

## Small-Scale Variability of Snow Properties on Sea Ice: From Snow Pits to the SnowMicroPen

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### ABSTRACT

Snow on sea ice alters the properties of the underlying ice cover as well as associated exchange processes at the interfaces between atmosphere, sea ice, and ocean. It contributes significantly to the sea-ice mass and energy budgets due to comprehensive seasonal transition processes within the snowpack. Therefore, several studies have shown the importance of comprehensive understanding of snow properties for large-scale estimates in the ice-covered oceans. However, field studies reveal not only a strong seasonality but especially spatial variations on floe-size scales. It is therefore necessary to locate and quantify seasonal snow processes, such as internal snowmelt, snow metamorphism, and snow-ice formation in the Arctic and Antarctic snowpack on small scales.

Doing so, we present here *in situ* observations of physical snow properties from point measurements (snow pits) and transect lines (SnowMicroPen, SMP) during recent expeditions in the Weddell Sea and off the northeastern coast of Ellesmere Island, Canada, from 2013 to 2019, covering summer and winter conditions.

Results from a case study of snow pit analyses in the Weddell Sea during austral winter reveal a high variability of snow parameters throughout the snowpack. It is shown that snow grain size dominates the spatial variability of the snow pack while snow density variability can be neglected. The additional use of the SMP allows to even quantify length-scale variabilities of snow properties in different ice regimes in both hemispheres.

Overall, results will improve our understanding of seasonal processes in the snowpack and will guide us towards upscaling approaches of vertical snow layers on Arctic and Antarctic sea ice.

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