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The Cryosphere Discussions

Interactive comment on "Improving satellite-retrieved surface radiative fluxes in polar regions using a smart sampling approach" *by* K. Van Tricht et al.

Anonymous Referee #2

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Overview:

The authors present a methodology, specifically for CloudSat's 2B-FLXHR-LIDAR product, to spatially represent downward SW and LW fluxes beyond the narrow swath. The intent and methodology are clear and the paper is well written and appropriate for this journal. Due to the sparse physical observations available in the Polar Regions it is often difficult to insure the automated stations are physically representative of the whole region. While satellite products have aided this endeavor, sampling frequency still remains an issue. The methodology presented in this manuscript provides a process that can be implemented to estimate surface fluxes beyond the satellite swatch to help fill gaps between satellite measurements. The authors present clear evidence that the

smart sampling improves validation statistics and increases available data points for automated stations in the Polar Regions observed. While I think this paper provides useful information that should be published there are a few subjects that should be discussed first. I have provided my comments below along with a few other suggestions.

Comments:

1) The main comment arises from understanding how the methodology handles the varying atmospheric and cloud/precipitation processes when deriving fluxes. This is particularly important when considering CloudSat observations farther from the indicated POI. A major assumption of the methodology is spatial homogeneity of atmospheric conditions - applying the transmittance (after spatial correction) to the POI. Atmospheric variables will strongly alter the transmittance and cloud location, temperature, and humidity are the largest factors in the downward flux uncertainties [as reported in Tables 6 and 7 in the cited Henderson et al (2013)]. For example, in terms of the cloud properties, it may be a useful exercise to evaluate the cloud variability as a function of distance along the CloudSat track near a POI to understand how cloud may impact the newly sampled results. Would the maximum distance needed for proper sampling frequency still be OK if cloud/atmospheric conditions were significantly different?

2) The main results in this work focus on a few POIs to demonstrate its effectiveness. While it is mentioned in the text that a large-scale extension of the sampling approach is beyond the focus of the manuscript, it would be useful to understand how practical it would be to extend this to a larger scale. I am not sure how difficult it would be to test this method on a gridded surface. It would be great if an example could be included to show how a larger sample would compare to the FLXHR-LIDAR product. If this is not possible I feel it is necessary to mention if this methodology computationally efficient to be applied at a larger scale or simple enough for a user to implement on their own.

Other Comments:

Pg 3, Line 15: I am not sure if Figure 1 is necessary. I think a description of the errors is sufficient.

Pg 3, Line 32: How similar are the broadband measurements in the AWS to the 18 bands used in FLXHR-LIDAR?

Pg 4, Line 3: Include the acronym for CPR

Pg 4, Line 8: CALIPSO/CloudSat is excellent for cloud detection and aerosol.

Pg 4, Line 9: Are you talking about 2B-FLXHR-LIDAR here? Not all CloudSat products implement auxiliary information.

Pg 4, Line 13: I think it is worth noting the high vertical resolution of the CloudSat and CALIPSO products. The vertical resolution is one feature that makes the CloudSat/CALIPSO products unique in estimating radiative fluxes.

Pg 5, Line 3: Water bodies emit more radiation compared to what?

Pg5, Line 27: This difference in transmission would be only for clear sky. Are these cases taken only for clear sky measurements?

Pg 8, Line 29: The text states yearly averages, however, the caption states monthly.

Pg 9, Line 10: It would be interesting to discuss the impact including the diurnal computations have on the results.

Pg 10, Line 18: I do not like the use of the term “sampling frequency” here. While the number of samples available does increase, these are not physical measurements being made and the satellite overpass frequency is not changing.

Line 13, Line 31: Again, the number of samples is increased due to spatial processing. The number of overpasses does not change.

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