Interactive comment on “Screening for Snow/Snowmelt in SNPP VIIRS Aerosol Optical Depth Algorithm” by Jingfeng Huang et al.

Anonymous Referee #3

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The article demonstrates that the VIIRS aerosol optical depth product contains snow/ice contamination issue over high latitude Northern hemisphere. New empirical snow and snowmelt masking was developed combining normalized differences snow index, brightness temperature threshold, snow adjacency test, and spatial homogeneity test. The impacts of the new masking were tested globally and validated against ground based AOD measurements. The topic is suitable for AMT and the contents are informative for the aerosol remote sensing community. The manuscript is well prepared. However, there are several issues that need to be addressed before this manuscript is suitable for publishing.

Thank you very much for your very detailed and thoughtful comments. Your suggestions are very valuable for us to further improve the quality of the paper. Please see below for our responses highlighted in blue. Thanks.

The manuscript indicated that there are two aerosol algorithm that applied on VIIRS sensor. It is not clear the reason to have two different coefficients of snow masks in two algorithms. Does IDPS have similar problem of masking out thick haze using the C1=0.01? Can the snow mask of EPS be applied to IDPS?

On Page 2 Line 63 – 71, we introduced the evolving IDPS aerosol algorithms and the new EPS aerosol algorithm that will replace the IDPS aerosol algorithm. The new EPS algorithm is different from the IDPS algorithm in many ways such as new AOD retrieval techniques and new screening schemes etc. If C1=0.01 is used, both IDPS and EPS aerosol products will have the same ‘thick haze over-screening’ issue. Since the IDPS aerosol product will be replaced by the EPS aerosol product, we only adjusted the C1 value for the EPS algorithm for testing purposes of the new snow/snowmelt scheme.

In our previous response to reviewers’ comments, we also had addressed this same concern before the AMTD publication:
“Because of the newly discovered over-screened thick haze issue that is attributable to the snow/snowmelt over-screening, the new snow mask was further refined by tuning threshold values, and it has been implemented in the NOAA Enterprise Processing System (EPS) VIIRS Aerosol Algorithm. Although both algorithms are currently running

operationally, one at IDPS and the other at NDE, the EPS aerosol algorithm will eventually replace the IDPS algorithm, therefore we are not seeking to further improve the snow mask in the IDPS aerosol algorithm any more. Instead, the S-NPP VIIRS aerosol products will be reprocessed by the new EPS algorithm."

Author discussed new snow mask for IDPS and EPS throughout the paper, however, in Fig. 2 the case study for EPS is missing. Without the case study the audience do know how under what boundary conditions the snow mask for EPS is different from the snow mask for IDPS.

In our previous responses to the reviewers' comment before the AMTD, we had addressed this same concern. For the aerosol retrievals in Figure 2, the EPS retrieval is very similar to the IDPS retrieval after the snow screening is updated.

The author failed to explain how five populations of pixels were generated in Fig. 3.

The explanation of five populations of pixels in Figure 3 are provided on Page 7 Line 227-230, followed by more discussions on the Figure from Lines 231-246.

Figure 5 analyzes the data loss due to different masking procedures, which is very dependent on the topography, the snow distribution and such. Only use one day as an example is not statistically significant.

Snow screening issue is more significant over boreal spring season and we choose spring dates to highlight the issue. Figure 5 demonstrates an example that is typical for spring days but not for global annual average conditions.

Figure 5 concludes that there are additional 3.44% loss of data however, in Figure 6 there are 16% (43/260) data loss for data that are collocated with AERONET. The total data loss is 37% (97/260), which is much larger than the estimates from Fig. 5.

There are fundamental difference between Figure 5 and Figure 6 statistics. Figure 5 is global evaluation but Figure 6 only counts VIIRS vs. AERONET match ups. For Figure 6, we only selected Northern North America as our region of interest, and selected boreal spring time from March to May as highlight seasons. Therefore the data loss is much larger than global evaluation in Figure 5.

Also in Fig. 5 there are different number of latitude bins after 50 degree north. It is not clear to me the physical meaning of snow adjacent percentage is 100%. It is more likely that at that latitude, there is no data available for this day.

We use 10 degree latitude bins for all figures in Figure 5. Because aerosol retrievals are only available over snow free regions, aerosol retrievals over high latitudes are very limited. Taking Figure 5c for example, there were no aerosol retrievals when latitude are higher than 75 degrees. For the 60-70 degree bin, the 100% indicates that those old retrievals that were previously contaminated because of old snow screening are now removed after the snow screening methods are updated.

Also, the author does not mention the quality of data whether they are “Good” data or all quality data in Fig. 6. Although the discussion of Fig. 6 indicates only “Good” data are used in the analyses, but the author should clearly state it.

We added ‘Good Quality’ in Page 7 Line 263 and in the Figure 6 caption as well. We only use good quality VIIRS retrievals for validation purposes. Thanks a lot for pointing this out.

The one last question is with the change of snow masking, what is the statistics of valid aerosol data that are misidentified as snow globally?

On Page 9 Line 313 to 316, for a global testing on May 18, 2014, a typical day in spring thaw season when snow and snowmelt prevail, the new snow test screened out an additional 3.44% ‘Good’ quality VIIRS AOD retrievals, which were otherwise contaminated by snow and snowmelt. This means if the snow screens are not updated, we likely have 3.44% valid aerosol data that are misidentified as snow globally for a typical data in spring thaw season. This number is lower for other seasons when snow and snowmelt are not a significant issue for VIIRS aerosol retrievals.