C02-05 The Effect of Wind on the Surface Snow Microstructure – Experimental Insights

Monday, 22 January 2024

11:00 - 11:15

Abstract

Snow precipitation frequently occurs under moderate to strong wind conditions, resulting in drifting and blowing snow. Processes like particle fragmentation and airborne metamorphism during snow transport result in microstructural modifications of the ultimately deposited snow. Despite the relevance (optically and mechanically) of surface snow for alpine and polar environments, the effect of wind on the snow microstructure remains poorly understood and quantified. Available descriptions of snow densification due to wind are exclusively derived from field measurements where conditions are difficult to control. Information on the effect of wind on the specific surface area (SSA) is basically nonexistent. The goal of this study is to systematically quantify the influence of wind on the surface snow density and SSA, and to identify the relevant processes.

We conducted experiments in a cold laboratory using a closed-circuit ring wind tunnel (RWT) with an infinite fetch to investigate wind-induced microstructure modifications under controlled atmospheric, flow and snow conditions. Artificially produced dendritic fresh snow was manually poured into the RWT for simulating precipitation during the experiments. Airborne snow particles are characterized by high-speed imaging, and deposited snow is characterized by density and SSA measurements resulting in a comprehensive dataset.

We measured an increase of the densification rate with increasing wind speed which significantly differs from previous model parameterizations. The SSA was found to decrease under the influence of wind, while increasing wind velocities intensified the

SSA decrease. For higher air temperatures (T_a > -5°C), both the densification and SSA rates significantly differ from the rather constant rates at lower temperatures. We attribute this to the effects of enhanced cohesion or sintering (density) and intensified airborne snow metamorphism (SSA) at higher air temperatures. A sensitivity experiment revealed a strong influence of airborne snow metamorphism on the SSA decrease. Our results provide a first step towards an improved understanding and modeling of the effect of aeolian snow transport on optically and mechanically relevant microstructural properties of surface snow.

Authors

W

Benjamin Walter

WSL Institute for Snow and Avalanche Research SLF

W

Hagen Weigel

WSL Institute for Snow and Avalanche Research SLF

Presenting Author

W

Sonja Wahl

Swiss Federal Institute of Technology Lausanne

WSL Institute for Snow and Avalanche Research SLF

Authors

L

Henning Loewe

WSL Institute for Snow and Avalanche Research SLF

View Related