

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-21

Anonymous Referee #3

Referee comment on "Measurement report: Comparison of airborne, in situ measured, lidar-based, and modeled aerosol optical properties in the central European background – identifying sources of deviations" by Sebastian Düsing et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-21-RC1>, 2021

Review of "Closure of In-Situ Measured Aerosol Backscattering and Extinction Coefficients with Lidar Accounting for Relative Humidity" by Düsing et al.

This study compares lidar measured optical properties to those computed with Mie calculations that used airborne in-situ based inputs over two different field campaigns. In general, the manuscript is unfocused and lengthy. The tedious amount of detail makes it difficult to completely comprehend and judge the merits of their analysis. I strongly suggest that the authors only include the details of the measurements that aren't described in other publications or are essential to the analysis performed in this work. The authors state that their study is both "unique" and "complex", which it is, but why is it important? What science is advanced by this work? There are only a few lines of background/motivation given that mentions radiative forcing and cites the IPCC, but it is not clear how this work reduces uncertainty in radiative forcing. Do the Mie-based calculations reproduce the optical properties well enough to meaningfully reduce radiative forcing uncertainty? The authors need to give more a clear science motivation in the introduction and then revisit their goals in the conclusions to discuss what has been learned from this work.

As a means to reduce the scope/length of the manuscript, I would suggest that the authors consider removing the lidar parameterization analysis. For this analysis, it is hard to tell if the comparisons are a bit circular at times with in-situ inputs into a Mie model being used to derive the lidar ratio parameterization. That parameterization is then used to derive the lidar extinction. Then the lidar extinction is compared to the in-situ measured extinction. It would make for a more straightforward comparison if the authors just made comparisons to the lidar backscatter coefficients and avoided the assumptions/parameterizations needed to get the extinction altogether. This would also help shorten the manuscript. Plus, the lidar ratio parameterization is more a necessity because of the limitation of the

Raman system to nighttime only and is less relevant to a general audience than the closure exercise.

The overall conclusions and taken home messages of the study are completely lost in the in the details of the comparison. The goal of the study is the demonstrate the closure of aerosol optical property measurements, but fairly large differences remain. The authors speculate on several different reasons as to why the modeled and lidar-measured optical properties differ, but no real definitive answer is provided. The study would benefit from further analyses that are more focused on achieving closure to within a meaningful degree of certainty and a clear motivation/definition of what is "meaningful". Before even attempting the closure exercise, it would be useful to discuss how good a closure one can expect given the uncertainties both the lidar and in-situ measurements. The uncertainties appear quite large at times which would suggest improved measurements techniques and methodologies are need before a useful closure exercise could be performed.

Other comments:

The abstract needs to be considerable shorter. As is, it is a detailed summary of the entire paper and largely repetitive of the material in section 5.

line 247: what "other studies"?

line 357: add space after "campaign"

line 523: biasing -> attenuate

line 863: remove "In Mie-theory"

Labels the panels in each figure (e.g. a,b,c) and use those labels when referring to specific panels in the text.

Figure 6, last panel: suggest addition a scale break in the x axis. As is, the x limits are too wide to discern any differences.

Figures 13, 14: the large amount of overlap in data points and errors bars make it difficult to see anything quantitative from these plots. These may be better plotted using some type of density-based plot.