Atmospheric Measurement Techniques
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Discussions

Interactive comment on "Fine and coarse dust separation with polarization lidar" *by* R. E. Mamouri and A. Ansmann

Anonymous Referee #1

The paper of R. E. Mamouri and A. Ansmann presents a new approach for the retrieval of fine and coarse mode dust volume concentration based on a depolarization lidar instrument.

The paper raises the important issue of fine-mode dust aerosol characterization using remote sensing techniques. This topic is largely ignored in the existing remote sensing literature and for this reason the publication of this paper is extremely timely and interesting.

The text is well written and the figures well explained. However the following points should be clarified before the final publication:

General issues:

1) The authors should state more clearly the underlying assumptions that they use in the retrieval. This is especially true for the initial step, the separation of the three components of the backscatter coefficient. The assumptions made in this step may be invalid in many different atmospheric scenarios.

Two distinct assumptions are made: a) When $d_p > 0.12$, the ratio of fine-dust and fine-non-dust backscatter coefficients if fixed. This is a strange assumption, as the processes that generate these two types of aerosols are not related. It could be a reasonable assumption for situations of mainly background contribution to the fine mode. However, is this still valid in cases of wildfires and urban pollution episodes?

b) When $d_p < 0.12$, there are no coarse-dust aerosols in the atmosphere. This may be applicable in more cases but still is it generally true? The fine-dust aerosols in this case represent background contribution? Is it possible to have only fine mode aerosols in dust transport event?

The assumptions and limitations are mentioned in various parts in the text but it will be beneficial for the reader to know clearly in which cases this algorithm can be applied as-is or when he needs to modify used assumptions. The method is not generally applicable, in contrast to what is claimed in the abstract and conclusions.

2) The authors should briefly discuss their definition of fine and coarse aerosols. Are the definitions of these modes used in the cited works of e.g. Sakai, Barnaba, O'Neill, and Dubovik compatible? Could these different definitions contribute to the total uncertainty estimation, and how much?

Specific comments:

p. 5176 l.6 What do you mean by **continental** dust particles and how can AERONET identify their presence?

p. 5176 l.17 Why do you use 16% for fine dust instead of 15% mentioned in line 10?

p. 5177 ll. 8-9 Mention that LIRIC can retrieve 3 different aerosol components, "fine-

mode, coarse-mode spherical, and coarse-mode non-spherical particles."

p. 5177 ll.17 -25 For clarity, consider separating the description of the one-step POLIPHON from the new developments (esp. ll. 19-20).

p. 5178 l.9 Consider rephrasing.

p. 5178 l.18 *were* checked...

p. 5179 ll. 19-20. The sphericity parameter etc are not calculated from the AOT but from the sky radiance measurements. You should also mention here the definition of FVF that you use in p.5180 l.11.

p. 5180 l. 17 Is the volume distribution retrieval of AERONET (and, consequently, the fine-mode volume fraction) reliable near the dust source? (see e.g. D. Muller et al., Mineral dust observed with AERONET Sun photometer, Raman lidar, and in situ instruments during SAMUM 2006: Shape-independent particle properties, JGR, 2010)

p. 5180 l. 29 Clarify if AOTf/c are calculated using O'Neil or Dubovik method.

p. 5186 ll. 12-14 Are these typical values actually used? If not, I don't think you need to mention them again.

p. 5187 l. 7. The PBL height mentioned here is not consistent with the values of p. 5189 l. 10.

p. 5187 ll. 6-9. Clarify which method you use to separate the PBL and FT lidar ratio from AERONET measurements.

p. 5188 l. 16. I don't think it's possible to argue that the "uncertainties are usually much lower" based on a single case study.

p. 5194 s.5.4 What are the v/AOT values actually used for converting extinction to volume concentration? Consider adding these values also in Table 1.

p. 5204. Fig 1. Consider marking the position of the measurement site.

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p. 5208 Fig.5 Verify that the numbers in the two-step diagram are correct. In the second step, pfmax = 0.12, so values above 0.16 should not be possible.

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