Supplement of Pre- and post-depositional processes affecting isotopic composition of seasonal alpine snowpacks — Austrian Alps

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Figures S1 to S5

References

2 Introduction

Figure S1 illustrates the schematic of snow sampling. The aim of this methodology is to use as little snow as possible and preserving the snow profiles as good as possible, so that we were able to sample the same snow profile over the research period.

Figure S2 illustrates how a mixed snow sample signal is unscramble into proportional distributions using cumulative precipitation distributions. The goal of this methodology is to obtain a proportional meteoric signal for the sampled isotopic signal.

Figure S3 illustrates the three sequential steps of the moisture source attribution: the specific humidity carried along the trajectories, the identified evaporative uptake and precipitation loss events, and the resulting fractional moisture contribution of each source region to the total precipitated signal.

Figure S4 illustrates the pair-plots and statistics between meteoric isotopy and meteorological conditions.

Figure S5 illustrates the normalized vertical distribution of temporal isotopic changes per sampling site.

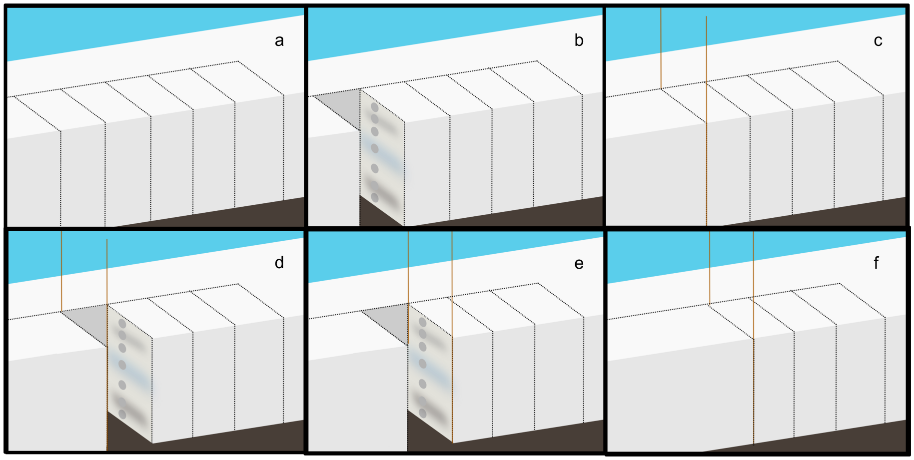

Figure S1. Schematic overview of sampling strategy, note the dimensions are not on scale. For illustrative purposes the snowpacks are shown with exposed sides, this was not the case in the field. a, the initial snowpack, covering the entire area. b, first snow profile dug and samples taken. Before the snow profile of b was closed, two poles were installed at the extend of the sampled snow profile. When fully closed, shown in c, the two poles identify the wall of sampling of that moment. During the next visit, a new snow profile was dug a few centimetres further uphill from the two sticks (d). This snow pit therefore exposes snow that has been covered for the entire snow season. Before closing the pit, the two sticks were moved to the profile extend again (e), such that profile extend can be retrieved the following sampling date (f). This approach enables continuous monitoring of the same layers over time without altering the layers to sample in the future.

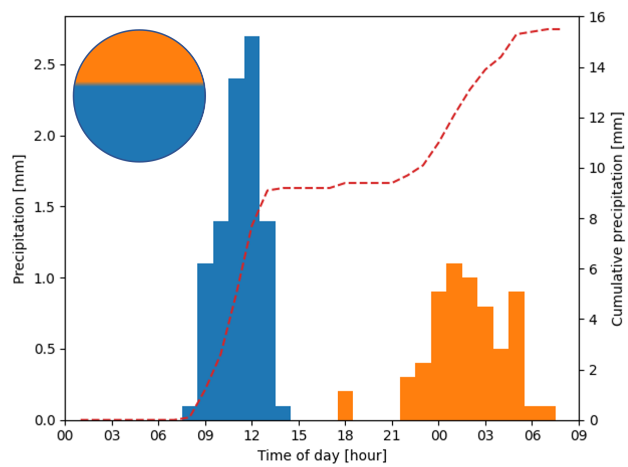

Figure S2. Conceptual illustration of two snowfall events contributing to a single snow core. The core (upper left) consists of snow from an earlier precipitation event (blue) followed by a subsequent precipitation event (orange). Based on cumulative precipitation, the fractional contribution of each event to the core is quantified. These fractions are used as weights to relate the measured snow isotopic composition to the corresponding meteorological conditions. For illustrative purposes, individual snow layers are highlighted using gray and blue hues.

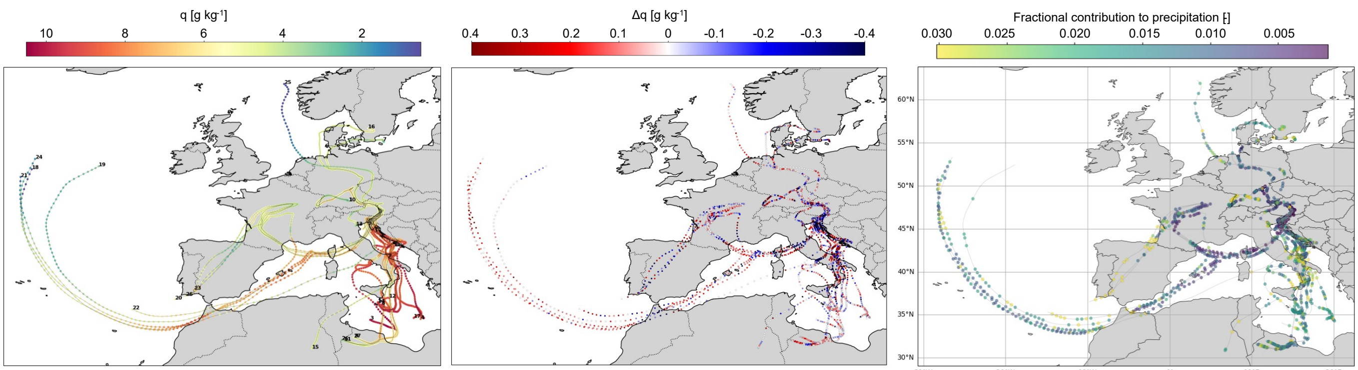

Figure S3. Back-trajectory moisture source diagnostics for all snow events at the BK sites. Left: Specific humidity (g kg^{-1}) along the 27-member ensemble trajectories, illustrating the total moisture carried by each air parcel over the seven days prior to precipitation. Centre: Specific humidity changes along the trajectories, where positive values (red) indicate evaporative moisture uptake events identified as source regions, and negative values (blue) indicate precipitation loss. Right: Fractional moisture contribution of each trajectory segment to the total precipitated moisture at the observation site, with warmer colours indicating a larger relative contribution. Together, these panels illustrate the three sequential steps of the moisture source attribution following Sodemann et al. (2008): identification of uptake locations, accounting for losses, and the resulting source weighting that underlies the atmospheric condition composites presented in the main text.

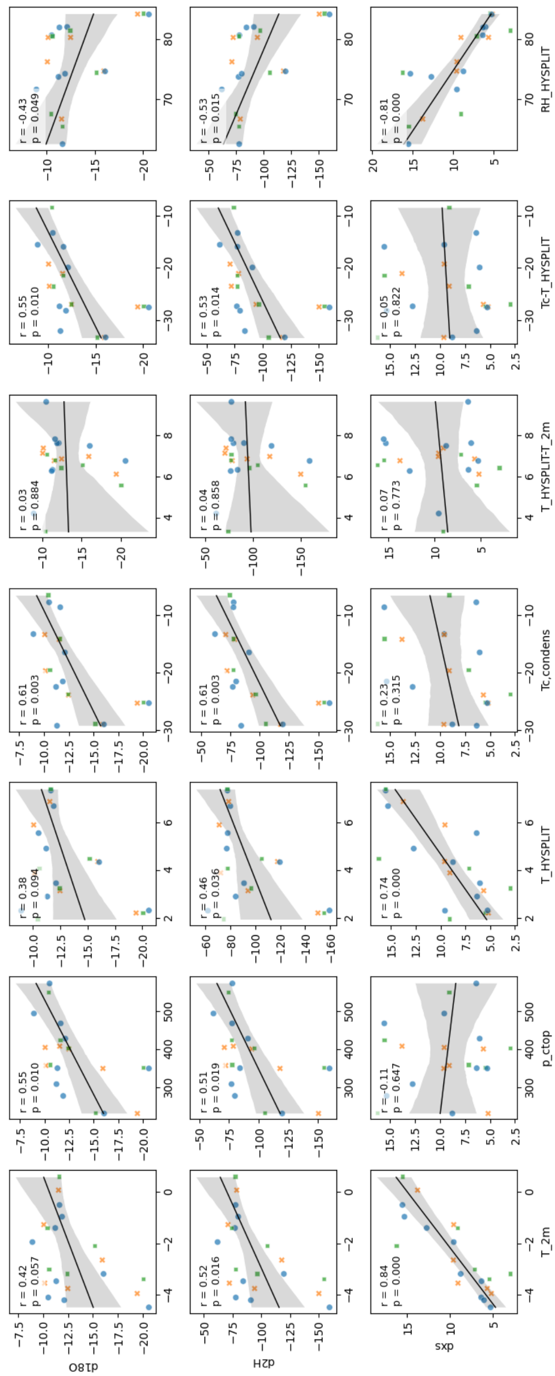

Figure S4. Pairplot and Pearson's r and p-value of atmospheric variables correlating to pre-deposition isotopic signals. The colours highlight sampling sites, blue dots are samples from 1500, orange crosses from 1600 and green squares from 1700.

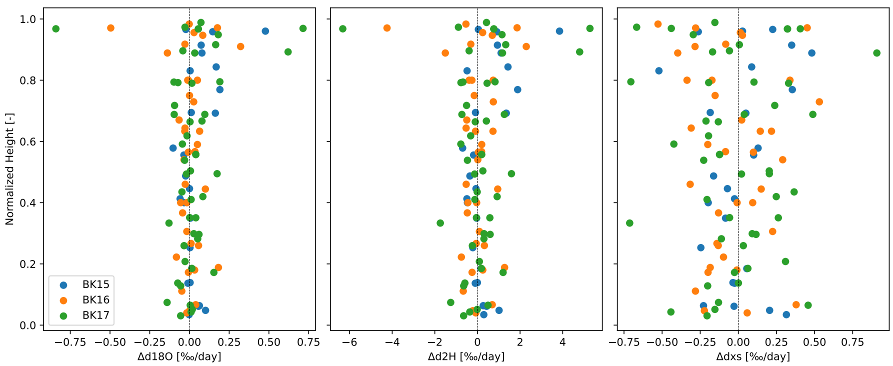

Figure S5. Isotopic change with normalized snow height during the Stable Snow Period (SSP). From left to right, changes in δ^{18}O, δ^{2}H and dxs. Samples were normalized based on the profile height of that week. The profiles are colour coded based on the sampling site coded on the abbreviation of the Bärenkar cirque (BK) and elevation of the observation site divided by 100.

References

Sodemann, H., Schwierz, C., and Wernli, H.: Interannual variability of Greenland winter precipitation sources: Lagrangian moisture diagnostic and North Atlantic Oscillation influence, J. Geophys. Res., 113, https://doi.org/10.1029/2007JD008503, 2008.