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Atmospheric Chemistry and Physics Discussions

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Interactive comment

Interactive comment on "Characteristics of biogenically-derived aerosols over the Amundsen Sea, Antarctica" *by* Jinyoung Jung et al.

Anonymous Referee #3

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The manuscript presents shipborne measurements of specific atmospheric aerosol, mainly methane sulfonic acid (MSA), non-sea-salt sulfate, OC/EC, and water-insoluble and soluble organic carbon (WIOC, WSOC) over the Southern Ocean and the Amundsen Sea. Measurements also include atmospheric and oceanic factors like wind speed, chlorophyll, dissolved organic carbon, particulate organic carbon, dimethyl sulfide (DMS), and taxonomy of phytoplankton. The authors explore the sources and variability of MSA, nss-sulfate, WSOC, and WIOC and attempt to link them to environmental and biological factors. For example, the authors do an adequate job of linking MSA to DMS, although their statistics are low; removing one measurement point changes their correlation. Nevertheless, these are important measurements that will eventually need to be published. The manuscript is well written and could benefit from shortening. I

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Discussion paper

recommend publication if the following comments are properly addressed.

Major comments: 1. The first major comment reiterates the comment already raised by anonymous reviewer #4. The authors suggest that the inverse relationship between WSOC/Na+ and WIOC/Na+ with wind speed implies that organics in the atmosphere are controlled by winds due to the breakage of the surface microlayer for periods of times associated with high winds. However, I believe that there are several inconsistencies in the text that will need to be clearly addressed prior to publication, mainly:

a. Both WSOC/Na+ and WIOC/Na+ are inversely related to wind speeds but the authors claim that only WIOC have a primary source whereas WSOC is mostly formed by oxidation of biogenic precursors. How do the authors then explain that both ratios correlated well with wind speed?

b. The authors hypothesize that WIOC is of primary origin, but their measurements indicate no correlation between WIOC and Na+. The authors attribute this to transport but their measurements clearly indicate a correlation between Na+ and wind speed, suggesting transport cannot completely rule out a correlation between WIOC and Na+. Also, why does WIOC correlate with the relative abundance of P. Antarctica? Presumably, this implies that a part of WIOC is formed from oxidation of BVOC?

c. Finally, why do WSOC concentrations (presumably of secondary origin, i.e., from the oxidation of BVOC) correlate strongly with Na+ and with DOC? The authors hypothesize that the WSOC relation on Na+ is due to higher surface area (from salt particles) and therefore higher WSOC concentrations are a result of a larger condensation sink. However, the authors present no compelling evidence to substantiate that hypothesis. Can the author examine the relation between WSOC and average short wavelength radiation? This could provide the evidence needed to argue that WSOC is formed from secondary sources. The linkage between WSOC and WIOC with biology needs to be better articulated.

2. What happens to the correlations in Figures 7 if the authors looked at WSOC and

WIOC instead of WSOC/Na+ and WIOC/Na+? This could remove the cross-correlation with wind speed (I encourage the authors to add these graphs as part of the SI).

3. The authors often mention correlation strength even though the p-value for the regression is higher than the specified threshold (in this case 0.05). A p-value larger than the threshold implies there is no confidence in rejecting the null hypothesis (which is: the variables are not correlated). I suggest the authors reframe their results accordingly.

Minor comments: P7 L29: specify at least once what +/- refers to, one standard error or the one standard deviation?

P9 L9-L10: The authors describe a weak but not significant relation between MSA and DMS. If the p-value is not significant than the authors cannot justify that a positive or negative correlation (see major comment 2). Please adjust elsewhere in the text where applicable.

P9 L13: The authors should provide more thorough reasoning for removing the point to the right. Indeed, removing that one point changes the correlation between DMS and MSA from non-existent to significant, due to the small sample number.

P9 L27-30: "Unlike MSA, the mean nss-SO42- concentration in the Amundsen Sea. . ." please provide justification to how the trend for nss-sulfate was comparable to that of MSA. Visual inspection of the data is not sufficient. Also, I am not sure how the authors arrived at the conclusion that nss-sulfate is influenced by marine and anthropogenic sources given the information in that sentence.

P10 L17: ". . . showing a similar variation trend to that of MSA". Quantify the agreement.

P11 L14-19: "We expected much higher WSOC and WIOC concentrations in the Amundsen Sea than the Southern Ocean because of extremely high Chl-a concentrations. . .". This result could be consistent with findings of Quinn et al. (2014) who argued that organic enrichment in the aerosol phase is likely controlled by the dissolved organic carbon (DOC) pool rather than chlorophyll concentrations.

P10 L20-21: Specify how the enrichment of WSOC and WIOC in the aerosol phase was calculated.

P10 L23: “For example, O’Dowd et al. (2004) observed that the contribution of OC fraction to the submicrometer aerosol mass increased from 15% to 63% between low and high biological activity periods in the North Atlantic.” I am confused by this sentence. The measurements presented in this article show no relation of WSOC and WIOC on chl-a concentrations (as explicitly written in the previous paragraph). Please clarify.

P11 L31: “the dominance of WIOC suggests that the bubble bursting process by local wind speeds is a significant formation mechanism of atmospheric WIOC in our area.” If this is true, then why don’t the author observe lower WIOC concentration over the Amundsen Sea compared to the Southern Ocean given that wind speed in the Southern Ocean were larger compared to over the Amundsen Sea?

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