

Düsing et al: The effect of rapid relative humidity changes on fast filter-based aerosol particle light absorption measurements: uncertainties and correction schemes, amt-2019-101

Review

General

The paper describes the effects of variable humidity on measurements of light absorption with filter-based absorption photometers. It has been known for a long time that elevated relative humidity distorts these measurements and this is the main reason why it has been recommended to only use data sampled at dry conditions. In certain type of measurements, especially recently popular balloon or drone-borne vertical measurements drying is not possible and rh is rapidly changing. It is therefore important to characterize the responses of the absorption photometers to the changing conditions. This is what this paper presents. It is probably the first one that actually quantifies the effect.

It is an interesting piece of work. For me the most interesting observation was the completely opposite response of the two absorption photometers and actually of the different filter materials. This very interesting indeed. Actually, it should be emphasized in the conclusions that the responses are filter material dependend and should be quantified if and when new filter materials are used in whatever filter-based absorption photometer, not just the two instruments used in this work. I can recommend the publication of the paper in AMT after some modifications. I did not find any major errors even though I did find some relatively small points to correct and change to the revised version of the ms. I will list them in the detailed comments below

Detailed comments

1) L106. "Ogren (2010) published the loading correction ..." and then the Eq. (4) is shown. This is not quite correct. Ogren (2010) presented a corrected version of the equation which was originally presented and also corrected by Bond et al. (1999).

2) L124-126 "... we used the σ_{abs} directly provided by the STAP and derived with the mentioned MAC in the case for the MA200, which already accounts for multiple scattering and filter loading corrections." How does MA200 account for multiple scattering and filter loading? What function is valid for Teflon? For STAP they are probably assumed to be done with the multiplication by Eq. (4), right?"

3) The manufacturers, their addresses, and filter materials used in the photometers are presented on lines 79-82, lines 129-132, lines 135-137, and 147-150. Maybe once would be enough.

4) L140. The reference to Holder et al. (2018) is to a conference abstract. I checked it at the conference book of abstracts. Sure, the abstract is there but it is so short that it does not contain any of the information you write on lines 139-145. If you cannot find anything that can be checked by a reader, you should remove these lines.

5) L213-214 "... Filter loading mass is calculated by multiplying the apparent loading mass concentration of the considered material..." What is apparent loading mass? Define it. Where do you get it from?

6) L221-222 " Four different ρ^* were .. for STAP, three for the MA200 ...". Were they not sampling simultaneously?

7) L249. When I look at fig 5 I see that the time when ammonium sulfate was sampled was hours. How stable could you keep the AS production? How would possible instabilities affect the result?

8) L257-261. There is speculation about possible effects of the negligibly small imaginary index of AS. There is a more plausible explanation. Why wouldn't the explanation be the apparent absorption or cross sensitivity of any filter-based absorption photometer to purely scattering aerosol that the authors are well aware of? The apparent absorption should be mentioned and discussed at some point of the paper already earlier.

9) Section 3.3. This section contains no other information but that a dryer dries humid air. The points in fig 7 are on the same line with and without drying so it does not tell anything about the responses of the absorption photometers. You would have obtained the same points also by reducing the original humidity. Even hypothetically there should not be a difference in reducing the original humidity or reducing it afterwards with a drier. Just omit the section.

10) L325-326. Please show a scatter plot of the exponential decay, not only the time series.

11) Explain clearly in the text and in the figure captions what is the difference between figs 3 and 5 and figs 4 and 6