



# Cloud Base Cloud Condensation Nuclei Measurements in Summertime North Dakota

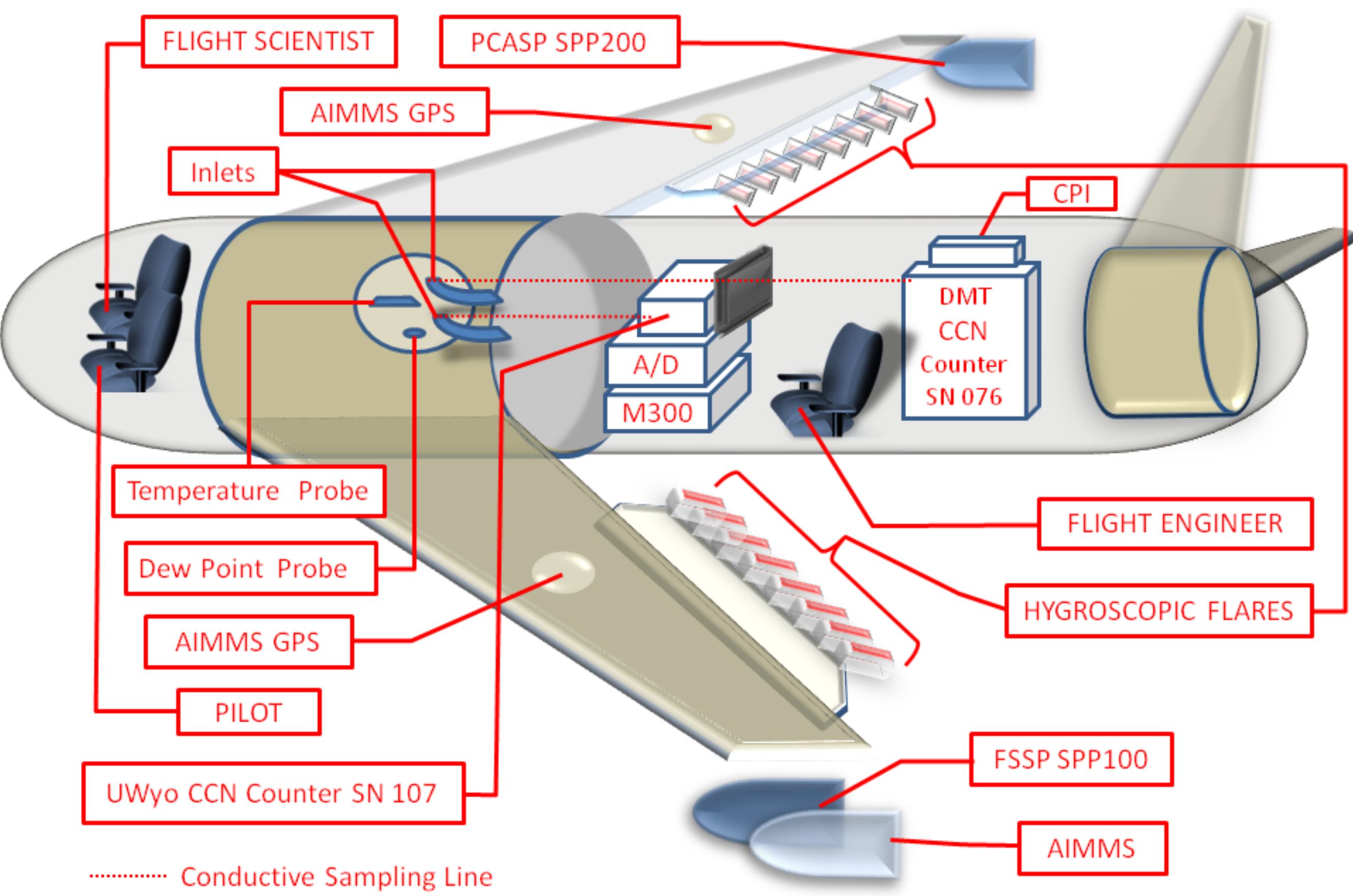
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## Objective

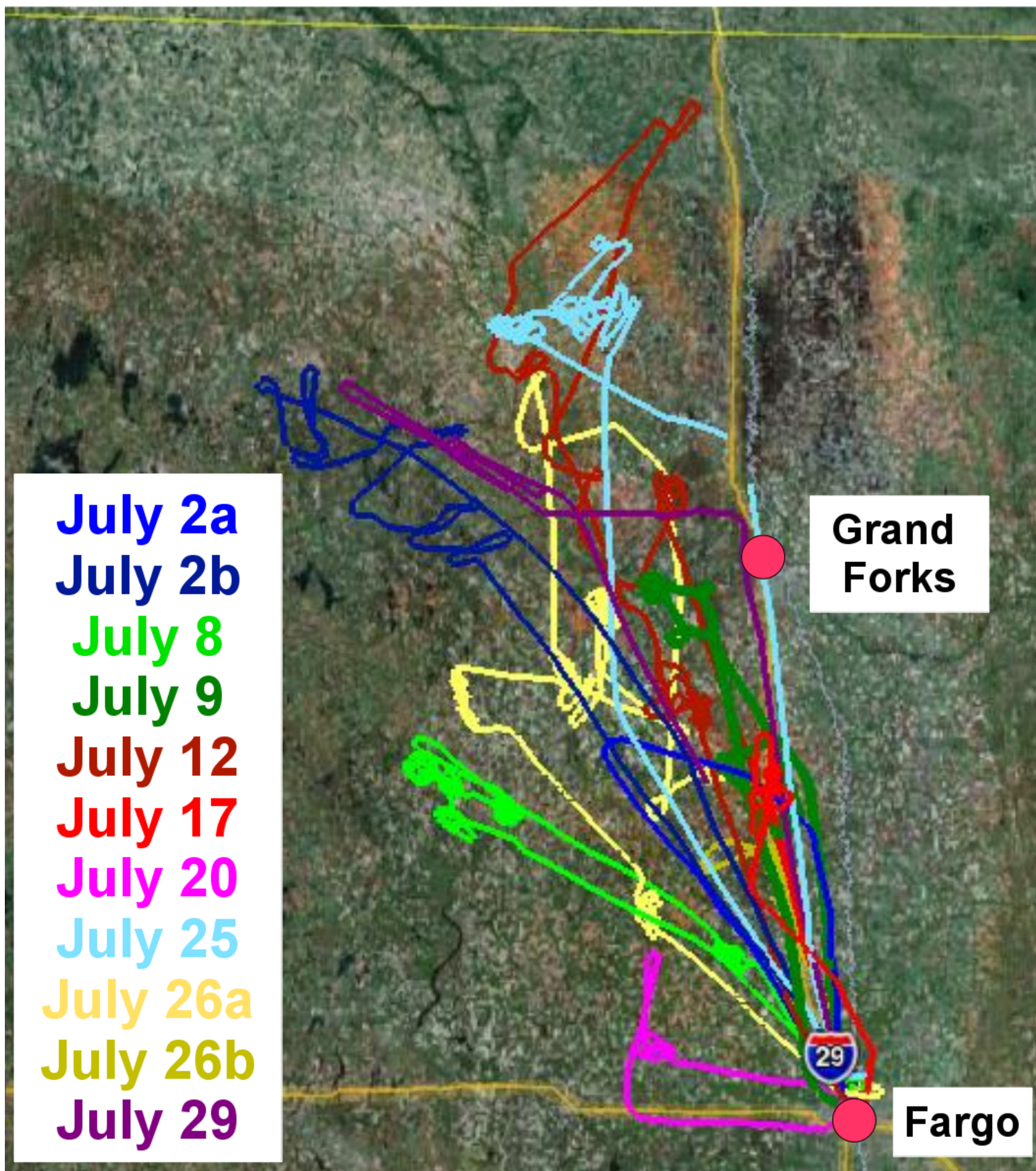
Airborne measurements of cloud condensation nuclei (CCN) were made just below developing cumulus clouds in North Dakota during the months of June and July over the summers of 2008, 2010 and 2012. Statistical distributions of cloud based CCN measurements are used to access the horizontal and day-to-day 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

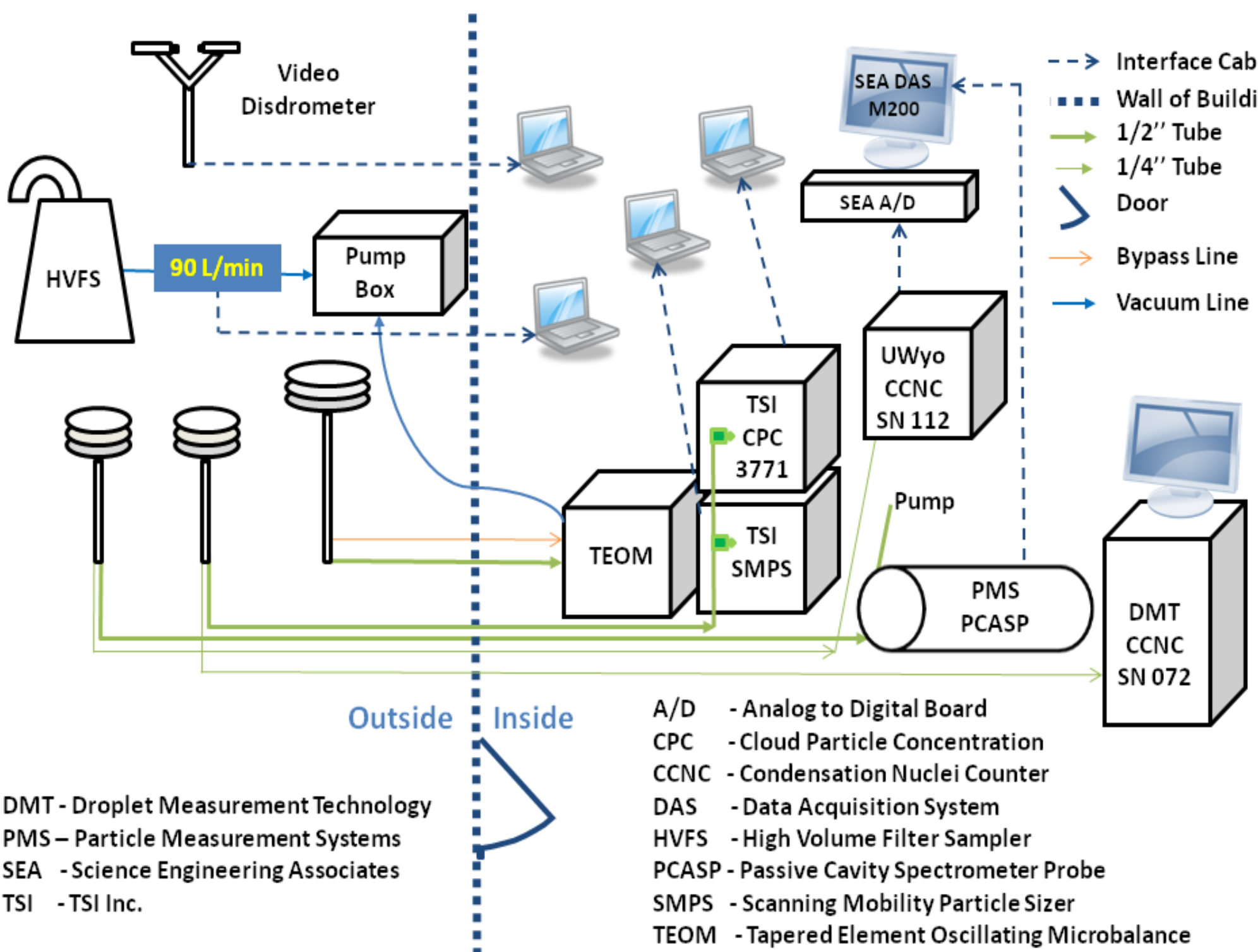
### Aircraft Measurements



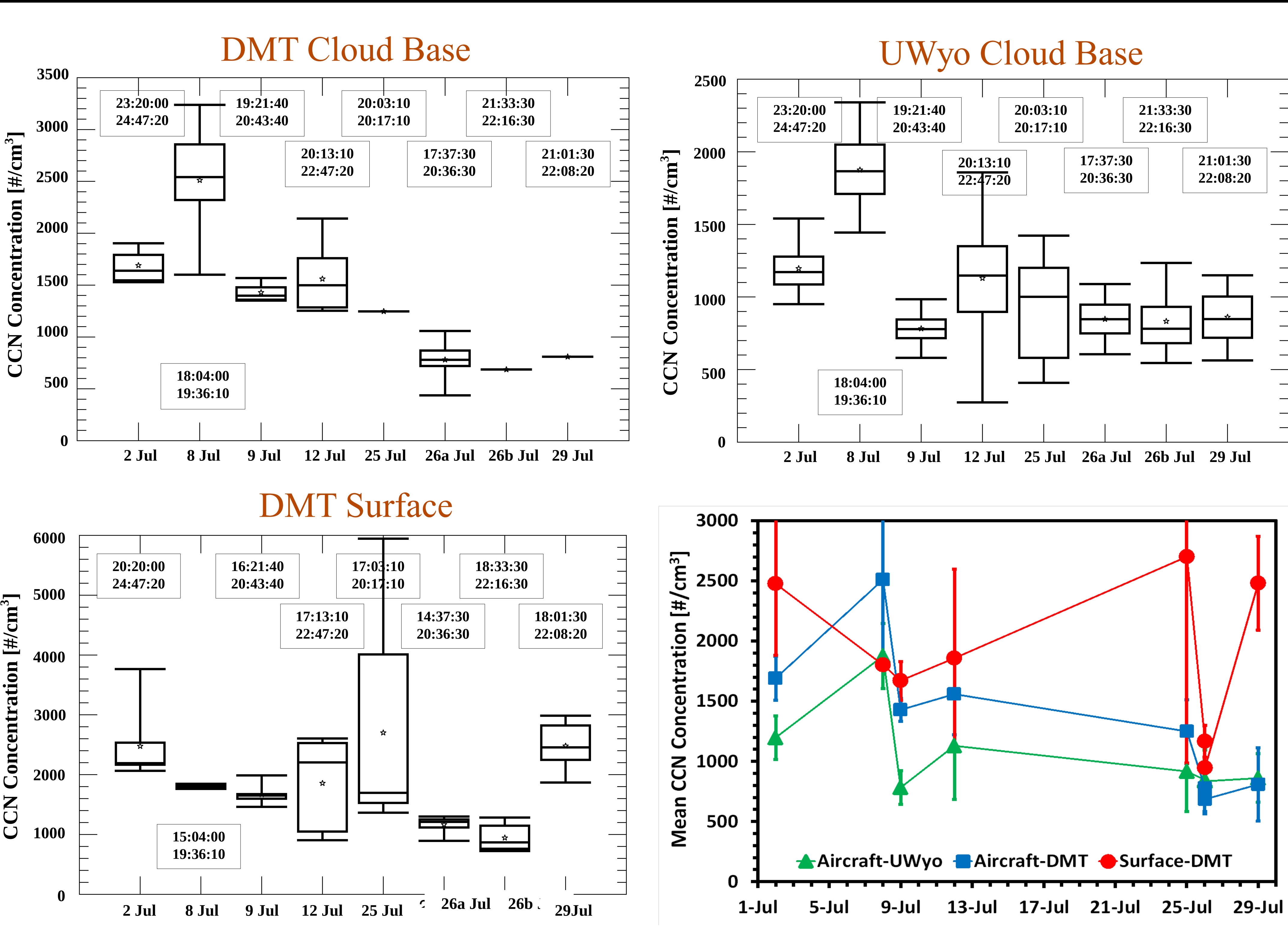
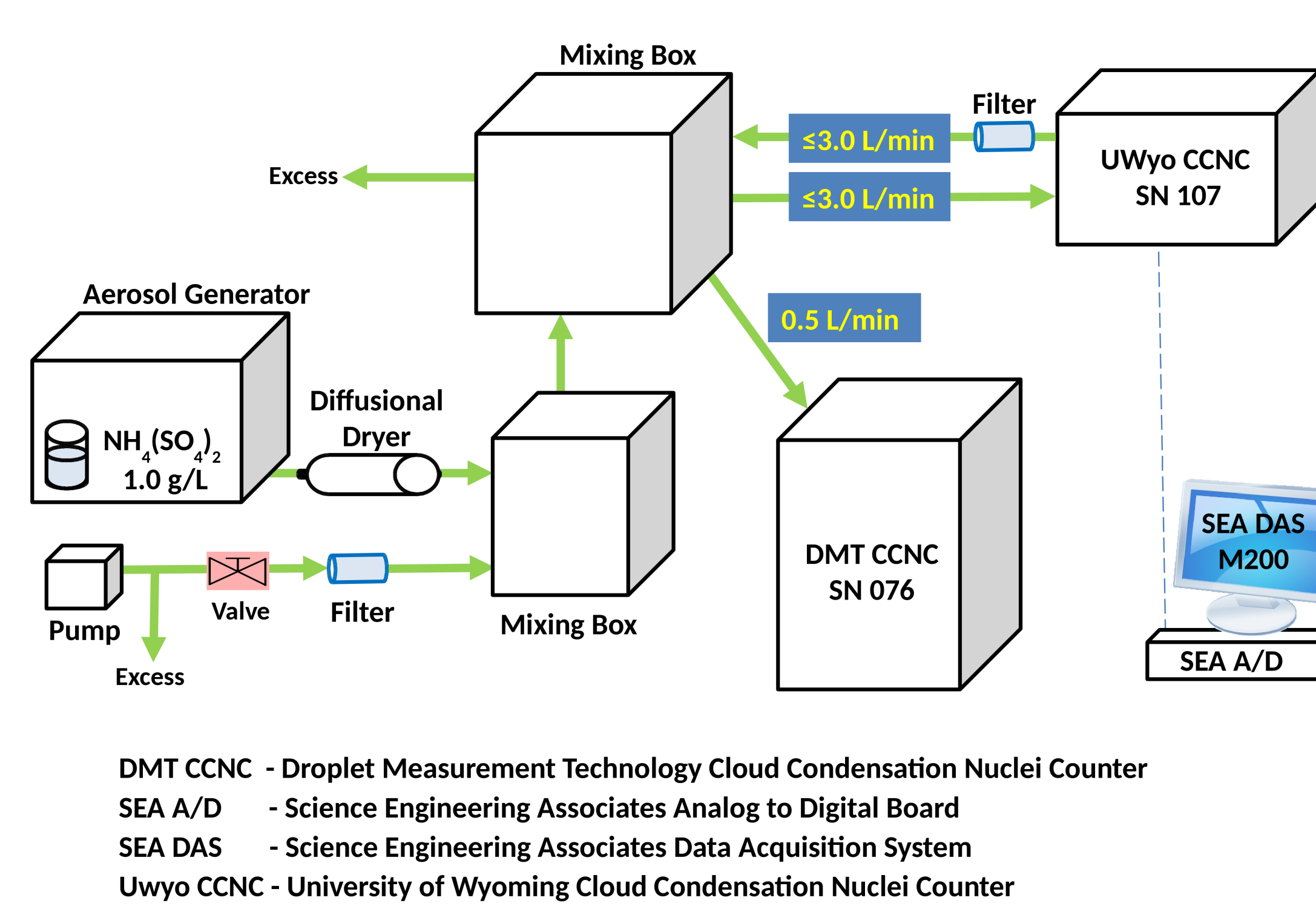
### Flight Tracks



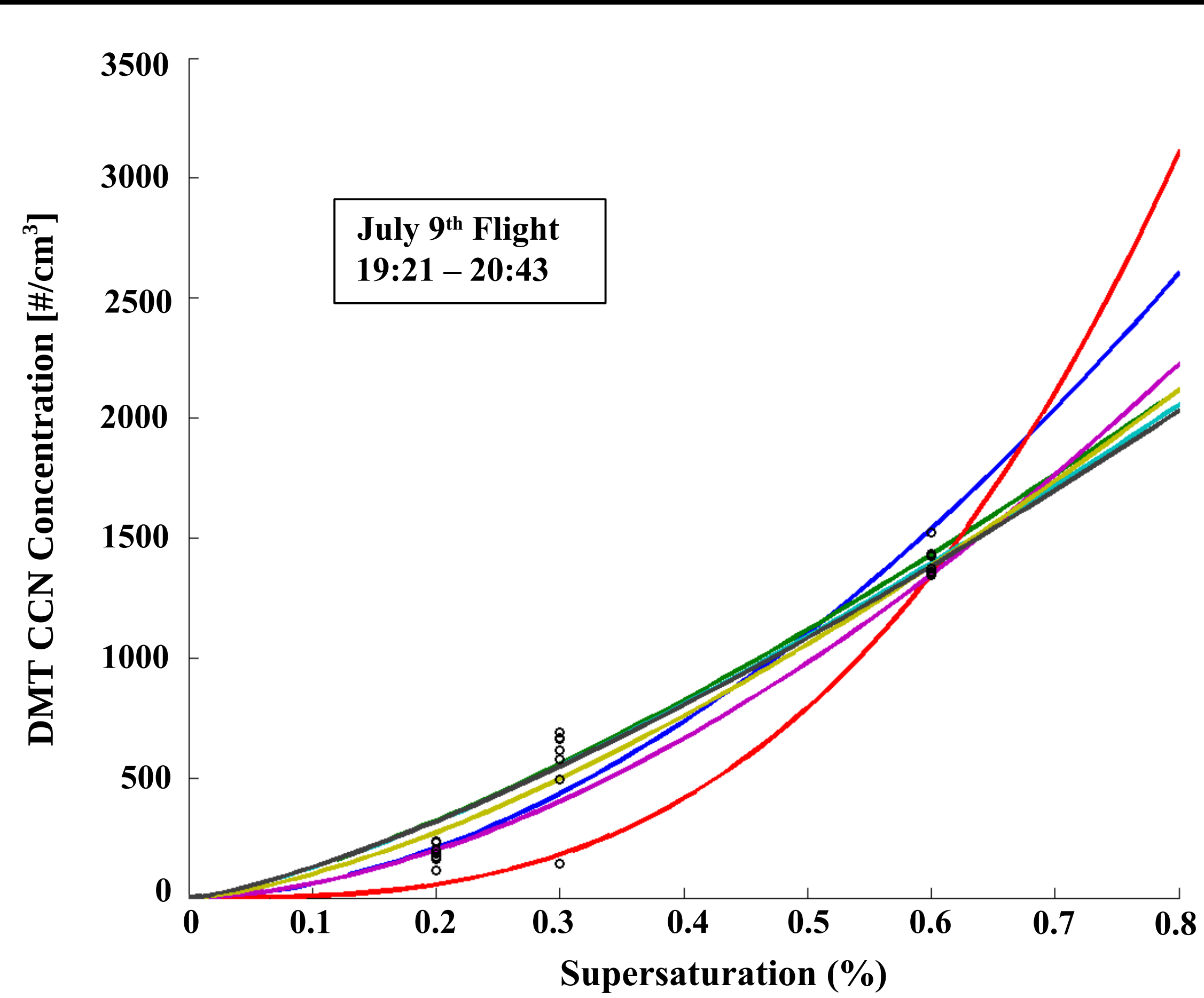
### Surface Measurement



### Laboratory Measurements

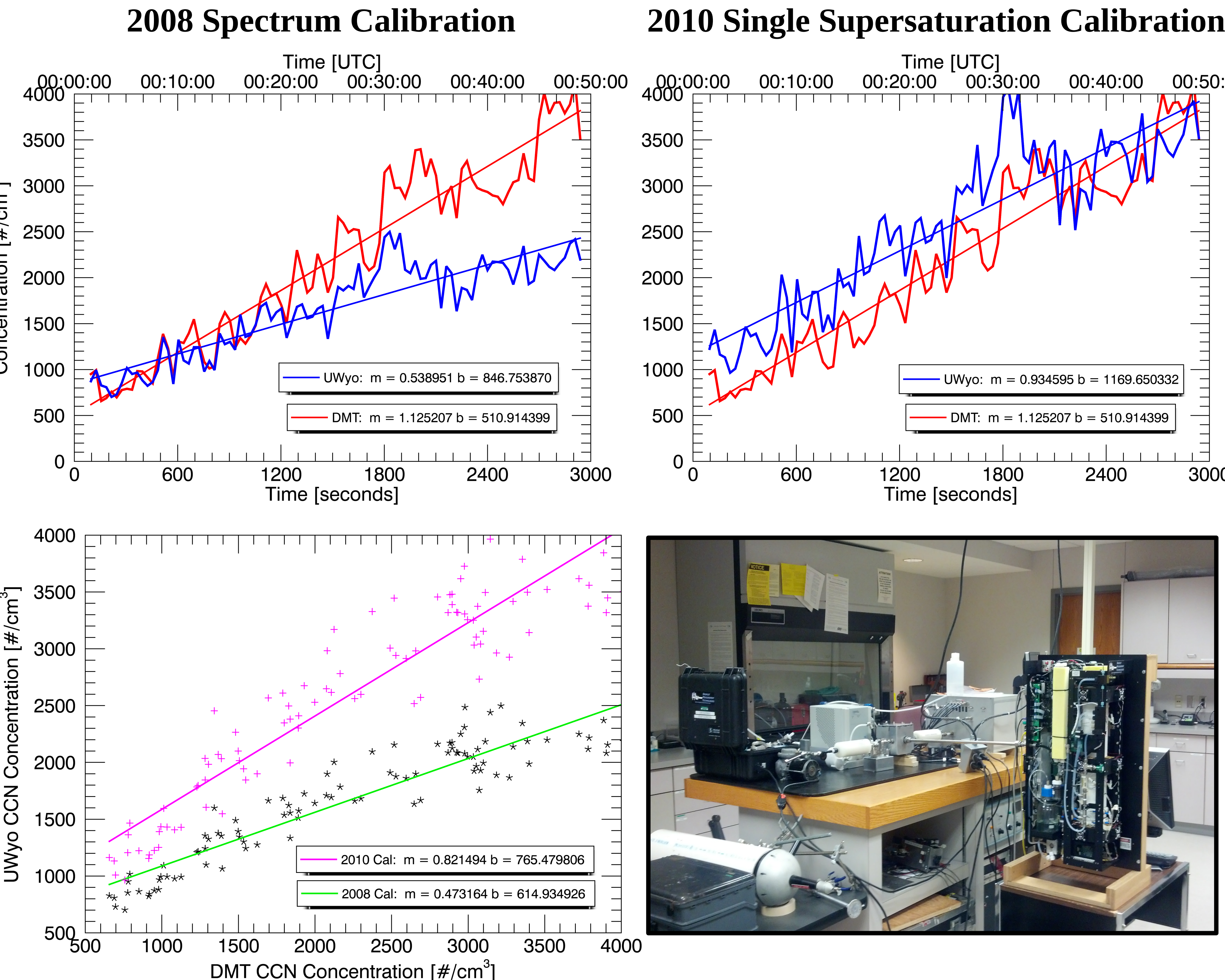


Statistical distributions near cloud base (top row) and at the surface (bottom left) of 30 s, 0.6% ambient supersaturation Cloud Condensation Nuclei (CCN) adjusted to standard temperature and pressure. Measurements are made using the Droplet Measurement Technology (DMT) (left column) and University of 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 percentiles, respectively. A comparison between the mean CCN concentration is made between counters (bottom right).



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 9<sup>th</sup>, 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.

## Laboratory Performance Checks (2014/06/25)



## 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

The North Dakota (ND) Atmospheric Resource Board funded the POLCAST field projects. ND NASA EPSCoR funded processing of the DMT CCN supersaturation measurements.