

## ***Interactive comment on “Pan-Arctic Aerosol Number Size Distributions: Seasonality and Transport Patterns” by Eyal Freud et al.***

**Anonymous Referee #1**

Received and published: 10 February 2017

This scientific paper gives an over view of the Number Size Distributions (NSD) measured at several monitoring sites located around the Arctic. Data is collected from 2010 to 2015 and using k-Means cluster analysis identifies 4 NSD - one nucleation and 3 accumulation. The paper then reviews the seasonality of these data and clusters - nucleation in the summer and accumulation (associated with Haze) in the darker spring-winter months. It also considers the sources giving rise to these NSD using the analysis of air mass back trajectories pointing to EuroAsia for the accumulation modes. The paper deals mainly with the accumulation mode particles and also shows that rain fall is important for aerosol scavenging. The paper gives a very useful observation of Arctic aerosol and recommended for publication.

Major Points None - well written paper.

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### Minor Points

Not wanting to interrupt the science, it would be useful to be able to refer to details of methodology in the Supplementary information. What type of normalisation was used before clustering and if one was not used how can a size dependence be avoided in the analysis?

The opening sentences of Section 3.3 are not completely clear. How was the decision to use 4 clusters arrived at? What happens if more clusters are chosen? Is there a spacial dependence when using 4 or more number of clusters? The output used to justify 4 clusters would be useful in the SI. Were validation statistics used and if so please present. Furthermore, was the whole 30,000 hour data set clustered at once or was there a limit set by the memory of the computer?

In figure 5, it would be interesting to see the minimum and maximum values plotted for each size bin to get a complete picture of the cluster output.

Pg 10 lines 35 onward, the explanation is not totally clear as to why the retreating ice and the trajectories in Figure 7 explain the skewed purple bars representing cluster 4 for Alert and Nord. Please clarify.

Pg 11 lin 18. For the mountain measurement site ZEP (looking beyond the widening of the Hoppel gap), how often does the boundary layer drop below the height of the station and what affect does this changing boundary layer have on the NSDs? And does a higher number of clusters reveal a different shape of NSD possibly associated with trajectories not associated with cluster 1 distributions?

Pg 13 line 40. How does the previous sentence referring to the height of the trajectories above 1km above the surface 'reinforce the claim that these areas are source region for accumulaton-mode particles in the Arctic? A detail or link is missing here - don't assume the reader will have prior knowledge.

Pg 14 lines 7-13. If they are of interest but you don't want to inflate the main text then

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put such figures into the SI.

Appendix A should go in the SI because the values are not discussed or add to the value of the main paper.

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Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2017-62, 2017.