Atmos. Chem. Phys. Discuss., 9, C1972–C1977, 2009
www.atmos-chem-phys-discuss.net/9/C1972/2009/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud condensation nuclei measurements in the eastern Mediterranean marine boundary layer: CCN closure and droplet growth kinetics" *by* A. Bougiatioti et al.

U. Pöschl

poeschl@mpch-mainz.mpg.de

Received and published: 17 June 2009

Bugiatioti et al. (2009) present an interesting data set on the composition and cloud condensation nucleus (CCN) activity of atmospheric aerosols. Their results confirm the message of earlier studies suggesting that the CCN activity of aerosol particles can be efficiently described/approximated with limited information about the chemical composition and mixing state (e.g., Dusek et al., 2006; Andreae and Rosenfeld, 2008; Rose et al., 2008a; Andreae, 2009; Gunthe et al., 2009; and references therein). Moreover, they show that (aged) organic particle components have no significant effect on droplet growth kinetics – at least under the conditions of CCN measurement (the temperature

level of the experiment was not specified but was likely higher than upon cloud droplet formation in the atmosphere).

I would like to compliment the authors on the interesting study and add a few comments, questions and suggestions:

1) Water vapour supersaturation and calibration of the CCN counter:

I find it very positive that the authors provide detailed information on the calibration of water vapour supersaturation in the applied CCN counter. However, there are a couple of points that could and should be specified in more detail in order to characterize the measurement precision.

1.1) At the end of section 2.3 the authors state that "The CCN instrument was calibrated numerous times throughout the campaign to characterize the stability of its characteristics.", but no further information about the outcome of the repeated calibrations is provided. Could you specify the achieved precision/variability? In Fig. 2b error bars are shown but their meaning is not specified.

1.2) As demonstrated by Rose et al. (2008b) and confirmed by Kuwata and Kondo (2009), the calibration of CCN counters with sodium chloride particles that are size-selected with a differential mobility analyzer depends on the shape of the NaCl particles. Depending on particle shape, which may vary from irregular/near-cubic to near-spherical, the mobility equivalent diameter can substantially deviate from the mass equivalent diameter needed for Köhler model calculations. As a consequence, the CCN calibration results can deviate by up to ~18% (see Rose et al, 2008b; Fig.12, Sect. 3.8, abstract and conclusions). Please specify your assumptions about particle shape, and please refer to earlier studies addressing and characterizing this effect and the resulting uncertainties.

1.3) With regard to the above points, I would suggest to calculate/estimate the overall uncertainty of water vapour supersaturation in your CCN measurements and adjust the

ACPD

9, C1972–C1977, 2009

manuscript accordingly. According to Fig. 2, the uncertainty of the investigated supersaturation levels seems to vary substantially (in particular with regard to the supersaturation level of 0.44%). It may be appropriate to specify the corresponding uncertainties (e.g., in Table 1) and to reduce the number of decimal places reported on p. 10312 (0.218%). Moreover, it may be worthwhile to mention and quantify the effect of uncertainties in water vapour supersaturation in comparison to the results and conclusions of the closure calculations (Sect. 3.4).

2) Characterisation of the CCN activity of the investigated aerosols and comparison with earlier studies:

In order to make the best possible use of the reported results, I would suggest not only to concentrate on the closure calculations, but to add more information on the average values and variability of parameters characterizing the CCN activity of the aerosols observed in this and earlier studies.

2.1) It might be useful to calculate and show time series and/or whisker plots and/or tables showing the average values and temporal variability of one of the several parameters that are available and frequently used for efficient comparison and modelling of different CCN measurement results: equivalent soluble fraction, kappa or rho_ion. The usefulness of reporting such parameters for comparison with other measurement results (CCN or H-TDMA) is demonstrated by Gunthe et al. (2009) and Shinozuka et al. (2009).

2.2) With regard to characteristic parameters but also with regard to the agreement between measured and calculated CCN concentrations, I would suggest to compare the results of this study directly to those of other studies performed with the same or different types of instrumentation and with the same or different ways of predicting CCN concentrations (e.g., Cubison et al., 2008; Kuwata et al., 2008; Rose et al., 2008a; Wang et al., 2008; Gunthe et al., 2009; Shinozuka et al., 2009; and references therein).

2.3) With regard to the message that CCN concentrations can be predicted and “clo-

ACPD

9, C1972–C1977, 2009

sure" can be achieved with limited information about aerosol chemical composition and mixing state, I would suggest to discuss the results of this study in relation to other (recent or earlier) studies pointing in the same direction (e.g., Rose et al, 2008a; Andreae and Rosenfeld, 2008; Wang et al., 2008; Andreae, 2009; Gunthe et al., 2009; Shinozuka et al., 2009; and references therein).

P.S.: I am aware that the studies cited above and listed below are not the only ones that could/should be taken into account. For practical reasons, however, I just cite here the studies that I am most familiar with. Further references are included in the cited studies as indicated above ("and references therein").

References:

Andreae, M. O. and Rosenfeld, D.: Aerosol-cloud-precipitation interactions. Part 1. The nature and sources of cloud-active aerosols, Earth Sci. Rev., 89, 13–41, 2008.

Andreae, M. O.: Correlation between cloud condensation nuclei concentration and aerosol optical thickness in remote and polluted regions, Atmos. Chem. Phys., 9, 543–556, 2009

Cubison, M. J., Ervens, B., Feingold, G., Docherty, K. S., Ulbrich, I. M., Shields, L., Prather, K., Hering, S., and Jimenez, J. L.: The influence of chemical composition and mixing state of Los Angeles urban aerosol on CCN number and cloud properties, Atmos. Chem. Phys., 8, 5649-5667, 2008

Dusek, U., Frank, G.P., Hildebrandt, L., Curtius, J., Schneider, J., Walter, S., Chand, D., Drewnick, F., Hings, S., Jung, D., Borrmann, S., Andreae, M. O.: Size matters more than chemistry for cloud-nucleating ability of aerosol particles. Science, 312, 1375-1378, 2006

Gunthe, S. S., King, S. M., Rose, D., Chen, Q., Roldin, P., Farmer, D. K., Jimenez, J. L., Artaxo, P., Andreae, M. O., Martin, S. T., and Pöschl, U.: Cloud condensation nuclei in pristine tropical rainforest air of Amazonia: size-resolved measurements and

ACPD

9, C1972–C1977, 2009

modeling of atmospheric aerosol composition and CCN activity, Atmosperic Chemistry and Physics Discussions, 9, 3811-3870, 2009

Kuwata, M., Kondo, Y., Miyazaki, Y., Komazaki, Y., Kim, J. H., Yum, S. S., Tanimoto, H., and Matsueda, H.: Cloud condensation nuclei activity at Jeju Island, Korea in spring 2005, Atmos. Chem. Phys., 8, 2933-2948, 2008 Kuwata, M. and Kondo, Y.: Measurements of particle masses of inorganic salt particles for calibration of cloud condensation nuclei counters, Atmos. Chem. Phys. Discuss., 9, 4653-4689, 2009

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. Atmospheric Chemistry and Physics, 8, 1153-1179, 2008

Rose, D., Nowak, A., Achtert, P., Wiedensohler, A., Hu, M., Shao, M., Zhang, Y., Andreae, M. O., and Pöschl, U.: Cloud condensation nuclei in polluted air and biomass burning smoke near the mega-city Guangzhou, China Part 1: Size-resolved measurements and implications for the modeling of aerosol particle hygroscopicity and CCN activity, Atmospheric Chemistry and Physics Discussions, 8, 17343-17392, 2008

Shinozuka, Y., Clarke, A. D., DeCarlo, P. F., Jimenez, J. L., Dunlea, E. J., Roberts, G. C., Tomlinson, J. M., Collins, D. R., Howell, S. G., Kapustin, V. N., McNaughton, C. S., and Zhou, J.: Aerosol optical properties relevant to regional remote sensing of CCN activity and links to their organic mass fraction: airborne observations over Central Mexico and the US West Coast during MILAGRO/INTEX-B, Atmos. Chem. Phys. Discuss., 9, 12519-12558, 2009.

Wang, J., Lee, Y.-N., Daum, P. H., Jayne, J., and Alexander, M. L.: Effects of aerosol organics on cloud condensation nucleus (CCN) concentration and first indirect aerosol effect, Atmos. Chem. Phys., 8, 6325-6339, 2008

ACPD

9, C1972–C1977, 2009

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 10303, 2009.

ACPD

9, C1972–C1977, 2009

Interactive Comment