

# ***Interactive comment on “How much information do extinction and backscattering measurements contain about the chemical composition of atmospheric aerosol?” by Michael Kahnert and Emma Andersson***

**Michael Kahnert and Emma Andersson**

michael.kahnert@smhi.se

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Below the reviewer comments are marked in blue, our response is marked in black.

1. It is well known, that the problem of inversion of standard  $3\beta + 2\alpha$  lidar measurements to the particle microphysics is undetermined and to constrain it, numerous techniques were considered. The authors suggest an interesting approach to assimilation of lidar measurements into chemical transport model. It looks like a promising concept to extract the information about particle parameters from lidar measurements. Paper is very well written and should be published.

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We thank the reviewer for his positive evaluation of our manuscript and for his helpful comments.

2. The structure may be questionable, because a half of material is put in appendices. These appendices are clearly written and are definitely useful for unprepared reader. I personally, had no problems with material structure.

We agree that the structure was not optimal for all types of readers. We found that the compromise suggested by reviewer 2 would adequately address these concerns. We refer to our detailed response to reviewer 2, which explains the changes we intend to implement in the revisions.

3. Additional references to the previous studies of lidar data inversion would be desirable, and other Referees have already suggested several.

Agreed. We will add a paragraph in the introduction with a brief discussion of other studies, also from numerical weather prediction data assimilation.

4. Stability of retrieval strongly depends on aerosol type. It is more challenging for aerosols with dominant coarse mode and for particles with strong absorption. The authors consider only one example (not the most challenging) in their simulation, so it is not very clear how the approach will work for other aerosol types. But this may be a subject of separate study.

Yes. Although it is not the subject of this paper to comprehensively test all sorts of mixed aerosol populations, we do agree that the case we picked was a little bit too easy. This is mostly because the background and reference cases were very close to each other. In such a case one does not see very clear differences between a constrained and unconstrained analysis. In the revised paper we will pick a more challenging case, and we will show our test results for both the constrained and the unconstrained 3DVAR algorithm. This will help to better illustrate what practical significance the constraints can have.

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