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Atmospheric Measurement Techniques Discussions

Interactive comment on "Reducing cloud contamination in AOD measurements" *by* Verena Schenzinger and Axel Kreuter

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Before starting describing the CF methods I would start the paper with some sentences like the paragraph below to show the importance of this study in combination with AOD related research and use: AOD is the most comprehensive aerosol parameter for radiative forcing studies. Surface based AOD measurements are conducted from various surface base networks (e.g. aeronet, gaw-pfr, skynet) (e.g. Holbern et al., Nakajima et al., 2020 AMT). The series are used for local, short term or long term aerosol studies and for satellite validation. One of the main problems of such measurements is the fact that they can not be conducted under cloudy conditions at least when present in the detector-sun path of photons. For that case there are algorithms that are used in order to eliminate the possibility of cloud-present measurements to

be included in the AOD data series. Such algorithms contribute substantially to the quality of AOD data worldwide.

Agreed, thank you for the suggestion. We will expand the first paragraph regarding the use of AOD measurements in radiative forcing and long term studies.

Authors use the PFR instrument in their analysis but the introduction is mainly for aeronet/cimel. The latest publication describing the PFR CF algorithm can be found here: https://gi.copernicus.org/articles/7/39/2018/ Also it is essential to mention the PFR algorithm more explicitly as it differs in some aspects from the aeronet. In general different networks are using slightly or more different algorithms for CF. For example in https://acp.copernicus.org/articles/18/3185/2018/ there is a comparison of different CF algorithms at synchronous AOD measurements from different instruments/networks.

We will add the references and go into more detail about the current PFR algorithm. (see also Referee 2)

In general the methodology is based on one minute data as derived from PFR. If the authors want to generalize the method being important for other AOD measuring networks some discussion on the measurement frequency vs method quality has to be presented. This is because for most other than PFR instruments, measurements are more than 1 minute apart increasing the possibility of cloud contamination in N consecutive measurements.

This is a good point. We will add a figure and discussion based on subsampling the data on the example day (used in Figure 2). Our algorithm, however, does not depend on consecutive measurements (unlike the currently employed one), but rather on the total number of measurements available.

The Angstrom parameter a: It is a very good proxy for cloud flagging. However its variability depends also in AOD. Low AOD measurement days lead to much more "sensitive" and variable angstrom a than the ones with higher AOD. In low AOD days small but real AOD variability in combination with AOD measurement uncertainties can lead to high angstrom fluctuations. Dust AOD variability could be an issue. Cuevas et al., discuss the 1 minute variability https://amt.copernicus.org/articles/12/4309/2019/amt-12-4309-2019.pdf in this paper and the supplement. The example presented here is a good example but probably some discussion should be included based on the above mentioned 10 year time series of AOD cases.

Indeed, the variability in the Angstrom parameters increases with decreasing AOD. But since the Angstrom parameters are only 2 out of 4 dimensions and the variation of AOD in these cases is also lower, so the algorithm is relatively robust for these low AOD scenarios. We have included examples in the appendix of low and high AOD days, as well as a day with Saharan dust and hence high AOD in Figure 3. The reference will be added.

Main effect of the non correct CF in an AOD series is the data cloud "contamination"that leads to a systematic higher instant AOD values but also affects daily, monthly AOD averages. Such systematic effects could have an impact on long term series statistics and much more to trend analysis of AOD related changes. I think this could be mentioned in the conclusions. It is an aspect that methodologies such as the paper presents, contribute towards better quality results.

Yes, thank you for the suggestion. We will adapt the last paragraph accordingly. However, it should be noted that there is a (maybe counterintuitive) possibility that the daily mean AOD can also increase when more thin clouds are flagged (if there is a real change in AOD over the day, but thin clouds only occur during the period of lower AOD).

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