly mineralized snowmelt and rainwater towards higher conductive water. This increased electrical conductivity comes from the absorption of solute content during the water flow through the active layer. Concerning the isotopic composition, discharge becomes progressively heavier in early summer after snowmelt season and tapers off in late summer, with a peak in isotopically heavy rainwater in August. These results demonstrate how the different hydrological components are correlated and how a combination of electrical conductivity and isotopy can be used to determine the water origin.

Martin Hoelzle, Dominik Amschwand, Martin Scherler