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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.

Anonymous Referee #2

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General comments: The paper presents simulations of dust influence on sulfate size distributions and loadings, as well as total particle and CCN concentrations. These effects are investigated for a dust storm that took place during the ACE-Asia experiment, and model output is compared to a range of measurements from that campaign. This study differs from previous ones in that saturation effects are taken into account when simulating heterogeneous reactions of SO2 on dust surfaces. Their results are consequently different from many other studies of dust effects on sulfate. This paper is therefore an important contribution to this research field, and will hopefully stimulate further studies. The paper is well written, and I find it worthy of publication in Atmospheic Chemistry and Physics after the following, mostly minor, comments and questions have been addressed:

Specific comments: - Page 14773, line 10: It has also been hypothesized that coatings will either completely or partly de-activate dust particles as ice nuclei. A complete deactivation was proposed by Girard et al. (Atm. Res. 2004), while e.g. Lohmann and Hoose (ACPD, 2009) find that a coating will prevent the dust from acting as contact IN, a more efficient freezing mechanism than immersion freezing.

- Page 14773, line 23: What is a "BET surface"?

- Page 14776, line 18-20: It would be good to also give the timestep of the model here, especially as you are comparing to observations taken at relatively high resolutions, averaged over 1 or 5 minutes.

- Page 14777, line 12-13: Although it's commonly used, how sure are you that exactly one monolayer is required for a dust particle to be soluble? A reference/discussion here would be good.

- Page 14777, line 18-19: Assuming that all soluble particles larger than 50 nm are activated to form droplets seems like a major simplification. The critical radius above which particles are activated is highly dependent on supersaturation, which is again controlled by the aerosol size distribution, vertical velocity etc. Comment, please.

-Page 14778, Equation 1: It is really not obvious to me why the soil aggregate flux should increase with snow/ice cover. Please explain.

- Page 14778, Equation 2: L and Lmax are not explained.

- Page 14780, Equation 4: Check this equation, I think the 20.u is a mistake.

- Page 14783, lines 133-134: Are you assuming all refractory matter is mineral dust? Although measurements are taken during a dust storm, I would assume that BC could still contribute significantly to the refractory aerosol distribution in this area. Please discuss.

- Page 14786, e.g. line 2-3: It is a bit strange to discuss whether the model over- or underestimates the dust loadings, when in fact the loading is not the result of the models dust parameterization, but rather some adjustment factors that seem quite arbitrary.

- Page 14786, line 23-26: I read this sentence many times, but still couldn't figure out what it is saying. . ..

- Page 14795: Could it be that your conclusion regarding the dust influence on CCN would have been different if you had chosen a larger CCN threshold radius than 50 nm?

Figures: - Figure 10: The CCN concentrations seem almost unrealistically high in some areas. Could it be that the assumption that all soluble particles larger than 50 nm activate to form droplets isn't necessarily a good one in this case?

Minor comments: -In references Bond et al. (2004) and Cofala et al. (2005), the co-author Kilmot should be Klimont.

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