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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud condensation nuclei activity at Jeju Island, Korea in spring 2005" *by* M. Kuwata et al.

M. Kuwata et al.

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We thank the referee for the useful comments and positive remarks. Our responses to the comments are described follows.

Comment: 3.1 CCN measurements: Page 15809. Figure 1 shows the CCN observation system used for this study. In this system, ambient particles were dried to a relative humidity (RH) $<$5% How the authors know the ambient particles are all dried after passing the diffusion dryers? Would it be possible some ambient particles still retain water? How would it affect the data analysis? Would the existence of wet particles help to explain the discrepancy between the modeled and observed D50?

Reply: We agree that even if particles were dried using two diffusion dryers, aerosol particles would contain small amount of water. This phenomenon may be relatively

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significant for particles that do not effloresce. However, hygroscopic growth at the lowered relative humidity is expected to be less than 5%, considering that of typical water-soluble organic compounds (e.g., Mochida et al., 2004). If particles contained a small amount of water, the observed D50 would be expected to shift to a larger size because of the overestimation of the dry diameter. However, this possible source of liquid water cannot explain the discrepancy between the observed and modeled data, because the discrepancy is much larger (20 ˜ 30%) than the possible overestimation of the dry diameter (˜5%).

Comment:4.1 CCN/CN size distributions: Page 15812. Is there any explanation why the curve for CCN data on 3/28 (22:00-22:30) is not sigmoidal in Figure 3? Does this phenomenon commonly observe? How would it affect the determination of D50?

Reply: CCN/CN size distributions obtained in laboratory experiments are generally sigmoidal. Thus, we can expect that the spectra can be fitted well by a sigmoidal function as long as all particles have the same chemical composition. However, the spectra should be a convolution of sigmoid functions if they are externally mixed. A convolution of sigmoid functions is not necessarily sigmoidal. Therefore, a non-sigmoidal size distribution indicates that particles are not completely internally mixed. This phenomena were sometimes observed. We do not think that the non-sigmoidal behavior in the size-resolved CCN spectra affects the validity of the determination of D50 as (1) multi-step activation was not observed and (2) incomplete activation was not observed. Thus, we can still regard the influence of the average (bulk) chemical composition on the size-resolved CCN spectra as quantitatively reflected in D50.

Comment: 4.2.1 CCN number concentration: Page 15813. Sawa et al. (2007) have reported high CO concentration between 22 to 24 March and 30 March to 2 April due to transport of CO from the Korean Peninsula and China. During these periods, CCN concentration also increased (Figs. 4a and d) Thus, these high CCN concentrations were likely caused by the enhanced concentrations of anthropogenic aerosols transported from these regions. Can the authors explain why the high CCN concentrations

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are related to enhanced concentrations of anthropogenic aerosols?

Reply: CO is emitted mainly by the combustion of fuels and biomass, and it is a good indicator of combustion emissions. Combustion sources emit not only CO but also primary aerosol components and aerosol precursors. A high concentration of CCN is thus associated with high CO concentrations. This point has been added to the revised manuscript.

Comment: 5.3 Possible causes of the discrepancy: The authors have discussed the possible causes of the difference between measured and predicted D50. It would be good to include the overall uncertainties or error bar in Figure (e.g., Figure 10).

Reply: We regard the uncertainty in D50 (observation) to be about 3%, from the standard deviation of the activation dry diameter of (NH4)2SO4. The value is much smaller than the variation in D50, so we did not show it on the figures for simplicity. In the case of Dcrit (calculation), the calculations were performed numerically (not analytically). This made the estimation of the magnitude of the error diffucult. Thus we could not show it on the figures.

Reference

Mochida M., and Kawamura, K.: Hygroscopic properties of levoglucosan and related organic compounds characteristic to biomass burning aerosol particles, J. Geophys. Res., 109, D21202, doi:10.1029/2004JD004962, 2004.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 15805, 2007.

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