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Discussions

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Interactive comment on "The retreival of snow properties from SLSTR/Sentinel-3 – part 2: results and validation" *by* Linlu Mei et al.

Anonymous Referee #2

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General Comments

This paper describes the results and validation of the XBAER algorithm that retrieves snow grain size (SGS), specific surface area (SSA), and particle shape (SPS) from Sentinel-3 SLSTR instrument. The paper presents the results and evaluate them using the MODSCAG product, in-situ measurements from SnowEx17, and airborne-based retrievals. The validation for cloud-free and partial cloud cover shows promising results from the XBAER algorithm; however, there are some issues related to the validation process and the paper's writing structure.

Regarding the validation process, the main negative point is that the authors state that these are preliminary results and that they are waiting for more data from the MOSAiC project to increase the number of observations for validation. However, this paper

accompanies another paper on the development of the XBAER algorithm. If these are preliminary results, it would make more sense to fit some of these results in the first paper, and then wait for the MOSAiC data to submit a more comprehensive validation in the second paper. I understand that it is hard to obtain enough data for remote sensing validation, but since there is ongoing data collection, the wisest decision will be to wait until the MOSAiC dataset is fully collected.

Regarding the paper's writing structure, in general, the paper lacks conciseness. A few general comments about this topic are the following: - There are long sentences on multiple occasions. - The authors should be more careful about using quantitative adjectives when describing their results or other authors' results. I would recommend using the actual number instead. - I would suggest that the authors make a thorough revision of the use of articles, prepositions, and verb agreements in the paper. - The purpose of this paper should be more clearly stated in the introduction. - There is excessive use of quotes. - The discussion paragraph is too long and speculative. There is a lot of discussion in the results section already. I would recommend the authors to create a section for results and discussion together instead. - The conclusion is too long and with too much redundancy. It should state the main findings, limitations, and future studies, and if it was able to meet the goals of the study. In addition, the main findings in the conclusion should follow the same order that the results are presented. - More detail is provided in the Specific Comments and Technical Corrections sections below.

Other general comments on the scientific soundness of the paper are the following: - How have you dealt with the forest in the Grand Mesa site? - One way to improve the SGS validation would be perhaps to extend the validation using more MODSCAG scenes. - It is not appropriate to use full cloud cover field measurements to validate a remote sensing retrieval that only works with cloud-free conditions. Using partially covered skies might still be a reasonable assumption, as long as the limitations of the retrievals under these conditions are addressed, but not full cloud cover as on Feb. 11,

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Interactive
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2017. Retrieving snow properties for full cloud cover only shows that your model is able to characterize the properties of cloud ice crystals, but that has no implications for snow properties on the ground.

Specific Comments

Line 14: The OLCI instrument was not used directly to retrieve snow properties; therefore, it would be better to only mention it when talking about the cloud screening process. Line 52: Melting snow does have lower albedo, but the main mechanism that decreases albedo is actually the absence of snow cover. Line 62: The terms field-based and in-situ are synonyms; there is no need to use them together. Lines 62 to 67: Consider splitting or rearranging this sentence to improve its clarity. Line 82: When you mentioned snow fraction. Did you mean snow cover fraction? Line 100: You should drop "imagery" if you are talking about instruments. You should also add one space before "(EO-1)" in the previous line. Line 104: I would rewrite this sentence as: "to partly take into account irregular shape impacts on snow reflectance". Lines 106 to 108: I am not sure if this information is relevant in this paragraph. Lines 108 to 109: It is unclear what the classification system is for. Is it for classifying SPS? If yes, it would be a good idea to specify that and explain how the system classifies SPS. Lines 130 to 131: In this sentence, the last "retrieval" is redundant. For the sake of conciseness, try to avoid doing this in other sentences of the paper. Line 150: Try to be more specific when mentioning pieces of the part 1 paper. You could maybe mention the section number to help the reader find it in the other paper. Line 152: I would suggest changing the title of the point to: "Difference between field-measured and satellite-derived SPS". Line 183: The acronym BRDF was not introduced in the text yet. Line 189: Try to be consistent with the terminology. I have seen in-situ, field-based, field-measured, and ground-based, used interchangeably. Better if you choose the most appropriate and use it consistently throughout the text. Line 199: European Space Agency (ESA) was previously introduced. Figure 1: It would be good to add a picture of the Senator Beck Basin site as well. In the map, make sure to increase the font and include the name

of the two sites. Ideally, it would be good to have an inset zoomed to the two sites together with the US map. Table 2: I am not sure if the SnowEx17 column is necessary here, since there is no linkage to the Yang columns, and it was previously mentioned. Line 239: The sentence "masking by gases and molecules" is not the most accurate. I would suggest changing it for "attenuation and scattering by gases and aerosols". Figure 2: I would suggest trying to minimize the amount of text in this flowchart. Also, you would have to connect the two biggest green boxes inside the dashed line to represent better that this is an iteration process. Figure 3: I am impressed with the spatial detail of XBAER retrievals, but I noticed two geometrical-shaped features in Eastern Greenland. Could you please comment on why this is happening in that region? Line 336: This parenthesis is probably unnecessary: "(humidity, temperature, . . . etc.)". Lines 336 to 347: I appreciate that you tried to compile as many studies as possible to perform a qualitative validation, but this section is too long. Instead of listing all the values, you can try to summarize what you found by the other authors focusing only on what you used for your validation. Line 348: There is no need to use quotations here. Figure 5: It seems that the legend of the cloud maps is wrong. It should be cloud (light blue) and cloud-free (white). Line 529: I am not sure if time series would be the best term to describe this analysis. The Sentinel-3 image is a snapshot of time, while the aircraft surveying takes about 2 hours to complete. It would be better to relate this to space (coordinates), and probably some correction would be needed to address differences in solar zenith angle between the two instruments. Was that addressed? Differences in solar zenith angle can also represent different amounts of shadows, which might explain some of the differences between XBAER and SMART. Lines 533 to 534: The mean SGS from SMART is actually higher than for XBAER. Lines 578 to 579: That depends on environmental conditions. Lines 587 to 589: It is unlikely that blowing snow would transport fresh snow from the ground to such long distances in such a short period. Line 636: There is extra space before the parenthesis. In addition, there is no need to repeat the ice crystal types in the conclusions. Line 656: It would be better to use "inversely correlated" than "anti-correlated".

Technical Corrections

Line 54: Replace "of change snow properties" to "of snow properties change". Line 54: Replace "annular" for "annual". Line 60: Replace "temperatures surrounding" for "surrounding temperatures". Line 70: Replace "summery" for "summarize". Line 86: Replace "Jin et al (2008)" for "Jin et al. (2008)". Line 90: Replace "usage" for "use". Line 96: Replace "the in-situ measurement" for "in-situ measurements". This sentence would be clearer if you add a comma after Antarctica. Line 114: Replace "e.g." for "e.g.,". This repeats a couple more times throughout the text. Line 116: There is a missing space before the citation parenthesis. Line 182: Replace "SLSTR/AATSR" for "SLSTR and AATSR". Line 217: There is a missing period. Also, you should replace "have not linkage" for "have no linkage". Line 226: Replace "is" for "was". Line 233: Replace "present" for "presented", and add a comma after "(about 80° SZA)". Line 263: Replace "details" for "detailed". Line 373: Replace "is" for "are". Line 439: Should replace "the warmer conditions leads to" for "which leads to". Line 527: Remove hyphen after "SGS". Line 645: Replace "minimization" for "minimizations". Line 671: Replace "usage" for "use".