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## ***Interactive comment on “Relating particle hygroscopicity and CCN activity to chemical composition during the HCCT-2010 field campaign” by Z. J. Wu et al.***

**Anonymous Referee #1**

Received and published: 23 May 2013

General comment: The article by Wu et al. on Relating particle hygroscopicity and CCN activity to chemical composition during the HCCT-2010 field campaign evaluates the coherence of a set of AMS, HTDMA and CCN data over 6 weeks of measurement in central Germany. In particular, the authors investigate the closure between chemistry (AMS)-based calculations of the hygroscopicity of particles and their direct measurements in the sub-saturation range (HTDMA) and supersaturation range (CCNG). Although many closure studies have been performed in the past, some interesting results can be drawn from this work. The relationship between the hygroscopicity parameter  $K$  of the organic compounds measured in natural aerosols and their degree

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of oxidation O:C is not so frequent. Some conclusions seem to be far fetched. Surface tension, non-ideality and partial solubility effects can not be addressed with this data set. I suggest that the paper is accepted for publication after some corrections.

Detailed comments

Experimental methods

Page 7651 ; line 1 : where do the cloud events take place, on the measurement site or at the mountain top?. If on measurement site, is there an adapted inlet ?

line 5 to 9 : to me these lines are contradictory : density is calculated using AMS size distributions, but the AMS size distribution are calculated using a supposed aerosol density ?

What was the CE used during the campaign ? Is it supposed to be constant whatever the aerosol chemical composition ? Since ammonium nitrate losses are discussed in the paper, it would be nice to apply a chemical composition-dependant CE as suggested by Middlebrook et al. 2012 (Middlebrook, A., Bahreini, R., Jimenez, J., and Canagaratna, M. R.: Evaluation of Composition-Dependent Collection Efficiencies for the Aerodyne Aerosol Mass Spectrometer using Field Data, *Aerosol Sci. Technol.*, 46, 258–271, doi:10.1080/02786826.2011.620041, 2012.)

Page 7650: uncertainty on the CCN measurement and corresponding KCCN? This is important in a closure study.

Results and discussion

Page 7653 lines 18-21 : the fraction of hydrophilic/hydrophobic particle may be linked to the fraction of accumulation/aitken particles for a given size.

Page 7656 line 16 : the  $r^2$  obtained on the scatter plots relating  $\kappa_{chem}$  and  $\kappa_{HTDMA}$  is indeed higher when using size segregated chemical composition than when using bulk chemical composition for 150 nm and 200 nm particles, but it is not the case for

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250 nm particles (the slope is also higher than when using bulk chemical composition).  
Can you comment?

Page 7657 : line 10 if the bias between  $\kappa_{chem}$  and  $\kappa_{HTDMA}$  is higher for high  $NH_4NO_3$  loadings, presumably due to losses in the HTDMA, then the conclusions should state that HTDMA measurement underpredict the particle hygroscopicity rather than that the AMS/ZSR method overpredicts the particle hygroscopic growth.

Page 7659, line 1 : slopes are improved with the new settings, but not  $r^2$ .

Page 7659, line 10 : It should be made clearer from this point that the authors make the hypothesis that only the more hygroscopic mode of the HTDMA is activated (which is not straightforward). This paragraph is inconsistent with sentences line 10 in the conclusion and line 17 in the abstract : if only the hygroscopic mode is considered, the closure is achieved within 10 %, right ?

Page 7659 , line 22 : I am not sure that the reasons for discrepancies in the closure can be discussed at the level of less than 10 % discrepancy. The level of confidence of each of the measurements added together is higher than this. The authors should provide the uncertainty on the difference between  $K_{HTDMA}$  and  $K_{CCNC}$ . Moreover, these effects are discussed for analysing a difference between two average values (calculated over the whole campaign) that show significant variability each. A similar analysis than previously performed when comparing  $K_{chem}$  and  $K_{HTDMA}$  (scatter plot,  $R^2$  and slope) would be more appropriate.

### Conclusion

Page 7661, line 11: The 30% discrepancy between  $K_{CCN}$  and  $K_{HTDMA}$  can be reduced if only the more hygroscopic particles are activated. This effect should be included before surface tension etc. effects are discussed.

Technical corrections Page 7646, line 25 : Under or overprediction instead of Under of overprediction

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Page 7649, line 17 size range of SMPS to correct

Page 7656, line 17 ( $r^2=0$ ) to erase

Figure 5: legend should mention size segregated chemical composition instead of bulk chemical composition

Page 7659, line 9 to 14: several errors in English language, the whole paper should be checked again;

Page 7661 line 7 closure studies

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Interactive comment on Atmos. Chem. Phys. Discuss., 13, 7643, 2013.

ACPD

13, C2682–C2685, 2013

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