Atmos. Chem. Phys. Discuss., 10, C9268–C9272, 2010
www.atmos-chem-phys-discuss.net/10/C9268/2010/

Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Water content of aged aerosol" *by* G. J. Engelhart et al.

Anonymous Referee #2

Received and published: 1 November 2010

This manuscript discusses the possibility of quantifying particulate water content using an aerosol mass spectrometer (AMS). The authors use dry and ambient RH size distribution data to obtain the total particulate water volume. This water volume is then compared to the AMS signal. The water content is also compared to modeled water content calculated from E-AIM II, using the chemical composition from the AMS. Using E-AIM II and recalculating the RH to that inside the measurement container housing the AMS, a linear relationship was found between modeled and measured water concentration. Although the applicability of the result for other AMS instruments and other aerosols is unclear, the authors have presented a methodology that, if applied by other groups, in the long run could prove to be very useful. The manuscript is well written and the methodology and result interpretation are clearly presented. I recommend this paper to be published, after modifications and clarifications described below.

General questions/remarks:

1) As stated, it has previously been thought that particulate water evaporates in the AMS, which would make you lose a lot of the water. If this is true (like prof. Jimenez pointed out in a comment), it may be that the chosen RIE for water is too low, and the nice linearity that you obtain may be an effect of a relatively stable aerosol (as Dr. Middlebrook pointed out in another comment). Do you indeed have a fairly stable aerosol or is it very dynamic? If it is dynamic, can you see changes in the correlation slopes? Particle size would strongly influence the mass fraction of particle bound water that is evaporated in the aerodynamic lens. How much did the mass weighted GMD vary in this experiment? This matter needs further discussion in the paper.

2) The organic fraction is sometimes used in the calculations, sometime it is not. Although the difference may be negligible when it comes to μg/m3, a large volume fraction of less hygroscopic organics might be very important when it comes to e.g. CCN properties, as it is the mean κ-value (Petters and Kreidenweiz, 2007) in combination with the dry particle size which is the important parameter when it comes to cloud formation. This question is not the focus of the paper, but could be worth to at least mention.

3) Would it be possible to correct the VGF to the ambient distribution by recalculating using Köhler theory? In figure 2 it looks like there is a difference of a few percent between DAASS-RH and ambient RH. How large is this potential error?

4) The modeled water content from the E-AIM model is lower for the recalculated RH than from the ambient RH (at least looking at the scale of the axis), which would imply that the temperature at the point of the AMS measurement was higher than the ambient temperature. Is this correct?

Details:

1) The Q-AMS instrument in introduced late in the abstract, after discussing results from E-AIM. It should be presented before results from the instruments are discussed.

2) Page 21654: Particle lifetime is mentioned twice (row 21 and 26) in a repetitive way.

3) Page 21655, Row 16: Reference should be Nilsson et al., 2009.

4) Page 21655, rows 26-28: Was it Choi and Chan (2002) who said that non-neutralized sulphate aerosols could be correlated to lack of efflorescence? Or should there be another reference here?

5) Page 21656, row 1: This sentence needs rephrasing. Can you define “hygroscopic”? It is true that kappa values of organics have been found to vary significantly (see e.g. Jimenez et al. 2009), but what do you mean by affecting the water uptake “negatively”? As long as the organic fraction of the particle is not completely hydrophobic, it will contribute to the water uptake. However, the organic part can both increase and decrease the hygroscopic growth factor (GF) of the particle; this all depends on what the rest of the particle consists of. Please clarify what you mean here.

6) Page 21656, row 5: As I understand it, this was a pure HULIS-measurement, and does not mean this is the GF for the entire organic fraction. Maybe this is not so relevant for this study.

7) Page 21656, row 6. I prefer “hygroscopic” instead of “hydrophilic”, since it is to my knowledge the term most commonly used.

8) Page 21656, row 28. “increased water uptake”. Same as point 5), do you mean that the organic fraction was not completely hydrophobic?

9) Page 21658, row 3: “EUSARRI”. Should be ”EUCAARI”.

10) Page 21661, row 17: What does “flash-vaporize” mean?

11) Page 21662, row 1: “with”. Should be “in”, right?

12) Page 21662, row 4: If you use pToF spectra you have the same results but size resolved. Why don’t you present or discuss these data in the paper? Is it really this easy to separate the signals? it seems like it since you have this nice linear relationship,

but if you have vaporization in the AMS during the particles lifetime before it hits the heater, I guess this would give a somewhat smeared signal?

13) Page 21662, row 3: “H2O+/N2+ scales with absolute humidity”. For non AMS users this is not obvious. Is there a reference for this, or did you do some measurements to confirm this?

14) Page 21663, row 11. These 10% of water is assuming that the aerosol is completely dry at 12% RH (or whatever your dry measurement RH is) right? So the water content could be slightly higher than 10%, given that you have a small GF also at your dry conditions?

15) Page 21666, row 11. “same chemical composition information as before”. Does this mean with or without the organic fraction?

16) Page 21666, row 13. “the agreement is striking”. A bit too “expressive” for my taste. Try to keep the text as formal as possible.

Figures:

Fig 1. I thought that you used closed loop for the DAASS measurements (except when switching between dry and humid). My point is that if you have a pump for the Exhaust in the schematics, there should also be one in the DMA loop.

Fig 2. Write “Time” on the x-axis.

Fig 4. Relative humidity is commonly described in percent.

Fig 8. Same as fig 4.

References:

Petters, M.D. and Kreidenweis, S.M.: A single parameter representation of hygroscopic growth and cloud condensation nucleus activity , Atmos. Chem. Phys. , 7, 1961-1971, 2007.

Jimenez J.L et al.: Evolution of organic aerosols in the atmosphere, Science, 326, 1525-1529, 2009.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 21653, 2010.