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## Characterization of organic aerosol across the Arctic land surface

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Organic compounds are of high importance in the Arctic because they contribute between one and two thirds to the submicron aerosol mass and may be co-emitted or interact with other aerosol species, such as black carbon, sulfate and metals; they also act as a vehicle of transport for persistent organic pollutants to the Arctic. Organic-containing aerosols (OA) can both absorb and scatter light, thereby changing the radiative balance, and may act as cloud condensation nuclei. OA might become increasingly important in a warming Arctic due to anthropogenic activities and natural emissions, e.g., as a result of expanded vegetation, intensified wildfires, decreasing sea ice extent and thickness leading to higher release of marine volatile organic compounds, and thawing tundra soils (permafrost) along shores and rivers. The continuous monitoring of organic carbon along with a detailed chemical analysis to determine its natural and anthropogenic sources, seasonal variability and inter-annual evolution in the Arctic is of prime importance for improved climate simulations and a realistic assessment of the effectiveness of potential mitigation or adaptation actions.

The OA chemical composition and corresponding sources remain largely unknown, partly due to the challenging measurement conditions. For example, tremendous effort is required for the deployment of online aerosol mass spectrometry at various environments for long time periods. To overcome this challenge, an offline Aerodyne aerosol mass spectrometer (AMS) technique has been introduced based on re-aerosolized liquid filter extracts. The method is capable of covering broad spatial and seasonal observations as well as determining the sources of OA (e.g. primary versus secondary, biogenic versus anthropogenic). Within the project iCUPE (Integrative and Comprehensive Understanding on Polar Environments), we extend the coverage of this technique to the most climate change sensitive region worldwide, using year-long/multi-year (from 2014 to 2019) quartz fiber filter samples collected at 8 surface stations from 68° N to 83°N, covering six Arctic Council nations including the least investigated Siberian Arctic.

Here, we present a project overview and first results from filter water extracts nebulized in Argon and measured with a high-resolution Long-Time-of-Flight AMS (average resolution ~7k). Preliminary data suggest significant variability among different sites and seasons with regard to the relative fraction of fragments-markers of certain sources, indicating largely regionally-specific sources of OA across the Arctic land surface. For example, during the same time period we observed more (roughly 90%) and more strongly oxygenated fragments (especially mass to charge ratio  $m/z$  44) at extremely remote sites. Our average  $f_{\text{CO}_2}$  ( $m/z=44$ ) of  $0.26 \pm 0.08$  and  $\text{CO}^+:\text{CO}_2^+$  of

0.40 ± 0.14 both indicate more oxidized OA than in continental aerosols. The Van Krevelen diagram shows that the addition of carboxylic acid groups (or alcohol+carbonyl on different C atoms) with significant fragmentation may dominate the OA oxidation at high O:C. We further discuss the integration of this analysis with advanced statistical tools for factor identification on the OA fraction. Additionally, the samples will be characterized with ultra-high-resolution mass spectrometry coupled with liquid chromatography, for a two-dimensional molecular identification of primary aerosol tracers and secondary organic aerosol precursors.