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Atmospheric Chemistry and Physics Discussions

Interactive comment on "New particle formation and its effect on CCN abundance in the summer Arctic: a case study during PS106 cruise" *by* Simonas Kecorius et al.

Anonymous Referee #1

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General comments:

The main objective of this field study is to assess the impact of new particle formation (NPF) and secondary aerosol on the cloud condensation nuclei (CCN) budget in the summertime Arctic troposphere. To this end, a physico-chemical characterization of newly formed particles, their nucleation process and growth constituted the scaffolding of this work. The authors succeeded to run a formidable state of the art equipment onboard RV Polarstern during an Arctic research cruise. The presented results and conclusions are predicated on an in-depth and sound data evaluation. The authors clearly state assumptions and shortcomings (e.g. the lack of gaseous H2SO4 or in

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situ organic carbon measurements, which would have been beneficial to constrain nucleation and growth mechanism). Nevertheless, the presented outcome of this work is a considerable progress in understanding aerosol-cloud interaction and its climatic consequences during Arctic summertime. In my opinion, the authors organized their manuscript straightforward and their conclusions are widely comprehensible. Without doubt, the topic addresses the scientific scope of ACP and I recommend a final publication after some minor revisions I specified below.

1. Chapter 2.1.1: I think you should better move the whole section to the corresponding places in the “Results” chapter, because it is reasonable to present this auxiliary information along with the described NPF events. In the present form, part of the information given now in chapter 2.1.1 are just repeated in chapter 3.

2. Chapter 2.2.3, line 204 & 205: Please briefly specify in which way you determine particle hygroscopicity (I guess kappa is derived from CCNC data?).

3. Page 10, lines 283 to 287: Contamination control: Did you entirely rely on the CNC data or did you also include relative wind direction and velocity from the ships weather station?

4. Page 10, lines 289 to 291: Data from Zeppelin Mountain Observatory: If these data are significant for your evaluation, I miss a more detailed discussion along with your results.

5. Page 18, lines 535 to 540: Estimating gaseous H2SO4 concentrations is crucial in order to describe nucleation and growth mechanism. If I understand aright, you used the tables and the given interpolation method presented by Yu (2010), where the basic input parameter is the observed nucleation rate (and not the growth rate)? Please clarify. In addition, you assume that because of the measured hygroscopicity parameter, only the binary system H2SO4-H2O is in the running and particularly not the tenary H2SO4-NH3-H2O system. In my view, it may still be worthwhile to envisage the latter option by comparison (see Napari et al., 2002).

6. Page 19, line 559: Sorry for nagging, but being a chemist, I have to note that ammonia is not an organic species (though it could be biogenic, if you mean this).

7. Page 22, line 655 and eq. (7): The CCN increase due to NPF is defined as the difference between the CCN formed under background aerosol with diameter >100 nm and the CCN resulting from NPF. I do not understand why you used a cut-off of 100 nm defining background conditions. First, the model handles a bi-modal size distribution with geometric mean diameter and geometric standard deviation as input. Secondly, during all NPF events to be considered (referring to Fig. 2), particles did not grow above 50 nm. Thus, if at all, it would be reasonable defining a cut-off at around 50 nm instead of 100 nm for the background case. Please clarify!

8. Figure 2: This series of figures show a wealth of information that I could not really decipher in the present printed version. A magnification of the on-line version is necessary, but the resolution of the figures are somewhat poor. I would therefore recommend remedying this point.

9. Figure 4: Fine, but what is about sea salt (Na+ and/or Cl-) data? These results are equally of some interest. For instance, a correlation with OC could give a hint whether part of the OC is primary aerosol that may be generated in conjunction with sea spray (just a mere suggestion for my part).

Typos (maybe not complete!):

10. Page 16, line 453: It should be 5.4 nm h-1 (not 5.4 h-1).

11. Page 23, line 678: . . .it can be concluded (not conclude).

Reference:

Napari, I., Noppel, M., Vehkamäki, H., and Kulmala, M.: Parametrization of tenary nucleation rates for H2SO4-NH3-H2O vapors, J. Geophys. Res.: 107(D19), 4381, doi: 10.1029/2002JD002132, 2002.

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