

31st December 2018

The authors addressed most of my concerns with the second version of the manuscript and the other additional information. However, I still have some questions that I would like to see answered before publication.

Major comments

- **Aerosol composition during growth:** I would like to thank the authors for the additional information and figures provided to answer my previous concerns (RC 3.7 and 3.8). However I tend to disagree with their answer, in particular, the authors stated that "the organic size distribution is shifting to larger sizes from the beginning to the end of the growth event", whereas for my understanding there is no shift but just appearance/disappearance of different modes. Moreover, the Aitken mode that is growing contributes to a very small fraction of the total signal in the AMS and therefore is difficult to draw any conclusion about changes in the Aitken mode composition during the growth events. I'm particularly concerned about the last part of section 3.2 where the authors speculate about the change in SOA composition during GE3 and GE6. The average size-resolved measurement for m/z 43 and 44 is used to investigate the "amount of organic aerosol oxidation during growth events". However, the measurement is obtained averaging over the entire event, therefore it cannot provide any information about the evolution of particle composition over time, the fact that the ratio between the two organic fragments is different between the Aitken and the accumulation mode is not surprising and doesn't say anything about changes in the SOA composition during the growth. In addition, in figure 9 the authors plotted f_{44} against f_{43} to show that the SOA oxidation increases during the growth, I disagree with this conclusion because the mass concentration of these two organic fragments is dominated by particles that are larger than the Aitken mode under investigation. Just by looking at the aerosol size resolved chemical composition it is clear that a variation in the Aitken mode could not explain the variance in figure 9 that, in my opinion, is entirely due to variations in the concentration and/or composition of accumulation mode particles. The authors should provide more convincing argumentations to show that SOA oxidation is changing during the growth events, for example they could try to reproduce figure 9 excluding the contribution of larger particles, but I'm afraid the signal to noise ratio would be too low for this. In any case section 3.2 should be revised to address these comments.
- **Back-trajectory:** I would like the authors to link the results of the

back-trajectory analysis in section 3.1.3 with the observations reported in section 3.1.2 that shows that growth events are recorded only when a small temperature inversion is present. I think these two results are strictly connected and the authors should present them in a more coherent way. Moreover, I didn't find any indication about the height of the back-trajectories, I think this is an important information that should be provided in the paper.

Minor comments

- Page 8, lines 30-35: this sentence is overstated because it extrapolates the analysis of the results from two single events to many more. I agree with the authors in saying that there are evidences from different studies supporting the role of organics for aerosol growth in the Arctic but they are mostly based on the analysis of very few events. Therefore, I would not say that LVOC are responsible for the frequent particle growth events observed on Ellesmere island, there are not enough measurements to support this statement.
- Page 8, line 11: Is there any specific reason for choosing 10-30 nm as the size range to calculate the growth rate?
- Page 8, lines 14-15: this sentence is not very clear and should be rephrased with something like: In particular, the absence of an inversion below the PEARL RidgeLab would correspond to air masses measured at the site that are less photochemically aged and more influenced by local and possibly marine sources.
- Page 8, line 29: The authors showed here that the vertical structure of the atmosphere is similar during clean days and growth events. I would be curious to know if there are differences (e.g. airmass history) between these two cases that could explain why particle growth was detected only during certain days.
- Page 8, line 32: a weak inversion does not imply a low particle surface area as stated in this sentence, this causality link should be removed.
- Page 9, line 15-17: I don't think that the different size ranges used for the growth rate calculation could explain differences up to one order of magnitude in the average value. I would think that different condensable vapours concentration and/or different environmental condition (e.g. temperature, solar radiation, etc.) could play a much more important role in determining the aerosol growth rate.

- Page 10, line 22: from figure S11 it seems like the relative intensity of m/z 79 between the ambient and the lab spectra is comparable, thus I think this sentence should be deleted.
- Page 10, line 28: here it is said that m/z 79 is peaked at larger sizes and any MSA would be present in the accumulation mode but most of the AMS fragments are peaked at larger sizes because this is a mass-based instrument. Moreover, during GE6, m/z 79 shows a pattern below 100 nm that resembles the total organic particle size distribution. I would appreciate if the authors could modify the text to address this comment and include m/z 79 size distribution in the supplementary information.
- Page 13, line 6: I would not say that the measurements reported in this paper are in contrast with those reported by Giamarelou et al. because they were taken in a location that is thousands of kilometers away from Ellesmere island. I would not expect to have the same nucleation and growth processes across the two sites just because they are at a similar latitude. I would suggest to delete this comparison from the conclusion and move the description of Giamarelou et al. results to the introduction.
- Figure 5: it would be useful to add the center of the Aitken mode on top of the particle size distribution to guide the eyes and show the aerosol growth.
- Figure 8: I see the authors reasons for extrapolating the aerosol size distribution down to 10nm but I still think this is misleading and I would cut everything at 50 nm.
- Figure 9: the colors of the markers associated with the seven hours average are inverted in GE6 panel.