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Interactive Comment

# *Interactive comment on* "On the distribution of relative humidity in cirrus clouds" *by* P. Spichtinger et al.

**P. Spichtinger et al.**

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**Reply to Reviewer # 1**

1) We decided to delete the early reference to Fig. 2; it is not absolutely necessary and we prefer to have the figures in the original order.

2) Ideally (i.e. if the data were free of noise) we would judge the symmetry or asymmetry of our distributions using the L–skewness of the undisturbed Gaussian. However, the data are somewhat noisy and perturbations of the order 5% of the maximum at 150% RHi is what we normally have in our data. The 5% perturbation to the Gaussian was used in order to see what an effect noise in the data has on the L–skewness (as we know that for the normal skewness, involving the 3rd moment, it is usually desastrous). In a sense, one can assign the predicate "symmetric" only to ideal mathematical distributions, e.g. the Gaussian, but never to data. For data, there is always a kind of

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uncertainty in such predicates, that comes from the inevitable noise. So, stricly speaking one must say “data set 1 has a L–skewness of x, while data set 2 has L–skewness y”. However, since it is easier to comprehend a classification we prefer to say “symmetric” and “skew” and we have a fuzzy boundary between these classes.

In the paper we have included the reasoning for the choice of a 5% perturbation, as this was missing sofar.

3) and 4) The correct english expression is “skew” (comparative “skewer”). See e.g. ISI glossary of statistical terms (http://www.europa.eu.int/en/comm/eurostat/research/isi/). There is a translation of this word into many other languages (probably including the language of the reviewer).

5) We use the growth time scale as defined in Kärcher and Solomon (KS) (1999, JGR 104, 27441-27459, their eq. B5). Note that they use $t_g$ to denote it. Our expression in eq. 3 is equivalent (the translation can be found in the quoted paper by Gierens 2003). The $t_g$ of KS is related to the radius change of growing ice crystals in an ensemble of ice crystals. This is not the same as the time required to consume all the supersaturation (assuming no further uplift for the sake of argumentation). In KS the latter time is denoted $\tau_g$ and this is plotted in their Fig. B1. The figure shows (look at the curve with $x_0 = 0$, i.e. that for very small initial ice crystal size) that, typically $\tau_g > 2$, which means that the transition time to equilibrium is typically more than double the crystal growth time scale. One can also argue using condensation rate: initially the crystals are very small, hence the condensation rate (proportional to radius) is very small. At the end of the relaxation phase the remaining supersaturation (the driving force for condensation) is small, hence again the condensation rate is small.

The reference Kärcher and Solomon is now given before Eq. 3.

6) No. Uplifting leads to cooling, hence to lower saturation pressure or lower water vapour concentration at saturation. Therefore, in an uplifting airmass more water molecules must be incorporated into ice crystals until saturation is reached than in a

stationary airmass. Evidently, uplift prolongs the transition time to saturation.

A short explanation has been added before Eq. 4.

7) For both simulation cases we use steps of $\pm 1\%$. In the cold case it takes twice as long time to make such a step than in the warm case. Hence, 800 steps in the cold case represent about the same time as 1600 steps in the warm case (this is probably what the reviewer means with “similar total simulation time”). However, the approach to equilibrium is taken via steps (loop counter) in the simulation not via time (there is no variable “time” in the simulation code). This is the crucial point here. Assume that the total simulation time would be T hours. Than one could say, that after T hours the cold cloud could take 800 steps, while the warm cloud could take 1600 steps in the same time period. Hence, in the cold case the resulting distribution is different from that in the warm case.

We have added one sentence for explanation in the respective paragraph.

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Interactive comment on Atmos. Chem. Phys. Discuss., 4, 365, 2004.



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