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Discussions

Interactive comment on "GARRLiC and LIRIC: strengths and limitations for the characterization of dust and marine particles along with their mixtures" *by* Alexandra Tsekeri et al.

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Tsekeri et al. present a study on the performance of two lidar algorithms in characterizing the vertical distribution of Saharan dust, marine particles and mixtures thereof for three case studies. The evaluation of retrieval algorithms that combine lidar with passive remote sensing measurements, such as sunphotometers or polarimeters, is an important piece in a much larger puzzle that aims to understand how to effectively combine measurements obtained from a number of different instruments in order to maximize the information content available in the data to accurately retrieve optical and physical properties of aerosols, allowing us to have a complete spatial (horizon-

tal and vertical) and temporal characterization of the atmosphere. The manuscript is well written and well structured, and the methodology used is sound. However, the results are presented mostly in qualitative terms. The readers would benefit from having more quantitative results described in the paper. I recommend the publication of this manuscript once the authors address the following points:

REPLY: We thank the reviewer for his/her kind words! We tried to address all his/her points, as shown below.

Specific comments:

Page 3: lines 26-28: This segment does not read well. Perhaps change to something like: "(...) coarse particles. The cross-polarized lidar signal at 532 nm allows the decoupling of the coarse mode into its spherical and non-spherical components"

REPLY: We inserted the change in the text.

Page 4, line 7-9: Please elaborate a bit more on the retrieval uncertainties. How do you determine them? What's the difference in determining the uncertainties for the total-column microphysical retrievals vs. for the profile retrieval of concentrations?

REPLY: The retrieval uncertainties of the total-column microphysical parameters have been developed following the approach described by Dubovik et al. (2000), whereas the profile retrieval uncertainties are currently under development. For the latter we need to take into account the lidar measurements as well. We changed the text as following (pg. 4, lines 13-16): "The retrieval uncertainties of the microphysical parameters are provided as well, following the approach described by Dubovik et al. (2000) and the profile retrieval uncertainties are currently under development."

Page 4, line 18: What do you mean by "whereas otherwise" in this case? It doesn't seem to fit in the sentence.

REPLY: We mean that it retrieves 3 modes only for the concentration profile, whereas otherwise, for all other microphysical properties it retrieves one mode.

Page 5, line 25-26: Suggestion: "Dust transport, while less frequent during the dry period, it is still observed (e.g. . . .) and it is characterized by a transport pattern (. . .)"

REPLY: We changed the text accordingly.

Page 7, line 1: "instrument and calibration precision" instead of "instrument precision and calibration precision".

REPLY: We changed the text accordingly.

Page 7, line 2: replace "Visible" by "visible range".

REPLY: We changed the text accordingly.

Page 7, line 16: replace "extent" by "fraction".

REPLY: It is the height extend and not the fraction of the fine particles. We changed the text as following (pg. 7, lines 20-21): ". . .and then to multiply it with the height extent of fine particles in the column, derived by the collocated lidar measurements."

Page 8, line 22: Why 40,000? Is that an arbitrary or standard number of particles that modelers use, or was there another reason for that choice?

REPLY: In Lagrangian dispersion models the number of tracer particles defines the accuracy of the simulation. 40000 particles are assumed adequate for the current experiment.

Page 9, line 12: what is Eta in "24 Eta vertical layers"?

REPLY: Eta refers to the ETA vertical coordinate system used in the ETA/NCEP dynamical core of DREAM model. We refer to the Eta/NCEP atmospheric model in beginning of this paragraph, line 8.

Page 9, line 13: Change 1/3 to 0.33

REPLY: We changed the text accordingly.

Page 10, lines 3-9: I think it might be good to include a shorter version of this in the abstract since currently you do not mention anything about the models or in situ measurements that you use to aid in the characterization study.

REPLY: We included the following in the abstract (pg. 2, lines 14-15): "The results are also compared with modelled dust and marine concentration profiles and surface in situ measurements."

Page 10, line 28: How much is "quite well" in % difference?

REPLY: We included the following in the text (pg. 10, lines 30-31 and pg. 11, lines 1-2): "Our results show that GARRLiC and LIRIC backscatter and extinction coefficient profiles at 355, 532 and 1064 nm agree quite well, with their differences being 10-20% with respect to GARRLiC values, well within the LIRIC uncertainties (Fig. 4a and b)."

Figure 4: Consider labeling each panel like 4a, 4b, etc so you don't have to refer to them as "first and second row in Fig 4".

REPLY: We changed the text accordingly.

Page 11, line 1: replace "cut above" by "restricted to"

REPLY: We changed the text accordingly.

Page 12, line 7-8: "Moreover, due to the low RH at the surface (16%) we do not (. . .)"

REPLY: We changed the text accordingly.

Page 12, line 10: What's excellent in % difference? Please quantify it.

REPLY: We changed the text as following (pg. 12, lines 15-16): "The concentration profiles from GARRLiC and LIRIC are in excellent agreement at heights >1 km, with differences to be less than 10% (Fig. 6a)."

Figure 6: Instead of having Fig 6b with two panels, just relabel each plot in Figure 6 as 6a, 6b, 6c. Makes it easier to reference.

REPLY: We changed the text accordingly.

Page 13, line 1: replace "indicatory" by "indicative" or "qualitative"

REPLY: We changed the text accordingly.

Page 14, line 7: missing LR unit (sr).

REPLY: We changed the text accordingly.

Page 19, line 3-17: Please quantify the agreement levels that you mention in this paragraph. How many %?

REPLY: We changed the text as following (pg. 19, lines 7-16): "For the first case GAR-RLiC achieves a successful retrieval of the dust vertical distribution and microphysical characterization that agrees well with AERONET and climatological values for dust, within the respective uncertainties. Both LIRIC and GARRLiC concentration profiles are found to be consistent with the BSC DREAM8b dust vertical structure, showing though up to 100% larger values than the surface in situ PM10 measurements. For the second case consisting of mainly marine particles, both algorithms provide satisfactory concentration retrievals, well within the time variability of the surface in situ PM10 measurements. The GARRLiC microphysical property retrieval is mostly not successful for the marine particles, with e.g. $\sim$10% more fine particle volume than the AERONET product and the surface in situ measurements."

Page 19, line 8: replace "from" by "than"

REPLY: We changed the text accordingly.

Page 19, line 24: replace "near-to-surface" by "near-surface".

REPLY: We changed the text accordingly.