

Review of “Measuring Snow Specific Surface Area with 1,30 and 1,55 μm Bidirectional Reflectance Factors” by Schneider et al.

First of all, I am very sorry for the delay of my comments.

Summary

This paper presents an interesting new instrument to estimate SSA of the surface snow from NIR reflectance in a non destructive way. The instrument is described in detail and calibrated. The accuracy is evaluated using model results and X-ray tomography measurements.

Recommendations

Overall, I think this paper describes an interesting new instrument to measure surface SSA along with a thorough evaluation of the accuracy and limits. However, I think that major revisions are required before publication as detailed in my specific and minor comments below.

Specific comments

1/ The introduction is in my opinion, a bit too scattered and confusing and some literature references are also missing. More specifically,

a - it's a bit weird to have references to calculation in an appendix in the introduction. For me, either the calculation already exists in the literature and then it would be nice to add the reference or it's a new result that should be included in the results section

b – page 2, lines 22-31 , I don't think it's necessary to go into too much details about the SSA evolution in time, a few sentences without any equation should be sufficient. It's not directly related to the objective of the paper and would give more space for discussing the state of the art of SSA measurements

c - page 3, lines 1-8, this section is really important for the rest of the paper. It seems to me that it would worth more details on the methods (advantages and drawbacks) and accuracy. Several methodologies are missing here such as IR photography (Matzl and Schneebeli, 2006) , SMP (Proksch et al. 2015) , and retrieval from spectral albedo which is also non destructive (Picard et al., 2016 , Dumont et al., 2017).

Regarding SSA calculation from X-ray imaging, I think adding some discussion also on the methodology and resolution issue would be nice (e.g. Hagenmuller et al., 2016).

d- Since you also present a Monte-Carlo model, maybe a short state of the art of existing theory and models to simulation snow BRF need to be added and why a new Monte-Carlo model is required ?

e.g. Malinka, 2014 , Kokhanovsky and Zege, 2004 , Xi et al., 2006

2/ Section 2.1. Some details are missing here (but maybe I did not check carefully enough), what is the diameter of the illumination ? How homogeneous is it ? What is the FOV of the photodiode ? In which azimuthal planes are they with respect to the illumination ?

3/ Page 7, Equation 5. Here I probably misunderstood something, why is the BRF averaged over all azimuths while the measurement is done only in two azimuthal planes ?

4/ Section 3, I think it would be less confusing for the reader to start with the model evaluation first.

5/ Section 3.1. The section is long and a bit confused, can it be re-arranged ?

6/ Section 3.3, comparison with SNICAR should in my mind be part of the model evaluation. It's a bit confusing to have it mixed with the calibration.

7/ In the discussion, I would also add some details on the surface roughness effects and liquid water effect maybe (e.g. Gallet et al., 2014)

8/ To my mind, both the conclusions and the abstracts should more clearly state the advantages and drawbacks of this new instrument compared to existing ones. The estimated accuracy in the SSA measurements should also be stated in the abstract.

Minor comments

Page 3, line 32, "flat black paint", it would be super interesting to know the spectrum, flat in which range ? I think these details are important for the discussions in the end of the paper.

Section 2.2. An accuracy assessment of the SSA calculation from the X-ray images would be nice. I think 14,6 microns is quite rough for snow types of snow (e.g. e and a in Fig. 3).

Section 2.3 Maybe a table would be clearer than a text description.

Page 6 line 19 scatter → scattering

Page 6 line 20. After how many scatter do you stop following the photon ?

Page 10 - last section, Picard et al., 2016 and Dumont et al., 2017 provide a detail assesment of the SSA retrieval uncertainties.

Page 11 – lines 3-7, this should be also indicated in the introduction.