

Author comments to Referee #3 (RF3)

Response to general comments:

The authors would like to thank RF3 for his/her thorough review of our manuscript. All his/her comments and suggestions were carefully considered and addressed.

I have one issue with the data analysis. I suspect the real part of dry refractive index is systematically overestimated. That is because of the discrepancy in particle size between the two sets of measurement being compared: The submicron particles that the UHSAS observed are held accountable for the extinction by the particles up to 5 μm that the nephelometer and PSAP observed. To reduce the systematic error, one could compare size distribution and extinction for an identical size range. An impactor is commonly used to pass particles under 1 μm aerodynamic diameter. Its passing efficiency modeled for geometric diameters (see, for example, paragraph [21] of Howell et al., 2006) allows adjustment of the measured size distribution for the particles behind it. Optimize the dry refractive index for the adjusted dry size distribution and the scattering and absorption measured behind the impactor. The overestimate in refractive index, which I think should be noted in the manuscript, has implications. It invites a systematic bias in the calculated extinction and backscattering except the extinction in the vicinity of the nephelometer and PSAP wavelengths (i.e., 532 nm extinction). So the behind-the-impactor retrieval may help explain the systematic biases shown in Figure 7. This possibility makes it worth trying even if the random error is to be magnified for the smaller coefficients and the uncertainty in the impactor passing efficiency.

The adjustment of the effective refractive index was not performed as suggested by the reviewer, but a discussion has been added regarding the bias that might originate from combining submicron size distributions to scattering and absorption measurements obtained for sub and supermicron particles.

Response to specific comments:

- 1) Page 1. Line 1. Insert "and" after "radii".
Done.
- 2) Page 2. Line 18. Replace the slash after dsm with a period.
Done.
- 3) Page 3. Line 14. "not necessary". Why? Low ambient RH?
Please refer to item 8 of the authors' comments to RF1.
- 4) Page 3. Line 16. Remove "of more than 700 lidar retrievals" because it is said in line 18.
Done.
- 5) Page 4. Line 21. Insert ", the latter" after "California".
Done.

- 6) Page 5. Line 5. Use the Greek letter instead of mu.
Done.
- 7) Page 5. Line 11. The first sentence is unclear. Is it necessary?
Sentence was removed.
- 8) Page 6. Line 18. Are these wavelengths correct?
Wavelengths were corrected.
- 9) Page 6. Line 29. Replace “proportional” with “related”.
Done.
- 10) Page 8. Line 13. The vertical resolution of 5 m corresponds to ~ 1 s for typical aircraft vertical speeds. But, while the TSI nephelometer records every second, it does not resolve scattering coefficient for each second. The residence time of particles in the TSI nephelometer is closer to 5s under typical flow rates.
The in situ measurements are interpolated vertically in order for them to match the HSRL-2 vertical resolution of 15 m for the optical properties, and 75 m or 150 m for the microphysical properties.
- 11) Page 10. Line 16. Is “approximately” necessary? Also Page 16. Line 8.
Removed.
- 12) Page 10. Line 29. Replace “measurements” with “measurements”.
Done.
- 13) Page 11. Line 2. Replace “sensitive” with “sensitivity”.
Done.
- 14) Page 13. Line 15. Replace “seem” with “seems”.
Done.
- 15) Page 13. Line 28-30. Isn't this because the particles sampled in California were somewhat smaller than those in Texas, as implied in Figure A2? Smaller particles are less prone to inlet loss. Can you show the bias for the 532 nm extinction as a function of the Angstrom exponent? The 532 nm extinction is a good choice here because it should be barely affected by the refractive index bias mentioned above.
This is discussed in the revised manuscript. We used the ratio between in situ and AERONET AOT and compared to the Angstrom exponent measured with AERONET.
- 16) Page 16. Line 2. What does “a preliminary assessment . . .” refer to?
To the preliminary results from sensitive studies that have been performed with simulated data in order to assess the uncertainties of the 3+2 retrievals. We added a reference to Table 1 to make the reference clearer.

17) Page 18. Line 32. Make “I” small.

Done.

18) Figure 2. Note the particle size range for the $dN/d\log D$ ($< 1\mu\text{m}$) and the measured scattering and absorption ($< 5\mu\text{m}$).

Done.

19) Figure 3. Make the “O” as large as “H” in the upper right box.

Done.

20) Figure 4. Indicate that the values refer to the fine-mode only. Perhaps also for Figure 5 and 6.

Done.

21) Figure 6. Should “ $q1+1.5\times\text{IQR}$ ” read “ $q3+1.5\times\text{IQR}$ ”? Also, what is the significance of $1.5\times\text{IQR}$? Why is this expression used instead of another set of percentiles like 5% and 95%?

Fixed. The $1.5\times\text{IQR}$ is the standard definition of outliers in statistics.