

Atmos. Chem. Phys. Discuss., referee comment RC4  
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## **Comment on acp-2020-1285**

Anonymous Referee #2

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Referee comment on "In situ observation of new particle formation (NPF) in the tropical tropopause layer of the 2017 Asian monsoon anticyclone – Part 2: NPF inside ice clouds" by Ralf Weigel et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-1285-RC4>, 2021

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### **New particle formation inside ice clouds: In-situ observations in the tropical tropopause layer of the 2017 Asian Monsoon Anticyclone**

This paper describes CPC measurements of sub-15nm particles over Kathmandu at up to 20km altitude. Elevated concentrations and new particle formation were frequently coincident with cloud ice at 11-16km altitude. The authors determine that the NPF occurrence can be limited by the integral radius of the ice particle size distribution, which, as they point out quantitatively, makes sense if precursor vapors condense onto the ice instead of forming particles. This and the other findings they document are very interesting and based on a valuable dataset and sound reasoning, although sometimes only weakly supported by the data (see major comment below). The paper has a bit too much text devoted to qualitative and/or speculative details, and a long-winded writing style which sometimes detracts from its key messages. However, if my comments below can be addressed, this generally very good paper will be well worthy of publication in ACP and it should be highly cited.

#### **Major comments:**

Based on the scatter in Figure 8, the integral radius doesn't work as well for controlling NPF as one might hope. Of course, given the difficulties of measuring NPF on an aircraft, not knowing accurately precursor concentrations or air mass history, one should not

expect too much. Perhaps because of this, the authors don't currently present quantitative metrics for whether or not the IR is any use. So maybe the authors can disentangle the data more brutally to extract some numerical information on the usefulness of the IR? If they excluded data with IWC below a threshold, say 0 on their log scale in Figure 8, then is there some correlation coefficient between IR and  $N_{uf}$ ? Even if no meaningful correlation can be presented, perhaps the message can be firmed up with further stratification of the data? Otherwise, it is hard to justify the lengthy text and detailed discussion associated with the IR in the paper, and the authors could instead substantially streamline these sections and perhaps focus instead on drawing out more quantitative conclusions about the role of in-situ vs liquid-origin cirrus.

Weigel et al 2020a is only referred to for specific details, why not take advantage of it for the broader context to avoid repetition (e.g of lines 173-193 in Weigel et al 2020a), and maybe even call this Part II of a 2-paper series (something to discuss with the editors)? The current situation is quite confusing. As another example, the first paragraph of the summary is background information that describes findings that are very similar to those in Weigel et al 2020a and there was not sufficient referencing provided.

### **Minor comments**

The diversity of units used in the field is confusing (not the authors' fault). Will be helpful to present aerosol number concentrations in  $\text{cm}^{-3}$  alongside  $\text{mg}^{-1}$  (as concentration in  $\text{cm}^{-3}$  is relevant for the molecular collision frequency leading to NPF) and altitudes in km alongside K and hPa throughout the text and especially in section 3.2.

Figure 2 might be more helpful as a frequency distribution of number concentrations exceeding a threshold, or if the existing figure is accompanied by something like that.

L389: "Furthermore, there is no obvious indication that the number of ice particles present had a direct influence on the NPF strength" seems inconsistent with later L516 "Although an ultimate observational evidence is currently lacking, however, these findings suggest that NPF is entirely prevented in cases when  $N_{ice}$  substantially exceeds  $2\text{-}3\text{cm}^{-3}$ " – maybe add a qualification to the earlier statement to make this later statement seem less at odds with it.

L409 Could cite and discuss Bianchi et al 2020 (an understandable omission given the date this article was posted). <https://www.nature.com/articles/s41561-020-00661-5>

L429 what about ammonia?

Personally, I find it much easier to read and review papers, especially long ones, if the figure captions are on the same page as the figures (and preferably presented when they are first mentioned in the text rather than at the end, though this is less important). By the time I have found the figure that relates to a point in the text, opened the paper in two more instances of my browser, found its caption, looked back to the figure, understood the caption, gone back to the figure, understood the figure, I have forgotten why I was interested. Maybe this is a matter of opinion, but the ACP guidelines here:

<https://www.atmospheric-chemistry-and-physics.net/submission.html#reviewfiles>

say "Figures and tables as well as their captions must be inserted in the main text near the location of the first mention (not appended to the end of the manuscript)" so it seems I am not alone.

While generally nicely written, the paper is long, and the writing could often be more economical. I encourage the authors to go through each paragraph sentence by sentence as if there was a page limit, and use more efficient phrasing and omit unnecessary details. The paper would be easier to read and the authors would save on page charges.

A few sentences are written confusingly: "In particular, the abundance of in-cloud NPF concentrates between ratios of 1:30000 and 1:500000, which may not further surprise, as the large aerosol number concentrations are indicative to result from NPF." What is an "NPF concentrate"?

Also, there are some typographical errors; I pick out only examples. Many commas (e.g. before "that") reminiscent of German should be removed. On line 234 "principle" is confused with "principal". Finally, while not strictly incorrect, manuscripts are usually "drafted", not "draughted". See <https://www.merriam-webster.com/words-at-play/using-draft-and-draught>