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Experimental and model based investigation of the links between snow bidirectional reflectance and snow microstructure.

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The variations of snow spectral bi-hemispherical reflectance with snow microstructure can be well explained using the snow specific surface area, i.e. the ratio of the surface of the ice-air interface to the mass of ice. Several theories and models are able to simulate the snow bi-hemispherical reflectance accurately. On the contrary the effect of ice crystal habits of snow spectral reflectances, and especially on snow bidirectional reflectance is not yet fully understood. The understanding of the variations of the angular distribution of light reflected by snow is however of a crucial importance for instance for snow remote sensing.
In this work, we estimate the bidirectional reflectance of 3 different snow samples within the solar spectrum and for 3 different incident angles (0°, 30° and 60°) from measurements in cold room using a spectro-gonioradiometer. The snow samples microstructure was measured before and after the snow reflectance measurements using micro-computed tomography.
For each sample, the measured spectra are compared to the simulated reflectances obtained using the model developed by Malinka, 2014 for the 3 samples. The impacts of several model inputs are discussed. We first investigate the effect of uncertainties in the values of the ice refractive indices. We also compare model runs using idealized chord lengths distribution and simulations based on chord lengths distribution obtained from micro-computed tomography. The effect of the vertical anisotropy of the snow samples on snow sample reflectance is also investigated.

Malinka, A.V., 2014. Light scattering in porous materials: Geometrical optics and stereological approach. Journal of Quantitative Spectroscopy and Radiative Transfer, 141, pp.14-23.