

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

Anonymous Referee #3

Received and published: 28 February 2017

The authors analyzed a multi-year observational dataset of aerosol number size distributions from five sites around the Arctic Ocean. They conducted cluster analysis and back-trajectory analysis to investigate the seasonality and transport patterns. This study could improve the understanding on the spatiotemporal variation and transport of air pollution over the Arctic region. Before this manuscript can be considered for publication, I have a few comments for the authors to address.

1. Page 2, Lines 30-31: For the authors' consideration, a very recent study (Qi et al., 2017) used an adjoint analysis to identify source regions of black carbon over the Arctic, which could be cited here.

References: Qi, L., Li, Q., Henze, D. K., Tseng, H.-L., and He, C.: Sources of Spring-time Surface Black Carbon in the Arctic: An Adjoint Analysis, *Atmos. Chem. Phys.*

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Discuss., doi:10.5194/acp-2016-1112, in review, 2017.

2. Measurement Section: the authors have provided qualitative descriptions on measurement sites and instrumentations. But more quantitative descriptions on the uncertainty associated with measurement instruments and methods as well as data processing should be provided in order to assess the validity of the analysis results in the text. Thus, I suggest including some quantitative discussions on the measurement uncertainties.

3. Page 4, Line 5: Please provide the full name of “DMA” here, since this is the first time when such abbreviation appears.

4. Page 6, Line13: “A 240-hour 3D back-trajectory ...”. A more recent study (Qi et al., 2017, see comment #1 for reference) conducted adjoint model analyses to quantify source contributions of black carbon over the Arctic region and they found that the large contributions from Asian anthropogenic sources are mainly on 1-2 month timescales, which suggested that it is likely 5-day or 10-day trajectory analyses underestimate Asian contribution to surface BC in the Arctic. Could the authors add some discussions on this aspect, since a 10-day trajectory analysis is used in this study? Also for Line 17, Page 13, would the argument here still be valid if a longer time trajectory analysis is used?

5. Page 7, Line 16: “... comprising 29 bins ...” How much uncertainty could this rescaling/re-distribution of size bins cause for the final analysis? Is there any specific reason for choosing 29 bins?

6. Section 3.3 (Cluster analysis): What is the accuracy of the k-means analysis to divide different clusters? Is there any way to quantify this? Would the different clusters also imply different aerosol components?

7. Figure 2: How would the data availability affect the final analysis? For example, for those years with a small fraction of available data at Tiksi and Barrow sites, would this

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cause any bias in the analysis of seasonality and transport?

8. The HYSPLIT model analysis basically represents the transport of air pollution following the wind/flow (i.e., physical process). However, there are a lot of chemical productions of secondary aerosols during transport. How to deal with and interpret the source regions of these secondary aerosols formed in the middle of transport pathways? Would such secondary productions of aerosols affect the trajectory analysis?

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