

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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We appreciate the reviewer for useful comments and recognizing the worth of the study.

Comment: To my knowledge, this is the first paper that describes the calibration of a DMT CCN chamber using both a DMA and a direct measurement of particle mass, from the APM technique. The APM is not widely available and so has not been used before for experiments of this type, although the DMT CCN chamber has been frequently calibrated with standard aerosol types such as sodium chloride and ammonium sulphate. The authors extract shape factors for these aerosol types that appear to match those in the literature quite well. They also indicate that the use of the Pitzer/Clegg models

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/parameterizations for the water activity are the most accurate to use, when trying to extract absolute measures of the true supersaturation in the DMT chamber. The paper is very clearly written and the experiments appear to have been well done. I recommend publication and do not have substantial specific comments to make, aside from those below. On a more general note, I think that this paper might have been more appropriate for another journal such as Aerosol Science and Technology or Atmospheric Measurements Techniques, but with it already at the ACPD stage, then that point is somewhat moot. However, I do ask the question of whether it should be labeled as a technical note, because its focus is very much directed to the calibration of a specific instrument (albeit a very valuable and now widely used instrument) from one supplier.

Reply: We regard that our investigation is not only useful for DMT CCNC users, but also helpful in calibrating other CCN instruments, as particle morphology do not depend on the types of the CCN instrument (it depends on particle generation). In addition, we regard that the present study is also useful for investigations on hygroscopic growth of aerosol particles. As there have been no methods to measure shape factors(χ)/effective densities(eff) of small (< 100 nm) particles, some investigations inferred these values based on hygroscopicity measurements(e.g., Mikhailov et al., 2004; Biskos et al., 2006). However, these investigations needed to assume that thermodynamics models are correct. As far as we know, this is the first data set for these values those are independent on thermodynamics. Therefore, we regard that our manuscript also facilitate researches on hygroscopicity. Although, we follow the decision of the editor regarding the issue, we do not think that the application of the present investigation is limited to DMT-CCNCs. To stress the point, we added the following sentences in the revised manuscript.

Section 2.2

“ Although, we employed the CCNC manufactured by DMT, the present result is applicable for other types of CCNCs, as they are calibrated similarly (e.g., Snider et al., 2006; Frank et al., 2007).”

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Section 4.2.

“The measurements of χ and eff without employing thermodynamics models are limited in the size range of < 150 nm (e.g., Kelly and McMurry, 1992). Our data are also useful for the investigations on hygroscopic growth of particles in this size-range.”

Comment: Page 1, Line 18 . “most probable” . change to “most accurate”

Reply: We changed the words.

Comment: Page 5, “Density calculated using Eqs. (14) and (1) (in this case, we can assume $d_{ve}=d_{me}$, as PSL particles have spherical shape) agreed with the values given by the manufacturers to within 5%, and this difference was corrected for inorganic salt particles.” More details can be given on why this difference might arise, and how the correction is applied. Is it known that the difference will persist for different types of species? i.e. is it necessarily a constant offset, independent of particle type?

Reply: Although, we could confirm that the DMA and the APM worked well within the errors in diameters associated with PSL particles, we found the difference in particle density. We could not figure out which instrument (or both) is responsible for the error. We developed a calibration curve, as the difference was size-dependent, It is difficult to understand the dependence on particle type, as we do not have any other standard particles other than PSL particles. We modified the description as follows:

Section 3.3 “The measured values of mp agreed by the calculated values within the errors associated with PSL particles (Table 2). Density calculated using equations (14) and (1) (in this case, we can assume $d_{ve} = d_{me}$, as PSL particles have spherical shape) agreed with the values given by the manufacturers to within 5%, and this difference was corrected for inorganic salt particles. Linear interpolation was employed for the correction, as the difference was size-dependent. Relative contributions of DMA and APM) to the difference are not quantified.”

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