

Interactive comment on “Study of aerosol microphysical properties profiles retrieved from ground-based remote sensing and aircraft in-situ measurements during a Saharan dust event” by M. J. Granados-Muñoz et al.

Anonymous Referee #2

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General

Although the topic is of high interest, the paper is not in a good shape and acceptable form. I was and I am still close to the point of voting for rejection. At least, major revisions are required. Clear and precise answers to the questions are expected as well as improvements regarding all points mentioned below.

The first part up to section 4.2 is ok. Referee #1 provides a long list of comments, so that I do not have to add all these points here. However, you may add two references

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to provide a better link to other AMT EARLINET special issue papers:

On page 9293, line 28 (l28), one could provide the reference: Biniotoglou, I., et al., Atmos. Meas. Tech., 8, 3577-3600, doi:10.5194/amt-8-3577-2015, 2015.

On page 9303, l14, the following citation could be made: Mamouri, R. E. and Ansmann, A.: Fine and coarse dust separation with polarization lidar, Atmos. Meas. Tech., 7, 3717-3735, doi:10.5194/amt-7-3717-2014, 2014.

Here is the list of my main points which all deal with the CAS-POL part.

As mentioned, I expect careful, precise answers to all questions. This will hopefully trigger a better internal discussion with the co-authors (especially with Darrel Baumgardner). Without fully satisfactory answers, the paper cannot be accepted for publication.

Major issues:

* p9308 l6: Where do the 50% for the refractive index assumption come from? Appendix says 20% sizing uncertainty due to refractive index.

* Fig. 6a: The errors plotted for CAS-POL volume concentration are on the order of 50%, but 90% are reported on p9315 l12. Where does this difference come from?

* Fig. 6b: What is shown in Fig. 6b? Is the particle linear depolarization ratio plotted, as used for example by Freudenthaler et al., 2009?

* Fig. 6b, figure caption: Nomenclature is not consistent. Sometimes "polarization ratio" is used, sometimes the same quantity is called "depolarization ratio"?

* Fig. 7: 1) As far as I understand, PCASP-100X detects the size range between 0.1 and 3 μm and CAS-POL detects 0.5 - 50 μm . Why are the data in the overlap region of both instruments not shown? Please also include the CAS-POL data below 4 μm . How good is the agreement between the PCASP-100X and the CAS-POL in the overlapping size range? 2) What is shown in Fig. 7? Is it a volume size distribution ($dV/d\log D_p$) or

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is it something else (volume concentration per bin)? Are the data in the individual bins normalized to the bin-width? 3) Please include error bars in Fig. 7.

* p9309 l6: Why is ice and not dust used to explain that a larger depolarization ratio is measured by the CAS-POL in comparison to the lidar?

* p9309 l9-11: P22/P11 is not the inverse of what is reported from lidar and CAS-POL! See Freudenthaler et al., Sassen et al. etc. for definition of the linear depolarization ratio.

* Fig. 8: P22/P11 should be in the range 0.0-1.0, and not >1.0 like plotted in Fig. 8

* p9309 l4-15: Besides that, the explanation is certainly wrong. According to scattering calculations (e.g. Dubovik et al., 2006 or Wiegner et al., 2009), P22/P11 for dust is larger at 168°-176° than at 180°. Thus, the scattering matrix shows that the depolarization ratio for dust reported by CAS-POL should be smaller than the value from lidar.

* p9313 l10-14: Unclear. Can you rephrase what is meant with this section?

* p9314 l28: How were the depolarization ratio signals averaged? A) Sum up signals from both channels and divide or B) Divide and average? For comparison of CAS-POL data with lidar measurements, option "A" should be used.

* p9315 l1: How was this uncertainty of 30% derived? Which uncertainties are considered? Variation of orientation leads to a much larger uncertainties...

* Fig. 10: This figure is a copy of Fig. 7 in Baumgardner et al., 2014, except that the label writes "Particle size = 2 μm " instead of "Particle size = 1 μm ". In addition, this calculation seems to be done for the CPSPD instrument which has a different instrument geometry ("off-axis laser" in the CPSPD in contrast to a "on-axis laser" in the CAS-POL).

* p9315 l6-8: The link between this sentence and the previous sentence is unclear.

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- * p9315 l8: How was the uncertainty of 50% estimated?
- * p9315 l12: It remains unclear where the uncertainties for volume concentration and median volume diameter come from.
- * How were the backscatter channels calibrated?
- * How do the presented "polarization ratio" values from CAS-POL (with values around 0.25) compare to the "polarization ratio" values (~ 0.30 – 2.50) presented by Glen and Brooks (ACP, 2013)?

Some minor issues:

- * p9294 l11–14: "Most comparisons, such as those reported ..." That is not correct. Weinzierl et al. used the size distribution and refractive index derived from multiple instruments together with an optical model to calculate extinction coefficients which were then compared to directly measured extinction coefficients from lidar. Therefore, quantitative intercomparison not only qualitative intercomparisons were done.
- * p9296 l16: Nomenclature is not consistent. Alpha is already defined as extinction coefficient, but here it is also used as Angström exponent.
- * p9306 l25–26: Not quite correct, as AERONET covers up to a radius of $r=15\mu\text{m}$
- * p9307 l3: Is the imaginary part of refractive index set to zero?
- * p9308 l14: 5d should be 5e
- * p9308 l16: EOD not defined (it is defined later in the appendix)
- * p9308 l21: 680 nm does not fit to 658 nm in sect 2.3
- * p9314 l2: There are no dashed lines in Fig. 9a.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 9289, 2015.

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