

## ***Interactive comment on “Comparison of aerosol properties retrieved using GARRLiC, LIRIC, and Raman algorithms applied to multi-wavelength LIDAR and sun/sky-photometer data” by V. Bovchaliuk et al.***

### **Anonymous Referee #3**

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The manuscript by Bovchaliuk et al compares results obtained for dust-dominated aerosols from different algorithms in three case studies. Overall the manuscript is in a good shape, but discussion is improvable. The manuscript is of interest for AMT readers and thus should be published after some clarifications and revisions.

List of comments:

Line 15: "It" -> "In"

Line 19: It is, in general, not correct that in situ measurements involves direct measurements. There may be some types of in-situ measurements that directly measure the

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quantity of interest, but most need data inversion. For example, measured scattered light gets inverted to particle size.

Line 22f.: There are also passive remote sensing instruments measuring terrestrial radiation (infrared, microwave).

Line 33: "Spatial" could be removed.

Line 60: You should already mention here the name of the lidar system "LILAS".

Line 66: "a multi-wavelength LIDAR" could be replaced by "LILAS".

Line 100: It is unclear what BASIC means here. My reader would first think that this is the name of the programming language used. From reading on it becomes clear that this is the name of an algorithm. To avoid confusion, I suggest to add in parentheses the written-out name of this algorithm.

Line 110: "scattered sunlight by atmospheric molecules": Not only molecules but also aerosols and clouds could be a problem. I suggest "sunlight scattered into the field of view of the lidar".

Section 3: Please mention that the Regularization algorithm assumes spherical particles (though it is mentioned in the reference, it is an important aspect that should be mentioned also in your manuscript).

Line 195: "origin of aerosols from mineral dust": Shouldn't origin be a location, like the Sahara?

Line 211: I'm surprised about the low uncertainty. If applying spherical particles to mineral dust the error can be significantly larger than 20%. This should be mentioned and considered in the discussion of your results.

Line 213: What means "mineral dust with inclusions of marine particles"? I guess you mean "mineral dust sometimes mixed with marine aerosol particles".

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Line 228f.: It is unclear what the difference between "dust intensity" and "dust load" is.

Line 258: It should be discussed why the BASIC LR value at 355 nm is so much lower than all others.

Line 261f.: "the second one with larger radii refers to the particles of thin cirrus clouds": This is speculation and contradicts the statement in line 236. In addition, in most cases cirrus clouds, particles would be larger than the size at your second maximum.

Line 310: "and decreases to 1.1 microns at night". But using a different method, so the "true" effective radius may have not changed.

Line 311f.: Lower RRI could be also effect of method.

Line 314-323: But the depolarization ratio shows that there was at most a very little contribution of marine aerosol during day-time. The depolarization ratio is  $\sim 29\%$  compared to  $\sim 34\%$  at night, but given the low lidar ratio of marine aerosol (15-20sr) compared to desert dust (45-60sr) the contribution of marine aerosol to extinction must have been  $< 10\%$  during day-time. Thus your discussion is not convincing to me.

Line 335f.: "Unfortunately, a comparison between the day- and night-time V values was not possible ... " But this is shown in Fig. 10. Please clarify.

Line 338: Again the 20% uncertainty seems unrealistically low.

Line 342: "were averaged into 60 points" is unclear.

Line 343: "The day-time Raman LR values decrease with altitude": Fig. 12 looks different.

Line 344: What means "slightly correct"?

Line 371: What is the "overlap zone"? Zone of full overlap or zone of incomplete overlap?

Line 381f.: Again, the decrease from day to night could be a method effect, which

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should be considered better in your discussion.

Line 382: "Th" → "The"

Section 4.3: The measured combination of lidar ratio and depolarization ratio is quite unique. The depolarization ratio indicates Saharan dust whereas the lidar ratio indicates dominance of sea salt. "Probably, a dust coating process played a role in this event." (line 419) seems very speculative to me. What I'm missing in this section is a discussion of realistic measurement uncertainties, in particular of the LR, and also of the possibility that sea salt got into a dry state (r.h.  $\sim < 50\%$ ). In addition, what confuses me is the high RRI from Garrlic which indicates that the contribution of marine aerosol was not significant (since marine aerosol has a much lower RRI). This should be considered in your discussion.

Line 393: Would it be possible or have you tried to use parallel and perpendicular signals also with GARRLIC?

Line 434: "Continental clean" seems wrong.

Line 442: "in one aerosol mode" might be replaced by "in the same size range".

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