

Cloud Base Cloud Condensation Nuclei Measurements in Summertime North Dakota David Delene (delene@aero.und.edu) and Mariusz Starzec, Department of Atmospheric Sciences, University of North Dakota

Objective

Airborne measurements of cloud condensation nuclei (CCN) were made just below developing cumulus clouds in North Dakota during the months of June and July over the summers of 2008, 2010 and 2012. Statistical distributions of cloud based CCN measurements are used to access the horizontal and day-to-day variations in CCN number concentrations. During the summer of 2012, both Droplet Measurements Technologies (DMT) and University of Wyoming (UWyo) CCN counters were used to obtain airborne and surface measurements. The DMT CCN counters measured at three ambient supersaturations of 0.2%, 0.3%, and 0.6%; while the UWyo CCN counters measured at a constant supersaturation of 0.6%. Processing software was developed to apply power law fits to the DMT CCN supersaturation spectrum measurements. Comparisons of the airborne, surface and laboratory data are made to understand systematic biases in the CCN measurements.

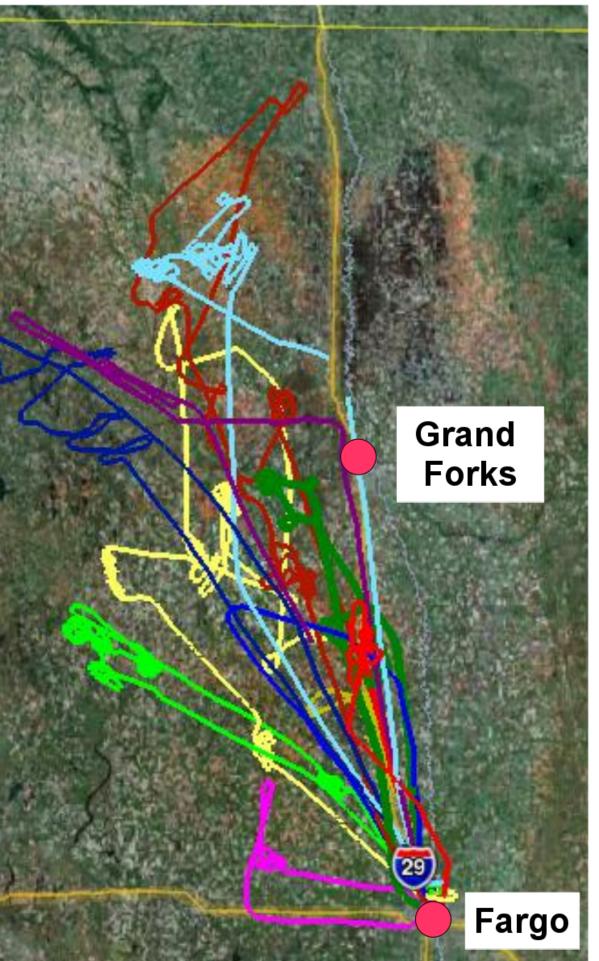
2012 Polarimetric Cloud Analysis and Seeding Test 4 (POLCAST4) Field Project In North Dakota **Flight Tracks Aircraft Measurements** July 2a July 2b Grand Forks 📱 Temperature Prob **July 8** FLIGHT ENGINEER July 9 Dew Point Probe July 12 IYGROSCOPIC FLARES AIMMS GPS July 17 PILOT JWyo CCN Counter SN 107 July 2 ············ Conductive Sampling Line July 29 Fargo **Laboratory Measurements** Surface Measurement Video Disdrometer Excess 99 Diffusional Dryer SEA DAS TEOM SMPS DMT CCNC SN 076 Valve Mixing Box Pump Excess A/D - Analog to Digital Board Outside Inside CPC - Cloud Particle Concentration CCNC - Condensation Nuclei Counter DMT CCNC - Droplet Measurement Technology Cloud Condensation Nuclei Counter DMT - Droplet Measurement Technology DAS - Data Acquisition System PMS – Particle Measurement Systems HVFS - High Volume Filter Sampler SEA A/D - Science Engineering Associates Analog to Digital Board SEA - Science Engineering Associates PCASP - Passive Cavity Spectrometer Probe

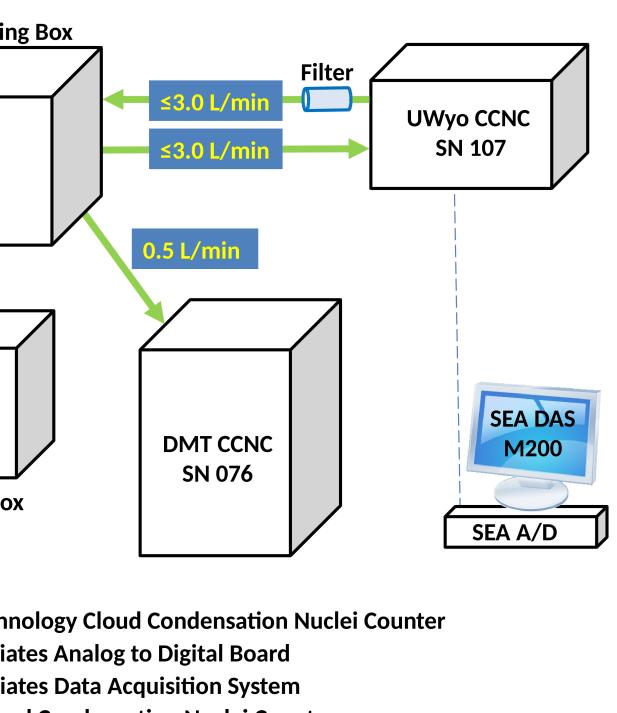
SMPS - Scanning Mobility Particle Sizer

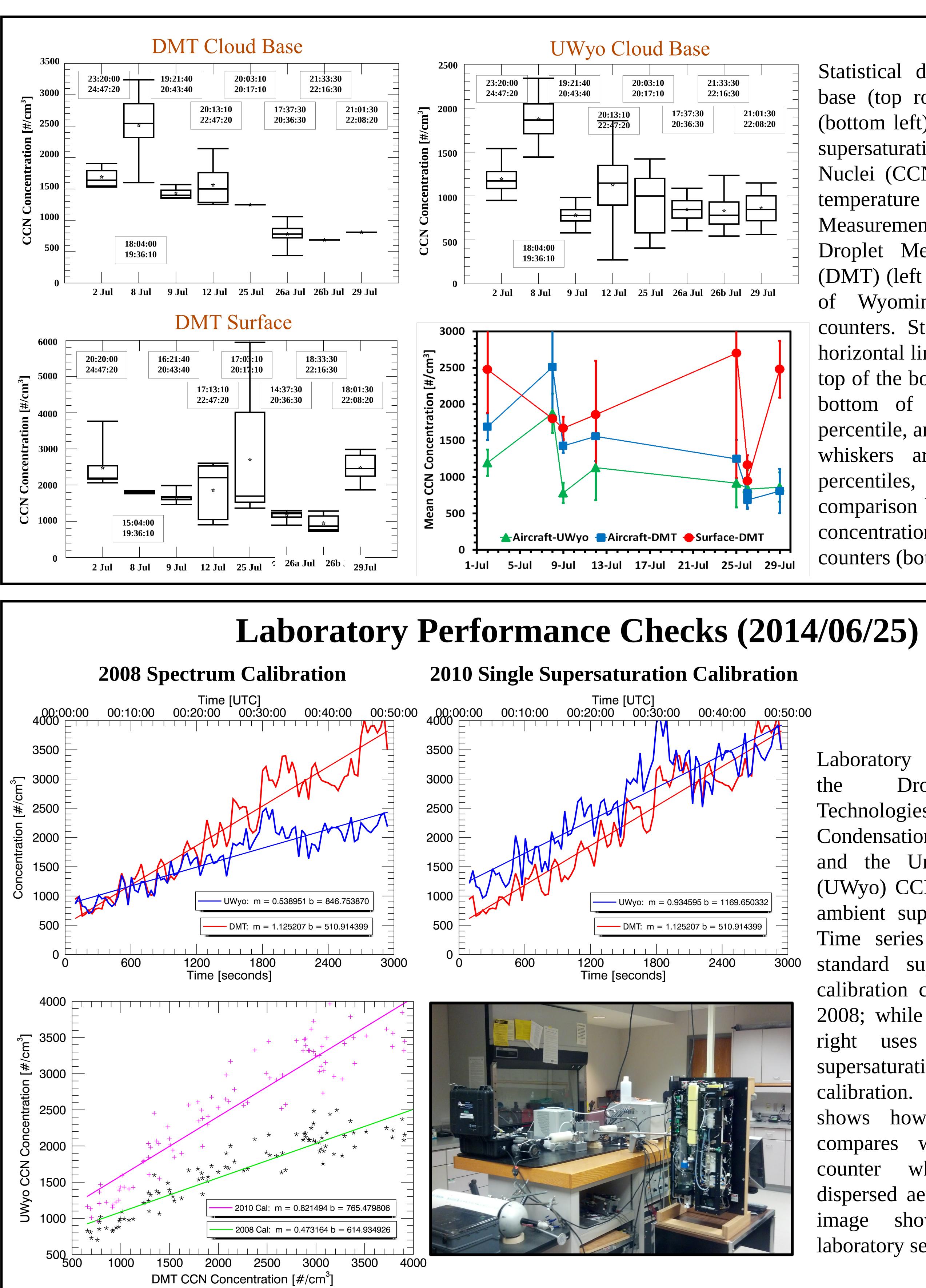
TEOM - Tapered Element Oscillating Microbalance

TSI - TSI Inc.

- Science Engineering Associates Data Acquisition System Uwyo CCNC - University of Wyoming Cloud Condensation Nuclei Counter

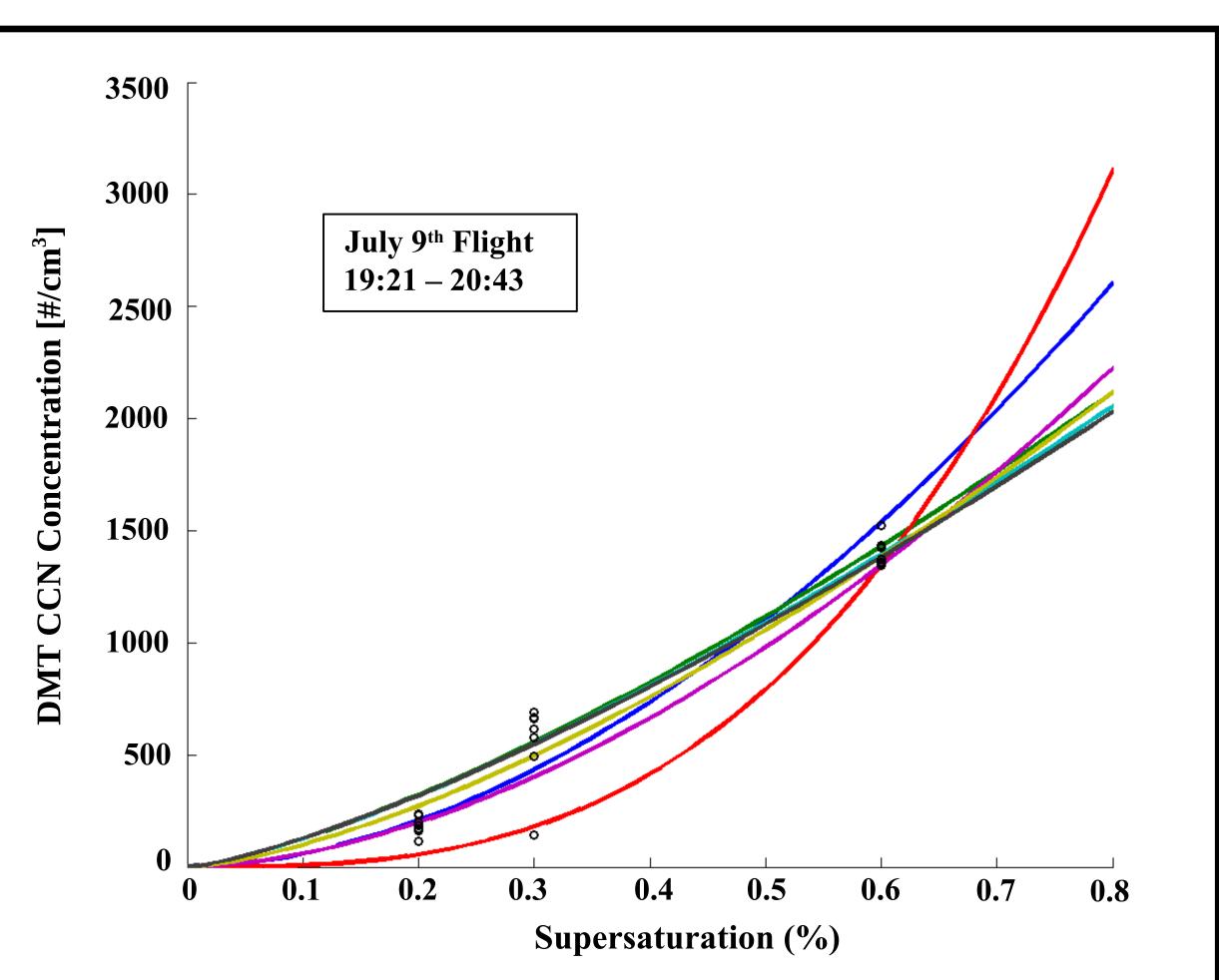






Statistical distributions near cloud base (top row) and at the surface (bottom left) of 30 s, 0.6% ambient supersaturation Cloud Condensation Nuclei (CCN) adjusted to standard pressure. and temperature Measurements are made using the Droplet Measurement Technology (DMT) (left column) and University of Wyoming (top right) CCN counters. Star symbols are means, horizontal line is the 50th percentile, top of the box is the 75th percentile, bottom of the box is the 25th percentile, and top and bottom of the whiskers are the 95th and 5th respectively. percentiles, comparison between the mean CCN concentration is made between counters (bottom right).

comparisons between Laboratory Measurement Droplet Cloud Technologies (DMT) Condensation Nuclei (CCN) counter l the University of Wyoming (UWyo) CCN counter conducted at ambient supersaturation of 0.6%. Time series on the left uses the standard supersaturation spectrum calibration conducted by UWyo in 2008; while the time series on the right uses only the operating supersaturation to perform the The lower left plot calibration. shows how the UWyo counter compares with DMT CCN the sampling counter when polydispersed aerosol. The lower right shows the June 2014 image laboratory setup.



Fit lines applied to 30 s averaged cloud condensation nuclei (CCN) concentration retrievals at 0.2, 0.3 and 0.6% supersaturation by the Droplet Measurement Technology (DMT) counter on July 9th, 2012. Black circles indicate the CCN retrievals across the flight and each line represents a fit to a corresponding 0.2, 0.3, and 0.6% CCN retrieval.

Conclusions

- DMT surface retrievals are higher than both the DMT and UWyo airborne retrievals.
- Laboratory performance checks indicate that the systematic bias seen between the UWyo and DMT airborne measurements are likely due to incorrect calibration of the UWyo CCN counter.

Future Work

- Conduct additional experiments to evaluate and calibrate the UWyo and DMT CCN counters.
- Apply the best CCN counter calibrations to the POLCAST field project data and analyze the three summers of measurements.

Acknowledgments

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