

Interactive comment on “Field measurements of hygroscopic properties and state of mixing of nucleation mode particles” by M. Väkevä et al.

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Response to the Anonymous Referee # 2

The Specific Comments

1) The term "ultrafine particles" We appreciate the Referee pointing this out. The instrument itself is called Ultrafine TDMA to differentiate it from those instruments best suited for measurements of particles from about 30 nm up to several hundreds of nanometers in mobility diameter. But to be precise, the UFTDMA instrument is at its best when measuring nucleation mode and small Aitken mode particles, i.e. particles smaller than 30 nm in mobility diameter. Thus the term ultrafine in this case denotes particles smaller than 30 nm. The terminology will be clearly defined in the revised manuscript.

2) About the inversion algorithm and concentrations. The simplified algorithm was used since it gave accurate enough values for the growth factors. When it comes to the con-

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centrations, however, we do not feel that the UFTDMA should in any case be used but to give an indication whether there are any, some or many particles. This unfortunate fact is caused by the very large uncertainty in concentration measurements of the UFTDMA system. For example water condensing inside the system (line from the DMA2 to the CPC, inside the CPC, etc) drastically reduces the overall concentration detection efficiency of the system, and the magnitude of this reduction can not be defined without regular concentration calibrations, which, on the other hand, are extremely difficult to perform in field conditions. Luckily enough the possible factors causing the reduction of the detection efficiency cause a systematic error into the concentrations (since only a very narrow size fraction is studied) and thus the growth factor data remains valid. The parts in text and figures where concentrations are mentioned will be changed so that they will not be misleading: in figures 1-6 the concentration plot (concentration vs. time) will be omitted, and when possible replaced with $dN/d\log D_p$ (cm^{-3}) for the size in question calculated using DMPS data. In figures 7 and 8 the figure captions will be rewritten to highlight that the concentrations are not the actual ambient concentrations, and that they should only be used as a rough indication about the amount of particles measured with the system.

3) Corrections of the field data. What comes to the usage of the correction by equation 4 - First of all there is an unfortunate error in the explanatory part of the equation. Only the "grown" part of the growth factor is corrected for, so the corrected growth factor (GF(corrected)) is $\text{GF}(\text{corrected}) = 1 + [\{\text{GF}(\text{measured}) - 1\} * \text{corr}]$, where corr is the correction factor calculated with equation 4. This will be corrected in the manuscript. A normal practise in correcting TDMA data is to use theoretical estimations about the growth behaviour of some well-known salt. Would this have been possible for the nucleation mode particles, we would definitely have used the theoretical approach in the corrections. But since the theories were not able to predict the same behaviour as was measured with the UFTDMA instrument, we decided to make corrections that were possible, just as the Referee states "even without any theory".

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4) Hygroscopic modes. It is true that the growth factors are easy to differentiate only when external mixing is observed. And it is also true that the values given should not be used as exact values, but as rough guidelines to categorise growth factors of 10 nm particles. More discussion about this issue can be found in the response to Anonymous Referee #1.

5) Figure 5. The concentration data in Fig. 5 was erroneous, the stable data points were taken from a wrong column. We thank the reviewer for noticing this. However, this plot is omitted in the revised version of the manuscript (see comment 2).

Interactive comment on Atmos. Chem. Phys. Discuss., 1, 379, 2001.

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