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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modelling of cirrus clouds – Part 1: Model description and validation" *by* P. Spichtinger and K. M. Gierens

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1 Reply to reviewer 2 (P. Wang)

1.1 Ad Specific comments:

1: As stated in the general comment at the beginning we follow the suggestions of the reviewers and split the paper into two parts. This is mainly due to some more extended discussions based on suggestions by reviewer 2.

2: The arctic stratus case presented in (Lin et al., 2005) was based on LIDAR observations and was also resimulated by Kärcher (2005); these results are consistent. Thus, we compared our results against observations and two different models, both including

much more detailed microphysics schemes than ours. We clarified this in the text.

3: Meyers et al. (1992) only presented parameterizations for heterogeneous nucleation processes while the parameterization of Koop et al. (2000) is for homogeneous nucleation. One could instead test the Koop parameterisation against a Rasmussen parameterization. However, we do not give much worth to such an exercise, since none of these is derived from first principles, and hence both have been formulated in a way to yield good fits to available measurements.

4: Nucleation means the formation of an ice germ (a nucleus) while freezing means the subsequent freezing of the parent droplet independent of its composition (i.e. whether it is pure water or a solution). Since nucleation does usually not occur without the subsequent freezing of the parent droplet the two notions are somewhat sloppily used for the same process. Since this does normally not cause confusion we simply leave the wording as it is.

5: We included the reference to sect. 3.2.2.

6: Indeed, this could have been done. However, we deem such a change insignificant for various reasons. First, the well–known uncertainty in the deposition coefficient has a larger effect on the results than the choice of C. Second, the formulation of ventilation factors etc. has been derived for spherical water drops and only few experiments have been carried out for other shapes than spherical (Hall and Pruppacher, 1976). Third, an ice cloud contains anyway a mixture of crystal shapes and habits. Inclusion of the correct capacitance factor for one habit leads to inconsistencies with other habits. We add a comment and the reference in the paper in the crystal growth section.

7: Unquestioned. We add a clarifying bracketed comment.

8: Yes, there is such a possibility. The code of Kärcher and Lohmann (2002) has been successfully applied to measurements of homogeneous nucleation in the large cloud chamber AIDA (Haag et al., 2003a) and to field measurements during INCA (Gayet et

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al., 2006). So, our comparison with results of Kärcher and Lohmann (2002) can be viewed as an indirect comparison with the AIDA and INCA results. We note this now in the paper.

9 and **10**: We have investigated the spatial structure of the simulated cirrus clouds in addition to the layer average investigations. While for most cases, the investigation does not give deeper insights, we found interesting differences in case of vertical updraught $w = 0.08\mathrm{m\,s}^{-1}$ between the simulations no shear/wind shear. These new results fit very well to our previous evalutions and are included in the manuscript, containing also new figures for Part 1b.

11: The occurrence of double peaks is not due to the initial humidity profile. It is rather a consequence of the ongoing cooling of the layer interacting with the sedimentation of the ice crystals. The upper peak is always at the upper edge of the ISSR/cloud. Ice crystals form there, then fall out, then supersaturation increases again (due to cooling) because the sink for excess vapour has fallen away. On reaching the threshold for homogeneous nucleation again, new crystals form, and so on. The mid–cloud peaks of RHi are caused by the ongoing cooling in combination with sedimentation, as well. The crystals sedimenting from above into the level at question make the timing and profile shaping of the mid–cloud peaks more complicated than that of the peaks at cloud top. We add a short paragraph for explanation in the middle of the discussion section.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 601, 2008.

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