



EGUsphere, referee comment RC2
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Comment on egusphere-2022-266

Anonymous Referee #2

Referee comment on "Sensitivity of modeled snow grain size retrievals to solar geometry, snow particle asphericity, and snowpack impurities" by Zachary Fair et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-266-RC2>, 2022

Review for manuscript:

Sensitivity of modeled snow grain size retrievals to solar geometry, snow particle asphericity, and snowpack impurities

This manuscript aims to present and quantify the impact of various variables on snow grain size retrievals. The authors adopted and tested the retrieval technique published earlier by Nolin and Dozier (2000) with different snow radiative transfer models (SNICAR and Monte Carlo). By perturbing the snow grain shape, solar incident angles, and concentration of light-absorbing impurities, the authors examined their corresponding impact on retrieved snow grain size. This manuscript is well organized and written. The experiments are reasonably designed with clear model descriptions. The reviewer has the following comments:

Section 2.1: The authors should consider adding more details or plots when introducing ND2000 techniques, specifically:

Page 3, line 4: "leading to an increase in depth of the absorption feature": is the "depth" defined at the wavelength of 1.03 microns only? Or is it for a wavelength range? Later in this paragraph: "Preliminary research by Nolin and Dozier (1993) demonstrated that a single band depth within the ice absorption feature could be used to derive snow grain size.". If "band" here is for at the wavelength of 1.03 microns only, consider using "channel"?

Page 3, line 5: Is "absorption feature" and "continuum reflectance" the same concept here?

Page 3, line 8: "Nolin and Dozier (2000) accounted for the latter issue by scaling band depth relative to the continuum reflectance, which is linearly interpolated between 0.95 μm and 1.09 μm ." Here, it seems "continuum reflectance" is just a linear line between 0.95 μm and 1.09 μm ?

Page 4, line 7: "Band area is computed from an observation of spectral reflectance and best matched to a band area within a lookup table or

to a calibration curve of modeled band areas." Here, it would be helpful to explain what does calibration curve looks like? For example, is band area a function of grain size?

ND2000 technique was well-documented in the original paper, and readers will likely be able to understand these concepts as they continue reading this paper. But before the authors dive into bias analyses, plots illustrating "continuum reflectance" and "calibration curve" (like Figures 10 and 11) would be helpful here.

Section 2.2.2

Page 5, line 5, "We assumed direct sunlight for all simulations." So all the downwelling flux on snow surface is direct solar flux? What about cloudy sky/diffuse light? Is this due to the limitation of the DM2000 technique? Would the impact of all variables on retrieved grain size be smaller/larger under a cloudy sky?

Figure 3: Since SNICAR is a two-stream model, it is no surprise the reflectances agree pretty well for the angle of 60 degrees. Out of curiosity, what about the other solar incident angles?