

Atmos. Chem. Phys. Discuss., referee comment RC2
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Review of Kinne et al.

Anonymous Referee #2

Referee comment on "Aerosol radiative effects with MACv3 and satellites retrievals" by Stefan Kinne et al., Atmos. Chem. Phys. Discuss.,
<https://doi.org/10.5194/acp-2021-954-RC2>, 2022

The study is essentially four papers in one, often loosely linked to the stated aim of being a user case study of an Aerosol_cci product. Unfortunately none of the four items are analysed with enough depth and novelty to recommend publication.

The first item, in section 2, focuses on the performance of the AOD and AODf dual-view retrievals based on "SR heritage" sensors. That analysis is clearly premature. As the authors write on line 89, there is a clear need for "DV sensor retrieval biases [to be] better understood and corrected". The SR retrieval teams should first publish a paper documenting time series of AOD and AODf over 1998-2020 with the different SR sensors, identifying possible global biases and coming up with ways to splice the different datasets consistently.

For the second item, in section 3, the authors give up on dual-view retrievals and use MODIS to very briefly look at decadal trends in aerosol optical depth. That analysis is out of the stated scope of the paper, and does not really add value to previous work, for example <https://doi.org/10.5194/acp-20-139-2020> .

The third item, in section 4, looks at possible changes in AOD from decreases in activity due to the Covid pandemic. That is an interesting question, but which requires a more careful analysis than done here. First, many aerosol sources remained active during lockdowns (<https://doi.org/10.1029/2020GL088913>) so the impact of AOD is smaller than could be anticipated. In addition, one cannot simply compare 2020 to 2019, because that ignores interannual variability (<https://doi.org/10.1029/2020GL091805>, <https://doi.org/10.1029/2021GL093841>, <https://doi.org/10.1029/2020gl091699>), the complexity of aerosol chemistry (<https://doi.org/10.1029/2020GL088533>, <https://doi.org/10.1093/nsr/nwaa137>), and a potential masking of the Covid signal by anomalous meteorology in 2020 (<https://doi.org/10.1029/2020JD034090>, <https://doi.org/10.1126/science.abb7431>).

The fourth item, in sections 6-8, looks at the impact of using DV-retrieved AOD fields on aerosol radiative effects in the MAC climatology framework. Differences can be explained by differences in AOD, and the authors find that assumptions on the single-scattering albedo have a large impact. Here, the use of DV retrievals feels unnecessary to draw these conclusions. The same analysis could have been done within MAC itself, and indeed most conclusions can already be drawn from the analysis by Kinne et al. 2019 (<https://doi.org/10.5194/acp-19-10919-2019>).

Other comments:

Section 2: The presentation of the three SR sensors in that section is minimal, yet the importance of their different capabilities between them and with MODIS is invoked very early in the analysis. What are the different swaths? What are the different fractional coverages?

Lines 16-17: "aerosol with a significant greenhouse effect" Need to clarify that this expression refers to longwave radiative effects.

Lines 31-32: "not associated with any specific year". That cannot be correct, since the reader is told a few lines later that MAC is suitable for looking at decadal trends.

Lines 53-54: Does "size" refer to diameter or radius? Is AOD_f defined in the same way in the DV dataset, in MODIS, and in MAC?

Lines 87-88: Why would the type of sideway viewing influence seasonal statistics?

Technical comments:

- Many acronyms are never spelled out.
- There is no section 5 but there are two sections 7.