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Atmospheric Measurement Techniques Discussions

Interactive comment on "Intercomparison of aerosol volume size distributions derived from AERONET ground based remote sensing and LARGE in situ aircraft profiles during the 2011–2014 DRAGON and DISCOVER-AQ experiments" *by* Joel S. Schafer et al.

Anonymous Referee #1

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The work "Intercomparison of aerosol volume size distributions derived from AERONET ground based remote sensing and LARGE in situ aircraft profiles during the 2011-2014 DRAGON and DISCOVER-AQ experiments" by Schafer et al. shows a comparison between the Aerosol volume size distributions (VSD) obtained by AERONET with near simultaneous in situ sampling from aircraft profiles acquired with the LARGE UltraHigh Sensitivity Aerosol Spectrometer (UHSAS). Due to the characteristics of UHSAS instrument, the comparison is focus on the fine mode, and particularly, on the

radius of the peak concentration and fine mode width, which are almost equivalents to the AERONET standard products for the fine mode: volume median radius and standard deviation from volume median radius. The average difference in the radius peak is 0.033 μm and this difference decreases to 0.011 μm when the effects of ambient humidification (hygroscopic growth) are accounted.

The value of the paper resides in the difficulty to conduct this type of validations with highly equipped aircrafts and coordinated with ground-based measurements. Overall, the manuscript is quite clear and good presented though there are some parts that are not completely well described, and some results are, in my opinion, not sufficiently justified. Therefore, my recommendation is to accept the paper after some major revisions.

Major remarks

- Page 3 line 34 and Page 8 line 15: the way growth-factor is estimated and how is applied to correct the VSD is not clearly presented on the paper. I reckon that some ideas can be gained in the study by Gasso et al. (2000), but due to the importance of this particular issue in the present work, I would strongly suggest including the corresponding explanations here. This may clarify the role of scattering and absorption coefficients measured by the nephelometers and PSAP. On the other hand, the authors could also consider adding a table with the wavelengths used and the aerosol parameters measured or/and retrieved by the different instruments in the study. For instance, the reader needs to guess that the absorption coefficients are measured by PSAP instrument, however, I think that it could be clearly stated in the manuscript as well as the utility of those measurements.
- In the page 7, the authors say that the relatively large differences found for California winter campaign cannot be attributed to the hygroscopic growth since the humidity was too low. They suggest that the explanation could be associated to

the high presence of aerosols in low atmospheric layers. My question here: is there any trend indicating that the VSD for heights smaller than 170 m present a peak in smaller radii? In other words, if we assume some continuity in the aerosol vertical distribution, and we observe the VSD at 280 m (or higher) and those at 170 m, is any tendency observed towards smaller radii?

- Page 11 line 2. The authors suggest that sensitivity to the fine mode concentration in AERONET standard inversion is worse than for the radius and standard deviation of the fine mode. I think that the sentence should be either reformulated or well referenced. For instance, that result cannot be inferred from the study "Accuracy assessments of aerosol optical properties retrieved from Aerosol Robotic Network (AERONET) Sun and sky radiance measurements" by Dubovik et al. 2000.

- Page 12 line 14. Just analyzing the figure 5, it is difficult to believe that there is any variation for the width$_{fine-mode}$ when applying the growth factor. Moreover, the authors claim that there is an improvement for this parameter in all the campaigns: Texas, from 0.023 μm to 0.012 μm, MD, from 0.065 μm to 0.043 μm and California from 0.064 μm to 0.044 μm. However, if we look at the tables 1 and 2, we find that the improvement only occurs in Texas: the values shown in table 1 for MD and California are 0.048 μm and 0.043 μm, respectively, hence quite similar to those obtained in table 2 (0.043 μm and 0.044 μm). I would think that the variations in the width$_{fine-mode}$ are related to the elimination of some data in the second study, due to the impossibility of estimating the growth factors in some of the profiles.

Minor remarks

- Page 3, line 3: It's not clear why only the duration of the first campaign is mentioned (2 months) and it is omitted for the ones in California, Texas and Colorado.

This fact could explain the differences in the number of measurements in Table 1.

- Page 3, line 19: I reckon that the expression: *...further from the sun (2°-10°)* should be changed by *...further from the sun (1°-20°)*. Note that the standard angles for almucantar measurements includes 7° and 8° (both larger than 6°) and from 100°, the measurements are done only each 20°.

- Page 3, line 28: The following sentence is not clear to me, please revise: *Although the UHSAS instrument only covers most of the fine mode size range (radius: 0.05-0.5 μm), it does allow for an assessment of the agreement of peak volume radius, size distribution width over a moderately large range of AODs.*

- Page 4, caption figure 1: I think that Colorado and Texas are reversed.

- Page 4, line 18: In the previous page we find a minimum of 0.05 μm and here somehow is shifted to 0.03 μm.

- Page 4, line 20: Although I think that it may be related to the Extinction/Scattering efficiency factors for the typical radius measured in the work, it is not clear why the authors considered the scattering at 500 nm to average the size distribution.

- Page 5, figure 2: Somehow the idea that figure 2 wants to show is not clear using the same color for all the measured size distribution. I suggest representing each size distribution using a color-map considering the scattering coefficient at 500nm (used as a weighing factor for the averaged size distribution). Also, it would be helpful to show the averaged size distribution in this figure.

- Page 5, line 1: I think that the use of "our" here is a bit confusing. I think it would be better to use AERONET standard retrieval products.

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