Atmos. Meas. Tech. Discuss., 8, C3122–C3127, 2015
www.atmos-meas-tech-discuss.net/8/C3122/2015/

Atmospheric Measurement Techniques Discussions

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-Mu noz et al.

Anonymous Referee #1

Received and published: 24 September 2015

The manuscript "Study of aerosol microphysical properties profiles retrieved from ground-based remote sensing and aircraft in-situ measurements during a Saharan dust event" of Granados-Munoz et al. deals with the interesting topic of dust observations with multiple techniques. This is an interesting study, including a promising comparison of remote-sensing and in-situ depolarization measurements. However, several aspect of the manuscript need to be changed and improved before it is appropriate for publication in Atmospheric Measurement Techniques. Find below some general and some detailed comments.

Overall comments:

———————-

* Define the scope of the paper: The manuscript sets several goals and, naturally, cannot reach all of them. The title and abstract suggest that this work is about the study of an interesting dust case (a topic more suitable for ACP, rather than AMT). The introduction suggests that the focus is on evaluating the LIRIC algorithm, or in any case on microphysical properties profiles. The conclusions stress the use of both columnar and profiling measurements. The same confusion propagates also in the presentation of the results. For example, it is not clear what is the usefulness of the Linear Estimation technique in the present form. On its own it is an interesting analysis, but why do you present it here? You should define a consistent scope for your publication and explain how all parts contribute towards that goal.

* Improve the comparison between different remote-sensing techniques: Assuming that your aim is to evaluate different retrieval approaches, what is missing is their actual detailed comparison. For example, how do LIRIC backscatter coefficient profiles compare to those derived by Klett-Fernald approach? How do the depolarization parameters assumed in LIRIC compare with the ones measured with the lidar? How does the refractive index derived using the regularization technique compare with those retrieved by AERONET or the linear estimation technique? How does the extinction-to-volume ratios used in LIRIC compare with the ones derived with the regularization techniques How does the mean effective radius derived by the regularization technique compares with the columnar values derived using Linear Estimation? Such comparisons will improve confidence to the results and will help clarify the underlying reasons for any discrepancies.

* Improve the comparison with aircraft measurements: There are several open issues with the aircraft comparison. Most importunately, lidar and CAS-POL seem to measure different depolarization quantities! In lidar studies depolarization is typically defined as

AMTD

8, C3122–C3127, 2015

"perpendicular" / "parallel" signals, while CAS-POL uses "perpendicular" / "total" signals. If this is correct, you will need to revise the manuscript and add detailed discussion on how these quantities are related, and in what extend you can compare them. Additional, as you explain in detail, there are differences in depolarization because of the different measurement angles. Your estimation of the errors is however only qualitative. It seems to me that you could actually do a quantitative calculation, as you have retrieved dust micro-physical properties and have a spheroid scattering model already implemented. What you are presenting here is a unique and valuable dataset, and it is worth to carry the analysis in detail.

Detailed comments:

---

p. 9293 l.2: Should be "non-spherical models" instead of "non-spherical particles"

p. 9293 l.22: You are implying that you can apply this LIRIC algorithm to micropulse lidars. Please provide evidence or rephrase. Also, in Pappalrado et al. 2014, it seems that most EARLINET instruments are anyway multi wavelength Raman lidars, so I don't see how this is a benefit of the LIRIC approach.

p. 9295 ll. 20: You need to specify the methods used to retrieve aerosol optical properties, together with all used assumptions / parameters for this specific case.

p. 9295 ll. 20-23: Provide a reference for these uncertainties. Also specify if these refer to statistical uncertainties due to expected signal-to-noise ratio or consider the assumptions of the retrieval algorithm.

p.9297 Sec 2.3: The length and content of this section is very unbalanced compared to ground based instruments (Sec. 2.2). This is your validation instrument, it should be described in more detail. You should move at least part of the Appendix here. Discussing the uncertainties of CAS-POL is a core part of the paper.

p. 9299 l. 1-3: You only describe uncertainties due to AERONET volume concentration.

AMTD

8, C3122–C3127, 2015

Lidar data don't have any impact in the final result? Please discuss.

p. 9299 l. 15-16: You need to specify the parameters / details of your retrieval. Min/max particle size? What was the assumed limits of the of complex refractive index. Also, specify how you specify the unknown uncertainties.

p. 9300 l.22, also Figure 1: Specify the wavelength.

p. 9302 l. 14: Lidar ratio is measured in sr, not sr-1

p. 9302 ll. 13-14: Specify how do you choose these values. Are they different for each retrieval?

p. 9303 ll.1-6: You need to give more details on how the retrieval was made. Photometer data are available only up to 08:12. How did you handle that for the last two profiles?

p. 9303 ll. 3-6: You mentioned that the total volume concentration values are of LIRIC are constrained by the photometer data. No surprise that you see the same trends. Please rephrase to indicate the correct causal relation.

p. 9303 l. 28: You convincingly highlight the qualitative coherences of the retrieved data. What about the quantitative coherence? You need to compare backscatter and depolarization coefficient profiles retrieved by LIRIC and those presented in Figure 3.

p. 9304 l. 24: Figure 5a) and b) shown only part of the 3b+2a+1d analysis that you use for the regularization technique. Please include all the used profiles (either directly, or through profiles of angstrom exponent and lidar ratios).

p. 9305 l. 9 : 2000m a.s.l.

p. 9305 l. 12: "1000m layer" (singular). According to figure 5, only one layer with 1000 m resolution.

p. 9305 l. 12: The averaging procedure is not clear. In Fig. 5a and b you present data

AMTD

8, C3122–C3127, 2015

up to ∼4500m. The 1000m layer should then be from 3500m to 4500m. But on Figs 5c and d you indicate a points at ∼4400m. Did you assign the value at the top of the averaging layer or at the bottom. Please be more specific.

p. 9306 l.2: Introduce the APS-3321 instrument in Sec. 2. Add a discussion of related uncertainties. What was the sampling setup? What exactly is the quantity presented in Fig. 5E? Is this aerodynamic radius or it has been converted? If yes, with what assumptions / procedure? You state that the instrument measured from 0.25 to 10um. In the plot you present data above ∼0.4um. Why do you have this discrepancy? Please explain.

p. 9306 l.22: Specify is this is the total volume concentration, or one of the components.

p. 9306 l.26: AERONET retrievals includes particles up to 15um!

p. 9307 l. 23: Bravo-Aranda et al. (2014) is not included in the bibliography!

p. 9307 ll. 23-29: This sentence is not clear , and needs to be rephrased. You should consider including a POLIPHON analysis for your case. It could provide further insight about the observed differences.

p. 9308 l. 16: Define EOD both in main text and appendix.

p. 9311 l. 20-22: Add references.

p. 9331 Fig 3: Change caption of middle panel from AE to beta-AE, to be consistent with the caption.

p. 9332 Fig. 4: Explain briefly what is included in the errorbars. It's not enough to reference a paper, just to understand one plot.

p. 9333 Fig. 5E: Add the retrieved size distribution for ∼4.5km.

p.9334 Fig. 6: You should add errobars to the red line. The figure in general is not very legible, you should improve the presentation.

AMTD
8, C3122–C3127, 2015

p. 9335 Fig. 7: Take care to represent the same quantities in Fig. 7 and Fig 6a. Is this dV/dlnr? Change the caption accordingly.

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