The Cryosphere

Discussions

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Interactive comment on "Attribution of Greenland's ablating ice surfaces on ice sheet albedo using unmanned aerial systems" *by* Jonathan C. Ryan et al.

Anonymous Referee #2

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This study represents a novel demonstration of aerial photography from unmanned vehicles to classify ice sheet surface types. The study goes on to explore the albedo statistics associated with six unique surface types, and includes an interesting discussion of some of the underlying mechanisms for albedo variability within each of these surface classes. The applicability of this analysis to Greenland-wide processes is limited because the study only explores albedo along a single transect over the course of 3 days. In one instance, I worry that the authors may have over-generalized a conclusion (described below), but in general I think the authors have maintained an appropriate scope and have not over-extended their analysis. The study is presented more as a demonstration of a novel technique which has the capability of leading to useful infer-

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ences. Clearly, quite a bit of data processing and analysis went into this study. Overall, I find this to be a very interesting and well-written study, and I recommend publication after minor revisions and comments below are addressed.

Major comments:

Conclusions #3 (p.11) states "We therefore conclude that the accumulation of surface meltwater is a result rather than a cause of the darkening of the ablation area (Wientjes and Oerlemans, 2010)" – Can this conclusion be robustly drawn from the rather limited spatial and temporal extent of measurements (25 km transect, only 3 days)? This conclusion might be legitimate for the domain that was studied, but I question whether it can be extended, based purely on the analysis presented here, to the entire ablation zone.

Minor comments:

Abstract and elsewhere: The term "mesoscale" is used here to represent scale lengths of 100-1000 m. In the meteorological community, mesoscale refers to scale lengths of several kilometers to hundreds of kilometers. Is there any precedence (in non-meteorological communities) for using "mesoscale" to describe sub-kilometer variability? If not, the authors may want to choose a different word to describe this scale.

p.2, 25: Consider changing "all-up", unless this is commonly used in this context.

P.3,7: It would be helpful to expand a bit on the "data cluster normalization" technique that was applied here. How exactly was this "compensation" achieved?

p.3,22: Does this RMSD refer to upwelling irradiance or to albedo? Please clarify.

p.3,31: "The relatively fast shutter speed minimizes image blur..." – True, although a ground speed of 25 m/s would imply movement of 2.5 cm while the shutter is open. This may be non-negligible compared with the stated pixel size of ~11 cm.

p.4,23-25: "The uncertainty in alpha_camera is probably due to..." – While this state-

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ment seems valid, it would be more concrete to ascribe differences between alpha_camera and albedo determined from the CM3 pyranometer to differences in their detected spectral ranges (where the CM3 measures from 300-2800nm). Related to this, it might be helpful to show or describe the spectral response of the camera sensor that was used. Many digital cameras actually respond to near-IR light (see, for example, if your camera responds to a TV remote, as mine does), rather than exhibiting sharp cutoff at 700 nm as implied in the text.

p. 5,12: "... based on Euclidian distance to five equally weighted nearest neighbors." – Why five? This seems odd for analysis in pixel space, where I would expect 4 or 8 nearest neighbors.

p.5,25: "... based on a comparison between the GAP/PROMICE weather stations..." – for clarity (if I understand correctly), I would instead say "... based on a comparison with albedo measured at the GAP/PROMICE weather stations...". Furthermore, you might want to elaborate briefly (1 sentence) on how albedo was measured at these stations. Was it also with CM3 pyranometers?

p.6,5: "We found no detectable bias between alpha_MODIS over the three survey days." – Bias with respect to alpha_pyra? Or do you mean to say that there was no detectable difference in MODIS albedo between these three days? Please clarify the text.

p.6,14: "The fractional area of surface water (both deep and shallow) are well correlated." – Do you mean that the fractional areas of deep and shallow water are well correlated with each other? Again, please clarify.

p.6,18: Grammatical error.

p.9,8-11: Multiple grammatical errors.

p.9,33: "complete complete".

Figures 4 and 5: Please briefly describe the color histograms shown in the corners of

the figures and how they relate to the main figures.