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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Numerical simulations of contrail-to-cirrus transition – Part 1: An extensive parametric study" *by* S. Unterstrasser and K. Gierens

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Abstract:

Instead of "most properties" we write "optical properties".

Introduction, pp14903:

The most important process controlling the evolution of the optical thickness is to our view vertical motion with the subsequent cooling or heating of the airmass. As our set of simulations does not consider synoptic motions it would not be justified to make such confirmation or denial statements. Instead we quote a recent paper that is appropriate



to shed more light on this question.

p. 14904, lines 24-26:

We rewrote this text piece to make it clearer.

p. 14908, line 25-26:

This is a good point. Now we consequently use the term 'optical thickness' instead 'optical depth' for both horizontal and vertical viewing directions.

p. 14910, lines 15-18 and p. 14911, lines 17-19:

We mention that Part 2 treats a few cases with atmospheric vertical motions and switched-on nucleation. Admittedly, contrails may form in cirrus clouds formed earlier by heterogeneous nucleation. We do not consider this possibility in our simulations because this is the first set of such simulations and we desired to have situations as simple and clear as possible. As you can see from the figures, the interpretation of the results is already quite complicated. If we would now allow for pre-existing cirrus, the situation would become still more complex, almost intractable. In part 2 we consider one special aspect of such a possibility, namely that soot particles released from the sublimating ice crystals during the vortex phase may re-nucleate. In the discussion section we quote a paper of Immler et al., 2008, which describes lidar measurements of contrails within cirrus clouds.

p. 14913, lines 25-26:

We reformulated the text to make it clearer.

p. 14913, lines 28-29, p. 14914, line 1, Discussion, p. 14928:

We included a further paragraph on subvisual cirrus in the discussion section and added two more references. However, we do not cite the recommended publication of Dessler since tropical cirrus at very low temperatures was studied there.

p. 14914, Figure 3:

In Figure 3 each column shows the results for a specific relative humidity as indicated by the labels on top. The different colors denote the various shear values, which is different to all other figures in this section. The brown curves show the $s = 0.006s^{-1}$-runs and in this case the simulations stop after $t = 7000$ (see table 1). We included in the caption the hint, that this figure does not use the coding of table 2. Furthermore, the caption of the table 2 now says that the outlined coding is not valid for figure 3. In Figure 2 (and most other figures in this section) all curves with the same linestyle (not colour) have the same end time, as the total simulation time depends on the actual shear value (table 1) and shear is denoted by linestyle.

Subsection 3.3.3:

We reformulated the paragraph. The answer is still only sketched in our paper, a detailed answer can be found in the cited paper of Gierens and Bretl, 2009.

p. 14920, lines 6-10:

The information given in this section may be useful for tuning simple large-scale contrail models with Lagrangian advection of plumes. As the presentation of the thought experiment has a different style than most other section of the manuscript, we move this part to the appendix to keep the flow of the main text smooth.

p. 14921, lines 21-25:

Your impression is true for the red and green curves, which show the low-supersaturation-cases. However, for the blue and brown curves ($RH_i = 120\%$ and $130\%$) this is not true. The area enclosed by the blue curves mostly overlaps with the area enclosed by the brown curves. So we think it is a fair statement to assess the two parameters as similarly (instead of equally) important.

p. 14923, lines 5-7:



You are right. It is not illustrated in the paper. We now mention this.

All typographical errors have been corrected.

p. 14913, line 1:

Short answer: Yes. We slightly change the previous sentence in order to enhance the clarity.

p. 14926, line 23:

We only mention the figure, but describe it later. Unless the publisher does not allow this, we prefer to keep it as it is.

p. 14928, line 8:

We now use $\delta_i$ for supersaturation.

Throughout the manuscript we replaced $T$ by $T_{ca}$ when we refer to temperature at cruise altitude.

We want to thank the reviewer for his/her thorough review and helpful recommendations.

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