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Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #1

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The goal of the article and supporting research, to determine the state, water content and volume growth factors and compare results among two instrumental methods and models, is valuable. The investigation of the AMS signals as a means of determining aerosol water content directly as well as via models is useful to the extent that it may supplant a separate measurement scheme, e.g. DAASS or similar.

The DAASS method, operation and data analysis were adequately presented and included the relevant parameters.

Comments regarding the details of the AMS operation and data interpretation with respect to water vapor and aerosol water have been submitted by AMS experts far beyond my level and I will not comment further.

The experimental and analytical method with respect to the AMS particulate water determination seems to be flawed in one respect, however. The RH to which the aerosol

was equilibrated at the inlet to the AMS was not ambient RH as in the DAASS nor was it measured or calculated from temperature and dew point temperature as far as I can tell from the manuscript. The only reference is that the aerosol in the AMS sample inlet was equilibrated to "around 25 deg. C" in the air conditioned field laboratory. Without a measured RH how was the AIM model initiated? Without knowledge of the AMS inlet RH how can a quantitative comparison be made to the DAASS where considerable effort was made to control and know the ambient RH and matching instrumental RH? Clearly there was reasonably good correlation of AMS vs. DAASS particulate water. Given the uncontrolled AMS inlet RH this is surprising. Is it a coincidence resulting from the fact that the aerosol chemistry was relatively stable (see acidity ratio) thus the two water contents varied similarly over time even though they were made at different RHs? Or was it simply due to the fact that most of the data was collected when the ambient RH was in the range of 30 to 60% where change in particulate water with RH is not large? Or a combination of both effects? The regression slope of 0.44 is likely due to a lower RH at the AMS inlet, knowing what I know about average ambient temperatures cf. lab temperature of 25C at Heraklion in May. Without the thermodynamic data, other than one example day, Fig. 3, it is hard to speculate further. As the authors stated, "This may explain some of the observed disagreement at high water content . . .". But there is more that could be said than that.

If these points are explained or corrected and discussed, then the paper will be acceptable and publishable.

Minor points to be addressed are listed below with reference to the text of the article, in quotes.

"An overview of the FAME-08 field mission with details on each of the measurements described below has been presented by Pikridas et al. (2010)." A one sentence summary of the goals of FAME08 within EUCARRI would put this work in the larger context.

"The sampling station is located at a 250 m elevation far from any major local anthro-

pogenic sources; the closest urban center is Heraklion, which is approximately 50 km to the west. The island's location in the Eastern Mediter- ranean makes it an ideal location." Quantify the distance from major sources and the size of the city of Heraklion. No site is "ideal" though it may in fact be very good.

"The difference between the ambient and dry mode aerosol volume distributions is equal to the particulate water concentration." .... is interpreted as the particulate water concentration.

"Permapure HD-2000) with final polishing via a carbon cap, silica gel dryer and a HEPA filter." Carbon capsule? Describe. Discuss the effect of the drying method and removal of organic vapors with the carbon capsule on volatile compounds other than water.

"If we assume that the aged submicrometer particle population was homogeneous and therefore all the particles have the same growth factor then:" Regarding this and other assumptions some uncertainty analysis should be presented. Assumption of volume additivity in eqn. 5. Assumption about no (negligible) water less than 10% RH even at low acidity ratio. Assumption of ammonium sulfate density in spite of variable acidity ratio.

"The sampling lines leading to the Q-AMS were sufficiently long for the sample to come into equilibrium with the room temperature, altering the RH from ambient conditions. This may explain some of the observed disagreement at high water content, as water content versus RH is exponential in nature. We will explore this in a subsequent section using thermodynamic theory." Given the lab temperature of "around 25 deg. C, the humidity around the aerosol at the inlet to the AMS cold have been above or below the ambient RH and as mentioned may explain much of the discrepancy. I do not see a further exploration of this possible artifact in the text. Somehow the AMS and DAASS data should be sorted to get reasonably equivalent or known RH conditions.

"The particles during FAME-08 showed no signs of efflorescence (Fig. 4)." Strictly speaking, since this is a plot of volume growth factor vs. atmospheric RH over a long

time period rather than a scan of growth factor vs. RH for a nearly constant aerosol composition over a shorter period, observation of efflorescence is not likely to be possible. Equally well, a lack of efflorescence may be due to the acidity of the aerosol or there could be efflorescence in the data but hidden by the variability (data scatter) over the longer time.

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