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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Source apportionment of particles at Station Nord, North East Greenland during 2008–2010 using COPREM and PMF analysis" *by* Q. T. Nguyen et al.

Anonymous Referee #2

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The paper presents a source apportionment analysis of aerosol sampled at Station Nord from 2008 – 2010. It builds on the earlier work of Heidam et al. by adding several years to the Station Nord time series and additional chemical species. Five sources were found to adequately explain the data including marine, soil, and three anthropogenic sources (Canadian Arctic dominated by Zn, a combustion source at Station Nord with high concentrations of Pb and As, and industry in Siberia with high concentrations of Cu). Geographic source regions were identified but little in depth discussion of the particular sources in those regions was offered. Based on research of industry/combustion sources and results of the back trajectory calculations, it would be helpful to add more information about potential sources in the Canadian Arctic re-

sponsible for the high Zn concentrations and specific industries in Siberia associated with the high Cu concentrations. I agree with the first referee that it would enhance the paper to show data from the time series (especially in combination with the earlier data from Nord) and not just the source apportionment results. Other concerns are listed below. Once all of the comments have been adequately addressed by the authors, the paper should be publishable in ACP.

p. 24175, line 5: What is meant by the "compositional change" of short-lived pollutants? The amounts of these species have changed in the Arctic atmosphere?

p. 24175, Lines 6 – 9: It should be made clear that model calculations suggest that BC contributes to Arctic warming. There are no measurements able to validate this claim.

p. 24175, Lines 16 – 17: This sentence reads as if North America is part of Eurasia.

p. 24175, Line 22: It would be more accurate to say that the deposition frequency during this time of year is low which limits the removal of Arctic haze through deposition.

p. 24175, Line 24: A reference is needed for the statement that Arctic haze may add to warming of the Arctic through its potential to absorb thermal infrared radiation (e.g., Garrett and Zhao, Nature, 2006).

p. 24177, Line 25: As the text says, absorption is the measured parameter. Change to "...to derive black carbon mass concentrations from measurement of the absorption coefficient. ..."

p. 24178, Line 7: Should be "particulate MATTER"

p. 24178, Line 21: Should be "TRANSPORT modes"

p. 24179, Line 3: Change to "the sources OF Arctic particulate matter"

p. 24182, Line 26: Change to "...which may NOT ALLOW FOR the differentiation..."

p. 24182, Line 27: What is meant here by "non-stationary conditions"? Is this referring

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to changing meteorology and transport pathways? It is not clear how the examples given in the following text illustrate the effect of long sampling times on the ability to differentiate sources.

p. 24182, Sections 3.1 and 3.2: The figures in the supplementary material that show the dominant species in each source should be included in the main text. This would make the discussion in these sections easier to follow. The paper is short enough that there is no need for them to be in the supplementary materials section.

p. 24184, Line 19: Change to "...which also included K, Ca,..."

p. 24185, Line 27: Can you describe more specifically what is included in "metal industry" relevant to sources to the Arctic?

p. 24186, Lines 18 – 26: It is stated that "differences in the deposition velocities of SO2 (gas) and SO4 (particles) impose an error....." Then the text goes on to provide examples to explain the imposed error. But the examples seem to have nothing to do with the impact of different deposition velocities.

p. 24186, Lines 23 – 26: The presence of NO3 in the coarse mode and SO4 in the fine mode suggests different mechanisms of incorporation into the particulate phase and not necessarily co-varying sources. It is known that HNO3 condenses onto coarse mode sea salt and dust while fine mode SO4 results from oxidation of SO2 to SO4 and heterogeneous reactions.

p. 24187, lines 11 – 12: What does an absence of NO3 indicate about the combustion source?

p. 24188: lines 6 – 10: It seems the authors are saying that Br is coming from a local and/or marine source and not from distant anthropogenic sources. This should be made clear here. For example, say "Br is not likely to result from anthropogenic sources but instead, from marine or local sources." What would the local sources be?

p. 24188, lines 18 – 20: It is stated that the results presented here indicate that sources

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have changed since the time period analyzed by Heidem et al. Could it also be that the larger number of chemical parameters included in the study affected the assignment of sources compared to the results of Heidam et al.?

p. 24189, Lines 14 – 20: It is suggested that the trajectories calculations indicate that there is a source of Zn from the Canadian Arctic. Li and Cornett (2011)are cited as saying the Canadian source is not Arctic Zn smelters. A sentence should be added explaining why Li and Cornett discount smelters as a source of Zn. If not smelters, any idea of what else it could be?

p. 24109, Line 5 – 8: What evidence is there that K is degraded in the atmosphere as it undergoes long range transport? Maybe there are many sources of K in the Arctic (sea spray, dust, biomass burning) that prevent it from being a useful tracer when using week-long samples to differentiate sources.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 24173, 2012.