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CLOUD CONDENSATION NUCLEI IN CUMULUS HUMILIS – SELECTED CASE STUDY DURING THE CHAPS CAMPAIGN

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ABSTRACT

The Cumulus Humilis Aerosol Processing Study (CHAPS) provided a unique opportunity to study aerosol and cloud processing. Clouds play an active role in the processing and cycling of atmospheric constituents. Gases and particles can partition to cloud droplets by absorption and condensation as well as activation and impact scavenging. The Department of Energy (DOE) G-1 aircraft was used as one of the main platforms in CHAPS. Flight tracks were designed and implemented to characterize freshly emitted aerosols at cloud top and cloud base as well as within the cloud, i.e., cumulus humilis (or fair-weather cumulus), in the vicinity of Oklahoma City.

Measurements of interstitial aerosols and residuals of activated condensation cloud nuclei were conducted simultaneously. The interstitial aerosols were measured downstream of an isokinetic inlet, and the activated particles downstream of a counter-flow virtual impactor (CVI). The sampling line to the Aerodyne Aerosol Mass Spectrometer (AMS) was switched between the isokinetic inlet and the CVI to allow characterization of non-activated interstitial particles outside of clouds in contrast to particles activated in clouds. Trace gases including ozone, carbon monoxide, sulfur dioxide, and a series of volatile organic compounds (VOCs) were also measured as were key meteorological state parameters including liquid water content, cloud drop size, and dew point.

We will report on the CCN properties in cumulus humilis. Several approaches will be taken. The first is single particle analysis of particles collected by the Time-Resolved Aerosol Sampler (TRAC) by scanning electron microscopy (SEM) and transmission electron microscopy (TEM) coupled with energy disperse X-ray spectroscopy (EDX). Specifically we examine differences between activated and interstitial ones, such as differences in chemical composition and morphology. The second analysis will link in situ measurements by AMS and PTRMS with the observations by TRAC. For instance, by comparing the characteristic m/z obtained by AMS and the CO or isoprene, one can gain more insight into the role of primary and secondary organic aerosols in CCN and background aerosols. Combined with observations of cloud properties, our goal is to provide an improved picture of CCN activation in cumulus humilis.
