4.071 Quantifying the sources of atmospheric ice nucleating particles from prescribed burns and wildfires.

Early Career Scientist

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Abstract:

Despite being a basic atmospheric process, our current understanding of ice nucleation in the atmosphere is low. One reason for this low understanding is that ice nucleating particle (INP) concentrations are low (only ~1 in 10^5 particles in the free troposphere nucleate ice), making it challenging to identify both the composition and sources of ambient INP. Carbonaceous combustion aerosol produced from biomass burning is one potential source of INP, as it can contribute to over one-third of all aerosol in the North American free troposphere. Unfortunately, previous results from both field measurements and laboratory studies are in conflict, with estimates of the impact of carbonaceous combustion aerosol ranging from no impact to rivaling the well-known INP mineral dust. It is, however, becoming clear that the ice nucleation activity of these aerosols depend greatly on both their fuel type and combustion conditions.
Given these dependencies, we propose that sampling from real-world biomass burning sources would provide the most useful new information on the contribution of carbonaceous combustion aerosols to atmospheric INP. In this work, we will present recent results looking at the sources of INP from prescribed burns and wildfires. To determine the specific contribution of refractory black carbon (rBC) to INP concentrations, we have coupled the Single Particle Soot Photometer (SP2) to the Colorado State University Continuous Flow Diffusion Chamber (CFDC). The SP2 utilizes laser-induced incandescence to quantify rBC mass on a particle-by-particle basis; in doing so, it also selectively destroys rBC particles by heating them to their vaporization temperature. Thus, the SP2 can be used as a selective pre-filter for rBC into the CFDC. Furthermore, we have also use a filter-based technique for measuring INP, the Ice Spectrometer, which can use pretreatments such as heating and digestion by H_2O_2 to determine the contribution of biological and organic particles, respectively.