Answer to Anonymous Referee 1:

Results of aerosol hygroscopicity measurements from a CCNC and an HTDMA are presented for spring and summer periods in 2016 at the Villum monitoring station in Greenland. These types of measurements are rare in the Arctic so the paper is a significant contribution to what is known about Arctic aerosol hygroscopicity. The research methods and analysis are thorough and the paper is well written. I only have the few comments listed below.

We are grateful that the referee finds our data and analysis on Arctic aerosols valuable and would like to thank the referee for his/her suggestions for improvements. In the following we like to answer comments in detail. We have replied to the reviewer's comments in italics and additions/changes to the manuscript are marked in bold.

Figure 3. Were there no UVA measurements available between August 25 and September 29 or was there no measurable UVA?

We found that data in the named period were not available. This is why data are not shown.

Section 3.2 and Figure 4: The sampling periods are not the same in the text and the figure. For example, the text says 20 April – 10 May and the figure says 20 April – 8 May.

Good point, we mean May 8, this has now been changed in the text accordingly. Also, there was a small discrepancy for the summer period in the text (15.08. – 28.08. compared to 15.08. – 10.09.). This has now been corrected and changed accordingly.

Line 441: Providing a theoretical value for ammonium bisulfate would be helpful.

After some literature research, we unfortunately have not found a theoretical value for ammonium bisulfate. We are grateful if the reviewer can provide us with some value. As ammonium bisulfate is little more hygroscopic as ammonium sulfate, we assume that a theoretical value will be little higher. We have added this assumption in the final version of the manuscript.

For ammonium bisulfate we would expect a slightly higher theoretical value compared to ammonium sulfate, which would match our retrieved calculations at RH = 85 %, while our calculations at RH = 90 % show little lower values.

Lines 552 – 566: This discussion is a little confusing. It is likely true that "the organic mass fraction must be assumed to contribute significantly to the hygroscopicity of the observed aerosol at Villum". However, the measurement techniques used focus on the particle size range where mass is negligible and number concentrations are highest. A more in-depth description of this discrepancy would be helpful along with more details on what is known about the size dependence of the organics in the Arctic. Nielsen et al. measured organics in PM1. Can more information be provided about how that organic mass is distributed across the PM1 size range? Perhaps from the Croft et al. results?

Experimental data stating the organic mass distribution across the submicrometer size range have not been found to the best authors knowledge for a comprehensive Arctic dataset. Nielsen et al. is investigating the chemical composition at Villum with respect to the bulk PM1 size fraction. It is true that some information is found in Croft et al. for Arctic aerosols as model

simulations were performed supporting our arguments that the organic mass fraction can be quite high for submicrometer and even for ultrafine particles during summertime. Also, atmospheric aging does very much support that organics originated from biogenic sources can well contribute to the organic submicrometer and even ultrafine size fraction of Arctic aerosols. Also, we found a paper by Tremblay et al. (2019), who investigated the organic mass fraction compared to sulfate of submicrometer aerosol at Eureka station during particle formation events. Accordingly, we have added some text to the discussion.

Croft et al. (2019) performed model calculations for Arctic aerosols during summertime showing that about 50% of the mass fraction around 100 nm in diameter can be of organic origin. Also, the atmospheric aging of Arctic aerosols, which are during summer to a large extent originated from local or regional sources supports that biogenic precursors can largely contribute to the organic mass fraction of Arctic aerosols that were investigated by HTDMA and CCN counter techniques in this study. Tremblay et al. (2019) found large organic mass fractions compared to sulfate during particle formation events in the submicrometer and even ultrafine size range at Eureka station using AMS techniques.

Line 589: “likely caused by the more numerous and diverse active aerosol sources during the summer measurement period”. Perhaps this should be local aerosol sources? Spring aerosol sources can be quite diverse given the long range transport that occurs during that time of year.

We agree that these are of course local sources compared to the spring period. Nevertheless, we argue that these sources may vary over the course of the full summer. As such we expect some heterogeneity in our observations. We have changed/added the following comment to the discussion of this topic.

In the summer we observed the above-described heterogeneity of aerosol hygroscopicity. This was likely to be caused by the numerous and diverse active aerosol sources during the course of the summer measurement period. These sources are mostly of local and regional origin that can stem from open waters, sea ice edges or directly from snow- and ice-covered surfaces.