Characterizing **airborne snow metamorphism** using water isotope measurements in snow and vapor from ring wind tunnel experiments

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MOTIVATION

Drifting and blowing snow events in alpine and polar regions relevant for:

› Local mass balance
- Redistribution of mass
- Enhanced sublimation of snow mass

› Surface energy balance
- Radiation balance
- Latent heat flux

› Snowpack characteristics
- Density
- Wind crusts
- Surface topography

feedback

Influence of airborne snow transport on snowpack characteristics not well constrained !

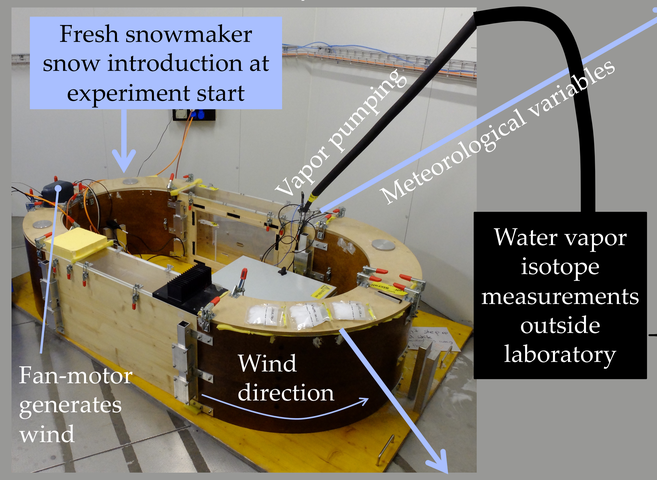
→ models rely on empirical parameterizations due to:

› Microscale process unfolding over large distances

› Difficulty of in-situ measurements

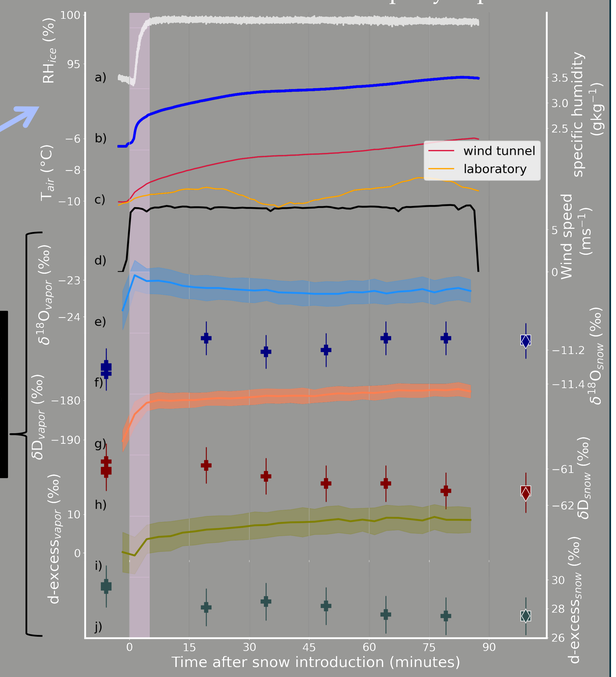
METHOD – Simulating drifting-blowing snow events

Ring wind tunnel experiments in cold laboratory



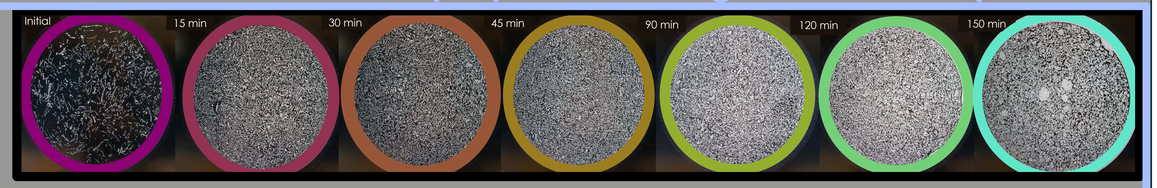
Repeated snow sampling for
1. µCT: particle size & SSA
2. isotopic composition

exemplary experiment



RESULTS – 1 Evolution of snow properties during aeolian transport

µCT scans of sampled snow

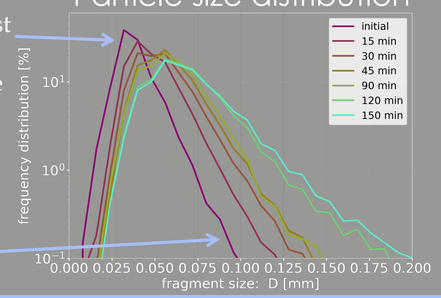


Snow crystal shape: dendritic → rounded

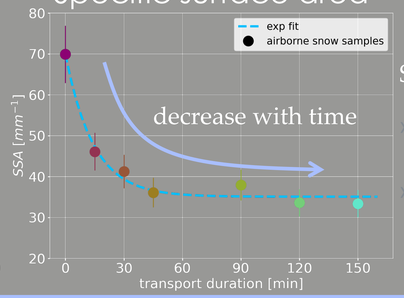
Particle size distribution

Shift in most abundant particle size

Shift in biggest particles



Specific surface area



$$SSA = \frac{\text{snow surface area}}{\text{snow volume}}$$

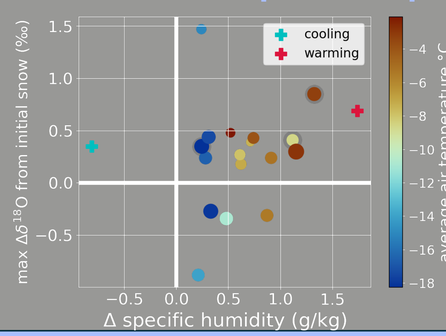
› characterizes crystal shape

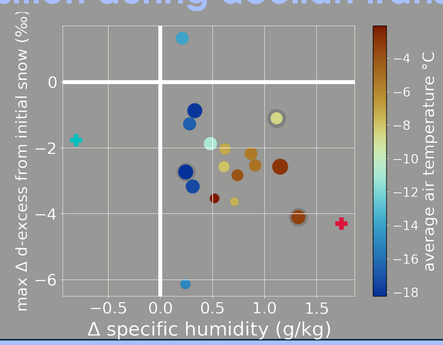
› determines radiative properties of snow

2 Changes in snow isotopic composition during aeolian transport

$\delta^{18}O$

Changes in the $\delta^{18}O$ signal demonstrate the occurrence of fractionating phase-change processes while snow is airborne.





d-excess

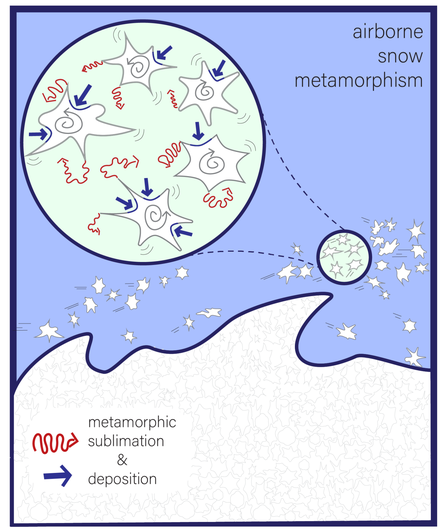
Strong decrease in d-excess shows that wind-drift modulates the snow isotopic composition.

CONCLUSIONS

› Observations of isotopic fractionation during aeolian snow transport

› Sublimation and deposition of water vapor on airborne snow particles change snow physical properties

› **Airborne snow metamorphism** as new process to include in models



OUTLOOK

› Which metamorphic process is responsible for isotopic fractionation?

› What are the fractionation factors associated with airborne snow metamorphism?

› Can water isotopes identify wind-blown snow?

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