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Atmospheric Chemistry and Physics Discussions

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.

- One major weakness of the article is its use of English, which in a few places, impacts the scientific meaning of some particular statements.

  A native speaker from the language office of FZ Jülich has revised the manuscript.

Specific comments:

- p. 21090, lines 2-5: This first sentence is long and contains two distinct thoughts. Suggest separating like 'sometimes exceed water saturation. Up to and more than 200%...'

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Interactive Discussion
Discussion Paper

line 5: change to ‘discussion continues on whether’

line 8: change strictly to strict

Done.

- line 17: ‘could hardly be explained’ is colloquial, probably better said with ‘are not explained’

  We replaced ’hardly’ with ’scarcely’, because homogeneous freezing could not be completely excluded.

- p. 21091, lines 6-7: ‘form not as soon as’ is awkward

  Changed to: cirrus clouds do not form ‘as soon as ice saturation is reached’ ...

- line 10: ‘In the case’

  Done.

- lines 11, 14 and 15: hyphens are not necessary.

  Though not absolute necessary, the hyphens are used to emphasize the different freezing mechanisms.

- Same general place: another useful reference on modeling RH distributions is a recently published paper by Comstock et al. (2008), JGR. They make the argument that fewer large ice crystals can greatly impact RH distributions.

  Thanks for this reference, it is introduced in the paper.

- Line 23: change interacts to interact

  Done.

- p. 21092, line 23: artifacts

  Done.

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line 27: ‘in the frame of this discussion’ is awkward, how about ‘in this context’?

Done.

- p. 21093, line 10: change frame to framework

  Done.

- line 20: how about ‘Experiments’? Experimentals just doesn’t work.

  The title of section 2. is changed to ’Aircraft measurements’

- p. 21096, line 27: is the uncertainty a bias or a root-mean squared value? Please clarify.

  The sentence now is: ’The root mean square uncertainty ...’

- p. 21097, line 8: delete ‘without such.’, and add ‘Otherwise,’, to the beginning of the sentence

  line 18: change to ‘we estimate’

  Done.

- p. 21098, lines 7-9: both warm and cold cirrus are partitioned in this study. Has a similar analysis been performed for ‘cloud type’, i.e., frontal, lee wave, convective detrainment, and in situ formed thin cirrus in the TTL? Or are the results more dependent on air temperature rather than cloud type?

  An analysis of cloud types is not included in this study, but is in progress with a larger data set.

- line 12: were these spirals or stacked flight tracks?

  These were both, plus ice clouds detected in during aircraft ascent or descent.

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- Line 25: delete ‘firstly’

  Done.

- p. 21099, line 1: which temperature range? INCA? C-F? Or cold vs. warm cirrus? Not clear.

  The sentence is changed to: ’In the overall temperature range ...’

- p. 21100, lines 8-14: Regarding the Jensen et al. observations, did they fly through an extraordinarily dirty air mass near land, or was the air transported from fires to the flight level? Probably should go back to paper to see how dirty the air really was, could be a ‘freak’ sampling case because of really dirty air.

  The flight Jensen et al. reported was not in a dirty air mass, but in the tropical tropopause. This is now introduced in the manuscript.

- p. 21103, line 8: change to ‘By knowing the minimum’ Furthermore, ‘in dependence’ is not clear. Should it be ‘that depends on temperature’?

  New sentence: ’By knowing the minimum, mean and maximum of $N_i R_i$ as a function of temperature, ... ’

- lines 19-20: supersaturation

  line 23: same as above

  Done.

- p. 21104, line 1: change to ‘...in case fewer ice” line 5: ‘and thin ice clouds needs and” unclear

  Done.

- p. 21105, line 22: are the authors referring to the ‘simulated’ number here? Unclear.

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New sentence: The most obvious feature of Figure 9 (top panel) is that the simulated ice crystal numbers ...'

- p. 21106, line 24: 'temperatures'

  p. 21107, line 16: change to simultaneous

  line 20: change 'maybe' to 'may be'

  line 25: change to '(around or lower than 1 cm/s)'

  p. 21108, line 1: To be consistent with use of words, shouldn't it be 'Scenario (ii)'?

  Done.

- lines 6-7: not sure what authors mean by 'general mechanism'.

  'general mechanism' is replaced by 'common mechanism'

- Lines 14-15: 'Here, we presented'.

  And change 'strongly' to 'thoroughly'

  Done.

- Line 18: 'explicable' is not clear

  'explicable' is replaced by 'explainable'

- p. 21109, were there any observations of vertical velocity in this field campaign to validate 'Scenario (i)'?

  Unfortunately no.

- p. 21110, line 4: Acknowledgments. Also, 'giving' is better than 'leaving'

  Done.

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- Another reference on the deposition coefficient that may be of use (at least for the warm clouds in this study) is a paper by Magee et al. (2006), GRL. They found lower values than previously assumed.

  We referenced those papers dealing with the details of possible mechanisms influencing ice growth implicitly in the 'Conclusions' on in-cloud supersaturations: '... we do not rule out the possibility that several mechanisms summarized and discussed by Peter et al. (2006) and Peter et al. (2008) (and references therein) might influence the depletion of water vapour by growing ice crystals: a low mass accommodation of H_2O on ice, nitric acid deposition on ice forming NAT or cubic ice formation. However, from our data set we can not deduce a large effect on ice growth.'

- A paper by Strom et al. (2003), ACP shows a nice analysis of RH as a function of IWC, similar to other studies referenced, but may also provide an unique perspective based on how tenuous/thick the ice cloud is.

  We included the results of this paper on the relation between tenuous/thick ice clouds and RHi in section 3.4 'Cirrus in dynamical equilibrium':
  'That means, supersaturation can live longer the thinner the ice cloud is. This is also seen from observations of Ström and Kärcher (2003) during the INCA experiment (temperature range 215-235 K, their Figure 4), showing that the fraction of in-cloud data points between RH_{ice} 80 and 140% increases significantly with de- creasing number of ice crystals.'

- p. 21117, Table 1: What about papers that use Microwave Limb Sounder retrievals? Several papers by W. Read et al. that may be worth considering.

  Read et al. (2001), JGR, and Read et al. (2007), JGR, report mostly UTH RH_{ice} in the interval 0-100%. $RH_{ice} > 100\%$ are assessed to be erroneous due to temperature errors or a fractional radiance error in the MLS measurement system.

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However, MLS data are analysed by Spichtinger et al. (2003) and shown in Table 1.

- Fig. 3 (lower left) and Fig. 7: Why is it that the processed data in Fig. 3 show some points down to RH = 0%, but yet, in Fig. 7, they are not there? Is that because there were so few points, that in the PDF plot in Fig. 7, they don't show up because the binning starts above some minimal value of frequency of occurrence?

  Thanks for this comment, there was an error in the plotting routine. The Figure is corrected accordingly.

- Fig. 8: A suggestion, lots of papers present RH PDFs on a log-scale. Can the authors consider making two sub-panels, one with the same coordinates at present, and another on a log scale, for easier comparison to papers that have log-scale PDFs?

  Done.

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