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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Parametric studies of contrail ice particle formation in jet regime using one-dimensional microphysical modeling" *by* H.-W. Wong and R. C. Miake-Lye

Anonymous Referee #2

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In this paper, the authors described and used a box model to simulate the formation and evolution of sulfuric acid, soot, and ice particles in the near field aircraft plumes. The effects of several key parameters or processes on simulated contrail ice particle properties in the jet regime were studied. The simulated results are generally consistent with what have been reported in the literature. Based on the simulated suppression of contrail ice particle formation by initial soot particles of very high number concentration (1E10 /cc) but small size (GMD=5 nm), the authors suggest a possible approach for contrail mitigation. The paper is well written and deals with a research topic that requires further research efforts. The paper is publishable after the following concerns are addressed.

1. In agreement with referee # 1, I also feel that the present manuscript is lack of substantial originality and new findings/advances.

2. While the authors stated generally in a number of locations that their simulated results are consistent with previous publications, the paper would be stronger if the model performance can be validated directly with some kind of measurements (for example, the evolution of volatile particle number concentrations reported in a number of previous publications).

3. I don't think that the proposed possible approach for contrail mitigation by emitting extremely high number concentration but small size of soot particles is practical. (1) The assumed soot emission index of 4.6E18/kg-fuel is much higher than the chemi-ion emission index ($\sim$ 1E17/kg-fuel) and it is unclear if it is physically possible to achieve such high soot emission index (note that coagulation may limit the maximum number concentrations). (2) Even if it is technically achievable, I don't think we want to inject such high concentrations of soot cores into the atmosphere. (3) This study didn't consider the entrainment of ambient particles and the condensation of organics species. If soot cores do not activate, entrained particles and volatile plume particles (having larger size if the organic condensation is considered) may activate and form ice particles. (4) This study appears to focus on only one ambient temperature (218 K). The authors' conclusion (about contrail suppression) may change at lower ambient temperatures (say 213 K).

4. Do you consider the coagulation of volatile acid particles with soot particles?

5. Page 22343, last sentence. Please give some details on how are the freezing points determined by sulfate mass fraction.

6. When plume reaches water supersaturation (RH_water>100%) at distance of $\sim$ 30 m (Fig. 1a), some of soot particles will be activated and become liquid water droplets which will then freeze homogeneously. Do you consider liquid water droplet formation and subsequent freezing in your simulations? Or you only consider the heterogeneous

freezing of soot particles?

7. In Fig.7b, It would be useful if the concentrations of ice particles (and liquid water droplets if simulated) as a function of distances are also provided.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 22337, 2009.