

Response to Reviewer's Comments

Dear reviewer,

We appreciate your valuable comments. We tried an effort to answer your comments and revise the contents. Please see the answer and revised contents below and give us your advice if needed.

Reviewer's comments and our answers

General Comments:

The manuscript is well written and documented with a sufficient number of relevant references. Minor changes are required to be fuller and more comprehensible.

Retrieving aerosol properties in horizontal plane is an open issue and here a new scientific approach is suggested. However, a more detailed analysis should be presented, revealing all steps and constants/assumptions used here.

→ We appreciate your feedback and have made the necessary revisions accordingly.

Specific comments:

Plots: A grid like the one applied in Figure 2a would be helpful to be applied in all relevant plots also. Wavelength (532 & 1064 nm) should be presented in a clearer way in all sub-figures. E.g., include it as a title or legend.

→ We appreciate your suggestions, and we have made efforts to incorporate your feedback by applying gridlines as suggested and presenting wavelength (532 & 1064 nm) in a clearer manner in all relevant sub-figures.

Ln 34-36: Please correct near-zenith measurement, means pointing almost vertically in the atmosphere, therefore, "in measurements with higher elevation angles" should be changed to "in measurements with low elevation angles."

→ We appreciate your detailed comment. We revised the sentence.

“The selection of a reference distance and a reference value is less straightforward in measurements with lower elevation angles as all range bins might contain considerable aerosol contributions.”

Ln56-57: you mention that “Backscattering at 532 nm is split into a parallel and a perpendicular signal with respect to the linearly polarised emitted laser light”. However, it is not clear to me if the parallel, cross or the combination of both components are used for the analysis of retrieving the PM concentrations. Is the depolarization channel useful somehow in your method or is it just an additional feature of the lidar?

→ We just described our scanning lidar system, but we just used parallel signals in this manuscript.

Ln 66-70: Please provide more details about retrieving PM concentrations. How was the separation of fine and coarse particles performed? What assumptions/constants were considered?

→ We used the Ångström exponent to discriminate fine and coarse particles for PM calculation. I apologize for not describing more detailed information about these. The mass concentration calculation algorithm is not the primary focus of this paper. Plus, these aspects are currently under investigation by my affiliated research team, and we are working on a manuscript submission in the near future. I hope you understand in this matter.

Ln 86: Please make clear what the special resolution of the lidar is.

→ We apologize for the error in our description of the lidar's spatial resolution in Line 59. The actual resolution is 4.8 meters, but to reduce noise, we sum six data points, resulting in a final effective resolution of 28.8 meters. We have corrected the sentence in Line 59 accordingly.

“Data are acquired with a maximum sampling rate of 30 MHz, which corresponds to a range-resolution of 4.8 m.”

Ln 87: What technique/equation was applied to calculate the signal-to-noise ratio (SNR) ? Please mention.

→ Thank you for your comment regarding the section where we did not provide detailed information. We considered the average of 150 long-range data points (approximately 7-10 km) as noise and used it as the background value. Since this aspect was not elaborated upon, we have modified the sentence as follows:

“Then, a background correction based on the signal-to-noise ratio, calculated as the average of 150 data points at the far end of the measurement range, is applied.”

Ln97-98: “Second, as any point in the scanned area could be an emission source, it is more likely that the reference distance for the Fernald-Klett inversion is a function of scan angles.” This sentence is a bit confusing to me. Is this indeed your second assumption of your method? Your method works only for multi-scanning measurements? What about horizontal measurements fixed in a specific direction?

→ Thank you for your comment. Our assumption in the observation is that, with horizontal measurements at a consistent elevation angle, the baseline remains unchanged for all angles or emission sources. We mentioned that the reference values could be under- or over-estimated due to emission sources or noise on certain angles. Our method can also be applied to find proper reference values for ambient aerosols in fixed measurements because we set multiple points to determine a representative reference value within a single profile.

Ln105: “...where we would expect to see background values” background values usually refer to atmospheric background and therefore molecular atmosphere which is not the case for horizontal measurements. Please rephrase.

→ We appreciate your feedback. Since we conducted horizontal measurements, the influence of altitude was negligible, and therefore, we omitted the molecular contribution (Ln. 95). Consequently, in the subsequent description, we considered all backgrounds to be attributed to background aerosols. As you pointed out, in the background correction, both background aerosols and molecular effects can be simultaneously excluded.

Ln179: “... by users without lidar expertise”. Please remove. This does not offer something to the discussion and is not derived as a conclusion from the above.

→ Thank you for your feedback. Following your suggestion, we have removed the mentioned phrase from the manuscript.