**Response to Reviewer 1**

We thank the reviewer for their feedback and constructive criticism, which have helped us significantly improve our manuscript. We have taken care to address each comment with a direct response. The text from your comments are shown in black and our responses are shown in blue. Responses include the manuscript text that was changed, removed, or added.

**Overall Notes** This paper introduces a python tool aimed at associating in situ aerosol measurements obtained during aircraft field campaigns with remote sensing aerosol retrievals, by addressing the need to compensate for the limited coarse-mode throughput of aircraft inlets and to hydrate in situ samples when comparing with ambient (remote sensing) observations.

As these calculations must be made if in-situ field data are to be used to validate remote sensing retrievals quantitatively, the algorithm presented here represents a useful tool for such applications. The observations used to test this approach were acquired during the ACTIVATE field campaign, and the scope of the present study is limited to fine-mode sulfate and organic aerosol, and a coarse mode taken as sea salt. They impose assumptions that limit considerably the applicability of the current implementation - constant refractive indices over the spectral range, spherical particles, parameter assumptions required to calculate the hydrated CRI, etc. However, these are stated clearly, which is as much as one can ask in an AMT paper. The remote sensing data were obtained from the HSRL-2 and RSP aircraft instruments, which avoids some of the sampling differences that arise when in situ measurements are compared with spacecraft measurements. As such, the approach seems most applicable for validating aircraft field measurements.

In summary, the paper develops a useful tool and presents a thorough analysis of its performance. For general application, there are significant limitations in the assumptions made, but given that the analysis is circumscribed to a narrow set of relatively favorable conditions, I think this is acceptable for publication in AMT, perhaps with minor modifications as suggested below.

Thank you for the comment. We agree with this assessment and, while some of the text has changed, this description of our work is still true. We address each of the suggested changes below, but no specific changes are made as a result of this summary.

**A Few More Specific Notes** Line 244. It might be useful to mention how far the aircraft travels in 45 seconds, to provide a sense for the horizontal resolution of the SMPS and other, aggregated measurements.

Thank you for the comment. The text "that can travel of 8 km across the ground in 45 seconds" has been added to the end of this sentence.

Line 270. Might be worth noting that remote sensing is more sensitive to volume than number concentration specifically for particles smaller than the observing wavelength. For particles larger than the observing wavelength, sensitivity is greater to particle cross-sectional area.

Thank you for the comment. We agree this is relevant information and we have added it to the paragraph that now reads as follows:

> In general, remote sensors are not as sensitive to particle number concentration as they are to particle surface area and volume concentrations. For particles larger than the remote sensor's observing wavelength, the remote sensor is most sensitive to particle cross-sectional area. For particles smaller than the observing wavelength, the remote sensor is most sensitive to volume concentration. Given the sensitivity of remote sensors to surface area and volume concentration, this work also discusses the logarithmic size-resolved aerosol particle surface area concentration ($a^{\circ}$) and logarithmic size-resolved aerosol particle volume concentration ($v^{\circ}$).

Line 454. Comparing Fig. 1 with Fig. 5, and taking the y-axis scales into account, I would say "...overall, much less variance."

Thank you for the comment. We agree this is a fair assessment and have changed the text to be "..., but the synthetic data see overall much less variance"

Line 469. As this is synthetic data, doesn't the statement here just mean that the numerical coding was done correctly? Not a bad thing to mention, but the statement here makes the observation sound more fundamental.

Thank you for the comment. We agree this finding has been overstated and have changed the sentence to be "To demonstrate

the functionality of this analysis, the synthetic data generation and retrieval processes were repeated with zero measurement noise, which results in a rate of successful retrievals of 100%."

Line 494. A word seems to be missing from this sentence.
Thank you for the comment. We appreciate catching the error. We have changed the text to be "...which suggests that the ISARA-derived products are less reliable at relatively low scattering signal (i.e., signal < 5 $\mathrm{Mm}^{-1}$)"

Lines 498-500. By way of explanation, wouldn't the 700 nm channel likely be the most sensitive to coarse-mode particles, for which many of the assumptions might be less applicable?
Thank you for the comment. We agree that this increase in MRB with increasing wavelength is notable and while it is only a few percent difference, we have added the following text to capture this: "Because this bias increases with increasing wavelength, it is possible that some of this discrepancy is due to larger particles that are more commonly comprised of dust, but this trend only accounts for a few percent difference in MRB".

Section 3.1.3. Just wondering how representative of the entire column the in situ data sampling might be. I realize the HSRL-2 data are height-resolved, which can help assess the vertical heterogeneity compared to the in situ sampling.
Thank you for the comment. We have analyzed this with some level of detail in Section 3.2 with regards to the RSP-derived and ISARA-derived products.

Figure 10. There appears to be a lot of scatter in the data, which the text does not seem to acknowledge. This is probably not surprising - in addition to the limitations discussed in the paragraph about this figure, given the likely horizontal and vertical variability in particle concentration combined with differences in sampling.
Thank you for the comment. To address this we have added error bars and standard deviations where appropriate throughout the text. We agree that there is a lot of scatter, however this appears to fall within the standard deviations of many of the points. The text has been changed as follows to address this: "Similar to $C_{\mathrm{ext}}$ and LR, the standard deviations in the HSRL-2+RSP-derived $N$ often encompass the 1-to-1 line.".