

Interactive comment on “Water content of aged aerosol” by G. J. Engelhart et al.

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This is an interesting paper which presents new results about the potential to use the AMS to measure particulate water. At face value, the results would suggest that no particle-phase water is lost in the AMS lens, which conflicts with the experimental results of Matthews et al. (AST 2008) and Zelenyuk et al. (Anal. Chem., 2006). This apparent conflict may be resolved by using a relative ionization efficiency (RIE) for water in the AMS which is larger than the value of 1.0 assumed in this study. To my knowledge a value of RIE of H₂O has not been published, but several groups have independently concluded that RIE of H₂O has a value between 2 and 4, as discussed at several AMS Users Meetings, including the recent 2010 meeting in Hyytiälä. Using those RIE of water values, the results of this paper can be interpreted as a loss of 50-75 percent of the original particle-phase H₂O, but with the amount of water remaining in the particles being proportional to the amount of water originally present in them. The

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reasons for the relatively high RIE of H₂O may be related to its low m/z, analogously to the similarly high values of RIE of NH₄ (really ionized as NH₃(g)) which are typically in the range 3-4, as routinely measured as part of the AMS calibration with NH₄NO₃. Clearly additional research on both RIE of H₂O and on the proportionality between particle-phase H₂O before and after the AMS inlet is needed. If the latter is found to hold in additional studies and a wide range of environments, it would be a very useful (if unexpected, at least by me) addition to the measurement capabilities of the AMS.

As an addendum to my previous comment, a paper was just published that reports a value for RIE of H₂O = 2 (Mensah et al., 2010). As for RIE of NH₄, I would be surprised if RIE of H₂O was constant across instruments and operating conditions, but perhaps that can be investigated by applying the methodology of this paper for other instruments.

The authors appreciate Dr. Jimenez's insights. We do agree with the main conclusion that our results are consistent with the product of the relative ionization of water and the evaporated fraction of water being close to unity for the conditions of FAME-08 and the Q-AMS used in the study. If for example the RIE=2 for water reported by Mensah et al. (2010) is applicable to our measurements then approximately half of the aerosol water evaporated in the AMS. What is rather surprising is that the fraction of water that evaporated in the AMS remained relatively constant during the full month of the FAME-08 measurements (discussed also in our response to Comment 2 of Reviewer 2). While the absolute aerosol concentration was quite variable during FAME-08 (see for example Figure 1 of Hildebrandt et al., ACP, 2010 or Figures 6 and 7 of Pikridas et al., ACP, 2010) the shape of the volume/mass aerosol distribution was relatively stable (see Figure 12 of Pikridas et al., ACP, 2010). This is a potential explanation of the surprising agreement of the AMS water measurement with the E-AIM predictions. Discussion of this important issue together with the recent Mensah et al. (2011) study has been added to the paper to improve the interpretation of the AMS water measurements.

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