

Response to referees for manuscript “Aerosol optical properties within the atmospheric boundary layer predicted from ground-based observations compared to Raman lidar retrievals during RITA-202” by Xinya Liu, Diego Alves Gouveia, Bas Henzing, Arnoud Apituley, Arjan Hensen, Danielle van Dinter, Rujin Huang, and Ulrike Dusek. (manuscript ID: EGUSPHERE-2023-2262)

We would like to express our sincere gratitude to the reviewers for their careful reading and helpful comments on our manuscript. We have revised the manuscript and responded to each comment below. We appreciate the opportunity to refine our research and look forward to the next steps in the publication process.

Reviewer #1 comments

I found several minor points that should be improved:

1. The sketch in Figure 3 Temperature is written

Corrected.

2. In the main text body, page 11, line 282... Figure 2(b) is written. but it is Figure 3(b). Please check numbering of figures and table in the main text carefully.

Corrected.

3. Figure 6(d): It took me a while to identify the different curves. The legend should be more clear. The blue line (without symbols) is the Raman lidar water vapor profile, in the legend is light blue, like the color of the uncertainty margin! The light blue uncertainty margin obviously belongs to the RH ECMWF profile. This is not obvious from the legend. The dark blue RH ECMWF profile has symbols (circles), but this is not shown in the legend. The RH tower observation are shown as symbols (stars) in the legend, but these points are hard to find in the figure. So please try to improve all this, one can even use open symbols (circles and squares) , dashed and dotted lines. There are many options to improve the figure. The same holds for Figure 7(d) and 8(d).

Thank you for your suggestions. We have modified Figure 6(d), Figure 7(d), and Figure 8(d) to improve visualization.

Reviewer #2 comments:

1. I suggest the abstract contains a bit more emphasis on the need of “... a well-mixed PBL including accurate corrections for hygroscopic particle growth” and to emphasize the fact that “... the relative humidity profile may have substantial influence on the shape of the profiles.”

Thank you for your advice. We have added relevant text in the abstract (lines 23-24) to emphasize these two important points you mentioned.

2. I am asking the authors to become crystal clear on the fact that particle loss effects during sampling of coarse mode particles by the in-situ instruments could become a serious issue if more coarse mode particles are present. Make a respective statement in the conclusion section, please.

In the revised manuscript, we have added text in lines 469-471 and lines 496-498 to highlight the importance of coarse mode particles.

3. Line 44, the word “of”: is it missing in “... spatial distribution aerosol ...”?

Corrected.

4. Line 72: please consider adding a bit more text to "... the extinction coefficient in the lower atmosphere ...", e.g. by adding "... in the region of incomplete overlap between laser beam and receiver field-of-view of the lidar detector system ..."

Done.

5. You need to add a short outline of your paper at the end of the introduction section (section 2 ..., section 3, ... etc). I think that is (still) a standard part of a scientific publication work.

We provide a brief introduction to each section at the end of the introduction (lines 78-83 in the revised manuscript).

6. Lines 140/141 "... the MPSS electrical mobility diameters were assumed to correspond 140 to volume-equivalent diameter.": can you please insert a reference that corroborates this comment?

We have added a reference at the place.

7. line 186: you need to add the pulse energy to the information on the laser.

Done.

8. Figure 3: there is a typo in "Temperature". Please also add (in the figure caption) the meaning of the abbreviations. Please explain (in the legend) the meaning of SIA, EC, SS, MD. Please explain in (3a) CC, RH, GF, PSD, no matter whether it is mentioned in the main body of the text or not. Essential information needs to be given in figure captions, too.

We corrected the typo and explained the meanings of the abbreviations in the Figure caption.

9. Line 215: MD? I am curious where mineral dust should come from? Or do you refer to road dust, agricultural dust etc.? I repeat that I do not intend to re-open the review process, but rather consider using backward trajectories in a more extensive way in your future work. 72-hours backward does not tell you a lot. Go for 5-days backward (at minimum). 10 days may be even better. The vertical movement of the trajectories is important, too. It tells you a lot about the possible source of particles.

The contribution of mineral dust (MD) to particulate matter concentrations in the Netherlands is relatively minor. Our research references data from the 2019 Trolix campaign (14th Sep to 6th Oct) conducted at the same sampling sites Cabauw, where MD accounted for approximately 30% of the mass concentration of coarse mode particles, with an average concentration of about 0.45 $\mu\text{g}/\text{m}^3$. Previous studies have found the primary sources of MD in the Netherlands are road dust (such as Tyre (mostly OC and Zn) and brake (Fe, Cu, Sn, Sb, Ba) wear processes) and agricultural activities (Amato et al., 2013; Hendriks et al., 2013).

We greatly appreciate the reviewer's suggestion to use longer backward trajectories to obtain more potential information on aerosol sources. To ensure the validity of our conclusions in this study, we have examined 10-day backward trajectories of the three cases in the manuscript and found that they are mainly influenced by similar sources as the currently used 72-hour backward trajectories. The Figure R1 below provides an example, illustrating a comparison between the 3-day backward trajectory and the 10-day backward trajectory for the first case on May 19, 2021, at 20:00. Both trajectories indicate that the predominant air mass transport was from the ocean to the land, passing through Ireland and the United Kingdom, ultimately reaching the monitoring site.

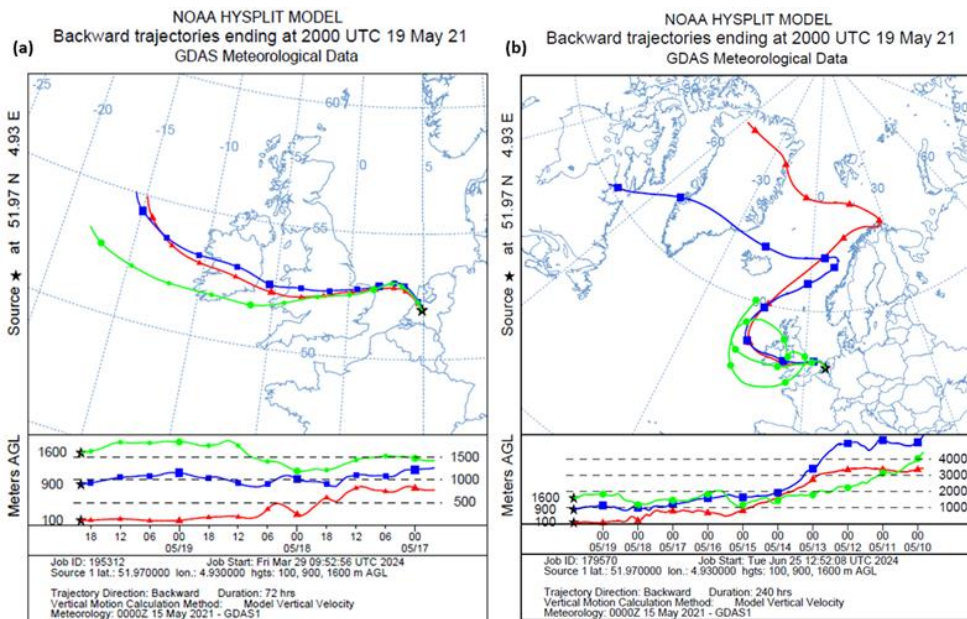


Figure R1: (a) 3-day backward trajectories (b) 10-day backward trajectories ending at 20:00 on 19-05-2021.

We will also take this into consideration in our future research work.

10. Line 280: I think it is nephelometer, not Nephelometer.

Corrected.

11. Line 248: number is missing in “approximately ... Mm⁻¹”.

Corrected.

12. Please check formatting issues like the following: often numbers are followed by the unit “m” without space, sometimes with space. Make it the same.

Done.

13. Line 413: add “sr” to “... 1.1 sr at 532 nm.”

Done.

14. Line 450: check the reference author name “Moritzet et al. “? Is it “Moritzet” or is it “Moritz et al.”? In fact, I do not find any reference with that name in the reference list. In other words: check your reference list for completeness.

Corrected.

References:

Amato, F., Schaap, M., Denier van der Gon, H. A. C., Pandolfi, M., Alastuey, A., Keuken, M., and Querol, X.: Short-term variability of mineral dust, metals and carbon emission from road dust resuspension, *Atmos. Environ.*, 74, 134–140, <https://doi.org/10.1016/j.atmosenv.2013.03.037>, 2013.

Hendriks, C., Kranenburg, R., Kuenen, J., van Gijlswijk, R., Wichink Kruit, R., Segers, A., Denier van der Gon, H., and Schaap, M.: The origin of ambient particulate matter concentrations in the Netherlands, *Atmos. Environ.*, 69, 289–303, <https://doi.org/10.1016/j.atmosenv.2012.12.017>, 2013.