

Interactive comment on “Measurements of particle masses of inorganic salt particles for calibration of cloud condensation nuclei counters” by M. Kuwata and Y. Kondo

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General Comments

Kuwata and Kondo (2009) report high precision measurements of the particle mass of mobility selected ammonium sulfate and sodium chloride aerosol particles used for the calibration of cloud condensation nuclei counters (CCNC). As described and discussed in several earlier studies, neither NaCl nor $(\text{NH}_4)_2\text{SO}_4$ particles are completely spherical when generated by atomization. Thus the mobility equivalent diameter of such particles is usually not equal to the volume or mass equivalent diameter which is needed for determining the effective supersaturation in the CCNC

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by Köhler model calculations. With the effective densities or shape factors of NaCl and $(\text{NH}_4)_2\text{SO}_4$ particles given in this paper, Kuwata and Kondo (2009) provide important data for the precise calibration of a CCNC, which is essential for measuring CCN with high accuracy. Moreover, the authors compare different Köhler models used to calculate the supersaturation in the CCNC and come to the conclusion that the Pitzer model is the most suitable one. The findings are important for the calibration of CCNC instruments and for the comparison of CCNC measurement results, and they re-confirm and complement the findings of related earlier studies. Several of the key messages are similar/equivalent to those of Rose et al. (2008), and as detailed below, the authors should specify more clearly, in which way their findings and messages re-confirm, complement and extend those of Rose et al. (2008). Apart from not properly considering related work, the manuscript is well written, and I recommend publication in ACP after the following comments and suggestions for correction/improvement have been addressed.

Specific Comments

P. 4656, L. 6-9: This statement is incomplete/incorrect. Please mention that Rose et al. (2008) have shown that the shape factor of NaCl particles may vary between 1.0 and 1.08 depending on the conditions of particle generation (drying). See Rose et al. (2008), Sects. 3.8 and 4.

P. 4663, Sect. 4.2: Fig. 5 also shows that ρ_{eff} increases and χ decreases with d_{me} . This may be worth mentioning and discussing in the text.

P. 4664, L. 25-26: importance of NaCl morphology for CCN calibration experiments. Please reference Rose et al. (2008) who had explicitly emphasized this message in their abstract and conclusions.

P. 4665-4666, Sect. 4.3 and Tab. 5: The results of Kuwata and Kondo (2009) confirm that the calculation of water vapor supersaturation in a CCNC depends strongly

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on the applied Köhler model, in particular on the applied parameterization of water activity. The calibration with NaCl and $(\text{NH}_4)_2\text{SO}_4$ particles led to the same results only when Pitzer models (Archer, Clegg et al., Pitzer and Mayorga) and equivalent parameterizations of water activity were used. Köhler models in which the water activity parameterization is based on data of hygroscopic growth up to $\text{RH}=95\%$ (Tang, Tang and Munkelwitz, Kreidenweis et al.) as well as ideal solution approximations were not suitable. Please refer to Rose et al. (2008) who had performed similar but more comprehensive comparisons of different Köhler modeling approaches (Sects. 3.7 and 3.8, Appendix A) and had also explicitly emphasized the same messages in their abstract and conclusions.

Technical comments

P. 4659, Eq. 9 and 10: Please use SI units or conversion factors with consistent units. The factor 1000 probably means 1000 g kg^{-1} ?

P. 4659, L. 19: "... are summarized" instead of "... is summarized"

P. 4660, L. 7: "... a maximum value" instead of "... the maximum value"

P. 4669, L. 9: ΔT is not the gradient but the temperature difference along the CCNC column; Note that a gradient should have the unit K m^{-1} rather than K.

P. 4670, L. 3: this line is without context

P. 4679-4683: Tables: Please indicate units in standard table format, i.e., next to or underneath each of the quantities (symbols) specified in headline, first column or caption of each table.

P. 4679, Tab. 1: units for M_s are missing

Reference:

Rose, D., Gunthe, S. S., Mikhailov, E., Frank, G. P., Dusek, U., Andreae, M. O., and Pöschl, U.: Calibration and measurement uncertainties of a continuous-flow cloud condensation nuclei counter (DMT-CCNC): CCN activation of ammonium sulfate and sodium chloride aerosol particles in theory and experiment, *Atmos. Chem. Phys.*, 8, 1153-1179, 2008.

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