Atmos. Chem. Phys. Discuss., 10, C7755–C7759, 2010
www.atmos-chem-phys-discuss.net/10/C7755/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Reconciliation of measurements of hygroscopic growth and critical supersaturation of aerosol particles in Southwest Germany" *by* M. Irwin et al.

Anonymous Referee #2

Received and published: 20 September 2010

This manuscript presents measurements of hygroscopic growth factors and critical supersaturations of atmospheric particles measured during a field campaign in Southwest Germany.

The authors test the applicability of the one parameter approach: the socalled kappa-Köhler model, to predict critical supersaturations from hygroscopic growth measurements. There is currently a large interest in the applicability of one-parameter approaches relating hygroscopic growth factors to critical supersaturations and it is important to increase the amount of field data on which to test these approaches.

The most important conclusion from the manuscript is that critical supersaturations de-

rived from growth factor measurements using the kappa-Köhler model diverge beyond measurement uncertainties from measured critical supersaturations in this campaign. This finding would point to care in applying the one-parameter kappa-Köhler model too generally.

While the data and conclusions are interesting and the study timely, I do have significant concerns related to the manuscript and find that it needs major revision. In particular the reference for the error treatment (Irwin et al. 2010) is not available and the description of the error treatment in the current manuscript is inadequate. The manuscript is difficult to read; the notation is not always well explained and should be checked for consistency. I have a number of suggestions and comments which I hope will be helpful to the authors in improving the manuscript.

Major comments:

The authors emphasize that a correct error treatment and propagation is essential – yet the reference Irwin et al. in which the error treatment should be explained is not available. This is problematic and I do not understand the short explanation line 3-7 page 17083 : "Briefly, the measurements of both the HTDMA and the CCNCc have been broken down into primary and secondary data quantities. . . . " and ". . . these standard errors can be propagated through to higher order data products in order to better interpret the results of any comparison or the conclusions drawn" What are these primary and secondary data quantities? What are the higher order data products?

Another key reference: the description of the field measurements, Jones et al. 2010 is not in the reference list.

Abstract: It says that hygroscopic growth factors were measured and critical supersaturating simultaneously derived – this is confusing – does "derived" here mean based on the GF's or on measurements using a ccn-counter?

Page 17075 line 21: "The Köhler equation can be . . ." This is a very long and compli-

ACPD

10, C7755–C7759, 2010

cated sentence. Could be written more clearly.

Page 17076: . . .it has been assumed that they may play a role in determining cloud activation (Abdul-Razzak and Ghan, 2004) – this has been shown before 2004 and it would seem appropriate to cite a more original reference.

The first part of page 17076 (lines 1-19) is not well structured and difficult to read and I suggest it be re-written. For example: “such an effect would results in an increase in the number of CCN” – compared to what?

Page 17078: What sizes of PSLs were used for calibrating the DMAs? What kind of bubble flow meter was used to calibrate flows?

Page: 17078: could the 60 s residence time between the humidifier and the second DMA course evaporation of some of the aerosol mass?

Page 17079: To help the reader it could be explained how the data measured at RH=84-88% were corrected to 86% RH. Line 1-2: “small changes in measurement” – what kind of small changes are addressed here? To help the reader the concept of growth factor probability distribution should be explained in the text.

In the figure caption (fig 1) it is called growth factor probability density – please use consistent notation.

Experimental: Was the aerosol dried before entering the DMA? – if so, to which relative humidity? Please explain why was the CCC-counter switched between polydisperse and mono-disperse aerosol?

It says in the text that the length of the sample lines from DMA to CPC and CCNC respectively matched – was the sample flow the same in the two instruments? Please provide information about the flow rates through the DMA and through the CPC and CCNC.

It must be defined better what is meant by ScD0 and D50S analysis.

ACPD

10, C7755–C7759, 2010

Page 17080: “The D50S analysis has a smaller associated fitting error resulting from the increase in the number of data points used in each sigmoidal fit” - what does this mean?

If I understand the authors do two things: 1) Plot CCN/CN versus supersaturation (five data points) at a fixed diameter, find DcD0 2) Plot CCN/CN versus dry particle diameter (20 datapoints) at a fixed supersaturion, find D50,S

If this is the case this should be described more clearly in the text and examples of the two types of plots should be shown to give a more intuitive idea about the quality of the data.

The DcD0 based on only five data points must be very uncertain? Also how long time was the CCN-counter measuring at each supersaturation and how long time was allowed for obtaining temperature equilibrium when changing supersaturation ?

Page 17081: “resulting in broad agreement with the integrated submicron volume time series from the DMPS “ – this should be explained better.

Page 17083: the definition of cloudy and not cloudy periods is not clear and should be explained better. Explain the notation NC1, NC2, CP3 etc

3.3 This section is difficult to read – in particularly the authors should specify how averaging was done – with respect to what over which time?

Page 17086, line 12: what is “low number”?

Page 17086: the use of the word “calculated” is confusing – these are based on measurements with the ccn-counter?

Page 17087: Lines 9-10, It says that 300 nm was above the measurement range for both the HTDMA and the CCNc during this experiments – but in Figure 2 the diameter goes up to 600 nm?

Line 19: for the surface tensions different from water – it should be mentioned that

ACPD

10, C7755–C7759, 2010

surfactant partitioning is neglected.

Page 17088 and figure 4: Could some of the discrepancy between model and experimental data lie in the calibration of the ccnc and HTDMA? For the ccnc the authors apply a dT dependent calibration factor over the range of supersaturations 0.11 to 0.8 %. Was the HTDMA only calibrated with ammonium sulphate of 150 nm? The measurements for ammonium sulphate for a range of dry particle sizes should be shown in figure 4 to compare with the theoretical values.

Page 17089, Lines 16-19: as far as I can see the kappa values discussed are the same within errors at the different organic:sulphate ratios.

Page 17090: I agree with the comment by B. Ervans. Figure S4 should be better explained. Why are only two data points included?

Figure 1: It is confusing that red is the high number of particle counts and also the average growth factor. I would suggest making the average growth factor white or some other color. What are the normalized counts? They are larger than one? Figure caption: what is the criteria for saying that the GF is "well represented" by the mean growth factor. It is difficult to see that there is an increasing prominence of bimodality with increase of size – this could be shown better I think in a separate figure with some examples.

Figure 3: The notation is not consistent with the text: Sc – should it be ScDo? Why is the color scale continuous when five discrete supersaturations were measured??

Minor: Page 17082 line 11: I think there is a 0 missing in GFD,RH? (GFD0,RH) Page 17087: line 14 described –> describe Page 17087, Line 26: Parenthesis after Fig 4 should be removed. 17095,line 21: instrument instrument uncertainty (remove one "instrument")

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 17073, 2010.