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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Hygroscopic properties of ultrafine aerosol particles in the boreal forest: diurnal variation, solubility and the influence of sulfuric acid" *by* M. Ehn et al.

Anonymous Referee #2

Received and published: 6 November 2006

Title: Hygroscopic properties of ultrafine aerosol particles in the boreal forest: diurnal variation, solubility and the influence of sulfuric acid

Author(s): M. Ehn, T. Petäjä, H. Aufmhoff, P. Aalto, K. Hämeri, F. Arnold, A. Laaksonen, and M. Kulmala

General scientific comment:

The manuscript presents interesting and new findings in the field of particle nucleation and particle hygroscopicity. I would encourage the authors to come up at least with some more assumptions in the Results and Discussion part as I know that our knowl-

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Interactive Discussion
Discussion Paper

edge is vague in this area. The manuscript is worth for publication in ACP, but I would like to address some detailed scientific comments on the manuscript.

Detailed scientific comments:

Abstract

It would be good to quantify your statements by citing a few numbers on your observations.

Page 9938, line 8: Are gases hygroscopic?

Page 9938, line 18: “during early morning” depending on what - only time for a constant size? Or depending on size?

Page 9938, line 19: “of condensable vapors” or on condensation processes in general taking place at night time and at day time!

Introduction

Mention, that the understanding of nucleation processes is a basic issue in aerosol science independent on our focus quantifying the impact of particles on climate.

Page 9939, line 18: “high” and “low”, please give growth numbers for certain sizes and certain RHs

Experimental setup

Please tell in general, where the systems were placed during the measurement period - air conditioned room? Also, a more detailed description about RH uncertainty during the measurement is expected.

Page 9940, line 18: “experience electrical charging” - I would rather say, they are brought into a well known equilibrium charge distribution.

Page 9941, line 1: What was the temperature range outside, what was the temperature range inside? Please specify your conditions a bit more detailed since they are

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important for the operation for HTDMAs!

Page 9941, line 4: This is the case for most species. Nobody is sure about some extraordinary species. But, in general, TDMAs are limited to what they can!

Page 9941, line 18: Ětemperature of the water: Does it not depend on pressure and temperature of water outside and pressure and temperature of water vapor inside the tubing? You control one of these parameters.

Data analysis

In general, you should clarify, why you use ammonium sulfate for the model. You should be able to support your decision by the data from the mass spectrometer. There could also be some good reason to use sulfuric acid or ammonium bisulfate for your calculations - at least for the smaller particles. How have no changes within air masses be monitored?

Page 9943, line 8: Which system are you talking about! Specify HTDMA!

Page 9944, line 8: From my calculations this is about nearly 2% uncertainty in RH.

Page 9944, line 10: I guess, you are talking about particle soluble volume fractions.

Results and Discussion

Please discuss your results with respect to possible uncertainties. Also, this part is missing a discussion of other inorganic species that could alter the hygroscopic behavior of particles in dependence of size and time. For example, think of the presence of nitrate during daytime and nighttime. These discussions could strengthen some of your findings and assumptions.

Page 9946, line 19: Here, better give a relative increase in terms of percent, when you have discussed uncertainties in percent at an earlier stage.

Page 9950, line 14: Excuse me, but I cannot find this tendency. Please show it for

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some events by giving numbers for different cases.

Page 9950, line 16: My guess is, this is because the model assuming ammonium sulfate fits better for larger particles. At 10 nm in diameter you may have sulfuric acid particles. With respect to sulfuric acid in the model, you would come up with smaller values in soluble volume fractions, but your tendencies in changes would lead to the same conclusions.

Page 9951, line 10: I guess, you mean the soluble mass flux.

Page 9951, line 13: You mean there may be additional organic compounds causing the growth, but how many species could be involved in this process is fairly well unknown.

Page 9951, line 17: ... in concentration of condensable gases ...

Conclusions

Page 9952, line 6: Here, better give a relative growth in percent or say from ... to ... .

Page 9952, line 9: For clearness, repeat once more, which pattern you mean.

References

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General comment on the manuscript style:

The manuscript is written in a good English style. The figures are easy to understand and figure captions are clear. Please use expressions at all times the same way. Say hygroscopic growth factor and never growth factor. So, you never will exchange formation growth rates and hygroscopic growth. I would encourage the authors to check the whole manuscript for used times. Please write in past or in presence. Furthermore, I would like to address some detailed comments on the manuscript style.

Detailed comments on the manuscript style:

Abstract

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Introduction

Page 9939, line 1: better: ... in the atmosphere

Experimental setup

Page 9941, line 13: better: ... chemical composition

Page 9941, line 16: better: ... the sample flow is conducted

Page 9941, line 21: better: ... the RH in the sheath flow

Page 9941, line 24: better: In the excess flow line ... is operated.

Page 9942, line 11: better: ... particle number size distribution

Page 9942, line 18: better: ... in dry particle size

Data analysis

Page 9943, line 13: This is not a complete sentence.

Page 9943, line 15: better: ... were inverted

Page 9943, line 16: better: ... transfer function

Page 9945, line 2, 5, 22, 25: better: ... soluble volume fraction

Results and Discussion

Page 9946, line 6: better: ... presenting instead of containing

Page 9949, line 3: better: ... growth factors

Page 9949, line 4: better: ... values were

Page 9950, line 4, 8, 10, 12 16, 17, 19, 23, 26, 28: better: ... soluble volume fraction

Page 9951, line 9: better: ... this contribution accounted on average for ...

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Page 9951, line 15: better: ... soluble volume fraction

Conclusions

Page 9952, line 7, 8, 9, 10: better: ... soluble volume fraction

References

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Table captions

Page 9956, Table 1 caption: better: ... soluble volume fraction

Figure captions

Page 9964, Figure 8 caption: better: ... soluble volume fraction

Page 9965, Figure 9 caption: better: ... soluble volume fraction

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Interactive comment on Atmos. Chem. Phys. Discuss., 6, 9937, 2006.