Review on the manuscript entitled "Annual cycle of aerosol properties over the central Arctic during MOSAiC 2019-2020 — light-extinction, CCN, and INP levels from the boundary layer to the tropopause" by Ansmann et al.

This paper follows, as many others, the MOSAIC campaign conducted from the oceanographic vessel Polarstern that was conducted over the years 2019 and 2020. It is mainly focused on the exploitation of data from the Raman lidar that was on board the ship. It is a unique dataset from the ice pack because on an annual sampling of the Arctic atmosphere. The paper is very well organized and written. It contains many relevant references to support the statements. It is totally within the scientific domain of ACP.

For all these reasons, I think it can be published without major changes.

In addition, it raises current issues such as the impact of biogenic aerosols on ice cores or the role of biomass burning aerosol that can be mixed with terrigenous particles. These are still open scientific fields of importance for climate projections.

Below are some questions/comments.

Introduction.

1) It is very complete, maybe a little long. Some parts could be more synthesized, such as the discussions on CALIPSO that happen in two different places.

2) L16. I think we are talking about the middle troposphere?

3) L31. The ship was also trapped in the ice in August/September?

Section 2.

4) L212. The optical thicknesses are low, and this will induce very large errors on the Angstrom coefficient. It should also be taken into account in the interpretations.

5) In subsection 2.6, it is assumed that aerosols do not change in nature with altitude in order to apply the same coefficients c?

6) In fact, these coefficients c are the inverse of cross sections, why not use directly this very explicit quantity in physics?

7) L231. On which dataset is the regression done, it is not very clear?

8) L320. Can't there also be nitrates on the duts?

9) Subsection 2.8.3. If a thermodynamic model is used to calculate INPs from the lidar measurement, how can this independently validate the climate models? Don't these models use related approaches?

Section 3.

10) L464. How can we be sure that it is deep convection, linked to a pyroCb, that injects the wildfire smoke into the lower stratosphere? Is it the altitude at which the aerosols are observed by the lidar?

11) L467. We found the same thing on biomass burning aerosols from Canada (https://doi.org/10.5194/acp-18-13075-2018)

12) L475. In Fig. 6, how many lidar profiles are averaged per month? Are they homogeneously distributed in the month?

13) L544. Is it normal that the profiles of particle number concentration are not shown? It would have been interesting to see.

Section 4.

14) L591. In Fig. 10, the empty blue circles are not identified.

15) On Figures 10, 11 and 12, wouldn't it be clearer to put envelopes of data variation?

16) How can we separate natural variability and uncertainty from these figures?

17) L610-611. I don't quite understand the sentence about the dry deposit.

18) L631. Why did you take 1% at 250 m? Did the in-situ measurements give 1% dusts in number?

19) In-situ measurements are usually on mass, there must be significant errors to pass in numbers. Is this the case?