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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cirrus cloud occurrence as function of ambient relative humidity: A comparison of observations from the Southern and Northern Hemisphere midlatitudes obtained during the INCA experiment" *by* J. Ström et al.

Anonymous Referee #1

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General comments

This paper describes measurements relating to cirrus cloud formation made during the INCA experiment, and the authors develop a model by which these measurements are interpreted. The paper contains worthwhile and interesting material, but the data analysis leaves a number of questions.

Specific comments

1. Section 2, Methodology, p 3305. This definition of CPF(RHI) appears a natural

one for in situ measurements; it involves simultaneous measurements of RHI and cloudiness. We expect to find nonzero CPF over a range of values of RHI above and below

2. The discussion of the impacts of different measurement techniques on resulting measured cloud presence fraction, $CPF_{meas}(S)$ (Section 3) is clear. The use of the terms 'NH' and 'SH' to identify the two aircraft campaigns is unfortunate, however, as (despite the authors' caveat) the discussion of the differences appears to refer to hemispherically averaged differences.

3. Section 4. Interpretation. While our comments (below) may reflect our misunderstanding of the work here, we suggest that at least part of the difficulty lies in the presentation, which we find extremely unclear.

   Since $S > 1$ no evaporating clouds are included.

   Equation (1) is not consistent with the definition of $CPF_{meas}(S)$ given in Section 2, and with the measurements that are presented there. $CPF_{meas}(S), S < S_c$, is the fraction of the measurements at given S (supersaturation with respect to ice) for which there is cloud. Equation (1), instead, gives something like the fraction of measurements for which $S' \geq S$ in which $S' \geq S_c$ for all S'. We can call this model cloud presence fraction $CPF_{mod}(S)$. The discussion surrounding the derivation of $CPF_{mod}(S)$ would yield $CPF_{mod}(S) = 0, S < S_c, CPF_{mod}(S) = 1, S > S_c$, because all phenomena that would create cloud at values of S between $S = 1$ and $S = S_c$ are neglected. This approximation includes the 'important simplifications' discussed on p 3312. A one parameter model is chosen that captures the decrease of cloud presence fraction with increasing supersaturation. Therefore all the physics is contained in the one parameter (S_0) and some discussion should be given as to the sensitivity of the results to variations in this parameter, and possible physical interpretations of the magnitude of the best fit value. Moreover, eq (2) is fit to data outside cloud but assumed to hold inside cloud as well.

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While it is plausible to assume that the probability p(S) is a decreasing function of S both outside and inside cloud, the conditions in cloud, including stronger updrafts, stronger radiative cooling, etc., may well significantly perturb p(S). For these reasons, comparing $CPF_{mod}(S)$ with $CPF_{meas}(S)$ has questionable value. The logic in this exercise should be at least clarified before the paper is accepted.

4. The calculation of an equivalent adiabatic water content is suggestive but, as the authors state, in view of all the important simplifications made, the values calculated are unphysical. Perhaps then the value of the calculations is in assessment of the importance of the neglected processes. A sentence or two addressing this point might be of use.

Technical corrections

I suggest that this paper be edited by a native English speaker before its final submission. Note typo in line 14, p 3312: inequality should read $1 \leq S \leq S_c$.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 3301, 2003.