M.S. Defense Announcement
Kathryn Moore
Wednesday, January 22 at 11:00 a.m.

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Defense
ATS Large Classroom (101 ATS)

Post Defense Meeting
Riehl Conference Room (211 ACRC)

Committee:
Sonia Kreidenweiss (Advisor)
Paul DeMott
Jeffrey Pierce
Delphine Farmer (Chemistry)

Constraining Marine Ice Nucleating Particle Parameterizations in Atmospheric Models using Observations from the Southern Ocean

The limited anthropogenic and terrestrial aerosol sources impacting the Southern Ocean (SO) make it a unique site to study the production of primary sea spray aerosols (SSA) and their role in modifying cloud properties. Previous observations of low ice nucleating particle (INP) concentrations and recent modeling work support the idea that the SO INP population is dominated by SSA. These marine INPs are hypothesized to strongly influence the lifetime, formation, and optical properties of the supercooled and mixed phase clouds that are common in the region, though direct observational evidence for this is lacking. This study focuses on improving our understanding of INP emissions in the marine boundary layer over the SO, with applicability to other ocean regions, and to provide in situ measurements with which to validate and improve INP parameterizations in global and cloud resolving models. Measurements of INPs and aerosols in the marine boundary layer were made during the Clouds, Aerosols, Precipitation Radiation and atmospherIc Composition Over the southeRN ocean 2 (CAPRICORN-2) study on the R/V Investigator during Jan. - March 2018. An initial focus of this thesis was on increasing speed and reproducibility of processing online INP measurements, as well as improving the determination of statistical significance and uncertainty bounds. Different approaches to parameterizing INPs in models are explored for SO aerosols, including the use of aerosol surface area and number concentrations. With an eye towards augmenting global datasets of INPs, a comparison of particle surface area measurements from four different techniques is presented, for use in developing and testing INP parameterizations for different sources and atmospheric conditions. Surface area concentrations derived from Wideband Integrated Bioaerosol Sensor (WIBS) and nephelometer observations are strongly correlated with direct particle size distribution measurements, and can be used in their stead. Uncertainty bounds for both techniques and a scaling factor for WIBS measurements are provided to aid in these estimates. INP concentrations observed during CAPRICORN-2 are very low across the entire temperature range measured (to -30 °C), even compared to previous measurements of marine-dominated airmasses. Unlike INPs from other sources, marine INPs appear most correlated with accumulation, rather than coarse mode, particles, and have a small upper size range of <0.4 μm. Commonly used relationships between coarse mode particle number and total aerosol surface area show no significant correlation with SO INP concentrations, indicating a different functional form or different independent variable may be needed to accurately parameterize marine INPs in models.