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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A combined particle trap/HTDMA hygroscopicity study of mixed inorganic/organic aerosol particles" *by* A. A. Zardini et al.

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Zardini et al. have submitted a well written and organized manuscript describing EDB and HTDMA measurements of mixed organic/inorganic particles. Hygroscopic growth measurements for ammonium sulfate (AS) mixed with citric, glutaric, or adipic acid are given as a function of composition and are compared with available data and ZSR predictions. Zardini et al. describe a number of interesting findings, including results on the compositional dependence of AS/citric acid growth curves and the complex AS/adipic acid growth cycles. This study also demonstrates the need for multiple experimental techniques to characterize the behavior of certain particles. For instance,

situations arise where EDB measurements indicate that particle mass is increasing, while HTDMA measurements indicate that particle volume is constant. Such results provide evidence that water is being taken up in particle veins. The article is suitable for publication in APCD; my specific comments are given below.

1. The authors' explanation of the pre-deliquescence water uptake for the 1:3.3, AS:AA system in terms of a reverse Kelvin effect for veins and pores is plausible, and the rough calculations appear to support this interpretation. However, I am not convinced that the complex behavior in Figure 8 is fully understood yet. In parts of the discussion (e.g., p. 5251, lines 26-29 & 17-20), the pre-deliquescence water uptake is addressed with a level of detail and assurance that exceeds the indirect observational evidence. Although I find the discussion engaging, I would be more comfortable if readers were explicitly reminded that dynamics such as the swelling and collapsing of particle veins was not directly observed.

2. AIM results are given for pure ammonium sulfate, but not for particles containing inorganic/organic mixtures. The online version of AIM has recently been updated to include organic compounds (E-AIM): http://www.aim.env.uea.ac.uk/aim/aim.php. Of the three organics in the current study, only glutaric acid is currently available as a "public" compound in E-AIM. However, my understanding is that new organic compounds can be added to the model by the user. The authors should consider comparing E-AIM predictions to the current measurements.

3. In their 2001 Optics Express article [8(6):314-321], Braun and Krieger indicate that the temporal analysis of light-scattering intensity fluctuations is ill-suited for resolving fast processes like the efflorescence of micron-sized particles. That study proposes using a pattern distortion parameter derived from fringe patterns to study efflorescence. Why wasn't the pattern distortion parameter used for efflorescence measurements in the current study?

4. On page 5246, the presence of impurities is given as a possible explanation for the

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lower DRHs for glutaric acid in the Peng et al. study. Particles containing impurities often have high efflorescence RHs. However, the ERH range of Peng et al. (2001) falls within that of Pant et al. (2004) and is lower than the ERH of the current study for the measurements in Figure 4. Of course, the variation in the ERH of glutaric acid in the current study for repeated humidity cycles complicates the issue. In any case, I am not sure that a strong argument can be made for impurities in the Peng et al. study considering that the ERHs do not appear to be high and the DRHs are in agreement with the Cruz and Pandis (2000) study.

5. Please add solubilities and vapor pressures for the organics to Table 1.

6. In the introduction, it would be helpful to cite field studies that have observed citric, glutaric, and adipic acids in particles.

7. In several places (p. 5244 & 5249), RMSD values are referred to as "typical" of liquid and/or solid particles. Please define typical RMSD ranges for the different phase states in the text or figures.

8. I would like to make the authors aware of a recent study related to their work: Understanding hygroscopic growth and phase transformation of aerosols using single particle Raman spectroscopy in an electrodynamic balance. Alex K. Y. Lee, T. Y. Ling and Chak K. Chan, Faraday Discuss., 2008, 137, 245-263

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