



## **Towards an optical measurement of snow density**

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Density is a critical property of snow, which controls its thermal, acoustic, mechanical and radiative behaviour. Although various methods have been proposed to measure snow density, the most common remains to weight a snow sample of known volume, which is slow and destructive. Previous attempts to use optical or acoustic methods were limited by the unknown complex microstructure of snow, which also modulates its properties. Here we demonstrate that snow density can be optically measured. To this end, we develop a theoretical framework to relate the effective refractive index of snow to its density. This theory is validated against laboratory measurements and numerical ray tracing simulations. We then show that snow density can be accurately retrieved by the combined estimation of snow absorption enhancement parameter and effective refractive index, both quantities being optically measurable. This paves the way for in situ non-destructive and fast measurements of snow density.