Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-101-RC1, 2019

Atmospheric Measurement Techniques
Open Access
EGU
Discussions

Interactive comment on "The effect of rapid relative humidity changes on fast filter-based aerosol particle light absorption measurements: uncertainties and correction schemes" *by* Sebastian Düsing et al.

Anonymous Referee #3

Received and published: 23 June 2019

The authors present a study of humidity effects on filter-based absorption measurements. These effects may be important with UAV-based (low-power filter-based) absorption measurements where flight durations are relatively short and so the drone may not spend a lot of time at a fixed altitude. These are some interesting experiments, and the authors nicely explain the theory of absorption measurements. I have not seen a lot of papers about the TAP, so this could have been a useful contribution.

However, I have several concerns with this manuscript. It is not clear to me that the authors understand the instruments they use or what the data are telling them. Some

key points are listed below:

1. The TAP has a reference filter measurement, where the particle-free air downstream of the first filter is exposed to a reference measurement. This could explain why the TAP shows a lower response to humidity changes, and possibly why the sign of the effect is opposite that of the mini-Aeth. However, the authors fail to mention this crucial design difference.

2. The effects due to humidity changes are *temporary*. This is shown by the rise in absorption followed by a return to normalcy. The authors try to explain the initial changes by speculations about physical phenomena, but the measurements return to that shown by normal, unaffected conditions even as the RH remains high. The water film or beads would not disappear if the humidity remains constant.

3. A lot of the manuscript focuses on 60-second average measurements. The typical flight time of a UAV is 30 minutes, maybe two hours maximum. At the short end, 60-second averages are not very useful. At the top end, the instrument has time to equilibrate at a particular altitude to wait out any RH effects.

4. The authors present an experiment showing that a dryer reduces the observed RH effects, but don't seem to understand or at least fail to explain why - the dryer likely reduces RH at the filter, so the effect on measured absorption should correspond to that at lower RH. This is seen by the similarity in slopes between the non-dryer and with-dryer cases. A key analysis would be (a) measuring the RH post-dryer; (b) comparing the effect at the post-dryer RH (say 90% pre-dryer, post-dryer 55%) to that at the same non-dryer RH (55%).

5. The authors compare the dry-to-wet and wet-to-dry changes without considering whether these changes are of the same magnitude both ways. There could be hysteresis effects, similar to particle hygroscopicity.

6. The filter loadings and changes in RH considered here are ridiculously high. See

for example doi:10.5194/amt-6-2115-2013; figure attached. RH changes are more gradual and Bap values are much, much lower, which suggests that we will not see the high spikes reported here (except maybe in biomass smoke plumes). The high filter loadings used here (∼50 microg/m3) are likely exacerbating any effects.

There are other minor issues, and the manuscript needs a once-over by a native English speaker.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-101, 2019.

T. S. Bates et al.: UAS measurements of atmospheric aerosols

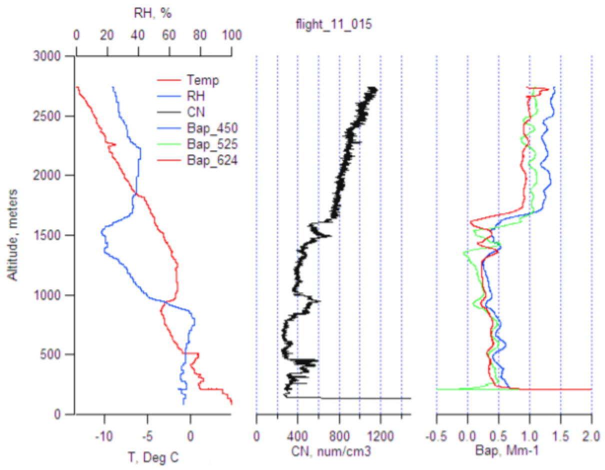

Fig. 5. The first 45 min of flight 15 (26 April 2011) showing the initial assent from the airport to 2700 m above the Kongsfjorden. Temperature and humidity (left), total particle number concentration (CN) (middle), and aerosol light absorption coefficient at three wavelengths (right). The mean CN concentration and aerosol light absorption coefficient measured at the Gruvebadet Laboratory during the STADS were 400 cm^{-3} and 0.56 Mm^{-1}, respectively.

Fig. 1.