

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.

Anonymous Referee #3

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Both active and passive remote sensing instruments have their own advantages and disadvantages in terms of the vertically-resolved retrievals of the aerosol microphysical parameters. It is clear that the combination of active/passive technologies is absolutely necessary in order to improve the quality of retrievals. Alexandra Tsekeri and co-authors are moving in that direction.

Finokalia lidar station is famous to have a unique geographical location allowing observation of the different combinations of the aerosol particles from Central Europe and Africa/Sahara. It is nice to get a reminder that Finokalia station is operational and actively delivering the valuable scientific data related to the dust and marine aerosols.

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The paper in overall is very well written. It is pleasure to read the text. The wording and grammar are close to be perfect.

I recommend to accept this manuscript for the publication after a few minor corrections.

General comments:

1. After reading the paper I got an impression that there is some kind of luck that GARRLiC and LIRIC algorithms work and result in a reasonable aerosol microphysical retrievals. Here is the list of introduced assumptions to support this impression:

A) "The volume concentration below the lowest height of the lidar signals is considered to be constant" (page 4, line 9)

It is very difficult to imagine the constant volume concentration in the first few hundreds meters above the ground. Please keep in mind that the comparisons with in situ are performed using the near-surface data.

B) The Raman signals from the lidar are such a useful piece of information about aerosols, but not used in the retrievals at all (see Fig. 1). There is only a plan to use the extinction optical coefficients in future.

C) "GARRLiC ... is able to retrieve only one refractive index for each mode." (page 16, line 14) "considering refractive index to be constant along the atmospheric column" (page 4, line 6)

The assumption of only one refractive index per profile is very damaging for the whole idea of vertically-resolved microphysical retrievals. The aerosols of different nature (thus, different refractive indexes) are often reside in a different layers of the same vertical profile. Please consider in your future studies to eliminate this assumption.

D) Some additional difficulties on the top of that:

- "In addition, as seen in Fig. 7a, most of the aerosol load is located below 1 km, where the lidar incomplete overlap region is located, which challenges even more the

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combined lidar/sun-photometer retrieval." (page 14, line 1)

As a result, there is a nice agreement between GARRLiC and LIRIC in terms of volume concentration (see Fig. 10a), very strong disagreement between GARRLiC and LIRIC in terms of ambient PM₁₀ (up to 3-4 times or so, see Fig. 10b.right above 1 km), and than finally fair agreement between GARRLiC, LIRIC, and in situ in terms of dry PM₁₀ (see Fig. 10b.right below 1 km). All these sudden turns are really thrilling! Please provide some explanation in the text.

2. GARRLiC and LIRIC algorithms are based on the usage of pre-calculated AERONET products. Without going too much into a details, they sound almost like a twins or, at least, share some part of the software code. For the final users at the lidar stations it is not convenient to have several twins-like algorithms in a package. It is confusing to have similar results for the one group of microphysical parameters and different results for the other group of parameters. Is there a plan to come up with the best way on how to combine the lidar/sun-photometer data that will merge/replace GARRLiC and LIRIC in a single algorithm? It is highly desirable if authors will share their vision regarding this issue in a paragraph of text.

Specific comments:

1. Page 4. Line 4: "The algorithm calculates the size distribution, spherical particle fraction and spectral complex refractive index, separately for fine and coarse particles, considering them constant along the atmospheric column, and the volume concentration profiles of fine and coarse particles."

This sentence is quite unclear and ambiguous. Please consider to split it into two simpler sentences.

2. Page 11. Line 11

"m." instead of "m:"

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