

Interactive comment on “Supersaturation, dehydration, and denitrification in Arctic cirrus” by B. Kärcher

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General Comments

The manuscript describes a model simulation of the timely development a cirrus cloud and its impact on dehydration and denitrification of the upper troposphere. The concept of the new model is described. For the presented case study, it is initialised with data for a real atmospheric situation based on observations or estimates. The major results of the study are: 1. Determination of saturation, ice particle growth and particle sedimentation as a function of altitude over a period of several hours. 2. Estimation of the uptake of HNO₃ in the cirrus cloud and in background STS particles and its partitioning.

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The manuscript clearly presents novel material: The capabilities of the new model are demonstrated here for the first time. The results of the simulation of the cirrus cloud for this particular case will help to understand previous and upcoming observations. The concepts on the uptake of HNO₃ in growing ice crystals and STS provide a new insight into the process of denitrification processes in the atmosphere. Therefore, the manuscript is addressing relevant scientific questions and recommended to be published. The presentation style is clear and the paper is well structured.

I recommend changes in one central point: In the manuscript, the author claims to study a polar cirrus case. The experimental data, however, are only used for model input, and they are further incomplete. Several parameters have to be estimated. The results of the simulation are not compared to the existing data. The scientific value of this study could thus significantly be enhanced if a sensitivity study varying at least the estimated input parameters is presented and/or the results are compared to the observations.

Specific Comments

Initialization of vertical profiles of theta, T and Si are only referenced as personal communication. I assume that they are obtained from a radiosonde measurement(s). This should be stated in the text. How close are they obtained to the cloud, and at which stage of its development?

Initialisation of vertical wind: Currently initialised uniformly with $w = 5\text{cm/s}$. Is there any information on the actual wind for this model case that supports this choice? If not, a sensitivity study varying w over realistic atmospheric conditions is very desirable.

Can the model simulation of these clouds be compared to the lidar and meteorological data, in order to provide experimental evidence for the quality of the model study? Several sentences in the manuscript create expectations to the reader which are finally not answered in this study, e.g.

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A polar cirrus case study is discussed with the help of a one-dimensional model (abstract) or

relatively well documented case study (1st sentence of conclusions)

Since important parameters such as HNO₃ and w are only estimated, no information of the timely development of the vertical distribution of T and Si are available and the information of the lidar measurement is finally not exploited, I could imagine other cases which are much better characterised and thus worth to be investigated with the presented model.

Technical Corrections

Page 1840 paragraph 1: ansatz -> approach

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 1829, 2005.

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