Zábori et al., Atmos. Chem. Phys. Discuss., 15, 5079–5128, 2015

Response to reviewer 1:

The authors thank anonymous reviewer 1 for comments on the manuscript.

The reviewer opposes publication until we have shown what is new between our results from two limited time periods of CCN measurements and the more extended data set of CCN analysis from Silvergren et al. (2014), both based on aerosol sampling at the Zeppelin research station, Svalbard.

There is a paramount difference between how the results from these two studies examining particle activation in the Arctic are obtained. In the case of Silvergren et al. (2014) aerosols of essentially all available sizes (PM10) in the Arctic air were sampled on high volume filter substrates (12 sampling periods over each about one month). The filters were taken to the lab and the material collected on the filters were dissolved into a liquid. The extract was analysed in various ways among the particle activation using a cloud condensation nuclei counter was measured. This procedure leads to a very strong averaging of chemical properties of the aerosol as well as over time. On the other hand the data cover a full annual cycle.

Our approach is very different as it is size dependent on-line measurements at the Zeppelin observatory. Very importantly, this means very little averaging over time and even more importantly no chemical influence from large particles that constitute most of the particulate mass. This difference between the two studies is fundamental.

Hence, despite the relatively short periods of intense observations, these data present a unique insight into the size dependent CCN activation in the Arctic atmosphere. Moreover, to our knowledge, these are the first and only data of this kind presented for the Arctic aerosol.

Based on the argument mentioned above, the from our measurement approach calculated hygroscopicity values κ can be understood to not be biased by the chemistry of large particles.

However, obviously the novelty of the data set was not enough stressed in the conclusions of the article. Therefore the chapter “Summary and conclusions” (p 5103) is extended. Moreover a paragraph is added pointing out the need for size-resolved CCN measurements over a longer time span.

Changes in the manuscript:

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 19, 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." The last sentence of the chapter was deleted.

References

Silvergren S. Wideqvist U., Ström J., Sjogren S., and Svenningsson B. (2014): Hygroscopic growth and cloud forming potential of Arctic aerosol based on observed chemical and physical characteristics (a 1 year study 2007-2008), J. Geophys. Res. Atmos., 119, 14,080 – 14,097, doi:10.1002/2014JD021657.