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Atmospheric Measurement Techniques Discussions

Interactive comment on "Quantitative comparison of measured and simulated O_4 absorptions for one day with extremely low aerosol load over the tropical Atlantic" *by* Thomas Wagner et al.

Anonymous Referee #2

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General comments

In recent years, more and more authors have indicated the need for scaling factors in order to improve the agreement of measured and simulated O_4 dSCD/dAMF. In the previous publication by Wagner et al. 2019, various factors were investigated to determine the possible cause of this disagreement. One of the key remarks made by reviewers and the community was that the uncertainty of aerosol information and its impact on the oxygen dimer could not be ruled out as a possible cause of disagreement. In this novel study, Wagner et al. examine the difference of measured and simulated

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Discussion paper

O_4 dAMF for low aerosol loads measured during a ship cruise in the Atlantic in 2019. The authors claim that due to the low aerosol load possible aerosol uncertainties can be neglected and that the underlying differences must have another, as yet unknown reason.
The document is well written and structured and the analyses have been carried out thoroughly and consistently. However, I recommend publishing it after making some minor changes listed below.

1. Please add a table including all uncertainties described in the document (e.g. pressure/temperature changes, aerosol parameterization, effective temperature, ...)
2. It would be interesting to have a time series of O_4 dSCD/dAMF RMS values (similar to A13) for the data shown in Fig.6 and A11. I would expect a clear trend in the RMS differences over the day maybe similar to the one you showed for AOD and scaling factor? How is the correlation of these RMS values and the retrieved/measured AOD?
3. You mentioned that sun photometer measurements allow to differ between the aerosol particle size. Please show the contribution of differently sized aerosol particles to the total AOD over the day as well as all AODs and corresponding Angström exponents.
4. Furthermore, I was wondering why you only showed results for one day? The AODs for the following days are also rather small. Do these days support your findings?

Specific comments

P1, L22, 25: Please add a selection of corresponding references to the sentences starting with (L22) "In recent years,..." and (L25) "Several studies found that a scaling factor...".
P2, Sec 2.2 and Fig.3: Since AODs at other wavelengths are available, please add them to Fig. 3.
P3, L87: "(with..." ⇒ "(which...?
Fig. A1: Your fit uses the wavelength range 352 - 387nm but Fig. A1 shows only wavelengths up to ∼384nm. Please change the x-Axis according to the applied fitting window. Furthermore, I was wondering about the shown residual. It appears to me that there are still some residual structures left. Especially three peaks around 372-376 nm look familiar and could be attributed to Fraunhofer-Lines. Could this be somehow related to your Ring-treatment or do you have another explanation?
P5, L177: Why was the albedo set to 0.05? Please add a references here. As far as I know, we can expect a small dependence on SZA. How large is the impact on O_4 when changing the albedo according to possible values?
P6, L215: "the the", please remove either first or second "the".
P6, L216: You wrote that Fig. A8 includes constant and linearly extrapolated values for lower altitudes but the greenish line does not look like a linear extrapolation to me. Why is that?
P6, L221: Why is the Angström exponent "assumed" to be 2 when you have AODs at several wavelengths available to calculate more accurate values?
P6, L224: decsribed ⇒ described
P7, L263: "smaller than" ⇒ "larger than"
P7, L276: "bebetween" ⇒ "be between"
Fig. A7 Could you please add a similar figure for the geometry with the smallest RAA to better assess the impact of AP and SSA variations throughout the day?

References

Wagner, T., Beirle, S., Benavent, N., Bösch, T., Chan, K. L., Donner, S., Dörner, S., Fayt, C., Frieß, U., García-Nieto, D., Gielen, C., González-Bartolome, D., Gomez, L., Hendrick, F., Henzing, B., Jin, J. L., Lampel, J., Ma, J., Mies, K., Navarro, M., Peters, E., Pinardi, G., Puentedura, O., PuÄůÄńte, J., Remmers, J., Richter, A., Saiz-Lopez, A., Shaiganfar, R., Sihler, H., Van Roozendael, M., Wang, Y., and Yela, M.: Is a scaling factor required to obtain closure between measured and modelled atmospheric O4 absorptions? An assessment of uncertainties of measurements and radiative transfer simulations for 2 selected days during the MAD-CAT campaign, Atmos. Meas. Tech., 12, 2745–2817, https://doi.org/10.5194/amt-12-2745- 405 2019, 2019

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