

Interactive comment on “Thin and subvisible cirrus and contrails in a subsaturated environment” by M. Kübbeler et al.

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The paper reports on airborne observations of ice particles during a campaign in 2008. In particular one flight on 17. Nov is analyzed where clouds were observed in a subsaturated environment.

Model runs on backward trajectories were performed that in general are able to reproduce the observations. The paper is generally well written, the data were obtained with state-of-the-art equipment and leave little room for doubts on their quality. The major finding is that ice exists in air with a relative humidity below ice saturation. My major concern is that the authors fail to explain why this should be interesting. Obviously, most of the flight paths happened to be at the lower part of the cirrus which quite typically is a subsaturated region where particles that have been falling down from the

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cloud above are evaporating. In fact this phenomenon can be observed by plain eye, giving ice clouds (cirrus) its distinctive fibrous look.

I think the paper should go through some substantial revisions with putting more emphasis on the time scales of growth and evaporation that have been investigated by the model. The introduction should provide some information on the current knowledge on the kinetics of ice formation and dissipation, including laboratory investigations. In the abstract it is mentioned that the clouds are expected to dissipate, the introduction should explain why and how fast. The part about modeling should be more detailed on the mechanisms and parameters controlling these time scales.

In the conclusion it should be noted that the observed distribution of relative humidity in cirrus (fig.2) is not typical for cirrus and was caused by the specific flight paths of this campaign where most of the time the lower parts of cirrus were probed. Also, it should be noted that a measurement uncertainty of 10% in the relative humidity does allow the possibility that the air was not that much subsaturated after all. (E.g. if the measured RH= 95% and the temperature uncertainty is 0.5 K the air might well be saturated.)

However, provided that the results are well established, it might be worth thinking about implication of the finding (i.e. the long lifetime of ice particles in subsaturation) on some effects of cirrus, e.g. on the redistribution of water in the upper troposphere. This might be of great interest in particular when it comes to ice clouds in the tropical transition layer and their dehydrating potential.

Detailed comments:

Introduction

page 31155 line 14 onwards: These paragraphs reports on the results and should not be part of the introduction, instead some information on current knowledge of the behaviour of ice in subsaturated condition would be helpful.

section 3

Its not clear to me whether the observation of (young) contrails really contributes to the conclusions of this paper. In fact it seems to me that including the contrails is more confusing than clarifying the major findings of this manuscript and should be left away.
section 4.2

Figure 10 and 11 are very difficult to read and the explanation in this section are therefore not so easy to follow. Please revise the figure, use more clear colors to distinct different axis and data. The explanation refers to a paper by Krämer and Hildebrandt 2010. Since this is a conference contribution only and both are co-authors of this manuscript it might be worth thinking about including some part of the conference paper here.

Technical correction:

page 31160 line 4: The notation $210/9$ means 210 divided by 9 and should therefore not be used here, maybe $220(9)$ could be used. The better idea would be to reduce the information to such figures that are really required to understand what you are trying to say.

p31161 section 3.2 title: It should be A340, I guess.

p31166 line 2 I am not sure if cirrus really "lives" ... probably terms like "exist" or "are present" is more appropriate.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 31153, 2010.

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