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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol composition and sources in the Central Arctic Ocean during ASCOS" *by* R. Y.-W. Chang et al.

Anonymous Referee #1

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The manuscript presents results based on AMS measurements during ASCOS in the Central Arctic and a PMF analysis that was used to determine aerosol sources over the course of the experiment. Three factors resulted from the PMF analysis: a marine biogenic, a continental, and an organic-rich factor that was attributed to a combination of marine and continental sources. The paper contributes to the unfolding picture of the sources and composition of organics in the summer time Arctic. There are many issues (listed below) that should be resolved before publication, however.

p. 14839, lines 20 – 24: Through long term measurements, field campaigns conducted over the past several decades, and modeling studies, sources of aerosol to the Arctic are reasonably well understood. Hence, the inability of models to agree with measured aerosol loadings in the Arctic is more a reflection on model capabilities than the current

understanding of sources and composition of Arctic aerosol.

P. 14840, lines 15 – 16: Change to ". . .because concentrations of transported aerosols are so low." As written, background is defined by the transported pollution aerosol.

p. 14843, line 15: Omit "which do not measure the organic component" as this implies that organics can not be measured with impactors or filters and that such measurements have never been done in the Arctic.

p. 14848, lines 3 – 5: Is this statement referring only to PMF performed on AMS data sets? Please clarify. There is a long history in atmospheric chemistry research of the use of PMF on a mix of organic, inorganic, and trace element species to identify factors representative of particular aerosol sources.

p. 14852, lines 4 – 6: Define what is considered to be "background" air. If continental emissions are part of the background air, then what would a perturbation to the background consist of?

p. 14851, lines 4 – 5: What data measured during the experiment is this statement based on ("submicron sea salt sulphate concentrations were negligible")?

p. 14852, lines 14 – 16: It is stated that "there are few external time traces with which to corroborate the time series for a certain PMF solution". Later in the paper, though, correlations of the time series of the factors with various tracers (DMS, Pb210 and Rn22) are presented. Please explain this apparent discrepancy.

Figure 5 caption: I find the terminology for the inset to be confusing. Do the black points represent all data except the last week of the study? What are the red points?

Figure 6: The figure doesn't give any information about what length of time is represented by the potential emission sensitivity. How does the reader know this represents one (or more) days back in time?

p. 14854, first paragraph: The period of 10 and 11 August is highlighted since the

marine biogenic factor is high. What about other periods when it is high such as 16 August? Also (as stated below), the brief mention here of the PSCF analysis is not very satisfying. If it is going to be used in the analysis, it should be discussed in more detail in the body of the paper.

p. 14854, lines 9 – 10: How was the MSA/SO4 ratio calculated from the marine biogenic factor?

p. 14854, lines 10 – 13: Why is temperature mentioned here when it is not mentioned in the discussion of the variability of the MSA/SO4 ratio shown in Table 2? Can it explain some of the variability?

p. 14855, line 6: Are primary organics emitted from the ocean through bubble bursting expected to be non-refractory and detectable by the AMS?

p. 14855, line 16: What evidence can be provided to support the "possible mixing from aloft"? What does M. Shupe (per. Commun.) base this on?

p. 14855, lines 17 – 18: How is it known that the transported air was influence by continental combustion? Is this based on chemical information?

Continental factor: Why is no FLEXPART analysis shown for 26 – 30 August?

p. 14855, lines 27 – 28: Largest value of F44 previously reported for what conditions? Please supply a little context.

Figure 9 shows there is a biomass burning source in Eastern Europe on Sept. 4 but it doesn't clearly convey any transport of the plume to the central Arctic. Hence, as presented, it doesn't provide very compelling evidence for a biomass burning source nor does it show "the modeled contribution of biomass burning to the air sampled on 4 September". Were there tracers measured on the ship that can confirm a biomass burning source such as aerosol potassium or gas phase acetonitrile? If so, those data should be presented here.

p. 14856, lines 18 – 21: What agreement is being referred to here? The agreement between a FLEXPART estimated biomass burning source and the organic factor? Can the agreement be quantified for the case in point (Sept 4)?

p. 14859, lines 5 – 8: Need to make it clear here that these results are for the summertime only.

p. 14859, lines 9 – 10: There also is evidence that the Arctic boundary layer can be heavily influenced by biomass burning at times (e.g., Stohl et al., ACP, 2007).

Supplementary material: The results presented in the paper rely heavily on the PMF and PSCF analyses. In addition, the paper is not overly long nor is the supplementary material. Having the detailed explanations of the PMF and PSCF analysis buried in the supplementary material is an unnecessary distraction. The supplementary material should be incorporated into the main manuscript.

Correlations of factors or components of factors with tracer species or factors from other studies are given throughout the paper. It would be useful to compile these into a table. In addition, a figure or figures that compare(s) mass spectra of the PMF factors found in this work to mass spectra that are used for reference throughout the paper (e.g., OOA factor at continental urban sites, mass spectrum of aged biomass burning aerosol) would be helpful.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 14837, 2011.