

## **Oceanic Transfer and Atmospheric Transformation of Marine Carbohydrates in the Arctic and the Southern Ocean west of the Antarctic Peninsula**

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Marine carbohydrates are released by microbes at the surface of the oceans and contribute significantly to dissolved and particulate organic carbon. They enter the atmosphere as part of sea spray aerosol (SSA) through wind-driven processes. However, the emission processes of marine carbohydrates, their atmospheric aging and their microphysical role in cloud formation processes are not well understood. To this end, the primary transfer of carbohydrates from the ocean via the sea surface microlayer (SML) to the atmosphere and their secondary atmospheric modifications were studied in the pristine Arctic (PASCAL/SiPCA cruise, May-July 2017) and Southern Ocean west of the Antarctic Peninsula (PI-ICE campaign, January-March 2019).

Here, we present marine carbohydrates found in bulk seawater (at 1 m depth), the SML, size-resolved aerosol particles and fog water and their contribution to organic carbon. Air back-trajectories and strong correlations between the aerosolized carbohydrates, sodium and the wind speed suggest local and regional wave breaking and bubble bursting processes as the driving emission processes for the atmospheric carbohydrates.

The carbohydrate to sodium ratios in seawater, aerosol particles and fog water showed a chemo-selective transfer of carbohydrates towards sodium during the sea-air transfer. A direct comparison of enrichment factors in the SML and the aerosol particles in the two polar regions revealed, however, a more complex marine environment in the sea-ice covered Arctic than the ice-free Antarctic Peninsula in the summer period, most likely due to the presence of different sea-ice related habitats, such as the marginal ice zone and melt ponds.

Finally, the monosaccharide composition of the carbohydrates detected in the aerosol and water samples gave strong evidence for bacterial modifications, rather than abiotic reactions or processes, of the aerosolized carbohydrates in the atmosphere after their oceanic emission.