M.S. Defense Announcement
Emily Lill
Tuesday, November 28, at 2:00 pm

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November 28, 2023
2:00 pm

Defense
ATS Large Classroom (101 ATS) or Teams

Post Defense Meeting
ATS Community Space Conference Room (116 ATS)

Committee:
Emily Fischer (Advisor)
Jessie Creamean (Co-advisor)
Sonia Kreidenweis
Diana Wall (School of Global Environmental Sustainability)

The abundance and sources of ice nucleating particles (INPs) within Alaskan ice fog

Fairbanks, Alaska often experiences low visibility due to air pollution. Low wind speeds and strong temperature inversions paired with local emissions from burning of wood, oil, gasoline, and coal lead to wintertime pollution events where concentrations of fine particulate matter (PM2.5) often reach 50 μg m^{-3}, exceeding the Environmental Protection Agency (EPA) 24-hour National Ambient Air Quality Standard (NAAQS) of 35 μg m^{-3}. When temperatures fall below -15°C and sufficient moisture is present, these pollution events can facilitate the formation of ice fog, further worsening air quality and visibility issues for aviation and transportation. The formation of ice crystals from supercooled droplets is aided by a small, but critical, number of aerosol particles from the pollution that potentially act as ice nucleating particles (INPs). However, studies evaluating the quantities and sources of INPs during ice fog are limited. The Alaskan Layered Pollution and Chemical Analysis (ALPACA) field campaign included deployment of a suite of atmospheric measurements in January - February 2022 with the goal of better understanding atmospheric processes and pollution under cold and dark conditions. We report on measurements of particle composition, particle size, INP composition, and INP size during an ice fog period (29 January - 3 February). There was a 153% increase in coarse particulate matter (PM10) during the ice fog period, associated with a decrease in air temperature. Results also show a 58% decrease in INPs active at -15°C during the ice fog period, indicating that particles had activated into the ice fog via nucleation. Peroxide and heat treatments were performed on INPs in order to determine the fraction of INPs that were biological, organic, or inorganic. One hypothesis consistent with the results of the peroxide treatments is that more efficient INPs derived from biological materials or organics that typically activate at warmer freezing temperatures may have been depleted during the ice fog event. Reductions in heat-labile (i.e. likely biological) INPs were 54 - 85% and 55 - 97% during and outside of the ice fog period respectively. A large reduction in heat-labile INPs was unexpected for Fairbanks in the winter due to the very low temperatures and limited biological aerosol sources.