Concentration of Cloud Condensation Nuclei Before and After Convective Storms

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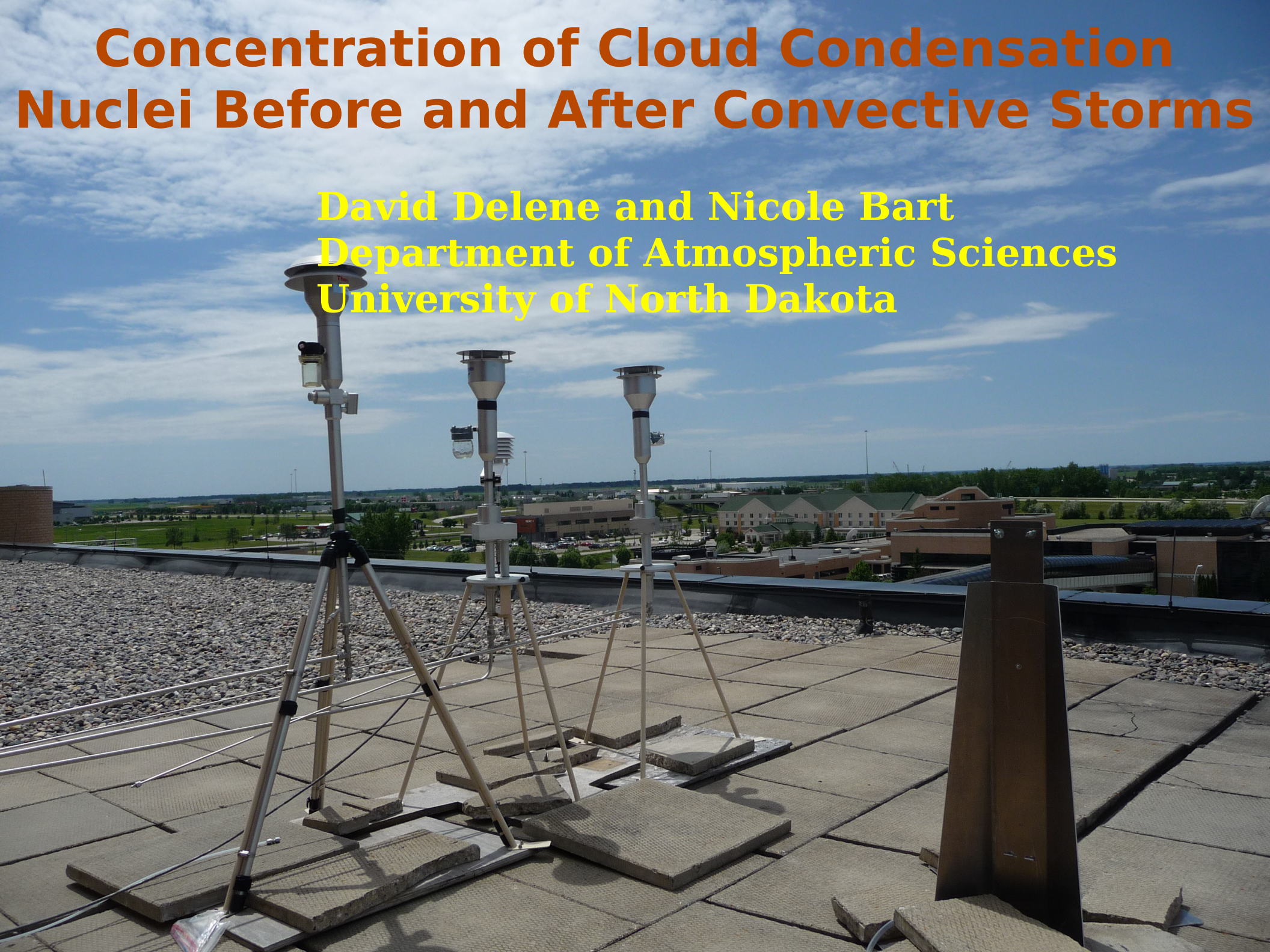


Objective

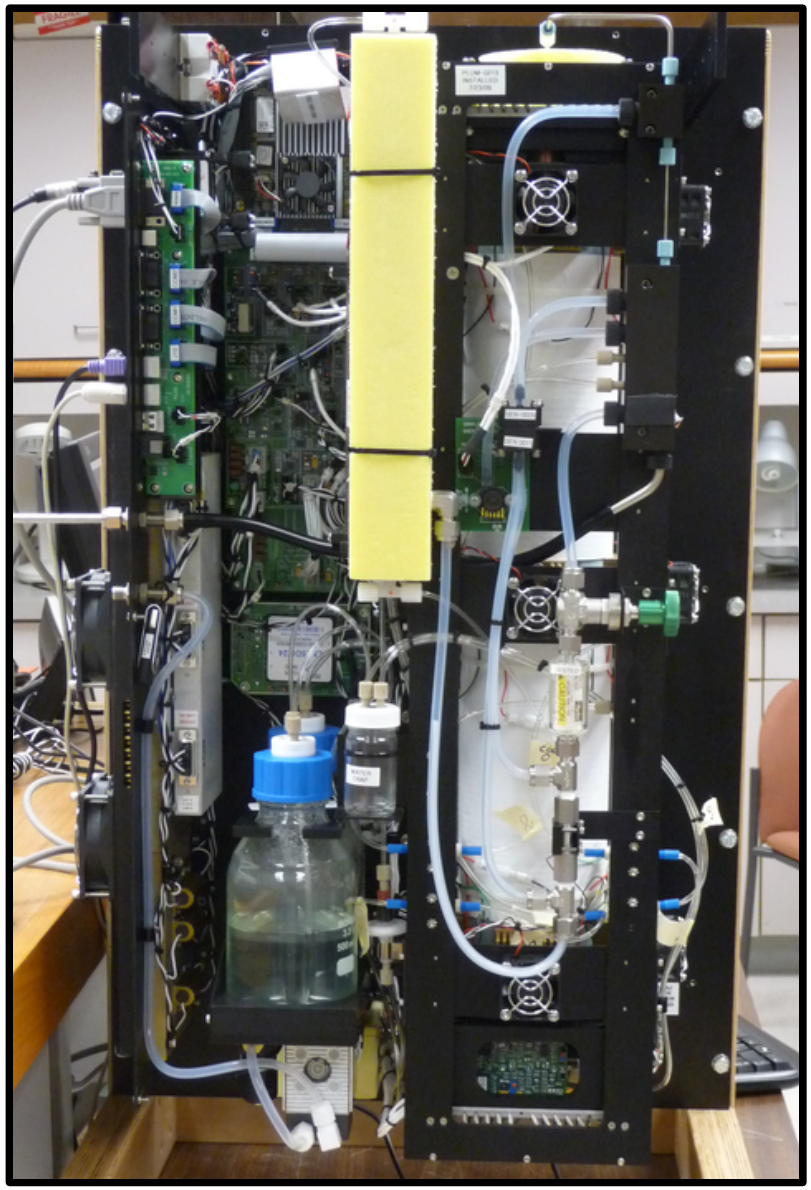
- Determine how the concentration of Cloud Condensation Nuclei (CCN) change during the summer and fall in North Dakota
- Determine the magnitude of changes that in CCN after a rain event.

View of Rain from Aircraft on July 8, 2012

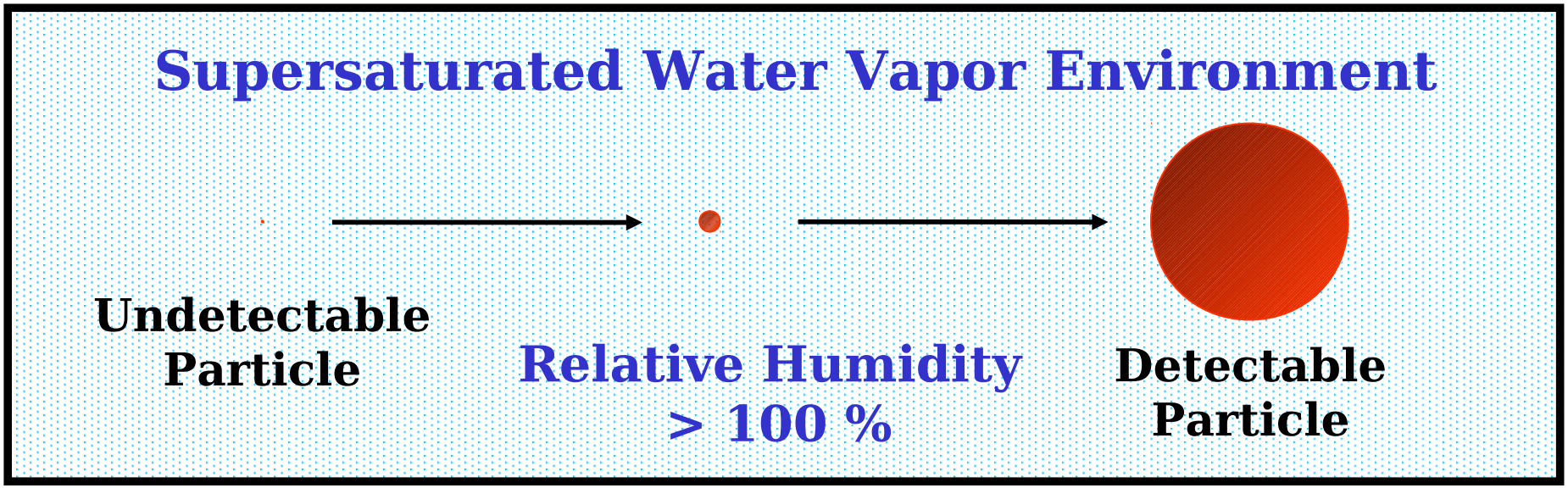
View of Rain on July 12, 2012

Aerosol Importance

- Scatter and Absorb Radiation
- Media for Chemical Reactions
- Serve as Cloud Condensation Nuclei CCN)

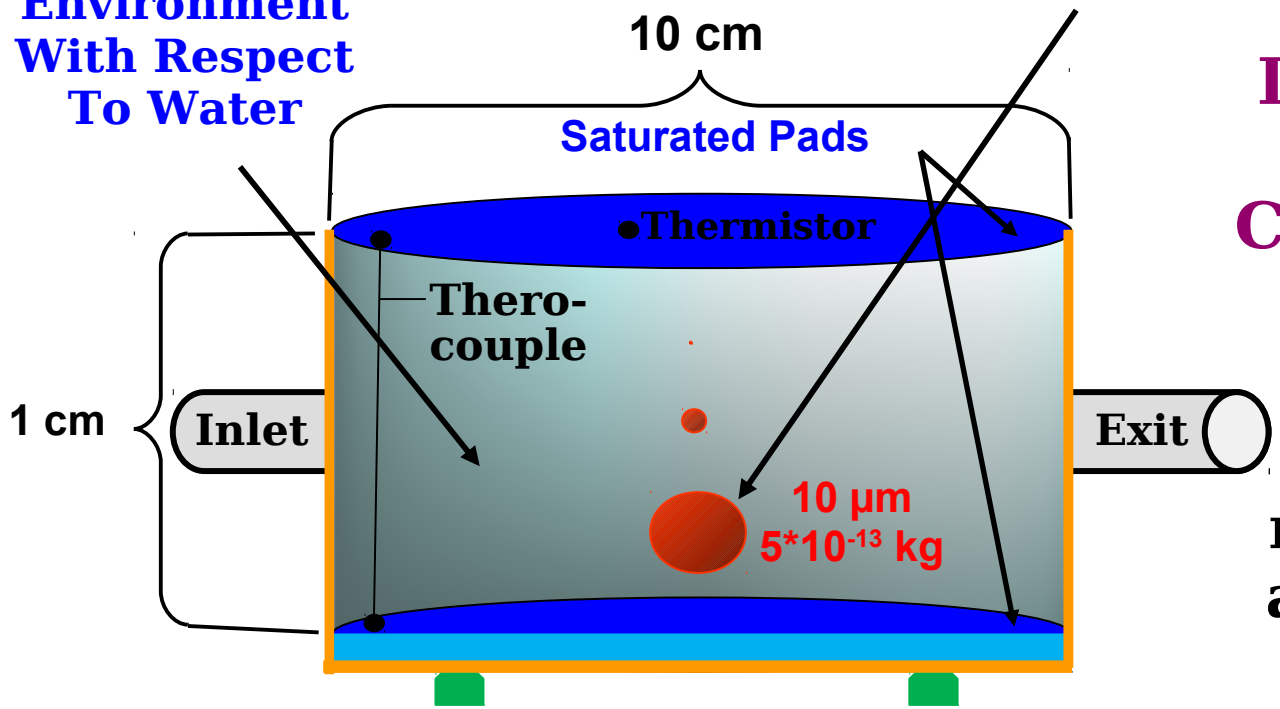


Grow Aerosols to Detectable Size



Supersaturated Environment With Respect To Water

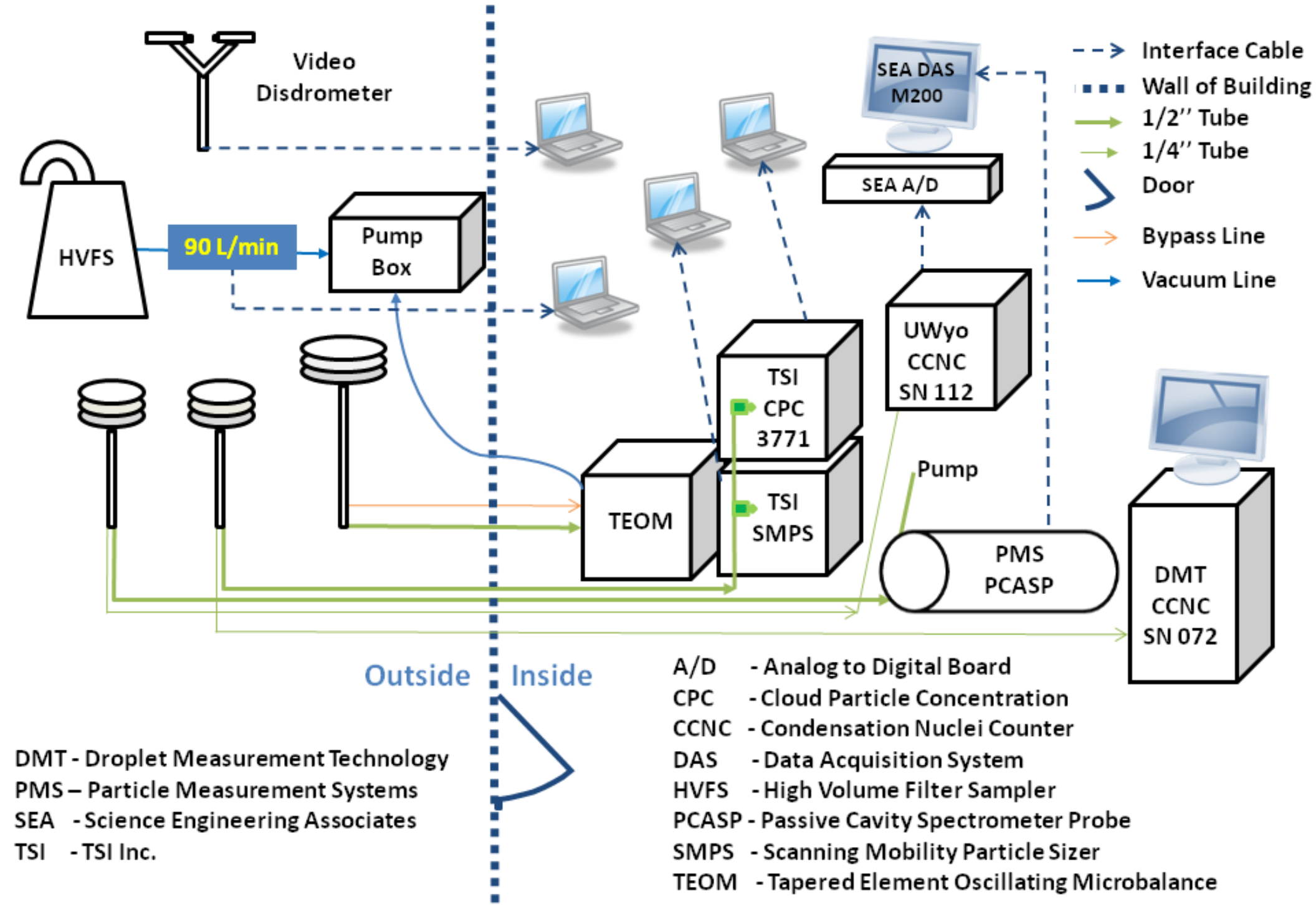
Grow to Form Droplet



Diffusion Chamber of a Cloud Condensation Nuclei Counter

Determines the number of particles in air that cloud droplets form on.

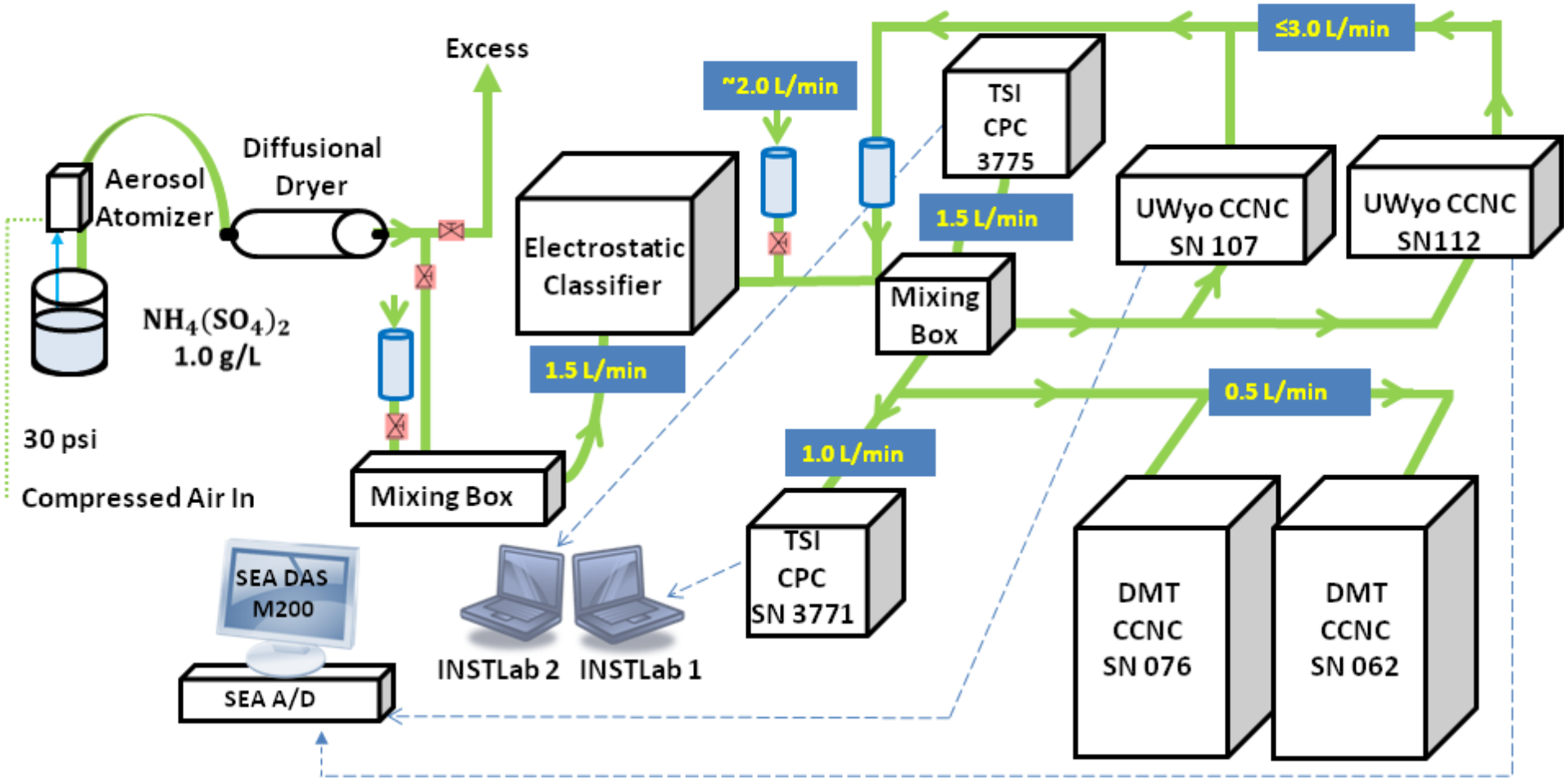
POLCAST4 Surface Measurements: Clifford Hall 601



DMT - Droplet Measurement Technology
PMS – Particle Measurement Systems
SEA - Science Engineering Associates
TSI - TSI Inc.

A/D - Analog to Digital Board
CPC - Cloud Particle Concentration
CCNC - Condensation Nuclei Counter
DAS - Data Acquisition System
HVFS - High Volume Filter Sampler
PCASP - Passive Cavity Spectrometer Probe
SMPS - Scanning Mobility Particle Sizer
TEOM - Tapered Element Oscillating Microbalance

CCN Counter Lab Calibration Setup



Interface

Valve

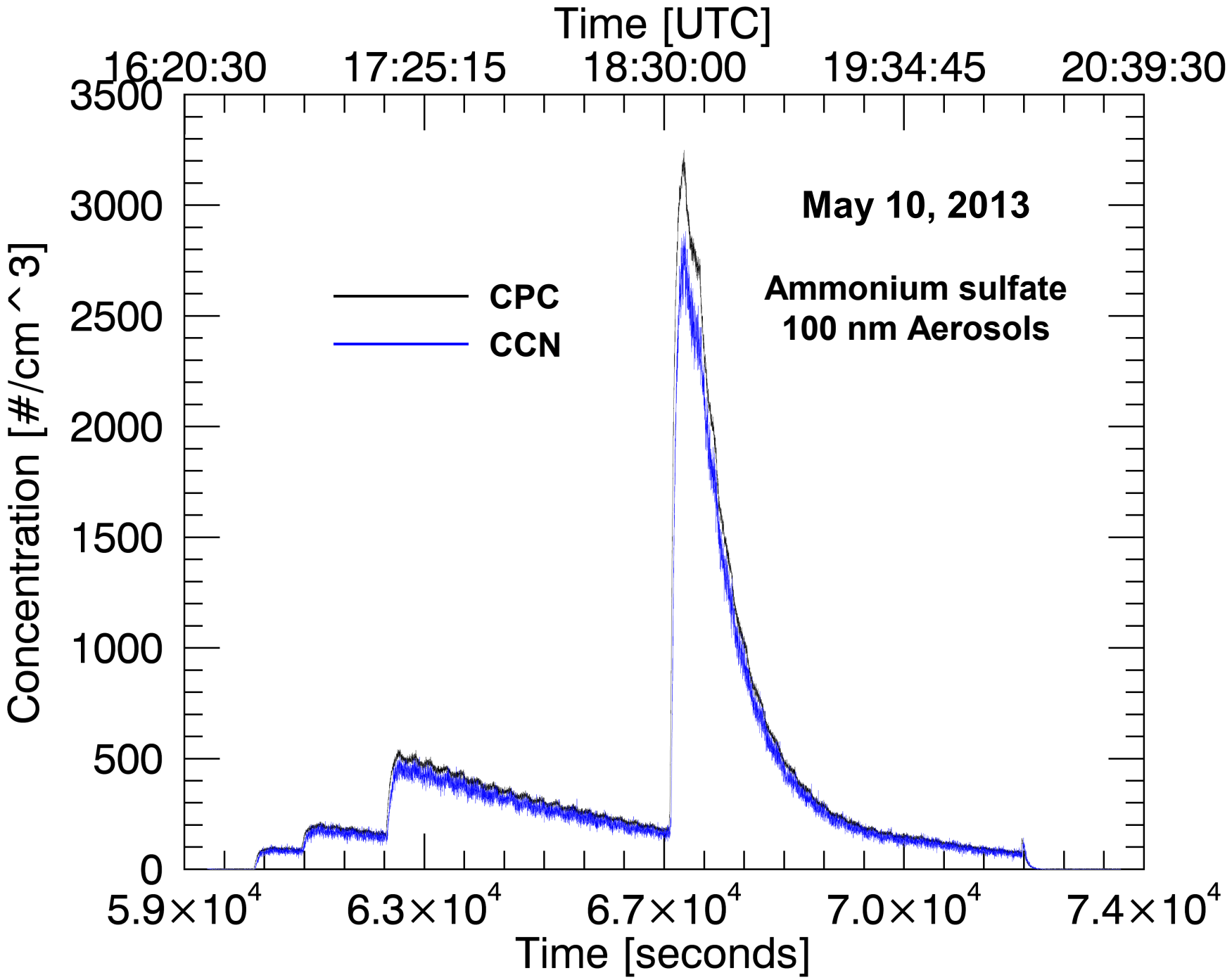
Filter

Direction of Air Flow

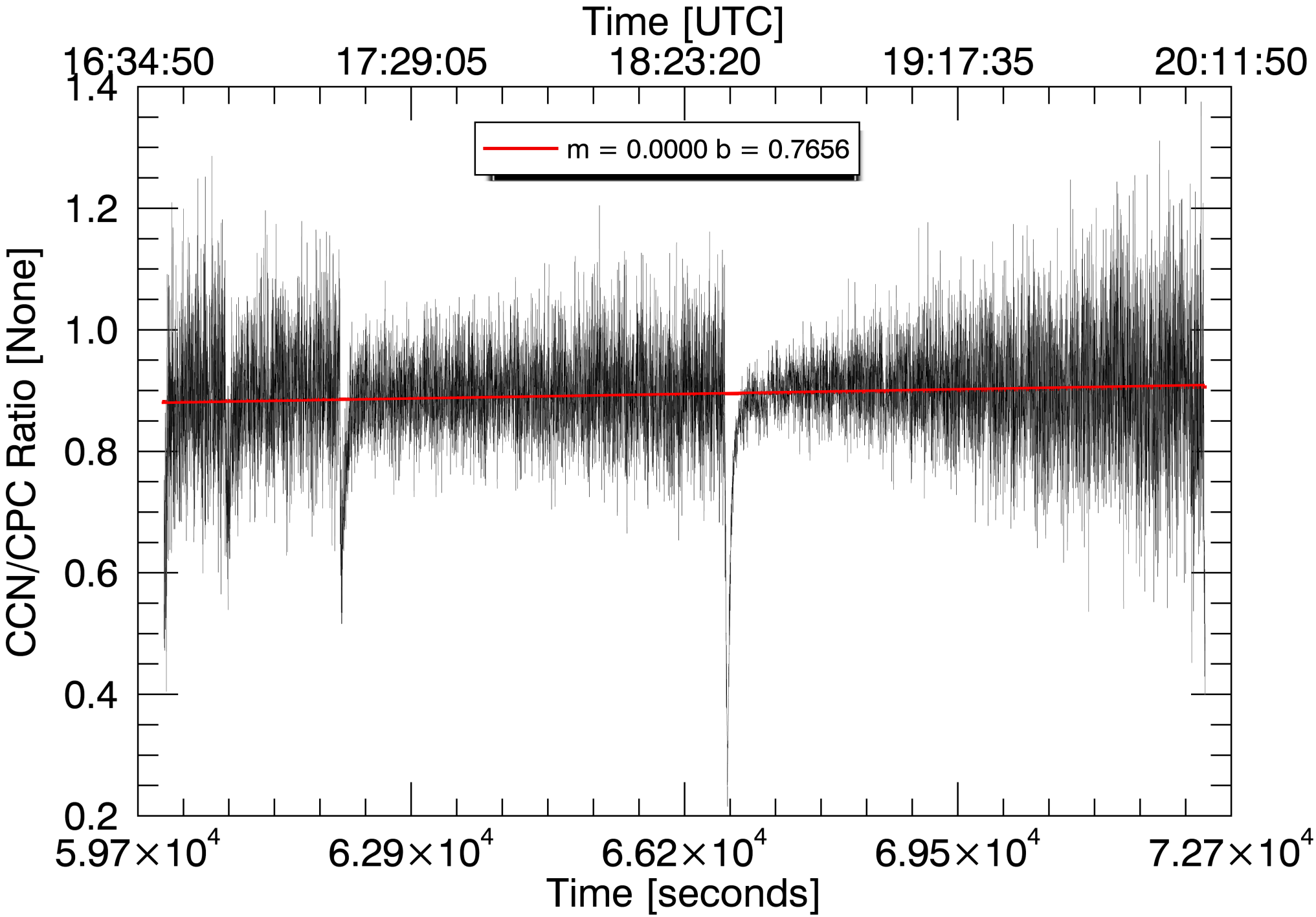
Direction of Water Flow

DMT CCNC - Droplet Measurement Technology Cloud Condensation Nuclei Counter
SEA A/D - Science Engineering Associates Analog to Digital Board
SEA DAS - Science Engineering Associates Data Acquisition System
TSI CPC - TSI Inc. Cloud Particle Concentration
Uwyo CCNC - University of Wyoming Cloud Condensation Nuclei Counter

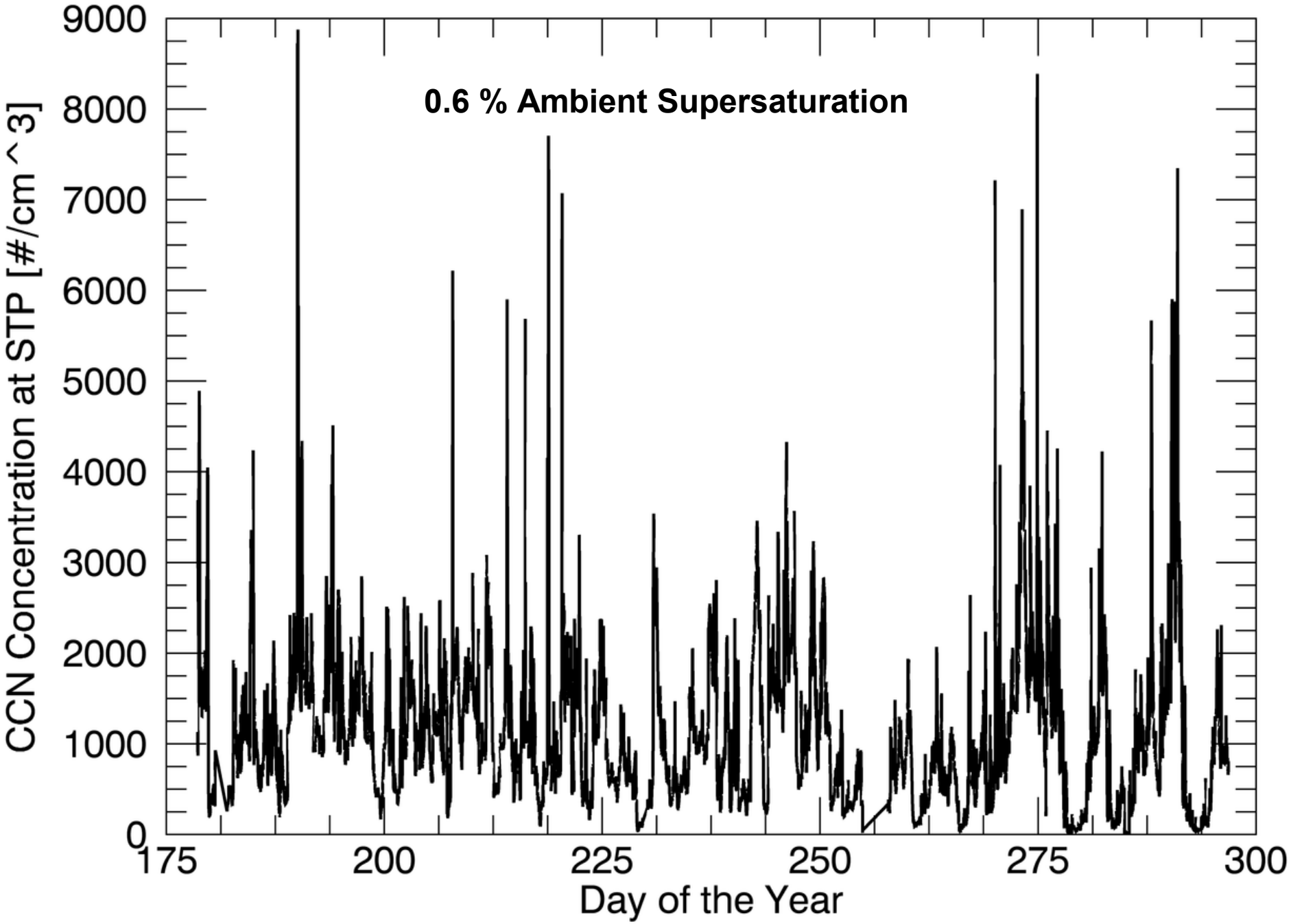
CCN Counter Performance Check



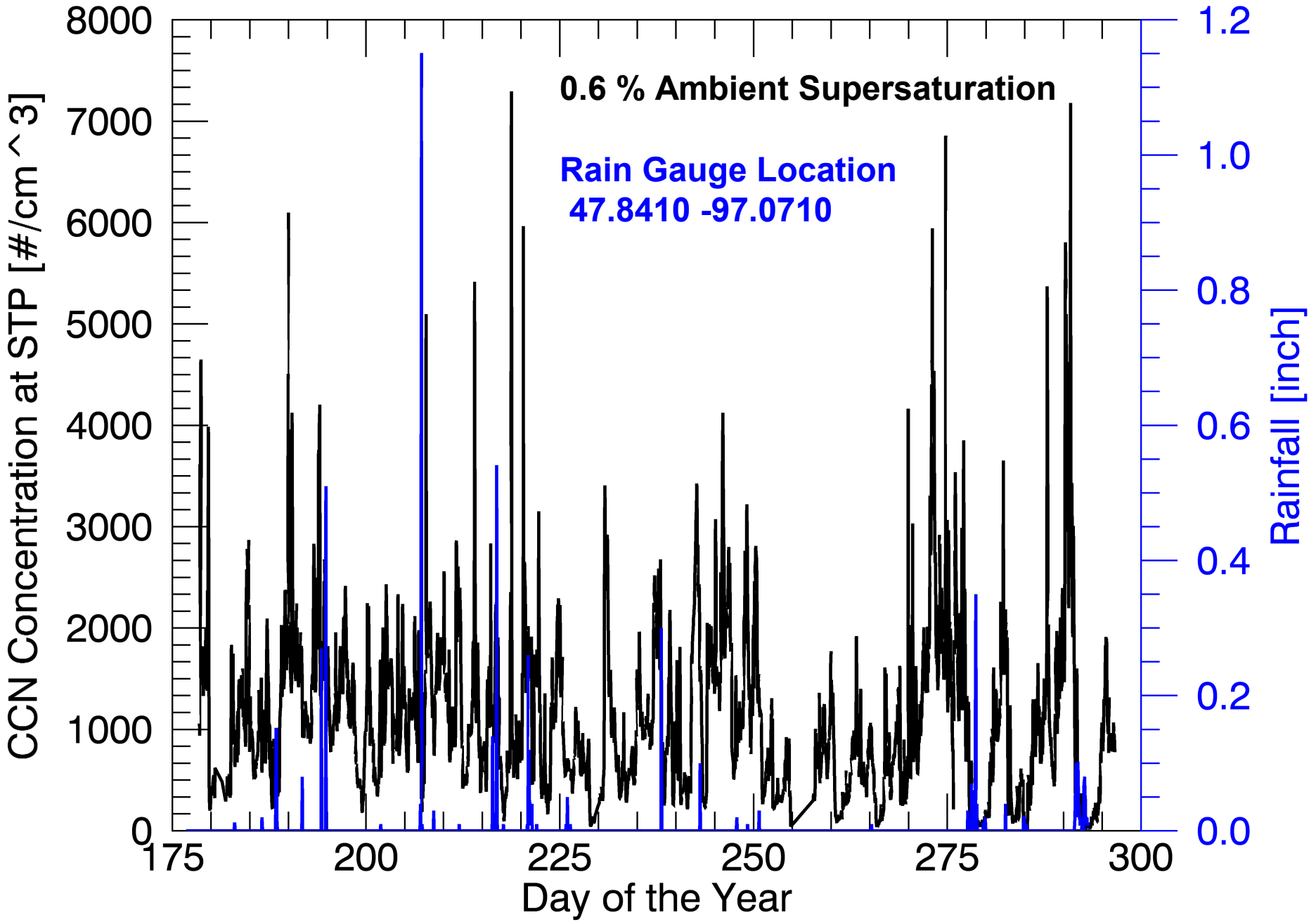
CCN Counter Performance Check



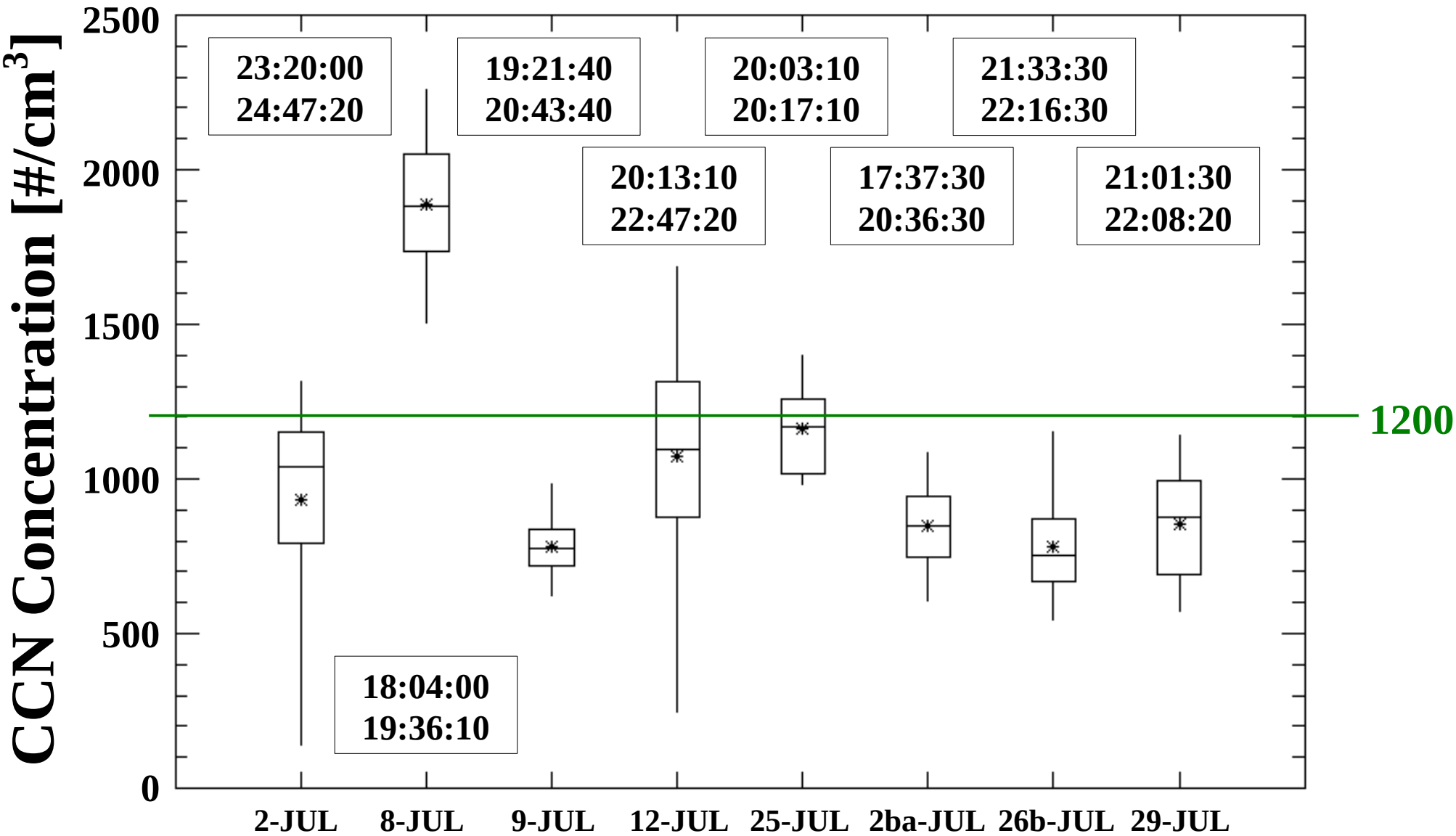
DMT CCN Surface Measurements
Grand Forks, ND: 10 min Samples in 2012



Surface Measurements: Grand Forks, ND
30 min CCN, 1 hr Rain Fall

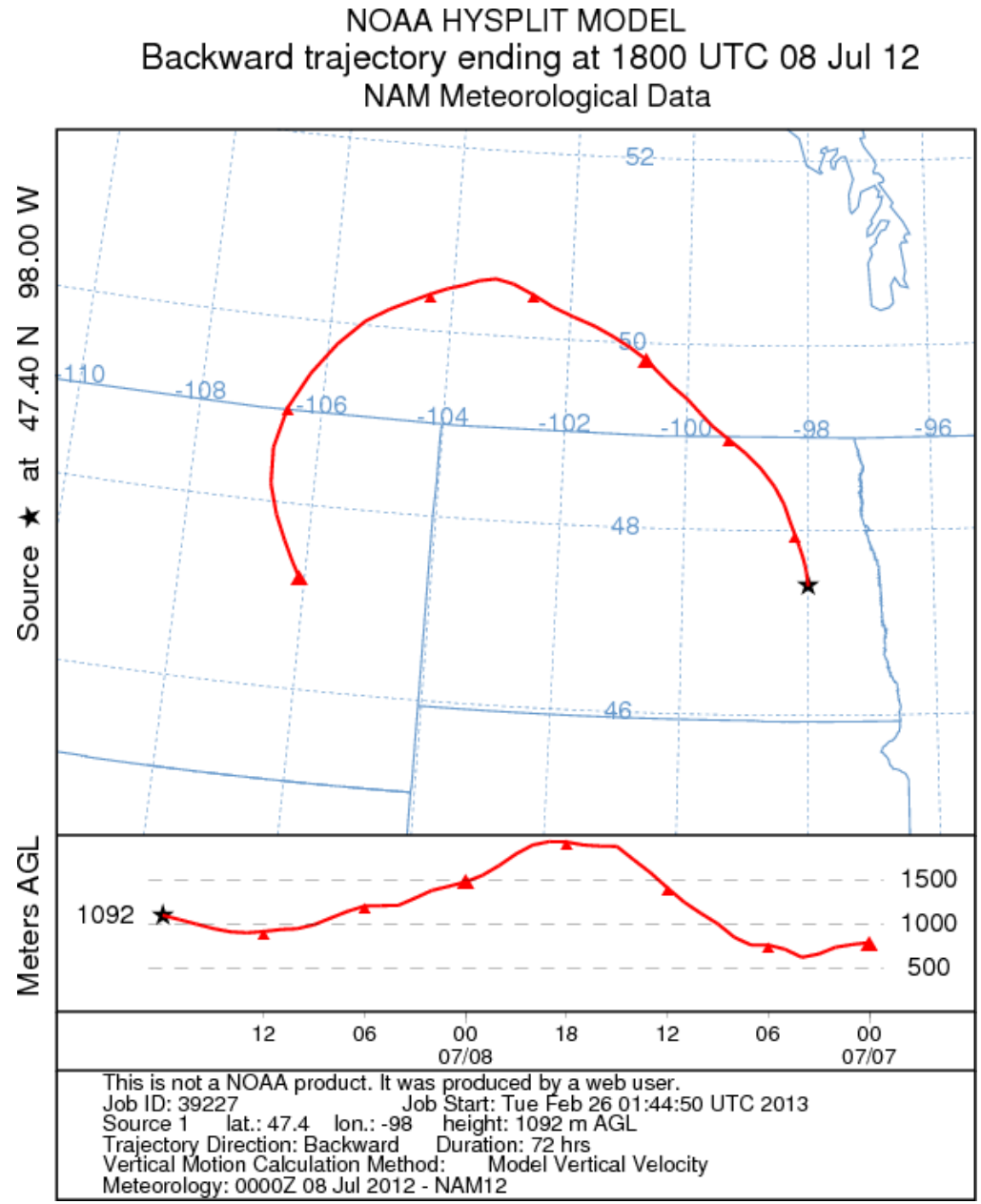


Cloud Base: 2012

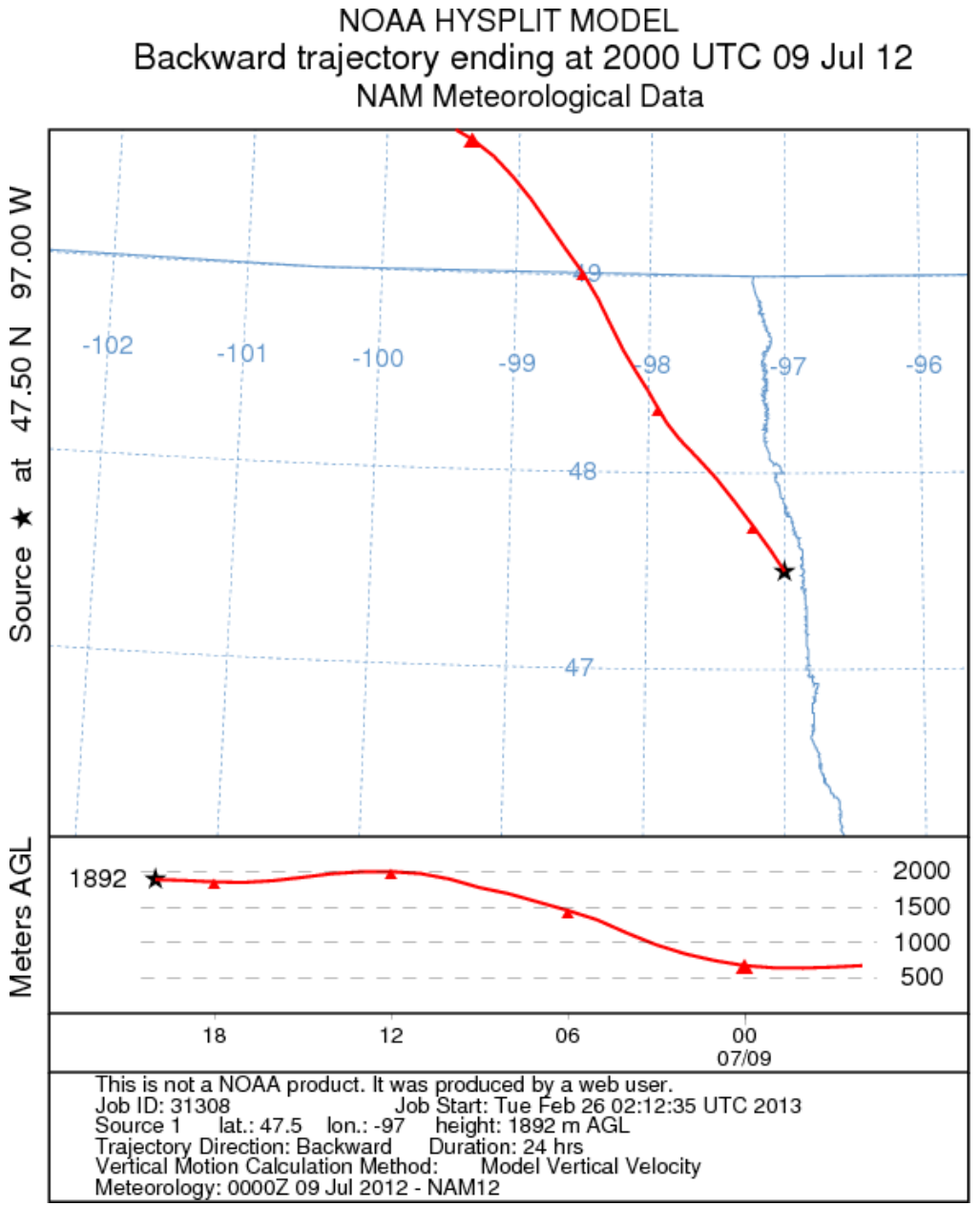


Statistical distributions near cloud base of 30 s 1 % supersaturation (counter's theoretical value) Cloud Condensation Nuclei (CCN) adjusted to standard temperature and pressure during the 2010 POLCAST3 field project. The solid circle is the mean value, the horizontal line is the 50th percentile, the top of the box is the 75th percentile, the bottom is the 25th percentile, and the top and bottom of the whiskers are the 95th and 5th percentiles, respectively.

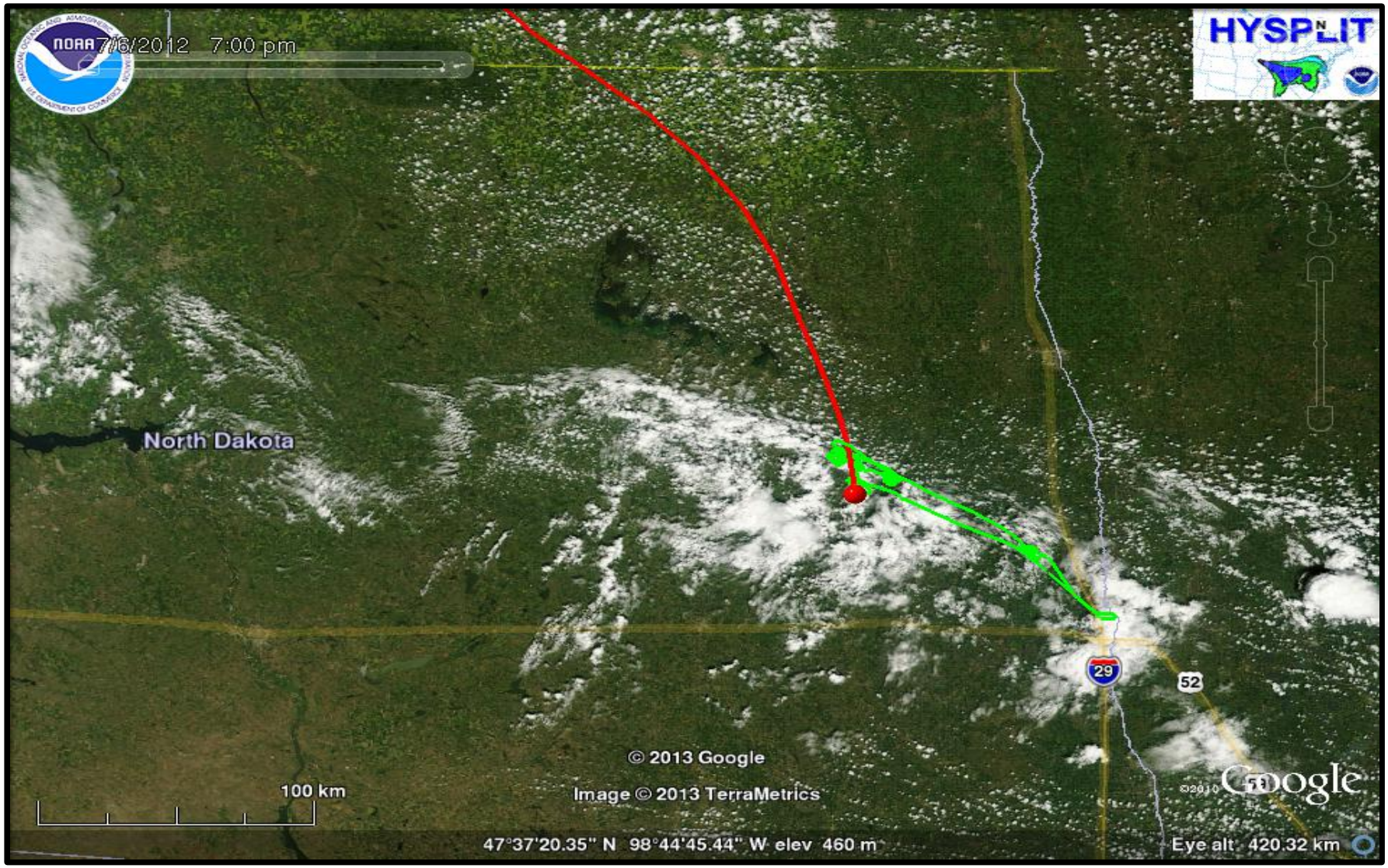
8 July 2012 (190 DOY - Case 1)



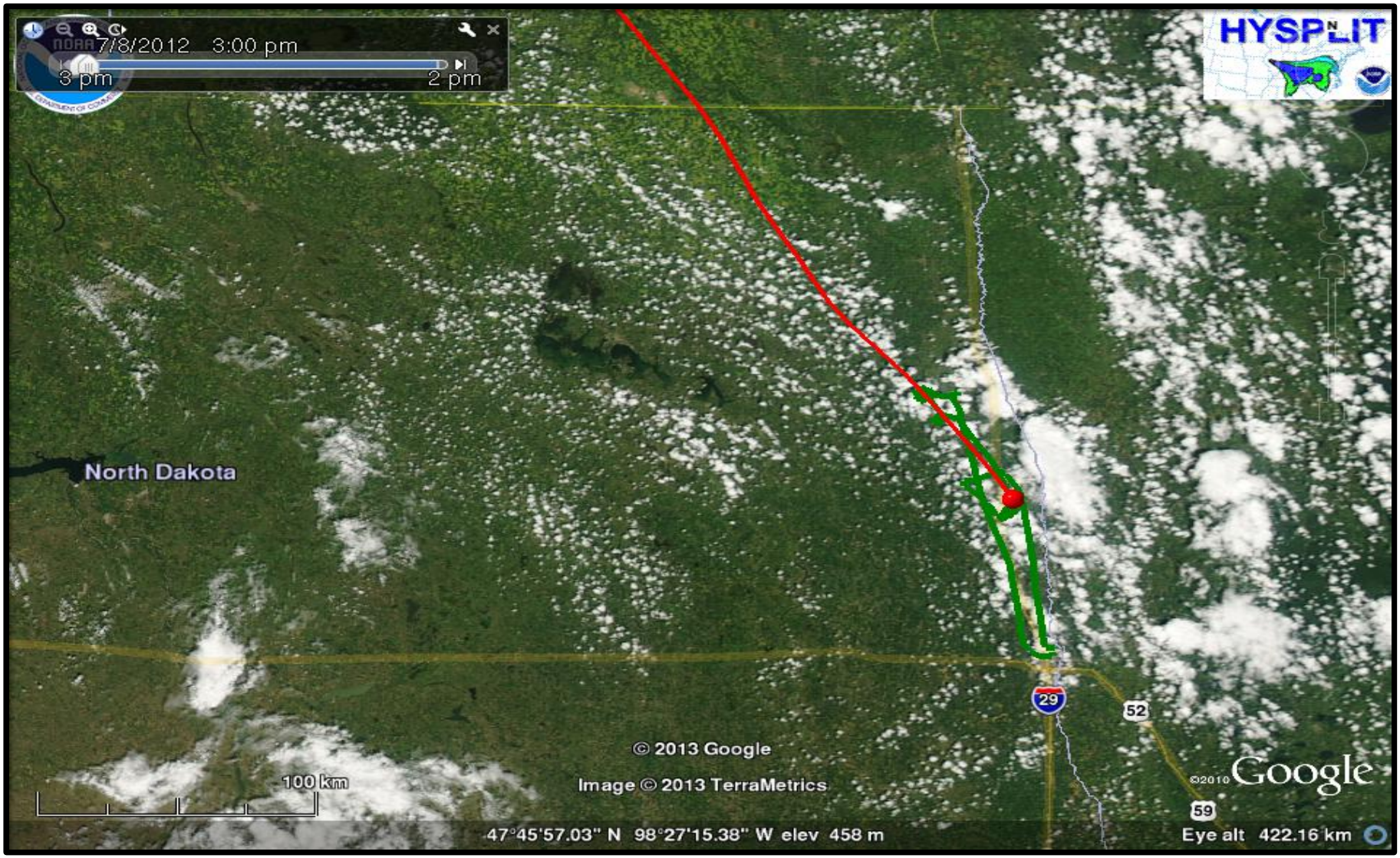
9 July 2012 (191 DOY - Case 1)



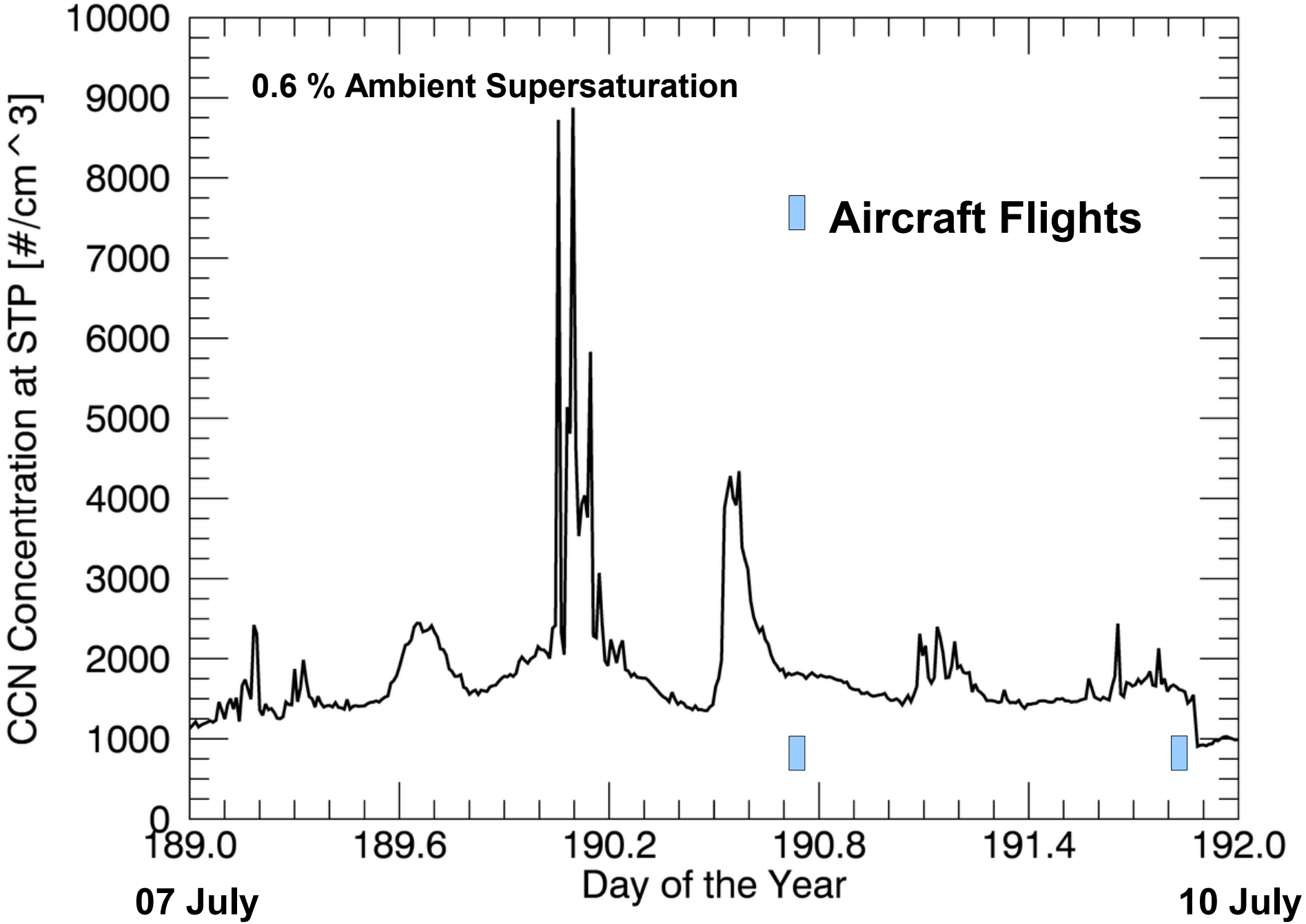
MODIS Terra Visible Image July 8, 2012 with Flight Track and Hysplit Backtrajectory



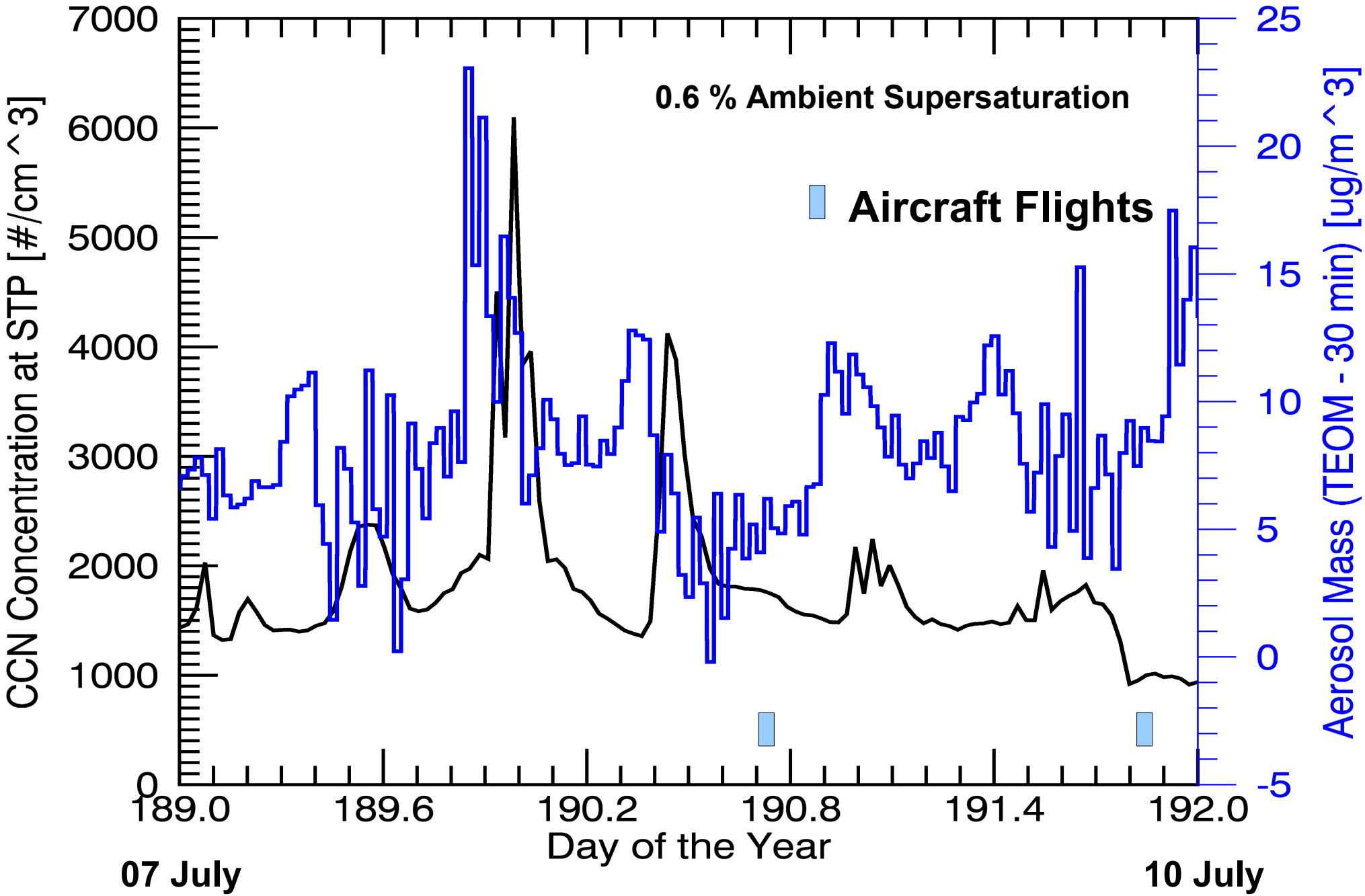
MODIS Aqua Visible Image July 9, 2012 with Flight Track and Hysplit Backtrajectory



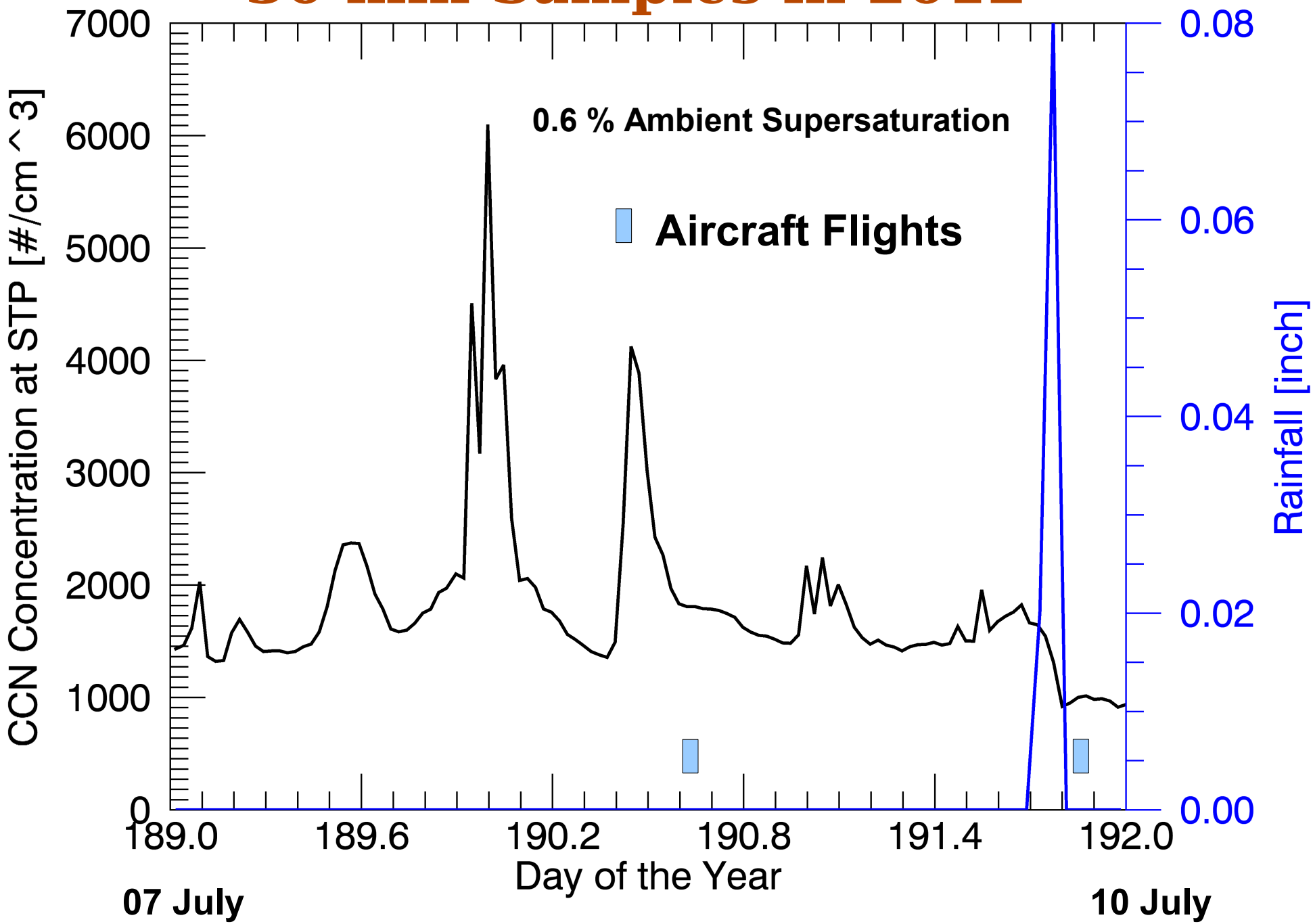
DMT CCN Surface Measurements
Grand Forks, ND: 10 min Samples in 2012



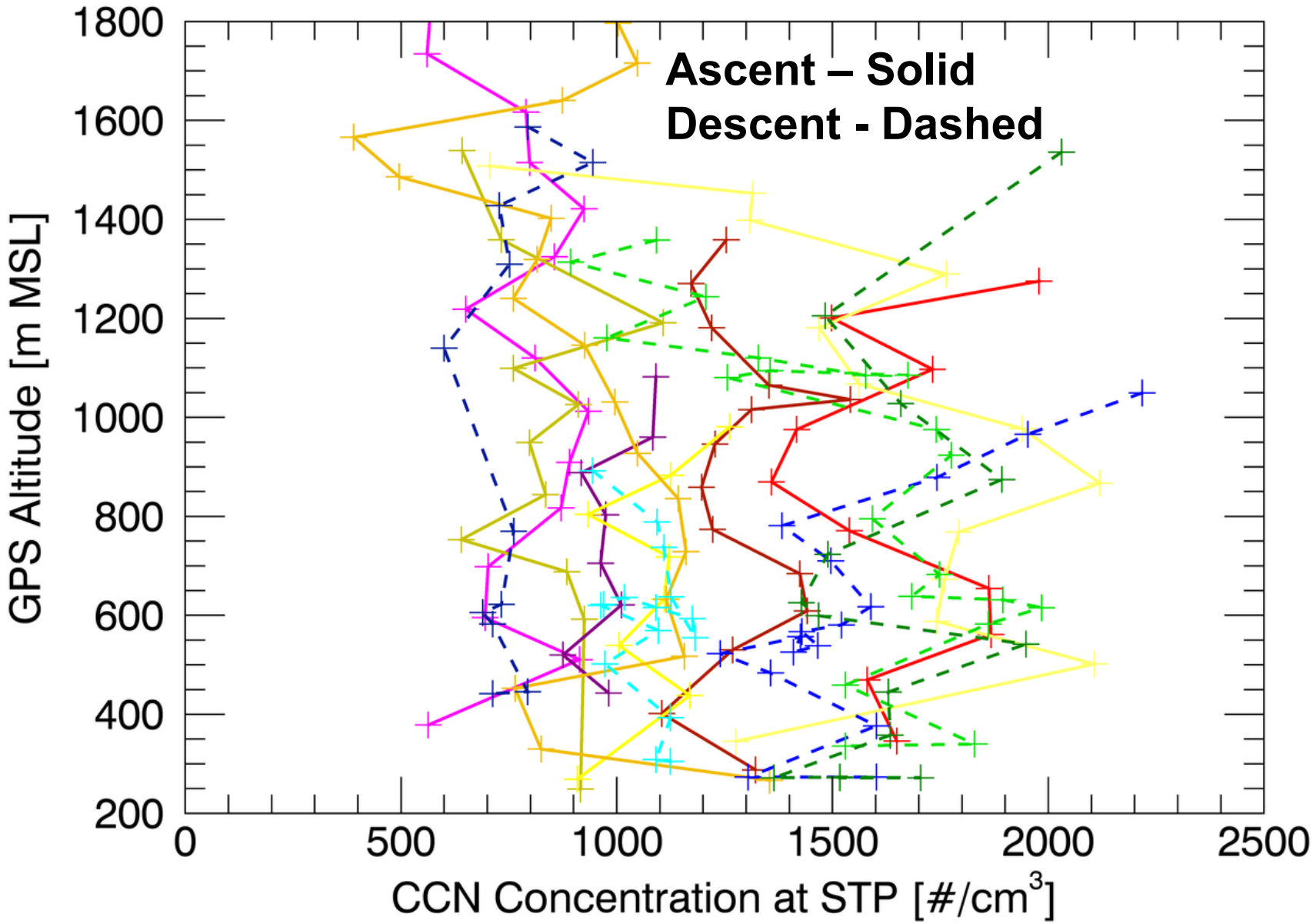
Surface Measurements: Grand Forks, ND
30 min Samples in 2012



Surface Measurements: Grand Forks, ND
30 min Samples in 2012

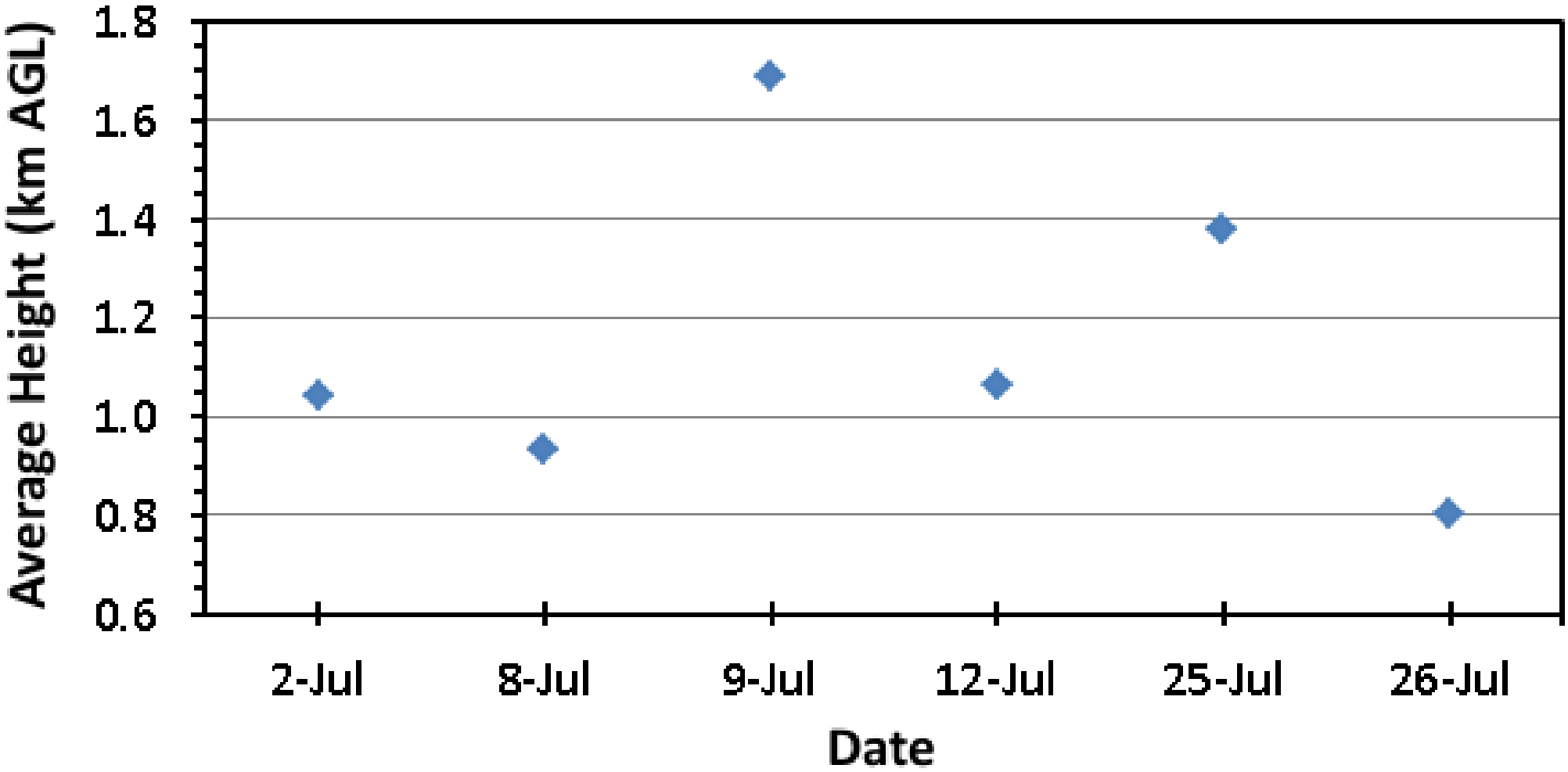


North Dakota: 2012



For individual profiles see, Bart, N. and D. J. Delene, North Dakota Aircraft and Surface CCN Measurements during the Summers of 2010 and 2012, Poster presented at the 93rd Annual Conference of the American Meteorological Society, January 6, 2013 in Austin, Texas.

North Dakota 2012



Conclusions

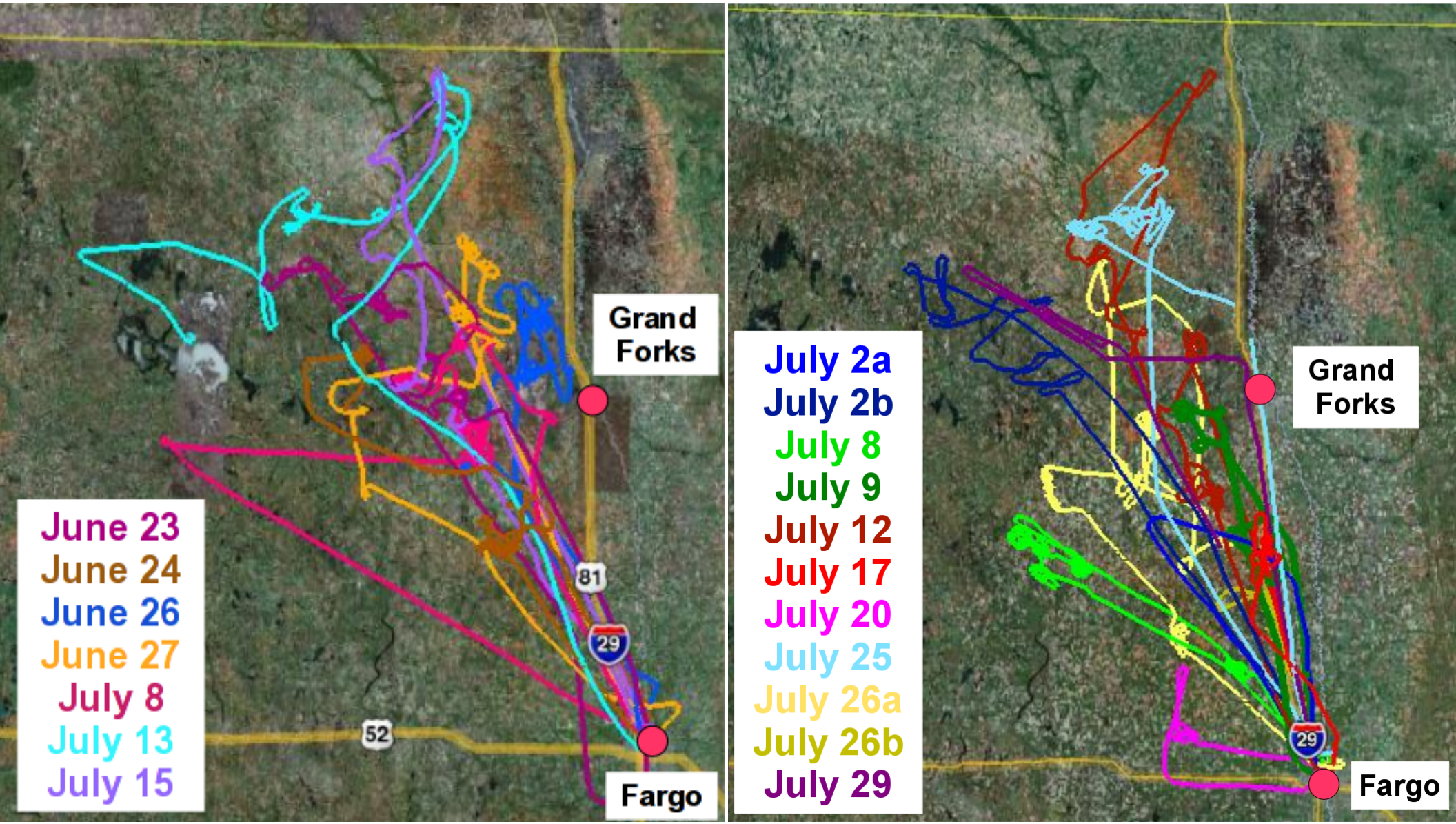
- Day-to-day variations in CCN concentrations are larger than regional scale changes.
- The below cloud base atmosphere is well-mixed so surface CCN measurements can be used to determine cloud base measurements
- Not clear the what is the cause of the observed day-to-day CCN changes; however, rainfall likely cause reduced CCN concentration.

Future Work

- Finish software development work for processing surface aerosol measurements.
- **Analyze season long surface measurement statistics and compare with rainfall throughout the region.**
- Compare changes in CCN concentration to changes in aerosol chemistry.
- Investigate how changes in CCN concentration affect model predictions of precipitation.


Questions:
Short Ones Now,
Long Ones During Tour

Cessna 340 Flight Tracks



Aircraft flight paths during the 2010 POLCAST3 (left) and 2012 POLCAST 4 (right) field project.