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Impact of the spaciotemporal variability of the snowpack conditions on internal liquid water fluxes

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In cold regions, the seasonal snowpack plays an important hydrological role. By storing and releasing solid precipitation, the snowpack gives shape to the yearly hygrogram. In addition, by modulating liquid water pathway and residence time, snowpack internal conditions have a strong implication on the partitioning of meltwater among streamflow, groundwater recharge and soil moisture storage. During rain on snow (ROS) events, snowpack conditions influence timing and amount of liquid water inflow to the surface drainage system, with winter floods and ice jams as potential consequences.

Recent observations and projections show an increase in ROS frequency in many cold regions of the world. This trend raises concern about a possible increase in winter floods and ice jams events with climate change. In order to better anticipate the hydrological consequences of the increasing ROS phenomenon, a good understanding of the processes and conditions influencing liquid water release from the snowpack is required.

The present study articulates around a multimethod approach to characterize liquid water storage and movement in a snowpack in a non-mountainous environment. By combining drone-based high frequency GPR, NIR photogrammetry, time domain reflectometry, stable isotopes of water and other manual measurements throughout a winter season, we aim monitoring the spatiotemporal evolution of the snowpack liquid water content as well as the water fluxes at the snowpack margins.

Preliminary results show that, combining the selected methods allows tracking liquid water storage and movements in the snowpack throughout an entire season.