Conference: 2016 Meeting of the Weather Modification Association (WMA) in Long Beach, California on April 27-29, 2016.

Title: Size Distribution Measurements of Seeding Nuclei

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Abstract: The size, number and composition of particles used to seed clouds is fundamentally important in understanding effects on precipitation. Additionally, knowledge of how seeding particles differ from atmospheric particles is necessary to determine changes in cloud micro-physics. Scientist can conduct computer simulations with different cloud micro-physics to determine precipitation changes between un-seeded and seeded clouds. Seed particle composition is known from the flare material or generator solution being burned to a first approximation; however, chemical transformation can occur during burning and particle coagulation can occur before particles enter clouds. The number of seeded particles that enter the cloud are important since each seed particles (e.g. immersion freezing ice nuclei, hygroscopic cloud condensation nuclei) typically only directly effects at most one cloud particle. The seed particle size is important to determine if cloud micro-physical changes occur. An ice nuclei that is too small may have dissolution of its lattice when interacting with a droplet. A cloud condensation nuclei that is too small may not activate to form a cloud droplet and remain an interstitial particle in the cloud.

A scanning mobility particle sizer (SMPS, TSI model 3772 CPC and 3081 DMA) and an aerodynamic particle sizer (ASP, TSI model 3321) measures the particle size distribution of a burning hygroscopic flare, an AgI flare, and an operating ground generator. Concurrently, a condensation particle counter (CPC, TSI model 3771) monitors the total number concentration of particle with diameters greater than 10 nm. The SMPS measures particles between approximately 10 and 500 nm diameter in 64 channels. The ASP measures particles between approximately 500 nm and 20 μm diameter in 52 channels. Sampling is conducted outside at the Ice Crystal Engineering facility in Kindred, North Dakota on 5 November 2015.

Background aerosol measurements from seven size distribution scans (21:44-22:00 UTC) show no nucleation mode, a broad accumulation mode and a slight dust mode. The background number concentration peaks at approximately 200 nm for the accumulation mode and 4 μm for the dust mode. The hygroscopic flare size distribution peaks at approximately 300 nm with a smooth decrease in concentration detectable to 15 μm. Analysis is ongoing for the AgI size distributions. Future work will attempt to reproduce the ourside flare size distribution measurement in the laboratory with flares being burned in a fume hood.