

Interactive comment on “Hygroscopic behavior of atmospherically relevant water-soluble carboxylic salts and their influence on the water uptake of ammonium sulfate” by Z. J. Wu et al.

Anonymous Referee #1

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The paper presents a laboratory study on atmospherically relevant organic salts. I get the impression that the measurements are carefully made and of good quality. However, I am missing some important pieces of information on experimental conditions as specified below. And even more important, one could also ask more from the analysis of the data. I recommend that the paper is published after consideration of the comments below, especially those concerning experimental procedure and data evaluation.

Description of the experimental procedure:

More information about the compounds studied is needed: Chemical formula for the compounds, did the sodium and ammonium salts of di-acids have one or two ammo-

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nium/sodium ions, density, molar weight, . . .

What was the residence time from DMA1 to DMA2 in the H-TDMA?

Was the aerosol RH and the sheath flow RH the same?

Which particle size was used?

Data analysis:

Some of the salts form hydrated crystals from bulk solutions. It could be discussed if this is also the case for sub-micrometer particles

Deliquescence RH can be estimated based on solubility. Also the lower DRH for mixtures can be interpreted theoretically based on solubility.

The hygroscopic growth(water activity) should be compared to that found by Peng et al. (or other literature values) when available.

The hygroscopic growth can also be estimated from molar weight, density and van't Hoff factor (one would probably have to make assumptions on dissociation). It would be interesting to see these in order to learn about how well hygroscopic growth can be estimated and for extrapolating to other organic salts. I would even say that without this, the results are of limited value, since they are only valid for a small number out of thousands of organic salts and other compounds.

How does the hygroscopic growth of the salts compare to the acids (when data is available in the literature)?

Is the hygroscopic growth (RH) consistent with a constant kappa?

Table 1: I have two comments to the polynomial fits. First, wouldn't it make more sense to use water activity instead of RH? Thus the effect of particle size would be minimized. Secondly, the polynomial fits used, are not well behaving, i.e. the coefficients alternate between relatively high positive and negative values. This is especially the case for

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ammonium sulphate and sodium pyruvate. Would it be possible to find a more well behaving way of fitting the data that is related to the physico-chemical understanding and goes towards 1 for RH/water activity = 0?

Minor comments:

Abstract, p 7694, l 14-15: It says "Köhler theory underestimated kappa for mixtures. . .". This does not state what the Köhler theory used is based on. "Köhler theory" could be replaced by "simple mixing rule" or similar.

P 7694 l 21. Hygroscopic properties of atmospherically relevant inorganic salts and their importance have been recognized more than 20 years ago. See e.g. the work by Fitzgerald et al.

P 7699 l 4-5 Check language

P 7702 l 17 "critic". Do you mean citric?

P 7702 l 14 I have two comments on the discussion about depression of water uptake by the organic salts: 1) The expression "depress" is misleading, unless you refer to other effects than the organic salts replacing ammonium sulphate with compounds that are not as hygroscopic. 2) On what do you base that the results are not expected? The kappa value based on the mixing rule is close to the experimental value.

P 7702 l 19 The Köhler theory is not proposed by Petters and Kreidenweis. They proposed a parameterization of the Köhler theory, which is very similar to what Fitzgerald proposed many years ago. The light that they put on the issue has, however, catalyzed a lot of progress in the scientific field.

P 7702 l22 Isn't this mixing rule the same as the one proposed by Zdanowski, Stokes and Robinson (ZSR method)?

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 7693, 2011.