Response to RC1:

Review of "The MISR Research Product Algorithm – Producing Global, Self-Consistent, Pixel-Level Aerosol Retrievals for the Multi-angle Imaging SpectroRadiometer". This article presents substantial updates to the MISR research algorithm, and analysis of how the updates compare with AERONET and other MISR products. Overall, the paper demonstrates the value of the product. I look forward to seeing this paper successfully published, and believe it will contribute meaningfully to the academic discourse. To help the paper to achieve its best results, I have six questions that I would like the authors to address. I believe that addressing these minor/moderate changes will make the paper even more successful

We thank the reviewer for constructive and very helpful notes, and we have done our best to address each point, as summarized below. Proposed additions to the manuscript and supplement in response to comments such as figures and tables have been isolated in the attached supplement.

Q.1. NIR-only Bc and revised mixture weighting (methodological refinements). The shift to NIR-only computation of the shape-similarity coefficient Bc (Eq. 2) is physically well-motivated, as NIR radiation penetrates the atmosphere more effectively and is less susceptible to the flat-field anomalies and stray-light effects that are most pronounced in the blue and green bands. Similarly, the revised mixture-weighting scheme (Eq. 3b) sharpens aerosol type selection by concentrating weight on the lowest-cost mixtures. Could the authors briefly comment on whether these two changes also reduce sensitivity to calibration residuals or cloud-contamination artifacts? Additionally, could the revised mixture weighting be overly aggressive in genuinely mixed aerosol scenes - for example, dust-smoke mixtures over West Africa - where a broader weighting might better represent the actual atmospheric state?

R.1 It is not easy to assess specifically whether the revised approach reduces sensitivity to calibration residuals. However, as MISR radiometric calibration issues are generally largest for the blue band, this might be mitigated to some extent.

Regarding the last point, it is possible that the revised mixture weighting is overly aggressive. But overall, the MISR aerosol-type retrieval amounts to selecting from among the mixtures in the algorithm climatology those that most closely match the observed radiances, so by far the most dominant factor affecting how well the retrieval results represent the actual atmospheric state is the assumed climatology. For this reason, we have aimed to present the limitations as well as the strengths of our particle-property retrieval results.

Q.2. NDVI-based CSA weighting and performance over bright/semi-arid surfaces. The updated over-land CSA weighting (Eq. 6), which incorporates NDVI thresholds in addition to PSA AOD, is well-justified and should help mitigate retrieval errors over bright desert surfaces. Do the authors have any quantitative assessment of how much this new weighting improves AOD retrievals specifically over semi-arid or bright-land surfaces relative to the Limbacher et al. (2022) version? In particular, the transition zone (NDVI 0.10-0.25) is where the blending is most active - a brief stratification of validation statistics by NDVI bin (low/medium/high) in the supplement would substantially strengthen this result.

R.2 An analysis of algorithm performance for three regimes of scene-wide NDVI has been added, comprising Table S4 and remarks in Sect. 3.1 (Contained in the supplement to these comments). Ideally, such analysis would be done based on pixel-level NDVI, though unfortunately this is not feasible for us currently. As it stands, we hope that Table S4 illustrates the rationale acceptably.

(Sect 3.1)
Compared to the version of the algorithm used in Limbacher et al. (2022), the updated methodology of additionally blending the contributions of the RSA and PSA using the prescribed surface NDVI provides improved results for low-NDVI scenes. Table S4 in the supplement shows that in scenes where prescribed-surface NDVI < 0.1 the new CSA displays an RMSE 45% lower than the previous version, with a 43% lower bias. In the regime of 0.1 < NDVI < 0.25, the new CSA also shows improved RMSE (0.089 vs 0.114), and bias (0.001 vs 0.014).

Table S4: Results of the new MISR CSA using additional attenuation depending on NDVI introduced in this paper alongside the version used in Limbacher et. al., 2022, stratified according to three bins of scene-wide prescribed-

surface NDVI. N is the number of coincidences, RMSE is the root mean squared error, MAE is median average error, bias is the mean AERONET-MISR bias, and r is the Pearson correlation coefficient.

	New CSA	CSA (2022)
	NDVI < 0.10	
N	6942	6942
RMSE	0.125	0.229
MAE	0.08	0.103
bias	0.084	0.147
r	0.917	0.889
	0.10 < NDVI < 0.25	
N	11513	11513
RMSE	0.089	0.114
MAE	0.032	0.033
bias	0.001	0.014
r	0.948	0.917
	NDVI > 0.25	
N	57344	57344
RMSE	0.082	0.083
MAE	0.026	0.026
bias	0	0.001
r	0.946	0.943

Q.3. The authors highlight the PSA's role in correcting the persistent low bias at high AOD that affects both the SA and earlier RA versions (lines 55-62). This is an important methodological contribution. Could the authors provide, either in the main text or supplement, a more explicit quantification of bias reduction specifically at high AOD (e.g., AOD > 1.0) attributable to the PSA component of the CSA? This would make the contribution of the prescribed-surface approach more transparent and easier to compare with future algorithms addressing the same problem.

R.3 The added Table S5 contains statistics for the three component algorithms, constrained for PSA AOD > 1.0. Here, the PSA is used as it determines the mixing coefficients for the CSA. The value of the PSA mixing may not immediately obvious from the RMSE and MAE, but the lower absolute bias compared to either the RSA or PSA should help demonstrate the usefulness of this method.

(Sect. 3.1)
Table S5 in the supplement constrains MISR vs. AERONET AOD to scenes where PSA AOD > 1.0. These results display the low bias of the RSA at high AOD, and that the CSA achieves lower absolute bias (-0.029 vs. -0.152) than the RSA by leveraging the results of the PSA.

Table S5: Statistics for MISR over-land RSA, PSA and CSA 550nm AOD vs AERONET 550nm AOD, filtered by MISR scene-wide PSA AOD > 1. N is the number of coincidences, RMSE is root mean squared error, MAE is mean average error, bias is the mean MISR – AERONET bias, and r is the Pearson correlation coefficient.

	RSA	PSA	CSA
N	1861	1861	1861
RMSE	0.387	0.508	0.299

MAE	0.168	0.286	0.143
bias	-0.152	0.217	-0.029
r	0.847	0.683	0.880

Q.4. The new cloud masking scheme is notably more sophisticated than in previous RA versions, combining MAIAC land masks, MODIS-Terra brightness temperature, and MERRA-2 sea-surface temperature. However, no direct validation of the cloud mask itself is presented - there is no assessment of cloud contamination rates or false-positive masking rates, particularly over bright desert surfaces where the brightness temperature test may be less reliable. Could the authors provide at least a qualitative discussion of the cloud mask's performance, or point to any existing validation of the MAIAC cloud mask over the relevant surface types?

R.4 This is a persistent challenge for satellite aerosol retrievals in general. We do not know of any dataset that provides systematic ground-truth for such an assessment. The reviewer has summarized the (qualitative) rationale for the added effort we introduced, with the aim of improving the cloud masking, but absent a ground-truth dataset, we are not sure how to take the assessment further.

Q.5. The authors rightly flag the inherent limitations of AERONET almucantar inversion variables - particularly FMF, SSA, and sphericity for quantitative validation (lines 182-190). The results show for AOD exceeding roughly 0.3-0.4, non-dust scenes are almost entirely dominated by small, spherical particles, while dust scenes show the expected coarse, non-spherical signature. This finding has clear relevance for anthropogenic aerosol studies, since urban and industrial pollution aerosol shares the same microphysical fingerprint as smoke in these retrievals. Would the authors consider adding a brief supplementary analysis at a small number of urban or industrially-polluted AERONET sites (e.g., Kanpur, Beijing, or a European site) during high-pollution episodes? This would explicitly demonstrate the MRPA's utility for anthropogenic aerosol characterization without requiring major additional development, and would complement the already-strong smoke and dust analysis. Additionally, it is reassuring to note that the retrieved mid-visible SSA under high AOD conditions (roughly 0.85–0.95) is consistent with the expected range for moderately absorbing aerosol types derived from surface observations, which supports the physical plausibility of the MRPA's particle absorption retrieval in optically dense plumes.

R.5 A supplemental analysis has been added in Sect. 3.4, comprising of Angstrom exponent, Single-scattering albedo, and fine-mode fraction plots and statistics for MISR AOD > 0.2, performed on a selection of sites in meteorological winter. This selection of sites is detailed in Table S2.3.

(Sect 3.4)

A limited number of sites in meteorological winter were selected to assess the performance of the MISR CSA in scenes likely at times to contain significant urban and/or industrial pollution. Table S2.3 in the supplement contains the list of sites used in this analysis. Figure S7 and Table S11 display results for MISR CSA vs AERONET Ångström exponent (446-867nm) for this selection of sites, constrained to MISR AOD > 0.2. With 240 coincidences, Fig. S7 shows incident data primarily grouped around 1.0 < ANG < 2.0 for both MISR and AERONET, which would be expected for sites primarily dominated by small, urban and/or industrial aerosols. For these coincidences, MAE is 0.166 and RMSE is 0.260, with a bias of 0.062.

Figure S8 and Table S12 display results for MISR vs AERONET FMF and SSA for the selection of sites in Table S2.3 and constrained for MISR AOD > 0.2, with cases for MISR AOD >= 0.5 highlighted in a different color. The number of AERONET almucantar coincidences for this selection is 203. For FMF, RMSE is 0.096, MAE is 0.058, with a bias of -0.030. For the SSA analysis, RMSE is 0.040, MAE is 0.021 with a bias of 0.013 (Table S12). Most coincidences for FMF in Fig. S8 are grouped towards being fine-mode dominated, and the SSA for these data is primarily between 0.85 and 0.95, as might be expected for pollution particles.

Table S2.3: AERONET sites and months selected for likely industrially-polluting sources

Janpur	D12
Beijing	D12
London	D12
Mexico City	D12

Figure S7: Plot of over-land MISR CSA vs AERONET Ångström exponent (446-867nm) for sites selected to be likely dominated by urban and/or industrial pollution aerosol sources.

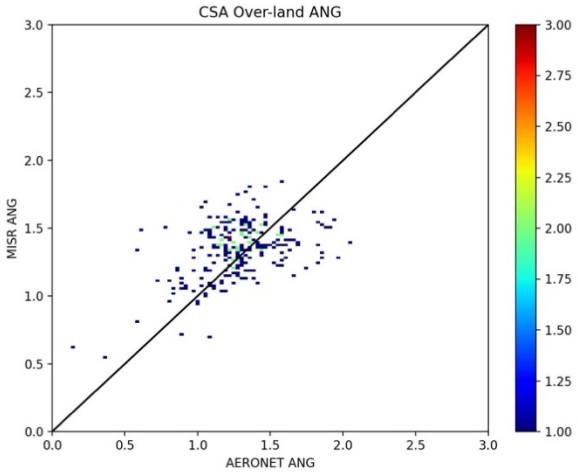

Figure S8: Plots of over-land MISR CSA vs AERONET fine-mode AOD_{550} fraction (FMF) and 550nm single-scattering-albedo (SSA) for over-land sites likely to contain urban and/or industrial pollution aerosol sources. Results are color-coded, with blue points corresponding to cases where 0.2 < CSA AOD < 0.5, and black points corresponding to cases for which CSA AOD >= 0.5.

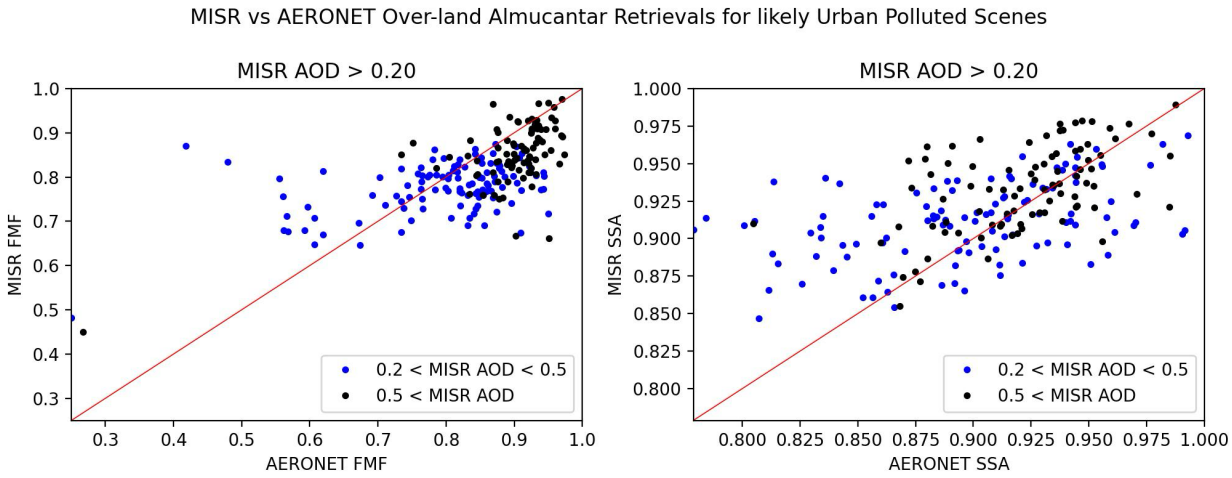

Table S11: Statistics for MISR CSA vs Ångström exponent (446-867nm) for sites selected to be likely dominated by urban and/or industrial pollution aerosol sources, constrained to MISR CSA AOD > 0.2. Statistics correspond to data in Fig. S7.

N	240
r	0.448
RMSE	0.26
MAE	0.166
bias	0.062

Q.6. The authors acknowledge that the CSA and V23 SA comparison datasets are not identical, which limits the strength of the performance comparison. Would the authors consider adding a supplementary table reporting CSA statistics computed over the exact same coincidences used in the Garay et al. (2020) SA validation, to facilitate future meta-analyses and more rigorous algorithm intercomparison? Additionally, two minor points warrant checking: (a) Figure 1 and Figure 5 captions both reference "October 2023" whereas the stated study period ends October 2022 - please verify; and (b) the over-water correlation coefficient r = 0.093 reported for the CSA (Table S6) appears inconsistent with the strong visual agreement in Figure 5 and may be a typographical error.

R.6 We don't have a way of getting the Garay et al. (2020) cases specifically, and regenerating such a dataset would be a considerable amount of work for what seems likely to be very limited benefit.

Citation: https://doi.org/10.5194/egusphere-2026-342-AC1

Response to RC2:

Review of "The MISR Research Product Algorithm – Producing Global, Self-Consistent, Pixel-Level Aerosol Retrievals for the Multi-angle Imaging SpectroRadiometer". This paper presents a new automated version of the MISR research algorithm that can provide aerosol particle property information on a large scale. Specifics on the technical improvements are provided and results are tested against AERONET data. The paper is successful in arguing for the scientific merits of the improved algorithm and should be published with minor corrections.

I have gone over Reviewer 1's comments and the author's responses, and I think the authors sufficiently addressed the issues raised by R1 (I had a few of the same questions). I have one general comment, followed by some technical suggestions.

We thank the reviewer for this review, and for the positive and constructive assessment of our work. We have made changes and additions accordingly, as summarized below.

General:

Although this is a paper on the technical aspect of the algorithm and not focused much on its applications, it would benefit from some discussion of the "big picture," especially in the Introduction section. In what context have the RA and SA been leveraged by previous studies (include citations), and why is it important? How are the potential applications of the MRPA different and/or how could it complement these studies or provide new opportunities? In short, why should someone who has less technical background and may not be interested in the algorithm design, but still has an interest in aerosol science, care? I realize some past work with fires and dust are mentioned in Sect. 3.3, but I still think something more explicit and located at the beginning of the paper would be very beneficial to readers. You may want to add a little more in the Conclusions too.

Fair enough. There is a considerable literature by our group and others using the MISR aerosol data to study wildfire plumes, desert dust, volcanic emissions, and pollution particles. We have added a full paragraph citing some of these papers, also summarizing the strengths of the research algorithm results as compared to the standard product, and pointing out that although the resources for generating results with the new algorithm for the entire MISR data record have not been available, users have access to the code, and it can be run by users for any parts of the MISR data of interest for specific aerosol studies.

Technical:

- **Figure 1: It may be useful to point out in the caption that the colorbar scales are slightly different**.

Good point. Thanks.

- **Figure 3: The resolution on this is lacking, making it a little hard to read and distracting. The panel lettering and the red overlay text is fine, but the rest is too blurry**

Ok. Done.

- **I found some inconsistencies in how you refer to the Supplemental Material. Sometimes it's called the supplement, sometimes the supplemental material, sometimes the Supplemental Material. I suggest making it consistent, but it's your call.**

Ok. It is now "Supplemental Material" throughout.

- **Line 268: Confused by this sentence - is it supposed to be two sentences, with the first sentence ending after "...against AERONET inversion data."?**

Now edited for clarity.

- **Line 287: There is an extra "there are" in the second sentence of the paragraph**

Fixed.

- **Figure 5: Same suggestion as with Figure 1**

Ok. Done.

- **Figures 7 and 8: Plots are a little small and hard to read. Is there any way to increase the font size? Perhaps you can decrease the negative space between subplots and make the whole thing bigger?**

Ok. Done.

- **They may handle this in Editing, but some of the figures seem more centered on the page than others**

This is done in editing.

Citation: https://doi.org/10.5194/egusphere-2026-342-RC2