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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Properties of young contrails – a parametrisation based on large eddy simulations" *by* S. Unterstrasser

Anonymous Referee #1

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The manuscript presents a parameterization of young contrails based on an extensive data set of large-eddy simulations available in the literature. The goal is to come up with simple relations for the geometric and microphysical properties of contrails (such as vertical extent and ice crystal number at the end of the vortex phase) that can be easily incorporated into global models like GCM.

I found this study is a remarkable effort to collect and condense data from detailed, small-scale LES in an intelligent and compact formulation that is manageable to use by global modelers. However, it doesn't bring new insights into current understanding of contrail physics nor discuss new simulation results and so it does not quite fit publication in ACP in my opinion. Given its technical nature, it would be perfectly suited for a GMD paper with essentially no additional effort and in such a case I would support

publication without hesitation. The final decision lies with the editor but in any case the author should address the following points:

- it is instructive to explain how the proposed parameterization can be made consistent with the GCM where it is plugged into. For example, how do the parameters H and N (or the corresponding normalized functions) enter in the conservation equations solved by a GCM that has its own physical assumptions and numerical approximations? In other words, which terms of the GCM (and how) should be modified? Of course the details depends on the specific code but can you provide a general strategy for implementing this parameterization in practice?

- There is a mistake in Eqs. 5 and 7. In the absence of phase transition, what is conserved is vapor mixing ratio whereas vapor concentration changes because of air density change (expansion/compression due to heating/cooling). Considering the process adiabatic, one has $p/T^k = const$ with $k \equiv \gamma/(\gamma - 1) = 3.5$ and $\gamma = 1.4$ the ratio of specific heats. Using the auhtor's notation this yields

$$(1 + s_i)\frac{e_s(T_{CA})}{T_{CA}^k} = \frac{e_s(T_{CA} + \Gamma_d z_{atm})}{(T_{CA} + \Gamma_d z_{atm})^k} \quad (1)$$

which differs from Eq. 5 by the exponent k in the denominator. The same correction has to be made to Eq. 7. The author should evaluate the impact of this correction in the parameterization or comment the choice of conserving vapor concentration (note the same issue would appear in terms of ice concentration which also changes because of plume dilution).

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 28939, 2015.