Response to Reviewer's Comments:
(*Authors' responses are in italic and in blue color*)

Reviewer 1:

This is an interesting application of GV data to understand how satellite data cloud masks could lead to uncertainty in radiation forcing estimates. The author develops an application of the Quickbeam simulator to the high-temporal resolution ground validation. Uncertainties in the radiative fluxes due to the missed detection of clouds from simulated CloudSat and CALIPSO cloud masks were estimated. They found that the seasonal cycle has a large impact on the magnitude of CRF biases due to changes in cloud microphysics, temperature structure, and surface albedo characteristics. For monthly averages, the combined CloudSat-CALIPSO mask provides the best match to surface observations, however, errors can get large when comparing 1-minute case data. Uncertainties in the cloud detection methods are described in the final section. This work is useful for the community as uncertainty estimates in Arctic regions are needed; the work, however, has numerous issues that need to be tackled first before publication.

*I appreciate the reviewer for the careful review, positive comments, and constructive suggestions. I believe the manuscript has improved greatly with the revision based on those suggestions.*

More significant comments:

1.

Results in Table 4, Table 5, Figure 10, and Figure 6 are difficult to interpret because of the sampling strategy presented. The author mentions that many cloud types are omitted from the study (snow, drizzle, liquid cloud+drizzle, rain, haze, or uncertain retrievals). It is important to understand how often these cases occur and how their exclusion impacts the results presented here. The CRF results are needed, however, if the sampling represents a small fraction of the total CRF they would not be representative of the total population of clouds. It would be helpful to understand the frequency of occurrence of each type mentioned here to get an idea of what is being sampled.

*The focus of study is the impact on the cloud detection and cloud radiative forcing. There might also be larger uncertainties associated with the retrievals including snow, drizzle, liquid cloud+drizzle, rain, or haze, and the radiative transfer models also have higher uncertainties to simulate the reflectivity and radiative fluxes for these cases. For these reasons, I excluded vertical profiles including snow, drizzle, liquid cloud+drizzle, rain, haze, or uncertain retrievals. This might be a good topic for future work.*

*In response to reviewer's suggestion, I provided the percentages of these profiles to all profiles for each month to show how many cases have been excluded. Also, in the discussion section of the revision, I emphasized this limitation and its possible impact on the total CRF "The study focuses on the impacts of active satellite sensors' low-level cloud detection limitations on cloud radiative forcing, so vertical profiles including snow, drizzle, liquid cloud+drizzle, rain, haze, or uncertain retrievals were excluded in calculating the CRFs. There are over 30,000 profiles in every month from October 1997 to September 1998, except that the total profile numbers are around 15,800 in October, which includes October 1997 and October 1998. Of all the profiles in every month from October 1997 to September 1998, the profiles with snow, drizzle, liquid cloud+drizzle, rain, haze, or uncertain retrievals account for 11.6%, 17.0%, 7.3%, 9.0%, 7.3%, 10.5%, 9.1%, 4.9%, 10.1%, 22.3%, and 20.8%. Majority of all profiles have been used in deriving the results in this study. ".*

Further, radiative calculations are performed once per hour. Why not compute all profiles? One of the main advantages of ground validation data is the high temporal resolution and a once per hour sampling lowers the accuracy of the data. If a subset of clouds is being examined, clouds could be missed and random errors could become large. It would be helpful to demonstrate that increased sampling does not impact the results (i.e. 6 times per hour or 10 times per hour).

*This is a good suggestion. The reason I used the hourly samples for the calculation is that the calculation is very time consuming. It will take a little over 2 months to calculate the radiative flux using the observations per minute, and a week for using samples per 10 minutes (6 times per hour). Also, the cloud properties usually do not change significantly within a few minutes, at least in the retrievals. Considering I have to repeat these calculations a few times for using data with all clouds, data with clouds from cloudsat+calipso/cloudsat/calipso, and some sensitivity studies, I decided to use the hourly data.*

*In response to reviewer's comment, I rerun all the calculations using samples 4 times per hour (every 15 minutes). I found the differences between using hourly data and using per 15 minutes data are small. The table below show their differences in monthly mean values at surface, with the maximum value at 0.6 Wm-2 (please see the table below). The differences at TOA are even smaller. All the findings in the submitted manuscript based on hourly data hold for those based on per 15 minutes data in the revision.*

*In the revision, all figures, tables, and text have been updated based on the calculations using per 15 minutes data. I also added a short clarification on the impact of temporal samples on the results, as "In this study, the radiation fluxes are computed and shown using profiles with 15-minute intervals (four out of 60 profiles), and there are 96 cases in a day except as otherwise stated. Daily means are computed based on the 96 values, and the monthly means are calculated based on the daily means. Computations are also made using profiles with 1-hour intervals (1 out of 60 profiles) to produce the daily means and monthly means. All the conclusions are the same, with the maximum differences in the CRF at the surface less than 0.6 $Wm^{-2}$ and even less for those at the TOA."*

*The table shown here was included in the Appendix.*

- Table : Monthly mean cloud radiative forcing (CRF) at the surface for longwave (LW), shortwave (SW), and the combined LW and SW (all) with the clouds from the surface observations collected during the Surface Heat Budget of the Arctic Ocean (SHEBA) experiment and the differences between the CRF with clouds in the surface observations only identified from combined CloudSat and CALIPSO, CALIPSO, or CloudSat and the CRF from the clouds from the surface observations.

| | All clouds from surface observations with hourly data | | | (CloudSat+calipso)-clouds from surface with hourly data | | | (CloudSat+calipso)-clouds from surface with per 15 minutes data | | | All clouds from surface observations with per 15 minutes data | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LW | SW | all | LW | SW | all | LW | SW | all | LW | SW | all |
| Oct | 32.7 | -0.1 | 32.6 | -1.0 | 0.0 | -1.0 | -1.0 | 0.0 | -1.0 | 32.1 | -0.1 | 32.0 |
| Nov | 34.2 | 0.0 | 34.2 | -0.2 | 0.0 | -0.2 | -0.1 | 0.0 | -0.1 | 34.0 | 0.0 | 34.0 |
| Dec | 21.0 | 0.0 | 21.0 | 0.2 | 0.0 | 0.2 | 0.1 | 0.0 | 0.1 | 20.5 | 0.0 | 20.5 |
| Jan | 22.0 | 0.0 | 22.0 | 0.3 | 0.0 | 0.3 | 0.3 | 0.0 | 0.3 | 21.8 | 0.0 | 21.8 |
| Feb | 20.5 | -0.2 | 20.3 | 0.2 | 0.0 | 0.2 | 0.4 | 0.0 | 0.4 | 20.2 | -0.2 | 19.9 |
| Mar | 34.6 | -4.2 | 30.4 | 0.1 | 0.3 | 0.4 | -0.1 | 0.2 | 0.2 | 34.8 | -4.3 | 30.5 |
| Aprl | 42.5 | -12.6 | 29.9 | -0.9 | 0.6 | -0.3 | -0.8 | 0.6 | -0.2 | 42.7 | -12.7 | 30.0 |
| May | 43.3 | -22.3 | 21.1 | -3.0 | 2.9 | -0.1 | -3.1 | 2.9 | -0.2 | 43.9 | -22.6 | 21.4 |
| Jun | 44.4 | -34.5 | 10.0 | -2.5 | 3.6 | 1.1 | -2.6 | 3.2 | 0.6 | 45.0 | -34.5 | 10.5 |
| Jul | 43.9 | -61.0 | -17.1 | -3.4 | 6.1 | 2.7 | -3.0 | 5.5 | 2.4 | 44.0 | -61.0 | -16.9 |
| Aug | 59.8 | -33.9 | 25.9 | -2.8 | 4.0 | 1.2 | -3.4 | 3.9 | 0.5 | 59.8 | -33.4 | 26.4 |
| Sept | 63.2 | -8.2 | 55.0 | -3.0 | 0.4 | -2.6 | -2.9 | 0.4 | -2.5 | 63.0 | -8.2 | 54.9 |

2.

As stated in the uncertainty section, the results presented are based on a single-shot cloud mask (on profile at a time). The combined CloudSat and CALIPSO cloud masking products as well as the cited 2b-FLXHR-lidar products use averaged data along the satellite track to better detect clouds that might be missing in a one-shot case. The cloud mask results derived in the current study would represent a worst-case scenario for cloud detection errors from the satellite perspective. As demonstrated in figures 20 and 21, a large portion of clouds could be detected if a small change is made in the retrieval. This uncertainty, however, is not translated back to the radiation. It is, therefore, difficult to relate how this uncertainty impacts results and makes it hard for the reader to interpret. It would be helpful to take a month of data, such as when errors are large, to demonstrate a range of CRF uncertainty due to changes in cloud mask thresholds.

*Good suggestion. I thought to include this in the submitted manuscript, but did not because the manuscript was already too long and had too many figures/tables.*

*In the revision, I added the following tables in the supplement of the manuscript to show the uncertainty in the CRFs in monthly means for all months due to threshold changes in* *the CloudSat and Calipso cloud detection. I also included text in the revised manuscript on this, as*

*"The impacts of the CALIPSO threshold changes on the monthly CRFs at the surface and the TOA are also investigated. Results show with increasing CALIPSO cloud detection capability, e.g. increasing thresholds, the LW (SW, total) monthly CRFs differences become smaller negative (positive, overall) (Table S#). Lidar with stronger cloud detection capability are desirable for better radiative flux estimations at the surface and the TOA. ".*

*"The impacts of the CloudSat threshold changes on the monthly CRFs at the surface and the TOA show that the LW (SW, all) monthly CRFs differences are smaller negative (positive, overall) (Table S#). Radar more sensitive to the clouds near surface would help to produce more accurate radiative flux at the surface and the TOA".*

*"Combination of stronger lidar and more sensitive radar in the cloud detections produces smaller negative (positive, overall) bias for LW (SW, all) monthly CRFs differences (Table #)".*

- *Table : Monthly mean cloud radiative forcing (CRF) at the top of atmosphere for longwave (LW), shortwave (SW), and the combined LW and SW (all) with the clouds from the surface observations collected during the Surface Heat Budget of the Arctic Ocean (SHEBA) experiment and the differences between the CRF with clouds in the surface observations only identified from the CALIPSO and the CRF from the clouds from the surface observations. The CALIPSO cloud detection thresholds are 4, 5, and 6.*

| | *All clouds from surface observations* | | | *CALIPSO-clouds from surface, with cloud detection threshold of 4* | | | *CALIPSO-clouds from surface, with cloud detection threshold of 5* | | | *CALIPSO-clouds from surface, with cloud detection threshold of 6* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *LW* | *SW* | *all* | *LW* | *SW* | *all* | *LW* | *SW* | *all* | *LW* | *SW* | *all* |
| *Oct* | *32.7* | *-0.1* | *32.6* | *-4.8* | *0.0* | *-4.8* | *-2.1* | *0.0* | *-2.1* | *-1.3* | *0.0* | *-1.3* |
| *Nov* | *34.2* | *0.0* | *34.2* | *-3.7* | *0.0* | *-3.7* | *-2.4* | *0.0* | *-2.4* | *-1.4* | *0.0* | *-1.4* |
| *Dec* | *21.0* | *0.0* | *21.0* | *-0.4* | *0.0* | *-0.4* | *-0.2* | *0.0* | *-0.2* | *0.0* | *0.0* | *0.0* |
| *Jan* | *22.0* | *0.0* | *22.0* | *-0.3* | *0.0* | *-0.3* | *0.1* | *0.0* | *0.1* | *0.3* | *0.0* | *0.3* |
| *Feb* | *20.5* | *-0.2* | *20.3* | *-0.9* | *0.0* | *-0.8* | *-0.4* | *0.0* | *-0.4* | *-0.2* | *0.0* | *-0.2* |
| *Mar* | *34.6* | *-4.2* | *30.4* | *-3.8* | *0.7* | *-3.1* | *-2.4* | *0.5* | *-1.8* | *-1.4* | *0.5* | *-1.0* |
| *Aprl* | *42.5* | *-12.6* | *29.9* | *-4.4* | *2.0* | *-2.4* | *-3.1* | *1.6* | *-1.5* | *-2.4* | *1.3* | *-1.1* |
| *May* | *43.3* | *-22.3* | *21.1* | *-7.0* | *5.7* | *-1.3* | *-5.0* | *4.4* | *-0.6* | *-3.6* | *3.4* | *-0.2* |
| *Jun* | *44.4* | *-34.5* | *10.0* | *-12.3* | *12.4* | *0.2* | *-9.1* | *10.0* | *0.9* | *-6.9* | *8.0* | *1.2* |
| *Jul* | *43.9* | *-61.0* | *-17.1* | *-12.4* | *21.6* | *9.2* | *-9.1* | *17.6* | *8.6* | *-6.7* | *14.7* | *8.0* |
| *Aug* | *59.8* | *-33.9* | *25.9* | *-14.4* | *11.7* | *-2.7* | *-10.0* | *9.4* | *-0.7* | *-7.6* | *7.9* | *0.3* |
| *Sept* | *63.2* | *-8.2* | *55.0* | *-19.3* | *3.1* | *-16.2* | *-15.0* | *2.6* | *-12.4* | *-11.3* | *2.1* | *-9.2* |

- *Table : Monthly mean cloud radiative forcing (CRF) at the surface for longwave (LW), shortwave (SW), and the combined LW and SW (all) with the clouds from the surface* *observations collected during the Surface Heat Budget of the Arctic Ocean (SHEBA) experiment and the differences between the CRF with clouds in the surface observations only identified from combined CloudSat and the CRF from the clouds from the surface observations. The CloudSat's thresholds are threshold -10, threshold -15, and threshold-20.*

| | *All clouds from surface observations* | | | *CloudSat-clouds from surface, with threshold - 10* | | | *CloudSat-clouds from surface, with threshold - 15* | | | *CloudSat-clouds from surface, with threshold - 20* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *LW* | *SW* | *all* | *LW* | *SW* | *all* | *LW* | *SW* | *all* | *LW* | *SW* | *all* |
| *Oct* | *32.7* | *-0.1* | *32.6* | *-14.6* | *0.1* | *-14.6* | *-14.2* | *0.1* | *-14.1* | *-2.1* | *0.0* | *-2.1* |
| *Nov* | *34.2* | *0.0* | *34.2* | *-9.5* | *0.0* | *-9.5* | *-9.0* | *0.0* | *-9.0* | *-2.4* | *0.0* | *-2.4* |
| *Dec* | *21.0* | *0.0* | *21.0* | *-2.9* | *0.0* | *-2.9* | *-2.7* | *0.0* | *-2.7* | *-0.2* | *0.0* | *-0.2* |
| *Jan* | *22.0* | *0.0* | *22.0* | *-9.3* | *0.0* | *-9.3* | *-9.1* | *0.0* | *-9.1* | *0.1* | *0.0* | *0.1* |
| *Feb* | *20.5* | *-0.2* | *20.3* | *-3.2* | *0.0* | *-3.1* | *-3.1* | *0.0* | *-3.1* | *-0.4* | *0.0* | *-0.4* |
| *Mar* | *34.6* | *-4.2* | *30.4* | *-8.3* | *1.2* | *-7.1* | *-8.0* | *1.2* | *-6.8* | *-2.4* | *0.5* | *-1.8* |
| *Aprl* | *42.5* | *-12.6* | *29.9* | *-16.1* | *4.9* | *-11.1* | *-15.9* | *4.9* | *-11.0* | *-3.1* | *1.6* | *-1.5* |
| *May* | *43.3* | *-22.3* | *21.1* | *-23.5* | *12.0* | *-11.5* | *-22.6* | *11.5* | *-11.1* | *-5.0* | *4.4* | *-0.6* |
| *Jun* | *44.4* | *-34.5* | *10.0* | *-16.8* | *11.5* | *-5.4* | *-16.4* | *11.1* | *-5.3* | *-9.1* | *10.0* | *0.9* |
| *Jul* | *43.9* | *-61.0* | *-17.1* | *-15.9* | *19.2* | *3.3* | *-15.7* | *19.0* | *3.3* | *-9.1* | *17.6* | *8.6* |
| *Aug* | *59.8* | *-33.9* | *25.9* | *-22.0* | *13.7* | *-8.4* | *-20.9* | *13.0* | *-7.9* | *-10.0* | *9.4* | *-0.7* |
| *Sept* | *63.2* | *-8.2* | *55.0* | *-16.2* | *2.0* | *-14.2* | *-15.3* | *1..9* | *-13.5* | *-15.0* | *2.6* | *-12.4* |

- *Table : Monthly mean cloud radiative forcing (CRF) at the surface for longwave (LW), shortwave (SW), and the combined LW and SW (all) with the clouds from the surface observations collected during the Surface Heat Budget of the Arctic Ocean (SHEBA) experiment and the differences between the CRF with clouds in the surface observations only identified from combined CloudSat and CALIPSO with different thresholds and the CRF from the clouds from the surface observations.*

| | *All clouds from surface observations* | | | *(CloudSat+CALIPSO)-clouds from surface, CloudSat threshold of standard-15, and CALIPSO threshold of 5* | | | *(CloudSat+CALIPSO)-clouds from surface, CloudSat threshold of standard-20, and CALIPSO threshold of 6 (maximum detection)* | | | *(CloudSat+CALIPSO)-clouds from surface, CloudSat threshold of standard-10, and CALIPSO threshold of 4 (minimum detection)* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *LW* | *SW* | *all* | *LW* | *SW* | *all* | *LW* | *SW* | *all* | *LW* | *SW* | *all* |
| *Oct* | *32.7* | *-0.1* | *32.6* | *-1.0* | *0.0* | *-1.0* | *-0.6* | *0.0* | *-0.6* | *-1.8* | *0.0* | *-1.8* |
| *Nov* | *34.2* | *0.0* | *34.2* | *-0.2* | *0.0* | *-0.2* | *-0.1* | *0.0* | *-0.1* | *-0.7* | *0.0* | *-0.7* |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Dec* | *21.0* | *0.0* | *21.0* | *0.2* | *0.0* | *0.2* | *0.2* | *0.0* | *0.2* | *0.2* | *0.0* | *0.2* |
| *Jan* | *22.0* | *0.0* | *22.0* | *0.3* | *0.0* | *0.3* | *0.3* | *0.0* | *0.3* | *0.1* | *0.0* | *0.1* |
| *Feb* | *20.5* | *-0.2* | *20.3* | *0.2* | *0.0* | *0.2* | *0.1* | *0.0* | *0.1* | *0.3* | *0.0* | *0.4* |
| *Mar* | *34.6* | *-4.2* | *30.4* | *0.1* | *0.3* | *0.4* | *0.5* | *0.3* | *0.7* | *-0.2* | *0.3* | *0.1* |
| *Aprl* | *42.5* | *-12.6* | *29.9* | *-0.9* | *0.6* | *-0.3* | *-0.7* | *0.4* | *-0.2* | *-1.4* | *0.8* | *-0.6* |
| *May* | *43.3* | *-22.3* | *21.1* | *-3.0* | *2.9* | *-0.1* | *-2.0* | *2.1* | *0.1* | *-4.3* | *3.8* | *-0.5* |
| *Jun* | *44.4* | *-34.5* | *10.0* | *-2.5* | *3.6* | *1.1* | *-1.8* | *3.0* | *1.2* | *-4.1* | *4.7* | *0.7* |
| *Jul* | *43.9* | *-61.0* | *-17.1* | *-3.4* | *6.1* | *2.7* | *-2.4* | *4.9* | *2.5* | *-4.8* | *7.6* | *2.8* |
| *Aug* | *59.8* | *-33.9* | *25.9* | *-2.8* | *4.0* | *1.2* | *-1.7* | *3.3* | *1.6* | *-4.8* | *5.2* | *0.4* |
| *Sept* | *63.2* | *-8.2* | *55.0* | *-3.0* | *0.4* | *-2.6* | *-2.3* | *0.3* | *-2.0* | *-3.8* | *0.5* | *-3.3* |

3.

Something seems off about the optical depth calculations shown in Figure 1. Previous studies using SHEBA data display column optical depth ranges up to ~30, with most clouds having column optical depths < 10 (Turner 2005; Zuidema et al 2005). If the vertical resolution is 63 m., Figure 1 shows optical depths greater than 5 for each vertical bin in the 15-20 bins below cloud top. This would lead to a column optical depth > 100 and does not seem physical for such a geometrically thin cloud. Given that the optical depth is used in the radiative transfer calculations as well as the CALIPSO cloud mask it would also lead to large uncertainty in the results as it prevents the CALIPSO cloud mask detections. This needs to be investigated to make sure the correct calculations have been made throughout the study.

Turner, D. D. (2005). Arctic Mixed-Phase Cloud Properties from AERI Lidar Observations: Algorithm and Results from SHEBA, Journal of Applied Meteorology, 44(4), 427-444

Zuidema, P., Baker, B., Han, Y., Intrieri, J., Key, J., Lawson, P., Matrosov, S., Shupe, M., Stone, R., & Uttal, T. (2005). An Arctic Springtime Mixed-Phase Cloudy Boundary Layer Observed during SHEBA, Journal of the Atmospheric Sciences, 62(1), 160-176

*In Figure 1 of the submitted manuscript, Figure 1b is the accumulated cloud optical thickness from the top of atmosphere, not the vertical distribution. The caption "(b) integrated optical thickness from top of atmosphere for CALIPSO" is confusing.*

*In the revision, I added a new figure to show the CALIPSO cloud optical thickness vertical distribution, and also modified the figure caption. I also added the two references in the revision.*

*The new figure is shown below.*

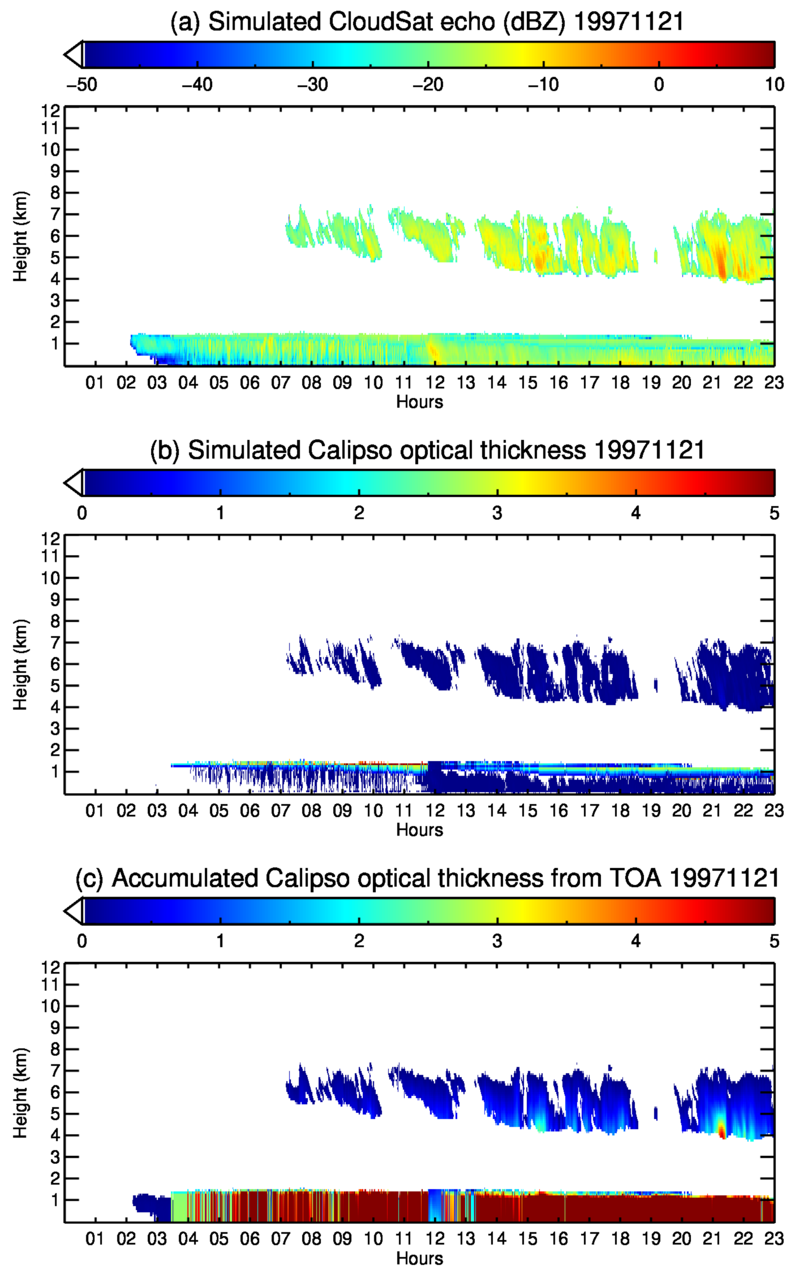


Figure 1: Simulated (a) CloudSat reflectivity and (b) CALIPSO cloud optical thickness, and 3) accumulated cloud optical thickness from top of atmosphere for CALIPSO on November 21, 1997 during the Surface Heat Budget of the Arctic Ocean (SHEBA) experiment.

5.

There are a large number of tables and figures in the paper. Figures or tables that are not necessary could be removed or added to supplemental. For example, the surface albedo figures are not needed as their source is described in the text. Further, the tables showing the raw numbers for vertical profiles could be included in the supplemental.

*Thanks for this good suggestion. In the revision, I moved a few figures and most of the tables to the supplemental section.*

Specific Comments

Paper Title: The title is too vague and suggests a global study when the spatial sampling is limited to ground validation sites in the Arctic. I would include the Arctic in the title to make it more specific or mention the use of SHEBA data.

*Thanks for the suggestion. The paper title has been changed to "Impacts of Active Satellite Sensors' Low-level Cloud Detection Limitations on Cloud Radiative Forcing in the Arctic".*

Pg 1 Line 22: Change "modulator of the radiation flux" to "modulator of radiation".

*Changed.*

Pg 4 Line3: I would make this clearer that phrases such as "with every 63 m from 150 to 1050 m" is talking about changes in vertical resolution.

*Changed to "and the vertical coverage is from 150 m to 22950 m with vertical resolution of 63 m from 150 to 1050 m and vertical resolution of 100 m above 1050 m."*

Fig 1b: A log-scale color bar would make some of the finer details of the cloud optical depth pop out a little more and limit the saturated COD above 5 (see comment 3 above as well).

*I kept the color bar. I added a new figure to show the COD vertical distribution. Please see the response to comment 3.*

Pg 7 Line 5. I would move the description of the radiative terms being calculated after the description the two sets of profile experiments.

*Done.*

Pg 7: Line 18: The use of "cloud layers" or "layers" gets jumbled here. I would describe cloud layers as layers with cloud data and total layers (50 or 125) as just "layers".

*Changed to "Streamer can simulate the radiation fluxes for up to 50 layers with cloud data. In this study, only layers from 150 m to 12.0 km are simulated. There are 125 layers from 150 m to 12.0 km in the retrieved cloud data sets, so that there are potential 125 layers with* *cloud data at maximum. Every layer with cloud data below 2.0 km was included in the Streamer input file…"*

Pg 9: Line 21: Please introduce Figure 6 first.

*Added "Figure 6 shows the cloud vertical distribution from CALIPSO, CloudSat, and combined CALIPSO and CloudSat and their differences with surface observations."*

Pg 9 Line 28: remove "very" from high optical depths.

*Done.*

Pg 11 Line 2: Should this reference Fig 6e?

*You are correct. Correction has been made in the revision.*

Fig 8: Is "all" the surface observations? This should be made clear.

*"All" has been replaced with "Surface observations" in the figure. The figure is updated.*

Pg 12 Line 12. With a difference of only a few percent, I would mention that the combined retrieval captures the majority of clouds above 1 km.

*The sentenced has been changed to "As the result, the combined CloudSat and CALIPSO detects most of the clouds that surface observation sees above 2 km, and majority of the clouds above 1 km."*

Fig 6. The Julian Day labeling is a bit confusing and would be easier to interpret if months could be added.

*Changes have been made based on Reviewer's suggestion. This figure has been moved to the supplement.*

Pg 16 Line 10: This is mostly due to the lack of sunlight during many months leading to the LW heating being the dominant term.

*Good point. Thanks. Added this sentence in the revision "This is mostly due to the lack of sunlight during winter months leading to the LW heating being the dominant term."*

Pg 28 Line 5: This caveat along with the one for CloudSat needs to be listed in the cloud mask description in section 2.

*Good suggestion. Added in the section 2 ". It should be noted that a more sophisticated detection scheme is used in the operational CALIPSO cloud mask product (Winker et al. 2009) and operational CloudSat cloud mask (Marchand et al. 2008), and results in this study should* *not be treated as the results from operational products.", and kept this in section 3 to emphasize the point.*