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Near-infrared photography to measure the specific surface area of snow: a new tool for the validation of remote sensing measurements

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The correlation between the reflection of snow in the near infrared and grain size is well known since Warren's paper of 1980 (Warren and Wiscombe 1980) and Dozier in 1981 (Dozier, Schneider et al. 1981). However, the observation goes back to Giddings and LaChappelle (1961). In the following years many attempts were made to define the somewhat elusive "equivalent optical diameter". Parameters considered are minimum and maximum diameter, curvature, convex radius, surface area, grain volume, etc. as well as the ratio between single parameters. However, the main problem is still the difficulty to measure unbiased geometric parameters of snow. Davis showed that stereological methods are best (Davis and Dozier 1989), but these are not available in field observations.

Here we show that digital near-infrared photography could be an efficient and simple tool to measure specific surface area. Snow pit walls with different types of snow which are typical for a seasonal winter snow pack were photographed in the near infrared spectrum using a commercial digital camera. At the same time snow samples were taken and casted. The specific surface area (SSA) of the different snow types was measured using desing-based stereological methods from vertical uniform random sections. Reflectivity was calculated from the corrected images based on reflectance targets. It increases exponentially with increasing SSA; the coefficient of correlation is 0.89.

Although the correlation was stated before on theoretical grounds, it was never validated with measurements. This relatively simple method makes a quantitative assessment of SSA in snow much more possible, which is a significant advantage for the calibration of sensors ranging from the visible to the microwave electromagnetic

spectrum.

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