

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

M. Krämer et al.

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[To make it easier to read, the answers are written in blue.](#)

SPECIFIC COMMENTS:

- 1 a) A significant fraction of the particles are not measured. The authors state on page 21097 that the particle are measured by an FSSP 100 or FSSP 300, which sample particles at size ranges of 1.5-30 micrometers and 0.3-20 micrometers, respectively. These instruments miss a significant fraction of larger particles. For perspective, Fig. 1 of Field et al. (JAS, December 2007) shows ice concentrations greater than 100 micrometers in (maximum) diameter for temperatures down to 218K. In both midlatitude and tropical clouds, there is a high probability of large particles > 30 micrometers at temperatures down to 218 K.

[Section 2.2 is rewritten: '...For a number of flights during the SCOUT-O₃ field](#)

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campaign a Cloud Imaging Probe was also operated at the Geophysica aircraft to complement the FSSP measurements towards larger particles ($12.5 < R_{ice} < 775 \mu\text{m}$, 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 $T < 240 \text{ K}$. Thus, the error in N_{ice} is small, ... '

- 1 b) In section 3.5.2, one has to wonder whether the unexpectedly low ice particle concentrations at low temperatures ($< 205 \text{ K}$) is caused by not sampling the large particles that presumably occur.

We added to section 3.5.2: '... note .. that the FSSP samples around 90% or more of the ice crystals, see section 2.2, i.e. the low ice particle numbers are not caused by missing ice crystals larger than the FSSP upper detection limit'

- 2 c) Another specific point is that the precision and detection limits of the water vapor instruments are not mentioned in this paper. This is one reason why flights are classified 'bad' for volume mixing ratios below 5 ppmv.

The uncertainties of the water vapor instruments are listed in Table 2. The reason why flights are classified as 'bad' is not the precision, we rejected altogether 9 flights, 5 of them at volume mixing ratios $> 5 \text{ ppmv}$ and 4 at lower volume mixing ratios.

This leads me to suspect that the reason for broader distributions of relative humidity at low temperature (e.g. the blue curve in Figure 8) is limited precision of the water vapor measurements. After all, the water vapor mixing ratios at temperatures $< 205 \text{ K}$ may be an order of magnitude lower than the mixing ratios at higher temperatures. Can the authors quantify the precision of the relative humidity?

We calculated the influence of the precision of the water vapour measurements on the RH_{ice} distribution at $T < 205 \text{ K}$: the maximum deviation in RH_{ice} caused by

the precision ranges from 1.5% RH_{ice}@205 K to 17% RH_{ice}@185 K.

Taking into account the observed number of data points in each T-interval, we further calculated that the broadening of the RH_{ice} distribution caused by the precision is around 10% RH_{ice}. This is significantly smaller than the broadening of the distribution of relative humidity at T < 205 K compared to the distribution at T > 205 K.

We included the discussion of the influence of the precision of the water vapour measurements on the classification of flights and the RH_{ice} distribution in sections 2.1.1 and 3.5.

TECHNICAL CORRECTIONS:

- Section 3.1, page 21098, line 5: change 20.8 to "20.8h"

[Done.](#)

- Section 3.2, page 21100, line 7: there is a large range of water vapor in the upper troposphere (1.5 to 100 ppmv), with the low end of the range near the tropical tropopause. Change "upper tropospheric range" to "typical values near the tropical tropopause".

[Done.](#)

- Section 3.4 (page 21103), Figure 5, and Figure 9: what is the "middle" curve? Is it the mean or the median? Please specify. At any rate, the "middle" curve does not accurately fit the data.

The 'middle' curves of N_{ice} and R_{ice} do not represent a mean or median, the min, max and middle curves are chosen 'by eye' to define the atmospheric range of our measurements without implying to present functional relationships for use in models.

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- Section 3.4, page 21103, line 23: change "supersaturations" to "supersaturation".
[Done.](#)

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 21089, 2008.

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