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Interactive Comment

Interactive comment on "Ice supersaturations and cirrus cloud crystal numbers" *by* M. Krämer et al.

M. Krämer et al.

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We would like to thank the referee for his helpful comments on the paper, in particular the positive one on the water vapour measurements but also the critical one on the ice crystal analysis.

We agree that the uncertainty of the ice crystal measurements - although state of the art - is much larger than for the water vapour measurements. However, we do not think that it is necessary to remove the discussion on N_{ice} from the manuscript as our conclusions are robust to potential artifacts (explained below). We will address these topics in a revised manuscript accordingly.

Detection of the largest particles

For a number of flights during the SCOUT-O_3 field campaign a Cloud Imaging Probe was operated at the Geophysica aircraft to complement the FSSP measurements to-

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Interactive Discussion

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wards larger particles (12.5 $< R_{ice} <$ 775 μm, de Reus et al., 2008). From these flights we determined the fraction of particles sampled by the FSSP: at least 80%, but typically more than $>$ 90% of the number concentration is within the FSSP size range in cirrus with T $<$ -40^{o}C.

Adding the small fraction of large ice particles to the ice crystal numbers shown in Figure 5 (left panel) and Figure 9 (upper panel) changes the general picture only slightly. Especially in the low temperature range, the number concentration of the ice particles still does not reach the range expected from homogeneous freezing.

Ice crystal shattering

In section 2.2, we discussed in agreement with detailed studies of de Reus et al. (2008), that a significant influence by shattering on measurements in the temperature range presented in this study is unlikely.

On the other hand, if shattering increases the number of ice crystals, our measurements provide an upper limit and the real ice crystal concentrations are even smaller. This implies that also for the higher temperature range the ice crystal numbers might be lower than expected from the homogeneous freezing process (Figure 9, upper panel). At lowers temperatures, the ice crystal numbers have even lower numbers far from those to be explained by homogeneous freezing.
For the steady state calculations shown in Figure 6, a lower ice crystal number implies that the relaxation times are longer and the steady state supersaturations becomes higher. Thus, our conclusion that the frequent observation of high supersaturations at low temperatures can be explained by conventional microphysics receives even stronger support.

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References

de Reus, M., Borrmann, S., Bansemer, A., Heymsfield, A., Weigel, R., Schiller, C., Mitev, V., Frey, W., Kunkel, D., Kürten, A., Curtius, J., Sitnikov, N., Ulanovsky, A., and Ravegnani, F.: Evidence for ice particles in the tropical stratosphere from in-situ measurements, Atmos. Chem. Phys. Discuss., p. submitted, 2008. http://www.atmos-chem-phys-discuss.net/8/19313/2008/. 21097

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