

Review of: "Impact of wildfire smoke on Arctic cirrus formation, part 1: analysis of MOSAiC 2019-2020 observations" by Ansmann et al.

Thank you very much for revising the manuscript and addressing my comments. I think that the manuscript has improved significantly as a result of the revision. In particular, I find the discussion even more balanced and the hypotheses better explained.

- I support the general statement that heterogeneous freezing played a major role during the period. The only thing I still don't quite agree with is the idea that homogeneous nucleation should only occur when the INP reservoir is completely empty. Homogeneous nucleation can also occur in parallel with heterogeneous nucleation if the updrafts are strong enough and the supersaturation is getting large enough (see, for example, Krämer et al. 2016 or Rolf et al. 2012 or Kärcher et al. 2022). This happens in the case when the existing ice surface after/during heterogeneous freezing is not sufficient to reduce the ice supersaturation via diffusive growth of the ice crystals. The short term updrafts by gravity waves of up to ~1 m/s reported in Podglajen et al. are sufficient to add homogeneous freezing even in the presence of INP particles (see for instance Fig.7 in Rolf et al. 2012 or Kärcher et al. Sec. 4.3). In Kärcher et al., only warm conditions were investigated. For cold conditions, as present in this study, I would expect the supersaturation to respond even more strongly to an additional updraft and even more likely to initiate homogeneous freezing because the saturated vapor pressure has a strong temperature dependence. The statement of "homogeneous nucleation should only occur when the INP reservoir is completely empty" is not particularly relevant to the first part of the paper series. I leave it to the editor to decide whether this needs to be explained further in Part 1 of the manuscript or it should be better mentioned in Part 2.
- Another small thing is, that you should avoid the very strong wording of "unlimited INPs" see line 496. Please change it to something like "large" or "virtually unlimited"... Otherwise, it would exist forever. I also believe that the INP reservoir is large, but it is definitely not infinite.
- Otherwise, I have no further objections to this part regarding publication in ACP.

Technical comments:

- Line 456: Please remove "the" in "a the updraft event"