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# Co-located high-resolution specific surface area and snow-micropenetrometry profiling in a mid-altitude alpine snowpack

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Snow on the ground is a layered assemblage of snow grains of various shapes and sizes. Future advances in the description of the physical properties of the snowpack require the ability to characterize profile information at the highest possible vertical resolution, using relevant experimental methods. Only such information will be able to inform on the requirements of new generation snowpack models, in terms of vertical resolution and quantitative description of the snow microstructure. To progress on this issue, we carried out snow stratigraphy measurements at Col de Porte (1325 m altitude, French Alps) on a weekly basis during the winter 2011-2012, where conventional snowpit data were complemented by high-resolution measurements of resolution specific surface area and penetration resistance at the microscopic scale (snow-micropenetrometry). All the measurements were carried out a few meters apart.

The vertical profile of the specific surface area (SSA, aka optical radius) of snow was measured using a new instrument, named « Alpine Snowpack Specific Surface Area Profiler » (ASSSAP), which determines SSA from near-IR reflectance (1310 nm) measured using a laser-diode pointing horizontally to the side of a 10-cm wide hole drilled in the snow, during the descent and ascent of the instrument. Following a dedicated inversion algorithm using data from an array of 4 InGaS photodiodes covering several viewing angles above and below the the measured spot, the data are avereged vertically yielding a vertical profile of SSA with a resolution of 1 cm. In short, ASSSAP is the handy and lightweight version of the POSSSUM system developed for deeper profiling (up to 20m) on polar ice-sheets (Arnaud et al., J. Glaciol., 2011).

Vertical profiles of the penetration resistance of snow (obtained using the SnowMicroPen developed at SLF, Davos) were obtained in the middle of the sampling area, prior to drilling the hole for SSA measurements. This sampling strategy provides co-located (within 5 cm horizontally) high-resolution profiles of SSA and snow-micropenetrometry information. The presentation provides examples of such combined measurements under wet and dry snow conditions, along with conventional snowpit data, and discusses how the information from these two complementary instruments may be used in the future to characterize quantitatively the profile of the physical properties of snow at a vertical resolution on the order of 1 cm.