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Studying the dynamic of a high Alpine catchment through the scope of multiple natural tracers

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The characterization of surface-subsurface water exchange in snow-dominated catchments is key to predicting streamflow generation under a warming climate. Stable isotopes of water (SIW) as flow path tracers have become very popular in such environments despite sampling challenges related to access in harsh winter conditions and the fact that such analyses remain costly compared to other natural tracers such as electric conductivity and water temperature. However, SIW alone capitalize on the well-known difference of the SIW ratios from water originating as summer rainfall versus winter snowfall, which propagate into the water stored in the subsurface and into streamflow.

In this presentation, we report our conclusions on the potential of year-round SIW samples to characterize the hydrological processes in the high elevation Vallon de Nant catchment (13.4 km²), located in the Western Swiss Alps. SIW ratios are shown to be particularly useful to characterize the interplay of direct (surface) and subsurface snowmelt input to the stream network during winter and early snow melt periods. We furthermore show that subsurface flow plays a critical role during all melt periods and our tracer data points towards the presence of snowmelt even during winter base flow.

We furthermore demonstrate the added value of soil and water temperature measurements to interpret SIW ratios in snow-dominated environments, by giving additional information on snow-free periods, on flow path depths and on temporary fast connections between surface and subsurface flow.