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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Vertical profiling of aerosol particles and trace gases over the central Arctic Ocean during summer" *by* P. Kupiszewski et al.

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We are grateful to the reviewer for the valuable input serving to improve the manuscript. In response to the general comments: we have attempted to shorten parts of the manuscript which seem lengthy and restructure sentences with overly complicated sentence structures. Also, we will review the conclusions and expand on parts which are insufficiently clear or too brief.

Below we answer the specific comments:

Abstract

10397:13-15: The sentence has been rephrased and now reads: "Within the lowermost couple hundred meters transport from the marginal ice zone (MIZ), condensational growth and cloud processing develop the aerosol population."

10397:26-27: We have changed "suggested" to "considered" in order to strengthen the conclusion.

Introduction

10398:11: Changed to mid-21st century.

10400:2: We state "former Soviet Union" as the paper referenced (Pacyna and Oehme, 1988) was written before the breakup of the Soviet Union and discusses transport of pollutants from the Soviet Union. Therefore, we considered it more accurate to keep the terminology used in the referenced paper.

10401:5: We have modified the sentence to include particle growth and, thus, make it clearer: "One such local source over the central Arctic Ocean is dimethyl sulphide (DMS), which, via photochemical oxidation and subsequent condensation on pre-existing particles, forms methanesulfonate (CH3SO3(-)) and non-sea salt sulphate (nss-SO4(2-)) (Heintzenberg and Leck, 1994; Leck and Persson, 1996a,b; Quinn et al., 2007)."

Section 4.3

10417: Where one value is followed by another in parentheses, we are referring to the median value (without parentheses) and the mean value (in parentheses). For example in lines 7-8 we write: "The median (mean) value within this layer was 7 (34) ppt(v)." This means the median was 7 ppt(v) and the mean was 34 ppt(v). Where there is only one value and we do not state that this is a mean or median value, the number simply gives the measured value, as in lines 5-7, where we write: "DMS concentrations (Fig. 8, left panel) showed large variability in the near-surface layer with observations between 2 and 123 ppt(v) within the lowermost 200 m."

10417:23: Yes, such a feature is to be expected as the only source of DMS is the surface. As a result, DMS concentrations would be expected to decrease exponentially with height above the mixed layer. Nonetheless, it should be noted that this is a very general feature, and higher concentrations are also possible aloft in certain cases (Lundeń et al, 2010).

It is also true that there is variability in the observations, particularly in the near surface layer. The variability is not particularly surprising however, as DMS concentrations are strongly dependent on the source of the air mass and whether it has been in recent contact with open water.

Section 4.4

10418:8: Changed to "25-75 percentile intervals."

Section 4.5

10422:4: We mention the raised DMS concentrations here as, interestingly, they suggest that the sampled air mass has been in contact with open water. However, we have found no evidence for this based on analysis of back trajectories and frontal zone systems. Therefore, in this case we are unable to explain how the DMS was lofted to such an altitude.

Section 4.7

10428: In order to avoid confusion, we have removed "semi-volatile" from the sentence so that it is now: "(. . .) the rapid appearance of the sub 10nm particles cannot be explained as a result of the growth of the freshly nucleated stable clusters of 1–2 nm diameter by a condensable organic vapor (. . .)".

Please also note: this case is discussed in depth by Karl et al. (2013) and we refer the reader to their paper for further details.

Section 6 Conclusions

Meteorological conditions vary greatly even within a single summer, with vertical aerosol distributions following suit. By describing in detail each of the flight periods we have attempted to demonstrate how the variations in conditions affect the vertical aerosol distributions. Nonetheless, it is hard to state whether there is a recurring cycle throughout the summer based on observations from a single campaign. Hopefully, further field measurements will provide a longer time series and allow further conclusions to be drawn on the temporal evolution of the aerosol distributions.

10433:25: Yes, we meant vertical extent – we have now added "vertical" to make this absolutely clear.

10434:11: We have rephrased the sentence: "(. . .) while free tropospheric pollution plumes were frequently observed, we consider them unlikely to have any direct significant contribution to the CCN population active in low-level clouds."

Figure 9: We have now included a reference to the respective period in each of the figure captions.

Karl, M., Leck, C., Coz, E. and Heintzenberg, J.: Marine nanogels as a source of atmospheric nanoparticles in the high Arctic, Geophys. Res. Lett., 40, 3738–3743, doi:10.1002/grl.50661, 2013.

Lundeń, J., Svensson, G., Wisthaler, A., Tjernström, M., Hansel, A., and Leck, C.: The vertical distribution of atmospheric DMS in the high Arctic summer, Tellus B, 62, 160–171, 2010.

Pacyna, J. M. and Oehme, M.: Long-range transport of some organic compounds to the Norwegian Arctic, Atmos. Environ., 22, 243–257, 1988.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 10395, 2013.