Atmos. Chem. Phys. Discuss., 13, C8461–C8464, 2013
www.atmos-chem-phys-discuss.net/13/C8461/2013/


Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Dust ice nuclei effects on cirrus clouds" *by* M. Kuebbeler et al.

**M. Kuebbeler et al.**

ulrike.lohmann@env.ethz.ch

Received and published: 25 October 2013

We thank the referee for his/her valuable comments and suggestions. The responses to your comments are below each comment.

Kuebbeler et al. present a study of dust IN on cirrus clouds by using the ECHAM5-HAM GCM. They consider multiple heterogeneous freezing modes and compare these to homogeneous nucleation (no dust IN effect). This takes into account coating state of the aerosol since uncoated particles would be possible depositional nuclei; in this way laboratory data help motivate this study. There is furthermore a comparison made to aircraft data where the GCM results compare well with in situ measurements. This is a timely topic and certainly one of interest to the ACP readership. The authors have performed an important study and one that certainly moves the field forward. The utilization of laboratory and field data makes for a more important results. I have minor

comments; this paper otherwise should be published in ACP.

1. The statement “In recent years field observations have reported about persistent high supersaturations above the homogeneous freezing threshold outside of cirrus. . .” with references to Jensen et al 2005 and Peter et al 2006 really is outdated; since that time substantial work has been done on in cloud humidity measurements and much of this data was incorrectly high. Furthermore, these observations really only exist in the lowest T range of the UT region. ssAlthough the point is likely valid there should be a bit more modern references here and acknowledgement that the 05 and 06 papers are likely based on highly uncertain data.

We added references to these papers:

Krämer, M., Schiller, C., Afchine, A., Bauer, R., Gensch, I., Mangold, A., Schlicht, S., Spelten, N., Sitnikov, N., Borrmann, S., de Reus, M., and Spichtinger, P.: Ice supersaturations and cirrus cloud crystal numbers, Atmos. Chem. Phys., 9, 3505–3522, doi:10.5194/acp-9-3505-20- 2009, 2009.

Taylor, J. R., Randel, W. J., and Jensen, E. J.: Cirrus cloud-temperature interactions in the tropical tropopause layer: a case study, Atmos. Chem. Phys., 11, 10085-10095, doi:10.5194/acp-11-10085-2011, 2011.

Jensen, E., Pfister, L., and Toon O.: Impact of radiative heating, wind shear, temperature variability, and microphysical processes on the structure and evolution of thin cirrus in the tropical tropopause layer, J. Geophys. Res., 116, D12209, doi:10.1029/2010JD015417, 2011.

2. Regarding “. . .direct measurements in cirrus clouds remain challenging. . .” I think the authors may want to reference the recent study by Cziczo et al. Clarifying the Dominant Sources and Mechanisms of Cirrus Cloud Formation 2013 here.

The reference to Cziczo et al. (2013) has been added.

3. Regarding the reference to Lohmann and Diehl (2006) for ice nucleation modes can



ACPD
13, C8461–C8464, 2013

the authors provide more data – perhaps a line per nucleation mode – as opposed to purely referencing? Given the complexity of parameterizing ice nucleation more detail should be contained here. Please also add some detail about how this is integrated with the new cirrus scheme presented in 2.2. Currently it seems there could be overlap in what was presented in Lohmann and Diehl (2006) and what is new. Please clarify.

We added more detail here.

4. Table 1 : for clarity should present abbreviations here or place later in text after definitions are made (e.g. COMP1, PREEX, etc.). Also, could you please present all values in the same system? – some N given in per l, other in per cc.

The acronyms have been defined and the concentrations changed to per cc throughout.

5. The choice of 1 uncoated and coated dust IN per l seems rather low abundance in the UT given what is stated later; the referenced work by DeMott et al. would suggest this could be higher by and order of magnitude or more; this paper later quotes 5-20 per l. Similarly, DeMott et al. 2003 presents measurements in dust layers of 1000's per liter; please explain the choices of 1 and 100 for the exemplary simulations.

We oriented ourselves at the values given in Kärcher et al. (1-500/l) because we are using that scheme.

6. Figure 1: Unless I'm missing something you haven't specified which row is which. I assume the call out is from top down but this should be specified, preferable within the figure and caption (not just the text).

Yes, the order is HOM, COMP1, COMP2 and PREEX. We added that in the caption.

7. It is unclear why two separate 'Results' sections are included; a single section with sub-parts would seem the standard format. Further, both Results sections tend to be on the long side. In large part these sections are simply text describing the figures. A careful choice of bullet points could reduce the length greatly without sacrifice of



ACPD
13, C8461–C8464, 2013





content.

The two results sections have been removed and shortened where possible.

Editorial: Please take care with punctuation. I noted several cases where there are issues. As an example ". . . implying that both, heterogeneous. . ." (no need for ,). Please do a careful read-through.

We did that.

---

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 9751, 2013.