Authors' response to comments are highlighted in **red.**

This manuscript by Limbacher et al. present a new MISR research algorithm (RA) for retrieving aerosol over land and water surface. To address the issues of large biases of high aerosol loading in MISR operational standard aerosol algorithm (SA), the proposed RA utilized and combined 2 schemes: (i) retrieved surface; (ii) prescribed surface from MODIS/MAIAC product. If the prescribed surface algorithm reported AOD<1, then the results from retrieved surface algorithm will be used; if the prescribed surface algorithm reported AOD>2, the results will adopt from prescribed surface algorithm; while if the 1<AOD<2, the results will be merged from 2 algorithms. In general, the methodology is sound. The validation with AERONET suggest a good quality for AOD, ANG as well as FMF, SSA and non-sphericity both over land and water. Overall, I think this paper is well-structured and clearly written, I recommend this paper to be published in AMT after some minor comments have been addressed.

The authors thank reviewer 4 for their comments and recommendation.

1. One interesting part however missing in the current manuscript is the direct comparison with MISR operational SA product. I would suggest to add at least some demonstrations of this part to show the evolution.
   Unfortunately, this paper (and our 2019 paper) are based on a subset of MISR data (Level 1 only) coincident with AERONET for a 4-year period. This dataset does not have MISR V23 data saved with it, which means making a direct comparison would be quite time-consuming. It would also make an already long manuscript even longer. We will absolutely do this in a future paper, as it is important for data users to understand the strengths and limitations of both algorithms (once the MISR research product is available to the public). Besides, such comparisons will be most relevant when we have completed our MISR Research *Product*, which we have recently been funded to produce, based largely on the work presented in this and other recent MISR RA papers.
2. In the validation section, the authors evaluate the fine mode fraction with AERONET almucantar inversion product. Why not to use AERONET SDA FMF, which definitely will provide more coincidences?
   This is an excellent observation. The reason we used the almucantar inversions is to understand how MISR (and AERONET) SSA, FMF, and non-sphericity were impacting errors. For instance, we discovered that as AOD increases over water, coarse-mode non-sphericity was increasing. For a variety of reasons (we postulate in the manuscript), this resulted in poorer quality retrievals of FMF, SSA, and coarse-mode sphericity itself. It would not be possible to do this analysis with the AERONET SDA data, as we would be missing SSA and non-sphericity retrievals.

#####SPECIFIC COMMENTS#####

Page 4 Line 15: How the temporally interpolation is done? Meanwhile, how do you deal with the differences of MISR and MODIS wavelengths?

We have added that this is linear interpolation. Outside of the adjustments made to MAIAC surface reflectance (which we describe in the paper) we don't adjust for differences between MISR and MODIS spectral response, as these are small effects compared to other uncertainties.

Page 4 Line 20: MISR's 36 channels? This should be a mistake. Do you mean 4 wls x9 angles?
We have added that this means 4 bands by 9 cameras.

Page 5 Line 21: Surface reflectance correction? This is not clear to me.
You correct your retrieved surface reflectance? If yes, how it can help to remove AOD bias?
or you correct measured TOA reflectance?
The prescribed surface retrieval initially produced even higher AOD biases than the ones presented in the paper. We used regions where the MISR retrieved surface algorithm agreed well with AERONET (and AOD was <0.2) to identify a correction for the MAIAC retrieved surface albedo (compared to the MISR retrieved surface albedo). We then applied this correction to all 9 surface reflectances given by MAIAC for a specific band. Ideally, this would have eliminated the prescribed surface bias. However, because we did not perform a camera-by-camera analysis, a significant bias remained in the data (unless the bias is calibration related). However, we only use the prescribed surface results when aerosol loading is high, so it is unlikely that a refinement in the prescribed surface reflectance will significantly impact our results.

Page 6 Line 15: How do you derive ANG from your algorithm, this is not clear in the text?
ANG is derived by a log-log fit of wavelength to extinction using all 4 MISR bands. Extinction cross-section ratios (b,g,r,n/Green) are saved for all 17 MISR aerosol components, and effective extinction cross-section ratios are calculated based on the aggregate mixture fraction arising from a combination of all 17 components.

Page 14 Line 24: ANG at 550 nm?
This was a mistake. We have changed this to ANG (446-867 nm)
Page 15 Line 17: So the NDVI<0.1 is not retrieved over land, right? Or you still retrieve it but not pass with high quality flag.
We still retrieve the data, but it did not pass our quality-assessment. We now have included retrievals with NDVI down to 0.0, which resulted in significantly more retrievals passing QA (including some desert retrievals)

Page 20 Line 1: it's not clear from Section 2. How the ANG is derived from the algorithm? Only AOD at 550 nm is mentioned.
ANG is not initially retrieved by the algorithm, but instead calculated by the aerosol component fractions, as described in 2.1.2. The actual calculation of ANG is exactly as provided in our AERONET data and validation methodology.

Tables 4 and 6: it looks like incorrect for AOD blocks. 0.2<AOD<0.5 not 0.2>AOD>0.5?
Thanks for catching that, you are correct.