

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-761

Anonymous Referee #1

Referee comment on "Identifying chemical aerosol signatures using optical suborbital observations: how much can optical properties tell us about aerosol composition?" by Meloë S. F. Kacenenbogen et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-761-RC1>, 2021

The authors address the important question of how to reconcile the various definitions of aerosol types used in different communities that deal with in-situ measurements, remote-sensing observations, and modelling studies. In essence, the authors describe a methodology for inferring a chemically defined aerosol species based on measurements of optical parameters. A data set of in-situ measurements collected during an airborne campaign over the US forms the foundation of this study. The topic is highly relevant as such studies are needed to overcome the divide between the different communities that study atmospheric aerosols. The applied methods are sound but the presentation of the work leaves much to be desired as outlined more specifically below. Ultimately, the developed approach should be applicable to mostly passive remote-sensing observations from space. While this is touched upon in the discussion, the work would be much stronger if the authors were to present more details of how the findings could be used to exploit spaceborne observations. Those observations of column optical properties are less likely to meet the unmixed aerosol conditions used in this study. A way forward could be to mix different chemically defined AMTs, retrieve their resulting optical properties, and check if the retrieval would still be able to disentangle the contributions.

Overall, the study requires substantial revisions before it can be accepted for publication. And even then, it would fit much better within the scope of AMT rather than ACP, as it is focussed on describing the methodology rather than applying it. This reviewer therefore recommends to move the contribution to AMT with major revisions rather than rejecting it for publication in ACP.

Here are some comments regarding the presentation. Once these items have been addressed, it will be much easier to assess the scientific quality of the work:

- The paper reads like a mash-up of an internal report and a PowerPoint presentation. Particularly the introduction reads like an aggregation of agency jargon.
- The structure is set up in a way that keeps the reader browsing back and forth to match the thoughts of the authors.
- The naming of the investigated parameters (e.g. PS-AMT, DO-AMT, DO-Class) is unintuitive and confusing. The meaning of those acronyms is introduced very late in the manuscript and only indirectly in the form of section headings.
- Important information, such as the definition of the PS-AMTs (which should be part of the methodology) is scattered over Sections 2, 3, and the Appendix. The threshold values used in the categorization should be clearly defined and justified.
- Figures are of bad quality or designed badly. Personally, this reviewer would prefer proper flow charts rather than the PowerPoint-style presentation in Figures 1 and 2.
- The referencing to figures and tables is excessive and keeps the reader browsing to keep up with the text.
- The text is littered with redundant statements in parentheses that re-state what has just been explained. Please pick one formulation and go with it.
- Please double-check all equations. At least Eqs. (A.1.1a) and (A.1.1c) are not correct.