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Wind slab formation in snow: experimental setup and first results

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The formation of wind-hardened surface layers, also known as wind slabs or wind crusts, is studied. Better knowledge about which processes and parameters are important will lead to an improved understanding of the mass balances in polar and alpine areas. It will also improve snow-cover models (i.e. SNOWPACK) as well as the forecast of avalanche danger.

A ring-shaped wind tunnel has been built and instrumented. The facility is ring-shaped to simulate an infinitely long snow surface (infinite fetch). A SnowMicroPen (SMP) is used to measure the snow hardness. Other sensors measure environmental conditions such as wind velocity, air temperature, air humidity, the temperature of the snow and of the snow surface. A camera is used to detect drifting particles and to measure the Specific Surface Area (SSA) at the snow surface via near-infrared photography.

First experiments indicate that mechanical fragmentation followed by sintering is the most efficient process to harden the surface. The hardness increased rapidly during drifting snow events, but only slowly or not at all when the wind speed was kept below the threshold for drifting snow. With drifting, the penetration resistance increased from the original 0.07 N to around 0.3 N in about an hour. Without drifting, a slow, further increase in resistance was observed. In about six hours, the hardness of the top 1-2 cm increased to 0.5 N.

During this eight-hour experiment consisting of about two hours with intermittent drifting and six hours without drifting, the density at the surface increased from 66 kg/m^3 to around 170 kg/m^3. In the unaffected region close to the ground, the density increased from 100 kg/m^3 to 110 kg/m^3.