

Authors response to referee Andrew Sayer
Manuscript number: amt-2021-71
“Introducing the MISR Level 2 Near Real-Time Aerosol Product”

General comments and recommendation:

This paper describes a near real time (NRT) version of the standard MISR aerosol product. NRT data are particularly useful for assimilation and monitoring purposes, so this development is welcome as the standard aerosol product has latency of several months. There is also a FIRSTLOOK product produced with latency of several days. The main differences between the NRT and standard algorithms are that the former uses different ancillary data (also the case for FIRSTLOOK) and cloud masking because those required for standard product are not available sufficiently fast. Additionally, NRT files are split into partial orbits (sessions).

The work is in scope for the journal. The quality of writing and presentation is high. My main issue with the analysis is that the focus of the comparison is between the FIRSTLOOK and NRT products, and not the “final” standard product and NRT. This is relevant because most climatological and validation analyses use the final product and not FIRSTLOOK. I understand that FIRSTLOOK has been the lower-latency alternative to the standard final product, but think it is worth extending the analysis to also show comparisons to the final standard product. This is because differences in ancillary data (e.g. wind speed over water) could lead to regional systematic differences in retrievals; even if not it would be good to quantify the sensitivity of the algorithm as a measure of retrieval “noise” added by the ancillary data treatment. So the present comparison is mostly examining the effects of the pixel selection criteria, and missing the effects from these other sources. The paper is not too long so I hope the authors would consider adding this in to some parts of the study. Note I am also not aware of an analysis of the differences between FIRSTLOOK and final AOD from the standard product, so adding the standard here will also be informative of that.

Re: We fully agree with the reviewer regarding this issue. When we started working on NRT analysis and on writing of this paper the standard aerosol (SA) product was not yet available, which motivated the use of the FIRSTLOOK product. However, right now SA is available. We therefore repeated our investigations using the SA product. All figures and analyses have been modified accordingly. Furthermore, we included both the FIRSTLOOK and SA results in Figure 3, which shows the overall AOD histograms for land and DW retrievals. The histograms of FIRSTLOOK and SA AODs are almost indistinguishable from each other, which confirms strong similarity of the two products. This is expected, as the ancillary datasets that feed into these two retrievals do not change considerably. Note that the wind speed data in MISR retrievals has three coarse bins centered at 2, 5, and 7.5 m/s. Furthermore, the algorithm attempts wind speed retrieval using glint pattern whenever conditions are favorable, which further limits the

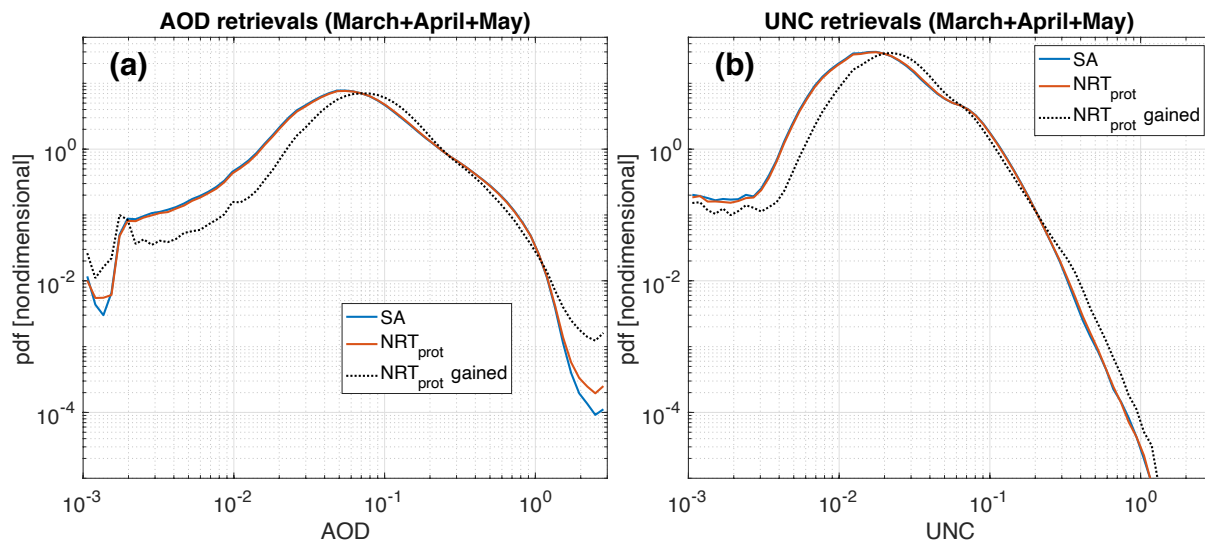
impact of wind speed database on AOD retrievals. None of the conclusions that we reached by using FIRSTLOOK had to be adjusted after we switched to the final SA product.

Other than that, I recommend publication following minor revisions.

Specific comments:

Lines 115-117: the authors mention the pixel-level AOD uncertainties. It would be good to make a statement about how these compare between NRT and standard products. It might be that they are near identical (in which case probably only a sentence is needed), while it might be that they show some differences. This could be important because NRT applications (e.g. data assimilation) often need an error model.

Re: We looked at the histograms of AOD uncertainties and found that NRT and standard aerosol (SA) products are in very close agreement, as shown in the figure below. The geographic distributions are also very similar, with small differences aligning with the areas where the differences in coverage are noticeable. We modified Figure 2 by adding a second panel showing the histograms of UNC retrievals in SA, NRT_{prot}, and NRT_{prot} gained.



Line 137: the paper says that the NRT aerosol products “are available” (present tense) at <https://asdc.larc.nasa.gov/project/MISR>. I checked and the only level 2 NRT products listed at the time of posting this review (April 2 2021) are two versions of cloud motion vectors. If the NRT aerosol product is not available at the time the paper is accepted, then the language in the paper should be changed.

Re: Unfortunately, operational processing of the NRT aerosol product has been delayed by a few months. We anticipate that the product will become available in May 2021 before the description paper is officially published.

Line 277: the authors introduce NRT_{prot} here but this is not used in figures – I think it would be clearer to use this explicitly where NRT_{prot} is being used (which I think is most analysis before Section 5?). Or am I misunderstanding this?

Re: Good point, it obviously should have been NRT_{prot} instead of NRT. This has been corrected.

Figures 2, 3: legend says “FIRTLOOK” rather than “FIRSTLOOK”. I do not think Figure 2 is necessary anyway, since Figure 3 contains the same information in a more useful way (land vs. dark water split).

Re: “FIRSTLOOK” was substituted with “SA” (standard algorithm). We still think showing the histogram in Figure 2 might be useful for some readers as a quick look at the overall performance of the NRT_{prot} algorithm. We furthermore added a second panel in Fig. 2 to show the histograms of retrieved AOD uncertainties.

Line 301: I am not sure I agree with this statement. Looking at Figure 3b, it looks like the NRT_{gained} pdf over land is flatted overall (more low and more high values than FIRSTLOOK).

Re: We softened the language here to read: “including a slightly flattened but still relatively comparable distribution of the “NRT_{prot} gained” retrievals.”

Line 304: I think this citation should be to Sayer and Knobelspiesse (2019) rather than Sayer et al (2020): <https://acp.copernicus.org/articles/19/15023/2019/>

Re: Yes, the citation has been corrected.

Table 1: is there an error in the count row, or am I misunderstanding? For example, if FL is 50.4 and NRT is 53.7 then shouldn't NRT_{gained} be 3.3 and not 5.4? The same comment applies to the other elements of this row.

Re: The NRT and SA datasets are compared using the same range of MISR blocks within each orbit. This is because session-based NRT files provide a range of MISR blocks (1 to 180) that they cover, which in turn allows us to select the same range of blocks from the SA product. However, the retrievals are not correlated one-to-one, meaning that there might be NRT retrievals within a block that do not have a SA equivalent, but also that there might be SA retrievals within a block that do not have a NRT equivalent. For that reason, the number of NRT_{prot}_{gained} is not a simple subtraction of the number of NRT_{prot} and the number of SA retrievals. We added the following clarification in the text:

“Note that the number of NRT_{prot} gained is not the same as the number of NRT_{prot} minus SA. This is because there are cases when a SA retrieval does not have its NRT_{prot} equivalent, making the SA count larger than it would have been otherwise.”

Tables 1, 2, 3: I wonder if it would also be useful to add rows indicating (arithmetic or geometric) AOD standard deviation for each case here. The shift (or lack of) in the mean is one thing but the truncation in variability is another. For example as one shifts to tighter cloud thresholds, Tables 2 and 3 show that the mean AOD does not change too much, but from the corresponding Figures it looks like there is some loss at both the low and high ends (possibly cloud shadows and clouds?). Adding standard deviation would be a quantification of how much this narrows the distribution (might also be negligible, it's hard for me to guess looking at the figures).

Re: We added arithmetic standard deviations to their respective means in Table 2 and 3 (but not in Table 1) as recommended. The standard deviations do not vary much when we change CSP and CSP9 thresholds, similarly to the mean and geometric mean values. When we change the ARCI threshold the standard deviations decrease gradually, getting closer to the standard deviation for the standard aerosol (SA) product. These STD decreases are again in overall agreement with the decreases we see in the mean and geometric mean values.

Line 322: I think "less" should be "fewer" as in principle this is a countable quantity.

Re: Corrected. Thanks for pointing it out.

Figure 7c: the colour scale makes it a bit difficult to see the absolute values here. Most of the world appears white but it's not clear whether this means ± 0.01 , ± 0.02 or what. I wonder if truncating the axis range (somewhere between 0.1-0.15 would probably work) and/or using a discrete or different colour table would make this clearer? Also, at present, the south polar region is in white ("zero difference") but I think should be grey ("no data").

Re: We changed the color scale in the figure. The updated plot has a reduced range of values (from -0.135 to 0.135) and 9 discrete colors with intervals of 0.03.

Figures 7, 8: I wonder if these should be presented as "NRT-FIRSTLOOK" (and hopefully "NRT-standard", see general comments) instead of "FIRSTLOOK-NRT"? That would seem more natural to me as we are comparing what is new (NRT) relative to the previous baseline (FIRSTLOOK or standard). It is possible that this is in fact what is done and the current headers are a typo. For example line 446 says NRT counts are lower than FIRSTLOOK in the southern subtropical oceans, but Figure 8b (if the plot title is correct) shows the opposite.

Re: Yes, we change the difference plots to NRT-SA. There was also a mistake in the text as the subtropical oceans have more NRT retrievals than SA (and FIRSTLOOK for that matter). This is due to the absence of upstream cloud classifiers in NRT processing and subsequently fewer subregions being excluded as cloudy.

Lines 469, 473-476: here the authors make a statement about what ARCI screening threshold is applied in the NRT product, and then make a suggestion that data users do their own experimentation for their particular use case. It is not clear to me from reading whether the

NRT product contains an “unscreened” data set plus ARCI values so that users can do this (as the standard product does)? Or does it only contain retrievals prescreened with the ARCI 0.18 threshold? Somewhere in the paper it would also be good to discuss NRT file contents (whether the file spec is the same as FIRSTLOOK/final or not – if so only one sentence is needed).

Re: We added the following clarification at the end this paragraph:

The NRT aerosol product contains both the recommended product contained within the main science directory “4.4_KM_PRODUCTS” that has the stricter ARCI threshold ($ARCI \geq 0.18$), and the unscreened product without the additional cloud and ARCI filtering designed for more experienced users, located within the AUXILIARY group.