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Interactive comment on "Atmospheric new particle formation characteristics in the Arctic as measured at Mount Zeppelin, Svalbard, from 2016 to 2018" *by* Haebum Lee et al.

Anonymous Referee #3

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Review of 'Atmospheric new particle formation characteristics in the Arctic as measured at Mount Zeppelin, Svalbard, from 2016 to 2018' by Lee et al.

The manuscript studies the characteristics of NPF at Mount Zeppelin, a location in the Arctic far from direct anthropogenic emissions. The study compromises ∼2 years of comprehensive valuable data suitable for NPF study. While NPF has been studied at the same location, the new data included in this study contains high time resolution of particle number size distributions of particle sizes relevant for new particle formation. The manuscript is well written, the methods used are clearly described and the literature review is thorough. I suggest publication in ACP after addressing the comments

Printer-friendly version

Discussion paper

below.

General comments:

1. The exact dates of the measurements need to be reported to identify the reoccurrence of the NPF seasons. The authors mention ‘89% during the 27 months sampling period’, but the exact months need to be mentioned.

2. I agree with Anonymous Referee #1 on the necessity of showing the correlation between concentrations of precursor vapours and particle formation rates and growth rates. How do the concentrations of these vary between event days and nonevent days. Something like your figure 9 would be nice to show also for gas-phase precursors. It could be divided into monthly event days and non-event days.

3. The trends of the precursor vapors during the measurement period (sulfuric acid and ammonia), the number concentrations in different clusters, and different modes (3-7 nm, 7-25 nm) as well as the particle formation and growth rates can be shown as daily or weekly medians, maybe in the supplementary. Similar to Kalivitis et al. (2019) figures 8c and 8d or Mikkonen et al. (2020) figure 2.

4. You calculate J3-7 but GR3-25, although the GR is not constant over the size bin 3-25 nm (Kulmala et al., 2013). Calculating a size segregated GR, i.e. GR3-7 and GR7-25 is recommended especially looking at your figure 4 (upper left), the GR is not constant over these sizes.

5. I don’t understand why you chose to present the data in UTC and not Local time. When using UTC, there is no relevance to solar radiation or to other locations. Please show your figures in local time (Figure 4 and Figure 5-middle). You can also show figure 5-middle relative to sunrise. See for example figure 6 in Dada et al. (2018).

6. What about nighttime clustering? your figure middle panel shows that the start time of NPF is around 20 UTC? also unit of time needs to be added to the figure or caption.

7. There seems to be an effect of temperature as well as CS on the probability of NPF.

See figure 13 in Dada et al. (2017). Does the occurrence of Arctic haze inhibit 3 nm clustering and growth? How different is the CS between NPF event days and non event days? If possible, you could examine how CS varies between the airmass clusters.

8. Why GR3-25 while N3-20? Maybe use 3- 25 nm as nucleation mode for consistency with your GR calculations and with previous literature. N3-25 has been referred to as nucleation mode particles in some literature (Vana et al., 2016; Zhou et al., 2020).

9. Comparison of instruments: how does your nano-smps compare to the instruments at the station? See figure 1 in Kangasluoma et al. (2020).

Specific comments:

Line 14: " a higher resolution than ever before", this sentence needs to be changed since previous studies have shown up to 10 s time resolution, unless you mean at the specific location you are measuring. Please change here and else where.

Line 36, anytime, do you mean anytime during the month? or anytime during the day? because very little nighttime NPF that grows to full NPF events are observed in the boundary layer.

Line 38, survivor —> survival

Line 175, 'Dall Maso' –> Dal Maso.

Line 190, survivable –> survival

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