Answer to the Editor:

Marine Carbohydrates in Arctic Aerosol Particles and Fog – Diversity of Oceanic Sources and Atmospheric Transformations

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Dear Alex Huffman,

We thank you for the positive decision. We are hereby submitting a revised manuscript addressing your two minor comments.

Editor: * Reviewer 1 asked whether there was an observed correlation between melt pond depth and measured CCHO concentration. You replied (paraphrasing) that there was some anecdotal differences, but that the number of measurements taken would fall below any statistical relevance. I agree that pointing out a formal correlation would be improper here, but it seems to me that there could be some value in reporting the qualitative observation you made and similar to what you summarized for the referee.

Authors: We added this observation to the manuscript. The added sentence now reads: 'CCHO concentrations exhibited significant variability among the melt ponds, with higher concentrations observed in aged ponds (depths ranging from 40 cm to open-bottomed) compared to younger ones, where depths varied between 20 and 40 cm.' (Lines 325-328)

Editor: * The abstract is very well written and nicely follows the format of the recently adopted ACP guidelines for abstract content (https://www.atmospheric-chemistry-and-physics.net/policies/guidelines_for_authors.html). After the new text you added to start the abstract, however, the length is now at ~335 words, which is beyond the new abstract limit of 250 words. I think with a little creativity and work you should be able to reduce wording somewhat to get to the abstract limit.

Authors: We strongly shortened the abstract to comply with ACP's word limit. The revised abstract now contains 248 words and reads: 'Carbohydrates, originating from marine microorganisms, enter the atmosphere as part of sea spray aerosol (SSA) and can influence fog and cloud microphysics as cloud condensation nuclei (CCN) or ice nucleating particles (INP). Particularly in the remote Arctic region,

significant knowledge gaps persist about the sources, the sea-to-air transfer mechanisms, atmospheric concentrations, and processing of this substantial organic group. In this ship-based field study conducted from May to July 2017 in the Fram Strait, Barents Sea, and central Arctic Ocean, we investigated the sea-to-air transfer of marine combined carbohydrates (CCHO) from concerted measurements of the bulk seawater, the sea surface microlayer (SML), aerosol particles and fog. Our results reveal a wide range of CCHO concentrations in seawater (22–1070 µg L^{-1}), with notable variations among different sea-ice-related sea surface compartments. Enrichment factors in the sea surface microlayer (SML) relative to bulk water exhibited variability in both dissolved (0.4–16) and particulate (0.4–49) phases, with the highest values in the marginal ice zone (MIZ) and aged melt ponds. In the atmosphere, CCHO was detected in super- and submicron aerosol particles ($CCHO_{aer,super}$: 0.07–2.1 ng m^{-3}; $CCHO_{aer,sub}$: 0.26–4.4 ng m^{-3}) and fog water ($CCHO_{fog,liquid}$: 18–22000 µg L^{-1}; $CCHO_{fog,\ atmos}$: 3–4300 ng m^{-3}). Enrichment factors for sea-air transfer varied based on assumed oceanic emission sources. Furthermore, we observed rapid atmospheric aging of CCHO, indicating both biological/enzymatic processes and abiotic degradation. This study highlights the diverse marine emission sources in the Arctic Ocean and the atmospheric processes shaping the chemical composition of aerosol particles and fog.' (Lines 18-36)