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Atmospheric
Chemistry
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Discussions

# *Interactive comment on* “Modelling the cloud condensation nucleus activity of organic acids” *by* Z. Varga et al.

**Z. Varga et al.**

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Answer to Referee #3

We express our thanks for the Referee’s comments, which helped us improve the paper. We have complemented different sections according to the Referee’s comments. Please find the detailed answers to the comments below.

1. We agree that water activity can be expressed using the van’t Hoff factor as shown by e.g. Kreidenweis et al. The aim of discussing equation 2 was to demonstrate its uncertainty when different van’t Hoff factors are assumed. This uncertainty is eliminated when osmolality-derived water activity is used. The discussion of equation 2 and section 3.2 has been complemented to make it clear.

2. We share the Referee’s opinion that the lack of information on the molecular weight,

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concentration and dissociation constant of real aerosol constituents hinders in the calculation of term B in the simplified Köhler equation. That is why we suggest using water activity derived from osmolality. Thus the approximation of the overall unknown “B” can be avoided.

3. In equation 1 and 2 the density of solution has been replaced by that of water (although it does not make noticeable difference since the density of the solutions studied practically equals that of water.)

4. On page 5347 we wrote: “It can be observed that surface tension depression is negligible for most of the organic acids if r/r0&#8805;4.” since the surface tension in such droplet solutions (0.070-0.072 Jm-2) is close to that of pure water (0.072 Jm-2). The surface tension in a droplet solution having e.g. r/r0=5 is the same independently of the dry size of the particle. Nevertheless, we agree that the Kelvin effect is more significant at the activation of particles of smaller dry radius (although this is the effect of the smaller radius and not the effect of the surface tension) and therefore modified the sentence in question.

5. We agree with the Referee that water activity is primarily determined by the mole fraction of the solute. Thus, organic acid solutions of the same mole fraction have very similar water activity indeed (assuming identical dissociation). However, our aim was to demonstrate the ability of the acid particles to act as CCN and in this case dissociation, molecular weight and density play important role, too (as also highlighted by the Referee). This is emphasized in the text, too: “At a given w/w% this difference is caused by two features primarily: molecular weight (MW) and dissociation constant (pK) of the organic acid.” We think that showing water activity as a function of mole fraction could lead to the interpretation that MW is not significant, which is not the case if the CCN ability of organic acid particles is investigated.

6. We admit that due to the similar CCN properties of the organic acids it is difficult to distinguish the individual compounds in figures 4-5. In order to improve visibility of

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data points we have modified the figures. Nevertheless, we did not change scaling to log-log in figures 4-7 since linear scaling is usually used (Prenni et al. 2001, Koehler et al. 2005, Kumar Hartz et al. 2006) and thus comparison between our results and other published results is easier. Furthermore, the log-log scaling did not improve the visibility of the individual data points. We have also complemented the discussion of published experimental data and referred to the paper by Koehler et al. (2005) as well. In our original model calculation activation was determined for anhydrous oxalic acid but the possible dihydrate formation is also discussed and results for both anhydrous and dehydrate are now shown.

7. Of course, wet to dry diameter is identical to the growth factor (GF) used in HTDMA studies. Since GF is more widely used we have renamed the scales to GF. It must be noted, however, that based on the water activity data available from our measurements still there may be a gap between HTDMA and osmometer results: HTDMA gives GF (RH) up to ca. GF=2 for dicarboxylic acids while we have data for GF&#8805;3 for 3 out of the 5 dicarboxylic acids. For the two dicarboxylic acids (malonic, glutaric) where GF data are available for GF&#8805;2, there is a minor discrepancy at the joint of the curves from osmometry and HTDMA. This deviation may originate from the fact that RH includes not only water activity but also the Kelvin effect.

8. The advantage of the combination of EDB- or HTDMA-derived water activity with osmolality data would be the extension of curves like e.g. in figures 4 and 5 to a wider ddry range. In this case, however, we would loose the possibility of comparing our results with other independent experimental results. That is why we did not combine osmolality-derived water activity with other data. We have completed the paper with the discussion of the activation of organic acid particles. It must be noted, however, that in the atmosphere such “truly dry” particles hardly exist, thus the traditional Köhler curve (with one local maximum) can be used as also stated by Bilde and Svenningson (2004).

9. We agree with the Referee that comparison of experimentally derived activation

curves with those assuming i=1 and &#963;=0.072 Jm-2 is useful. Therefore, we have inserted these curves into figures 6 and 7 (in the original manuscript). Furthermore, we also show Köhler curves with different sets of assumptions as requested.

Minor issues:

The references have been corrected and the calculation method for the van’t Hoff factor has been added to the text:

i=Osmolality/molality

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Interactive comment on Atmos. Chem. Phys. Discuss., 7, 5341, 2007.

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