

Response to reviewer 3:

The authors thank anonymous reviewer 3 for comments and suggestions for the improvement of our manuscript.

General comments:

1. The literature overview in the introduction and the sections later when discussing about the results is representing the major part of the paper. I would emphasize more on the CCN results of this study, and maybe prepare a Table with all the other studies and the results of this paper.
 - *The quite extensive introduction presenting studies of CCN in the Arctic had three main reasons:*
 - a) *To ease literature research for scientists who deal with CCN research in the Arctic.*
 - b) *To show the limited amount of studies conducted on CCN in the Arctic and therefore emphasize the importance of this study, in general.*
 - c) *To show that (to our knowledge) no size-resolved CCN study was ever conducted in the Arctic environment and therefore emphasize the importance of this study.*
2. Related to the comment above, the introduction is quite long and heavy to read. It would benefit from not presenting all the values from each single study (at this point the reader does not know their relevance to this study). I would extend the last paragraph of the introduction with relevant info and references from the literature review paragraphs and move the single values from different studies in a comparison Table or present them later when discussing about the results.
 - *Actually, most of the results from studies presented in the introduction are not used for further comparison with our study as they do not present size-resolved measurements from the Arctic region. But still we think it is important to present the studies, because of the reasons named above. To reduce the “heaviness” of the introduction, section titles “Land-based measurements”, “Ship-based measurements” and “Aircraft measurements” are added.*

Specific comments:

Methods:

1. Section 2.2: Please provide information on the inlet/sampling system for the CCN, DMPS & CPCs. Are there notable losses?

Behind line 10 on page 5087 it is added: “The shared inlet of the DMPS, TSI CPC

3025, and TSI CPC 3010 was precipitation protected with an estimated cut-off size of 5 μm ." In line 6 on page 5087 the sentence is modified to: "A commercially available DMT CCN counter connected to a 1/4" stainless steel tubing inlet registered CCN concentrations at SSs of 0.2, 0.4, 0.6, 0.8 or 1 %." In the CCNC the flow inside is maintained as laminar flow in the saturation column, and the particle evaporation in the following OPC is negligible because of the minimal temperature difference (smaller than 2 degree Celsius, ref: factory manual). The particle loss in the flow can be regarded as negligible (or at least, equal to all) since we are using a common inlet in the setup.

2. Page 5087, lines 16-19: Add the resulting time resolution for the size resolved CCN cycle. 10 min per cycle?
 - One cycle (up and down scan over the 15 different particle sizes) lasted for 20 minutes. However, instead of the duration of one cycle, the total number of used activation spectra is added to the "Experiments" section: "The measurement period for the first case study lasted from around 9.40 a.m. on 27 June to around 10.15 a.m. on 29 June during which about 290 size-resolved CCN scans were conducted. The measurement period for the second case study began at around 7.30 p.m. on 21 August and ended at around 10.50 a.m. on 24 August, resulting in about 374 size-resolved CCN scans." (p. 5087, lines 22 ff.)

Results and discussion:

1. It would be very informative and interesting to know also the temperature during the cases.
 - We have added the range of temperatures observed during the two events, which were (3.8-9.4 and 2.3-5.9, respectively).
2. Page 5090, lines 15-19: New particle formation has been observed throughout the day, thus most frequently around noon. Having only one case here I would not state your results are in big contrast with previous results of Tunved or others. On the other hand you observe particles of 15nm at midnight, which means the actual NPF at 1nm has occurred many hours earlier on the previous day, probably in the afternoon (the growth does not seem to be very fast). Re-think this statement.
 - We agree the word "contrast" came out wrong. It was not the intention to highlight a difference, rather compare our observations with what indeed is the most common observation at this location. The section is changed to accommodate for this.
3. Page 5091, lines 23-29: Similar comment to the one above. The case value is 40% higher than the average but still well inside the 75 percentile, so it is

quite a normal value. Maybe comparison to data from 2008-2010 would be better if the cut-off size is considered to make the difference.

- *As for the case above, our intention was not to stress a difference, just to try to be quantitative of how the data sets compared. We removed the “40%” which makes the comparison more subtle. We agree that the values are quite normal.*
4. Page 5092, line 3-5, & Fig.7: Are the bad data for 22 Aug also removed from Figure 7? It seems in the Figure that only 21 Aug has some data missing.
 - *The figure was redone and the data excluded when not used in the analysis.*
 5. Page 5093-5094, lines 29-2: Also here the case value is well inside the 75th percentile, so it is an exceptional value.
 - *The sentence on page 5093-5094, lines 29-2 was changed to: “Although, the total particle number concentration during the period in which the CCN size-resolved measurements were conducted is about 80 % higher than the long-term average, the particle number concentration still falls within the 75th percentile.*
 6. Page 5099, lines 13-29: Please add a sentence (at the end) to connect this paragraph to this study. The paragraph info is used later in chapters, but at the moment it feels bit loose.
 - *To connect the paragraph to the following section, a sentence on the end of page 5099 is added: “In the following section, the obtained information of the activation diameter, as well as the chemical information about the aerosol at the Zeppelin research station from another study are used to calculate the hygroscopicity parameter κ .”*
 7. Page 5101, lines 15-18: The particles >400 nm in the filters will make a major part of the total mass and probably is the main reason for the possible discrepancies.
 - *We agree and reformulated the sentences on page 5101, lines 15-18 to: “This could be due to the overestimation of the inorganic fraction in the “bulk κ ”, as particles with diameters >400 nm were also able to reach the filter. The chemical composition was therefore probably not accurately representative of the CCN-sized particles.”*

Summary and conclusions:

1. The section is more of a summary at the moment. Few compact sentences of the main results, their importance and prospects for future work would be good.
 - *After the sentence “For the June 2008 measurement period, D_{50} was 60 nm, while for the August 2008 measurement period, D_{50} was approximately 67*

nm.”, it is added and modified in line 12 on page 5104: “For the first time κ values for the Arctic were calculated based on activation diameters obtained from in-situ size-resolved CCN measurements, meaning the κ values are based on a conserved chemistry of the particles. Values of the hygroscopicity parameter κ were calculated to be 0.4 and 0.3 for June and August, respectively.” Moreover it is added after the sentence “Therefore, the κ values based on in-situ measured size-resolved CCN measurements and growth factors are probably more meaningful in characterizing the ability of an aerosol population to become activated to cloud droplets.”, in line 17, page 5104: “In future, it is needed to establish long term size-resolved CCN measurements in the Arctic to study the size dependent activation of particles for different seasons. An analysis of the difference in resulting κ values with κ values resulting from long-term chemistry analysis of the particles is needed to quantify and explain the reason for the differences and to point out possible differences to κ to the cloud model community.

Tables

1. Table 3: This table is very small and is not needed. The values are stated in the text. They could be added also in Table 1 if wanted.
 - *The values of Table 3 were added to Table 2.*

Figures

1. Interpretation of Figures 2 and 7 would benefit from plotting also the mean size distributions for the periods: before-during-after.
 - *5 day-backward trajectories were calculated on an hourly basis and combined with Fig. 2 and Fig. 7., to be able to better interpret the changes in particle number size distributions with a change in air mass patterns.*
2. Maybe the trajectories for each case could be compiled in same Figure as done with the lidar plots (see Figs 6 & 11).
 - *Based on comment 5) of reviewer 2, 5 days-back trajectories were calculated on an hourly basis and combined with Fig. 2 and Fig. 7., to be able to better compare air mass transport patterns with occurring particle number concentrations and particle number size distribution characteristics.*
3. Figure 14: Is the y-axis particle concentration, N? By summing up the CN channels the N_{tot} would be only around 20-30 cm^{-3} for the June case and just bit more for the August case. Or is this just me misunderstanding the plot?
 - *Yes, the y-axis is the number particle concentration N, however the data are raw data and used to calculate the ratios, shown in Fig. 15.*

Technical corrections

1. Page 5096, line 25, 28, 29: Concentration values “XXX particles cm⁻³”, delete “particles” to be consistent throughout the paper.

- *Done.*