AGU PUBLICATIONS

Journal of Geophysical Research: Atmospheres

Supporting Information for

Multi-Year Study of the Dependence of Sea Salt Aerosol on Wind Speed and Sea Ice Conditions in the Coastal Arctic

N.W. May[1], P. K. Quinn[2], S.M. McNamara[1], and K.A. Pratt[1,3,*]

1. Department of Chemistry, University of Michigan, Ann Arbor, Michigan, USA
2. Pacific Marine Environmental Laboratory, NOAA, Seattle, Washington, USA
3. Department of Earth and Environmental Sciences, University of Michigan, Ann Arbor, Michigan, USA

Contents of this file

Introduction

- Text S1 expands upon the analysis and evaluation of the potential influence of frost flowers on aerosol chemical composition.
- Figure S1 shows Na^+ vs. Cl^- molar concentrations for all time period types, as a function of sea surface and wind speed category.
- Figure S2 presents median submicron and supermicron Cl^-/Na^+ molar ratios for each sea surface and wind speed category.
- Figure S3 presents the fractions of submicron and supermicron SO_4^{2-}/Na^+ molar ratios that were below 0.02, indicative of frost flowers, for each sea surface and wind speed category.
- Figure S4 presents the fractions of submicron and supermicron sampling periods that fell into each sea surface category for each month.

Text S1. Results & Discussion: Influence of Frost Flowers

SO_4^{2-}/Na^+ molar ratios were calculated to determine the potential contribution of wind-blown frost flowers to the observed SSA mass concentrations. The SO_4^{2-}/Na^+ molar ratio of frost flowers in Barrow, AK was previously determined to be largely below 0.02 due to the precipitation of mirabilite (Na_2SO_4) at low temperatures [*Douglas et al.*, 2012]. In comparison, SO_4^{2-}/Na^+ ratios for fresh seawater and fresh SSA are ~0.06 [*Keene et al.*, 2007]. Therefore, the fractions of sampling periods with a SO_4^{2-}/Na^+ molar ratio < 0.02, suggesting possible significant frost flower aerosol influence, were calculated, as show in Figure S3. Very few sampling periods were characterized by these ratios. Sulfate-depleted periods were only observed for supermicron and submicron sampling periods, respectively, with leads present and moderate (0.03 ± 0.04; 0.02 ± 0.02) to high (0.1 ± 0.2; 0.02 ± 0.02) wind speeds (Figure S3). The presence of periods with SO_4^{2-}/Na^+ molar ratios < 0.02, as well as increased wind speed, is possibly indicative of aerosolized frost flowers from newly forming sea ice [*Rankin et al.*, 2000]. However, the increase in the fraction of potential frost flower influenced supermicron periods from low to moderate and high wind speeds when leads were present is not statistically significant, and the fraction of periods (0.02-0.1) is relatively low. Therefore, overall, the influence of wind-blown frost flowers on the SSA mass concentrations in this study was likely minor, and wave-breaking represents a greater influence on the local aerosol.

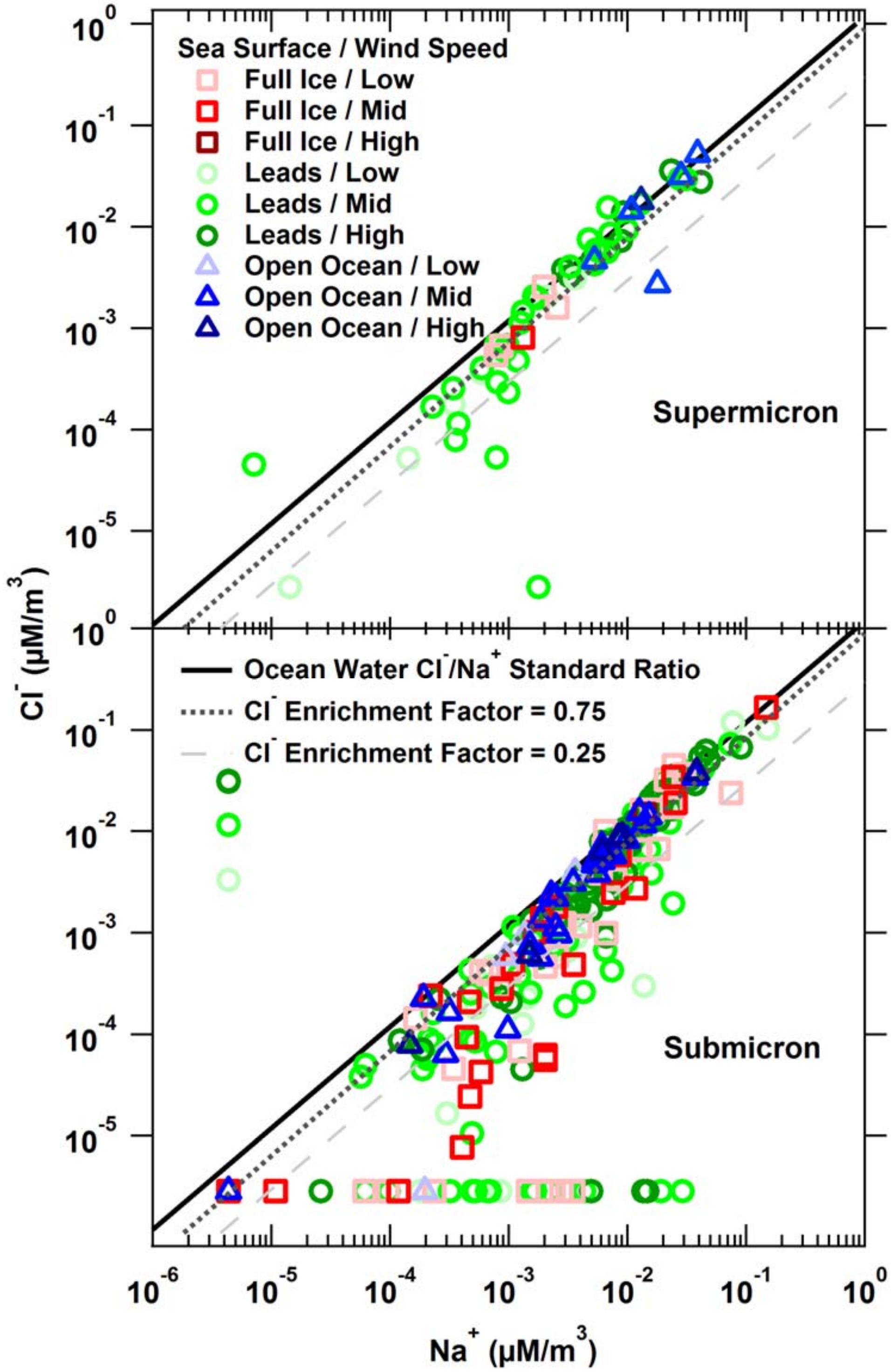

Figure S1. Cl^- concentration vs. Na^+ concentration for supermicron (top) and submicron (bottom) particle samples divided into categories based on sea ice conditions and wind speed. The Cl^-/Na^+ ratio of ocean water is shown in the solid black line, with points falling below the line representing periods where atmospheric Cl^- depletion has occurred [*Keene et al.*, 1986]. The extent of Cl^- depletion is denoted by the dotted dark grey line representing 25% depletion and the dashed light grey line representing 75% depletion.

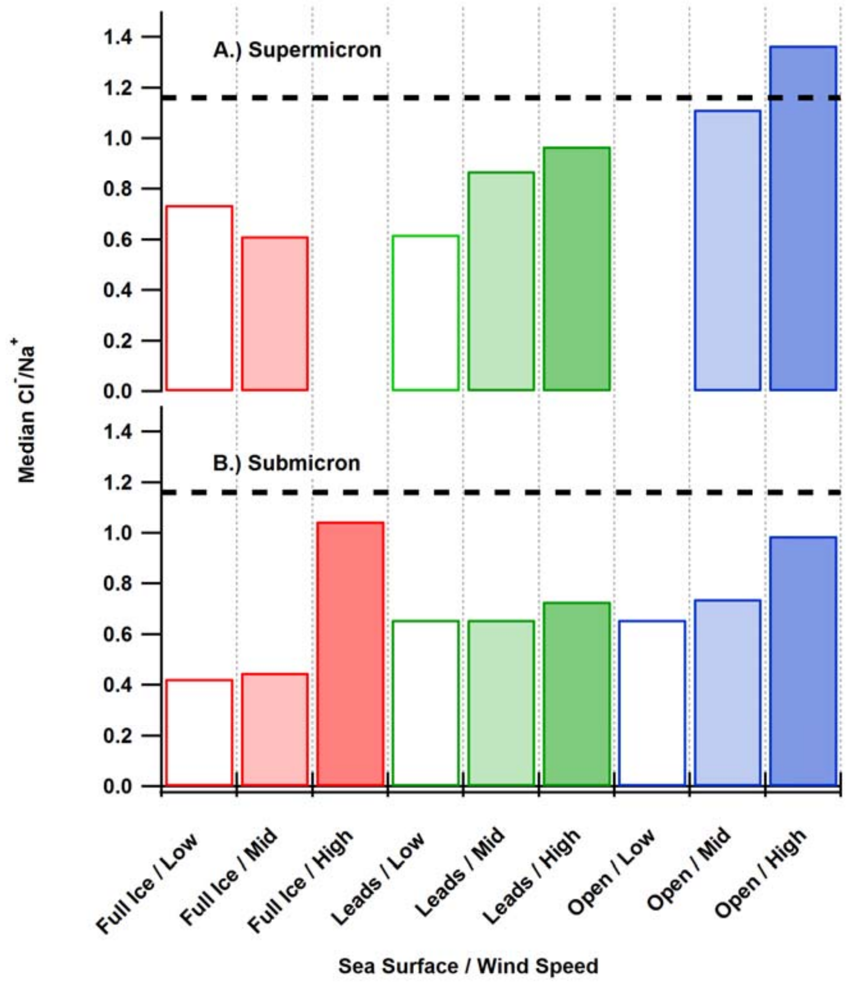

Figure S2. Median Cl^-/Na^+ molar ratios for the submicron (<1 µm) (a), and supermicron (1<10 µm) (b) particle size ranges separated into 9 bins based on local sea ice extent and wind speed, with the Cl^-/Na^+ ratio of ocean water shown in the dashed black line. Sea ice extent categories include: full ice, leads present, and open water. Wind speed categories include: low (<4 m/s), mid (4-7 m/s), and high (>7 m/s).

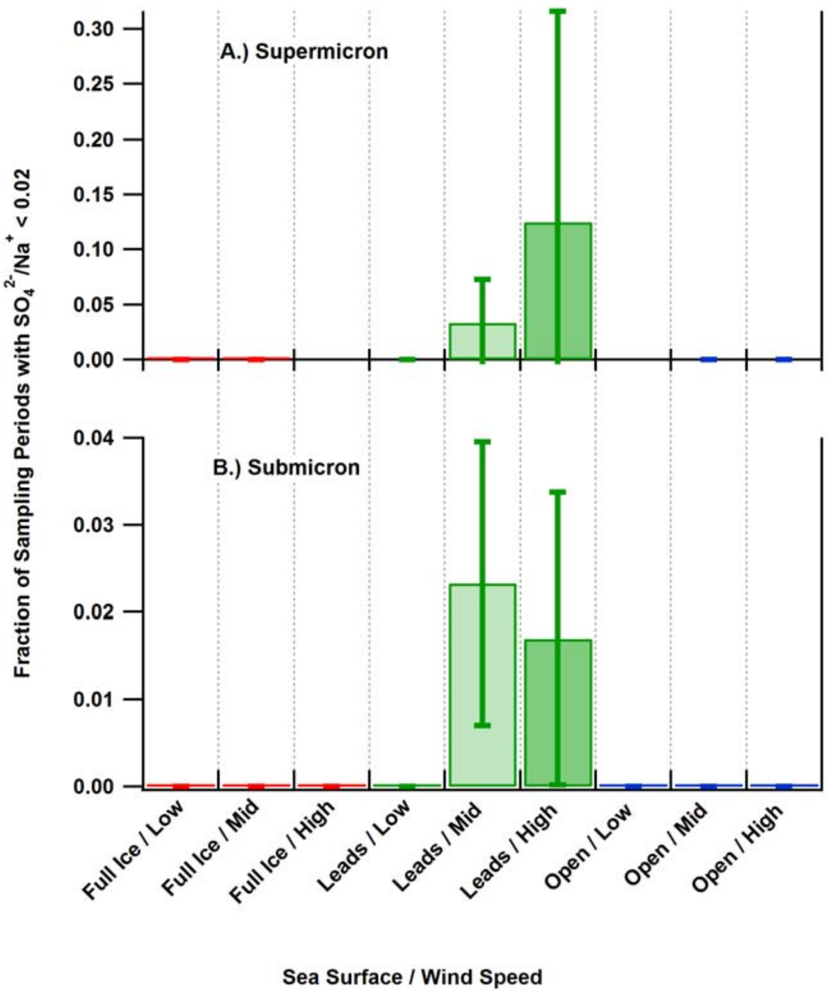

Figure S3. The fractions of sampling periods with $SO_4^{2-}/Na^+ < 0.02$, potentially indicative of aerosolized frost flowers, for supermicron (a) and submicron (b) particle size ranges, respectively, divided into categories based on sea ice conditions and wind speed, similar to Figure S2.

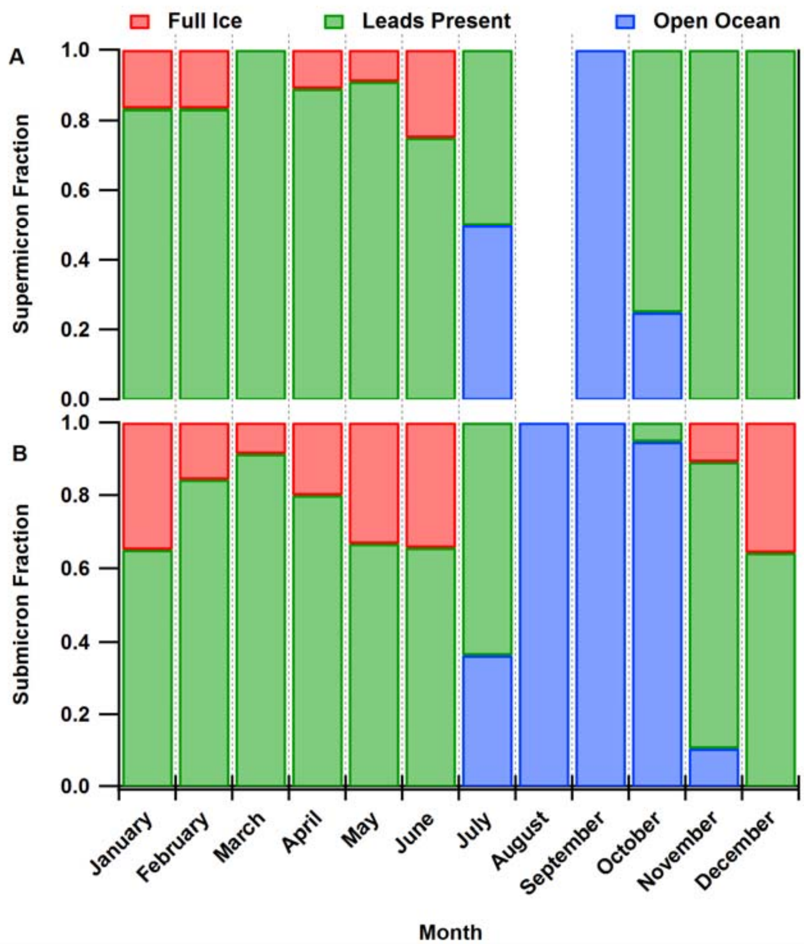

Figure S4. Fractions of supermicron and submicron sampling periods in the three local sea surface categories as a function of month.