Response to reviewer 2:

We thank to the reviewer for the proposed corrections to improve our paper. Here, all the issues raised had been addressed. Accordingly, the manuscript had been modified.

Response to reviewer:

Wu et. al, present a case study on particle water uptake during two nucleation events. Distinctly different particle hygroscopicity is observed during the two events. The authors interpret the hygroscopicity measurements in terms of parameterisations of the nucleation process, the so-called "soluble fraction", supporting measurements and in the light of other recent field observations of nucleation events. The main weakness of this manuscript is that the main conclusions are based more on expert judgement as to why the simple "models" used to interpret the behaviour fail. There is little direct measurement evidence or behaviour that backs up the conclusions reached.

Response:

Considering the reviewer's comments, we gave more discussions in the revised manuscript. The AMS results were removed from the texts. The uncertainty analysis was added into the new version. Another method (Nieminen et al., 2010) for calculating particle growth contributing by H_2SO_4 condensation was adopted instead of that in Stoltzenburg et al. (2005). In addition, a Lagrangian study was performed to estimate the particle growth rate. The detail modifications are given below.

General Comments

The term "solubility" is used incorrectly throughout the manuscript. The authors appear to confuse solubility with particle hygroscopicity on a number of occasions. E.g. a compound may be infinitely soluble, but a particle comprised of such a substance may exhibit little hygroscopic growth at 90.

Response:

We agree. The term "solubility" was replaced by hygroscopicity in the MS.

In estimating the soluble volume fraction the authors state how they derive the water activity of different diameter particles. How is the Kevin Effect taken into account when calculating the ammonium sulphate growth factor? In the 25 nm to 50 nm diameter range the Kelvin effect is quite large, if it is not accounted for adequately the conclusions reached in this study might be quite different, i.e. the measured growth factor to ammonium sulphate growth factor ratio will be biased low.

Response:

Thanks for the comment. The statement is not very clear. The kelvin term was considered in the calculation.

Modifications in the MS:

"When calculating $HGF_{(NH4)2SO4}$ in different diameters, the parameterizations for $(NH_4)_2SO_4$ water activity developed by Potukuchi and Wexler (1995) and the density reported by Tang and Munkelwitz (1994) are used. The Kelvin term was considered in the calculation. "

The interpretation of the HTDMA measurements is not supported by any direct measurement of the 25 to 50 nm particle composition. As the authors acknowledge the aerodyne AMS cannot focus the 25 to 50 nm particles of interest, given that all the conclusions in Section 4 are based on an interpretation of the AMS data this makes them difficult to accept.

Response:
Yes, we agree. The discussions on AMS data were deleted because the AMS cannot detect the chemical composition of newly formed particles.

Standard of English falls below that required by ACP throughout the manuscript. This makes the article difficult to follow and in a number of places ambiguous. This must be resolved before any resubmission.

Response:
We improved the English.

Specific Comments

Page 11419, line 16: The authors state that the inversion method is "based on the TDMAinv method", in what way(s) does the inversion technique differ from TDMAinv or is it the same?

Response:
The statement is not very clear. We modified this sentence. The TDMAinv method developed by Gysel et al. (2009) was used to invert the HTDMA data.

Page 11420, line 18: Studies have shown SOA is typically not hygrophobic, in contradiction to the statement here. Indeed, the authors point this out on lines 21-23.

Response:
Yes, we agree. "fraction is secondary organics, which are typically hydrophobic" was removed from lines 21-23.

Page 11425, line 15: What is meant by a "perfect" mode as opposed to an "imperfect" mode? A measure of the spread of the distribution might be more informative, combined with a test of the robustness of the retrieval (see Gysel et al 2009)

Response:

Thanks for this suggestion. We took a look Gysel's paper. But, considering the discussion about the mixing state of newly formed particles does help the topic of the manuscript, we deleted the description of "perfect" mode.

Technical Comments
- Use consistent date format rather than switching between yyyy/mm/dd and yyyy-mmdd etc.
- Consistent use of indices e.g. 1/A or A−1.
- Figure 1: I believe it is conventional for a vertical colour scale to have the high values at the top. Label all axes in a consistent manner e.g. Name [units]

Response:

The consistent date format was used in the entire texts.

Unit A-1 was used.

The figure 1 was modified.

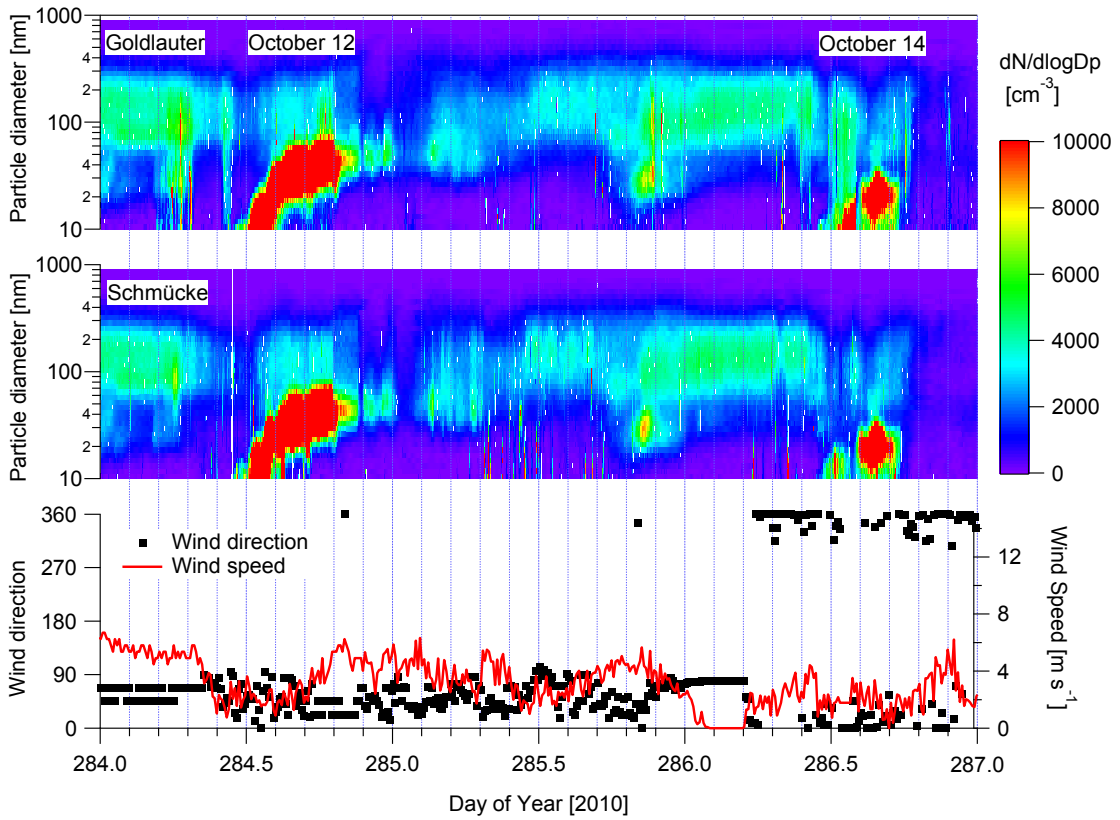

Fig. 1: The evolution of particle number size distribution and weather conditions on October 12 and 14, 2010.

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Potukuchi, S., and Wexler, A. S.: Identifying solid-aqueous phase transitions in atmospheric aerosols—i. Neutral-acidity solutions, Atmospheric Environment, 29, 1663-1676, http://dx.doi.org/10.1016/1352-2310(95)00074-9, 1995.
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