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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The impact of dust on sulfate aerosol, CN and CCN during an East Asian dust storm" *by* P. T. Manktelow et al.

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We are grateful for the helpful suggestions to improve the paper.

1. 14773: See response (1)to first reviewer.
2. 14776: Advection timestep is 30 minutes, emissions, chemistry and microphysical timestep is 15 minutes, and nucleation/condensation timestep 3 minutes. Changing the length of the timestep was found to change GLOMAP-bin total aerosol number concentrations by less than 5% (Spracklen et al., 2005b). This information has been added to the paper.
3. 14777: The question of dust "solubility" and how it depends on the coating with

soluble material is an open question. It is known that thin coatings can enable insoluble particles to be active as CCN (e.g., Kumar, P., I. N. Sokolik, and A. Nenes (2009), Parameterization of cloud droplet formation for global and regional models: including adsorption activation from insoluble CCN, Atmos. Chem. Phys., 9, 2517-2532). However, the process of activation needs to be greatly simplified in a global model, so we assume that one monolayer is sufficient for an insoluble particle to be "soluble". Soluble means that it can be activated in a cloud if it is larger than a defined "CCN size", which we assume here to be 50 nm dry diameter. Varying this coating thickness does not substantially affect the dust loading in the model. The other way this monolayer assumption affects our results is in counting CCN. The monolayer assumption provides an upper limit to the contribution of dust to CCN and we make this clear when estimating the net effect of dust on CCN.

4. The referee questions the assumption of droplet activation at a fixed 50 nm dry size. We have stated in the text that this activation diameter is representative of 0.3% supersaturation, typical of observed values in low clouds (page 14795, line 1). But we agree that the supersaturation varies with particle size distribution, updraught speed etc. We have previously tested a range of size assumptions to account for this variability (Fig. 10 of Spracklen et al., Evaluation of a global aerosol microphysics model against size-resolved particle statistics in the marine atmosphere, Atmos. Chem. Phys., 7, 2073-2090, 2007). The effect on the aerosol size distribution was quite small, so we now use the simpler, faster assumption. We now state this in the paper.
5. 14778: Equation 1. F_{snow} has been changed to $(1 - F_{snow})$
6. L and L_{max} should be LAI and LAI_{max}. Changed.
7. 20u* is correct, see equation 1 of Alfaro and Gomes (2001).

8. All refractory aerosol is assumed to be mineral dust. BC was found to make only a minor contribution to the refractory aerosol concentrations observed during these flights. The maximum concentration of BC measured was only 2.6, 7.7 and 2.2 μg m^{-3} in C130 flights 6, 7 and 8, respectively (Huebert et al., 2004).

   Huebert, B., Bertram, T., Kline, J., Howell, S., Eatough, D., and Blomquist B.: Measurements of organic and elemental carbon in Asian outflow during ACE-Asia from the NSF/NCAR C-130, J. Geophys. Res., 109, D19S11, doi:10.1029/2004JD004700, 2004.

9. 14786. This sentence has been reworded to "Clarke et al. (2004) demonstrated that the combined mass of fine sulfate, nitrate and ammonium was at its highest when the coarse mode (D_p>1 µm) concentration was about 80 µm^3 cm^{-3}, but was about 50% lower when the coarse mode concentration exceeded 500 µm^3 cm^{-3}."

10. 14795: The choice of CCN size doesn't have a significant effect on the fractional contribution of dust. As can be seen in Fig 9, the size distribution around this size is not much different with or without dust.

11. Comment on CCN concentrations in Fig. 10. CCN concentrations greater than 5000/cm3 is at the upper end of what is observed in the most polluted regions.

12. Reference changed.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 14771, 2009.