Ph.D. Defense Announcement
Kevin Barry
Monday, November 6, at 12:00 pm

Kevin Barry
Ph.D. Defense

November 6, 2023
12:00 pm

Defense
CIRA Commons or Teams

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

Committee:
Sonia Kreidenweis (Advisor)
Paul DeMott (Co-advisor)
Susan van den Heever
Emily Fischer
Thomas Hill
Jessie Creamean
Pankaj Trivedi (Agricultural Biology)

Ice Nucleating Particles in the Arctic: Measurement and Source Tracking

The Arctic landscape is dynamic, with sea ice melting and permafrost thawing. Its near-surface air temperature is warming 3.8 times faster than other regions. This is known as Arctic amplification. Clouds affect this level of amplification, and their phase is important for determining the surface energy budget. Arctic mixed-phase clouds can last for several days but are not represented well in global climate models. Special aerosols, called ice nucleating particles (INPs) trigger ice formation in the atmosphere at temperatures warmer than -38 °C, and thus are important for determining the lifetime and radiative properties of these clouds. Observations of INPs, especially over the central Arctic, are limited, and many sources are unknown. This dissertation has the overarching goal of increasing understanding of Arctic INPs. This is achieved through first presenting a full year of INP measurements in the central Arctic, as well as a full year of their composition, using coincident sampling of bacteria and fungi to gain insight into airmass origin. Next, some of the potentially most active Arctic INP sources are explored. Permafrost, which was known previously to contain high levels of INPs, was tested for its activity and persistence in water, and ability to be aerosolized through bubble bursting over several weeks. Then, sources of INPs were surveyed in a region that is controlled by permafrost (a thermokarst landscape). This included field measurements of permafrost, vegetation, sediment, active layer, water, and aerosol samples. A high temperature heat test was developed as a diagnostic tool to differentiate sources. Coincidentally, clean working methods to measure INPs were optimized, as efforts to reduce contamination are needed to accurately sample in this region. The main findings from this work suggest a regionally relatively homogenous population of Arctic INPs at most times of year, which is encouraging for efforts to represent them and understand their changes in the future. Permafrost-sourced INPs were enhanced near the coast and can persist over time. Unexpectedly, other components of the thermokarst landscape were found to be rich, organic INP reservoirs, emphasizing that the Arctic tundra is a diverse collection of potential contributors to the aerosol.