M.S. Defense Announcement
Kevin Barry
Tuesday, October 1 at 10:15am

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October 1, 2019
10:15am

Defense
ATS Large Classroom (101 ATS)

Post Defense Meeting
Riehl Conference Room (211 ACRC)

Committee:
Sonia Kreidenweiss (Advisor)
Paul DeMott
Elizabeth Barnes
Delphine Farmer (Chemistry)

Fire and Ice: Analyzing Ice Nucleating Particle Emissions from Western U.S. Wildfires

Wildfires in the western U.S. can have impacts on health and air quality and are forecasted to increase in the future. Some of the particles released from wildfires can affect cloud formation through serving as ice nucleating particles (INPs). INPs are necessary for heterogenous ice formation in mixed-phase clouds at temperatures warmer than about -38 °C and can have climate implications from radiative impacts on cloud phase and by affecting cloud lifetime. Wildfires have been shown to be a potential source of INPs from previous ground-based measurement studies, but almost no data exist at the free tropospheric level that is relevant for cloud formation. The Western Wildfire Experiment for Cloud Chemistry, Aerosol Absorption, and Nitrogen (WE-CAN) campaign that was conducted in summer 2018 utilized the NSF/NCAR C-130 to sample many smoke plumes of various ages in the free troposphere and aged smoke in the boundary layer. INP measurements were made with the CSU Continuous Flow Diffusion Chamber (CFDC) and with aerosol filter collections to analyze offline with the CSU Ice Spectrometer (IS). The results presented in this thesis indicate a contribution of smoke to the INP budget over the plume-background air, but much variability exists in composition and in concentrations among fires. Treatments of the filter suspensions show a dominant organic influence in all plume filters analyzed while a biological INP population is evident in several cases. For the South Sugarloaf fire, which had a primary fuel of sagebrush, the highest INP concentrations of the campaign were measured, and the unique INP temperature spectrum suggests lofting of material from uncombusted plant material. Normalization of INP concentrations measured in WE-CAN confirms that smoke is not an especially efficient source of ice nucleating particles, however emissions impacts may still occur regionally. The determination of a Normalized Excess Mixing Ratio (NEMR) of INP emissions for the first time will permit modeling of such impacts, and possible INP in-plume production will be explored in future research.