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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "A curved multi-component aerosol hygroscopicity model framework: 1 – Inorganics" *by* D. O. Topping et al.

**D. O. Topping et al.**

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The authors would like to thank you for your time in reviewing this paper and support of the work which has been presented. The remarks made are addressed below.

Page 8633, line 14. Typo in charge on Na. Change Na2+ to Na+ Response - this has been corrected.

Page 8637, line 20. Shouldn't this equation be : aw = fw * xw (i.e. mole fraction of water seems to be missing)?. Response - Yes this has been corrected.

Page 8638, line 10. The authors need to refer to the more recent paper by Wexler and Clegg, JGR, NO, D14, 10.1029/2001JD000451, 2002, for work done on the importance of double salts in ambient atmosphere. Response - The text has been updated

accordingly. At line 24 the following body of texts occurs. Wexler and Clegg (2002), in developing AIM online, analysed the importance of double salts in the atmosphere. They found that, for a mixed NH4-SO4-NO3-H2O system, model calculations which do not include double salt formation predict an aqueous phase to persist until lower relative humidities. This has implications for light scattering properties for example, and mass transfer calculations for gases equilibrating with the aerosol phase.

Page 8647, line 11. The distinction between the ZSR and thermodynamic models is not clearly explained. I understand the difference, but it needs to be explained a bit more clearly. Response - Line 12 now includes the text - 'The ZSR model uses the method invoked by {Malm and Kreidenweis 1997} for mixed solutes whereas the thermodynamic model is that presented in this paper.'

-Having said that, I don't understand what the authors are trying to say with Figure 4. The legend and caption of this figure is not clear at all. Which model is used to predict the 8, 20 and 100nm lines. And why do the ZSR and ADDEM lines not agree with the 8, 20 and 100nm lines in the supersaturated region? What size particles do ZSR and ADDEM lines correspond to? Response - This figure has been altered to make the ZSR and thermodynamic comparisons more clear. The aim of this figure was to compare both models for a purely aqueous aerosol across three different dry size, but also highlight eh advantage of using a thermodynamic model in being able to treat solid precipitation. In the initial figure, the red lines correspond to the thermodynamic model ADDEM, whereas all the blue lines correspond to the ZSR approach. The difference between both models in the super saturated region is down to the neglect of the solute interactions in the ZSR approach.

-Secondly, what dry size particles were assumed for mixtures listed in table 3? Response - Page 8647, Line 20-21 now reads - 'Table (3) shows percentage deviations (here defined as (GFZSR/GFthermo -1)x100% ) between the two approaches for some binary and ternary mixed systems, neglecting the influence of curvature.'



**ACPD**

4, S3650–S3652, 2004

-Ĕ Also, it is stated that the bold values represent growth factor differences. Differences between what?.. Response - The growth factor difference simply represents the difference between both models used. The table caption has been updated accordingly to clarify this. Also, page 8647, line 27-28 now reads ‘For all given systems at higher relative humidity, the corresponding absolute growth factor difference between the two models is likely to be within the experimental uncertainty of the HTDMA’.

Ĕ Finally, do these calculations include full gas-liquid-solid equilibrium or only solid-liquid equilibrium?. Response - Page 8647, line 14 now includes the text - ‘For the thermodynamic predictions, only solid-liquid equilibrium is treated, whereas the ZSR model can only treat purely aqueous systems here.’

On page 8648, line 18, it is stated that surface tension effects were neglected in the discussion above. This is confusing, because Figure 4 shows results for particles of sizes 8 and 20nm. Please clarify. Response - Page 8648, line 18 has been removed. The subsection now starts with the text - ‘Since the size of the aerosol particles can range from just a few molecules to particles with radii larger than 100 μm, it is important to understand the role the surface effects have on the deliquescence process by which small drops are formed [Mirabel et al., 2000].’

Page 8649, line 26. Change ‘humiditys’ to ‘humidities’ Response - the text has been updated accordingly.

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Interactive comment on Atmos. Chem. Phys. Discuss., 4, 8627, 2004.



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4, S3650–S3652, 2004

Interactive Comment