Research Aircraft Observations of the Micro-physics of Ice Clouds

Citation Research Aircraft

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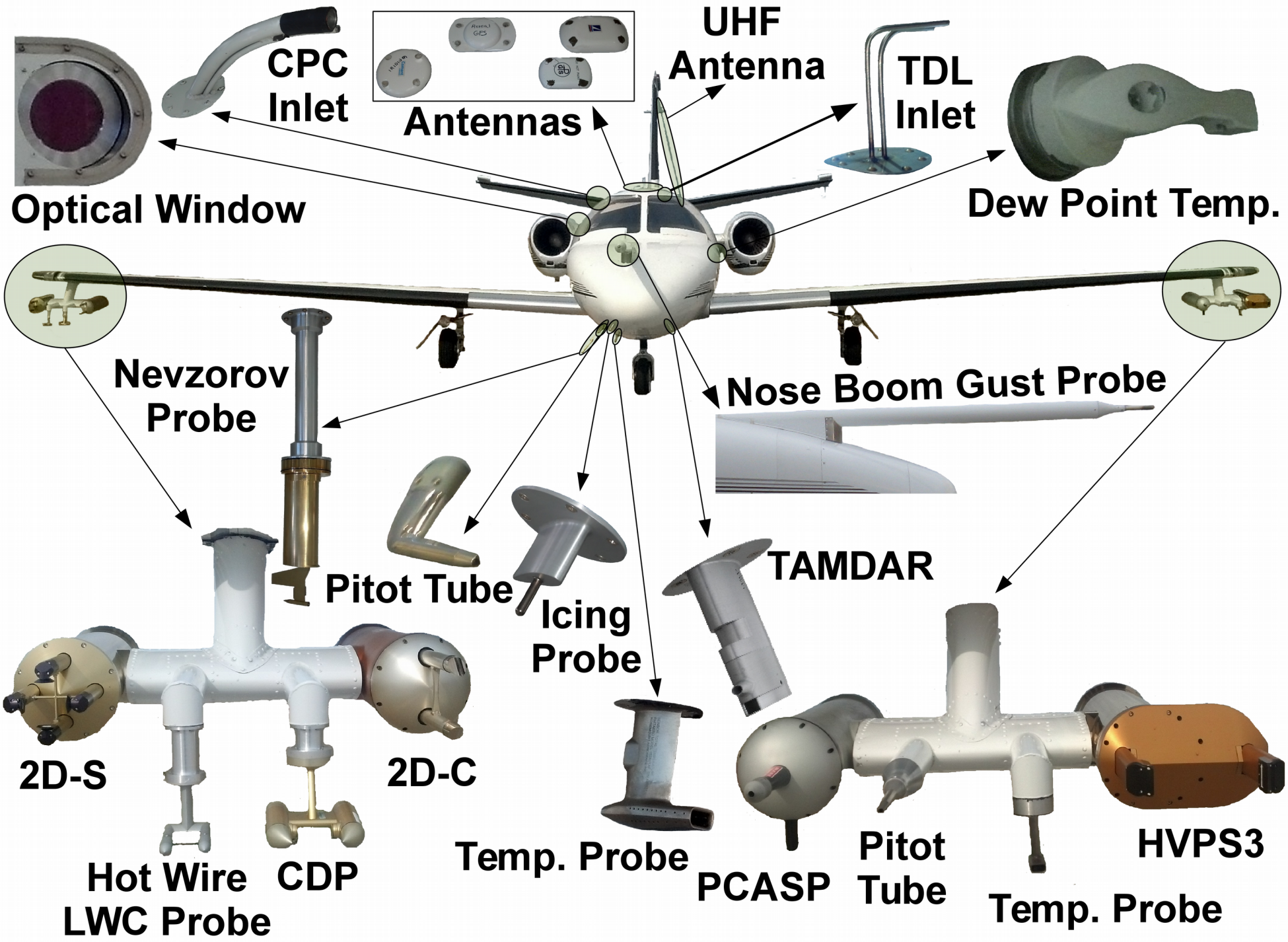
Objectives

Obtain microphysical measurement concurrent with observation of the MCR Doppler radar to enable evaluation of microphysical properties of cirrus clouds.

Mid-Course Radar (MCR)

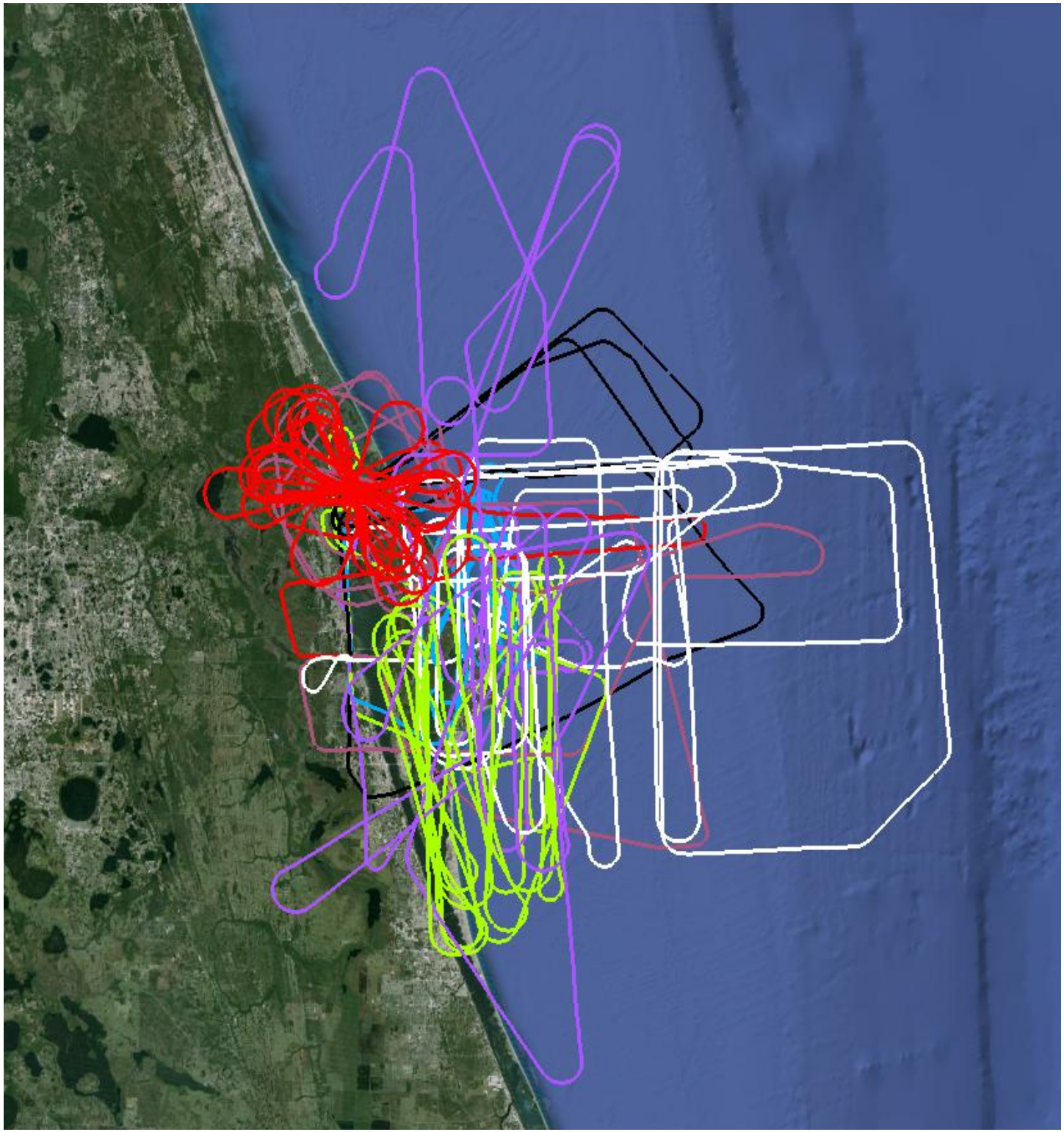
- C-band, Dual-polarization Doppler Radar
- 3 MW Operating Power, 0.22 Degree Beam Width
  - Pulse Volume of 504 m^3 at 12,000 m
  - Box around Citation Research Aircraft has a volume of 1,050 m^3

2015 Aircraft Instrumentation



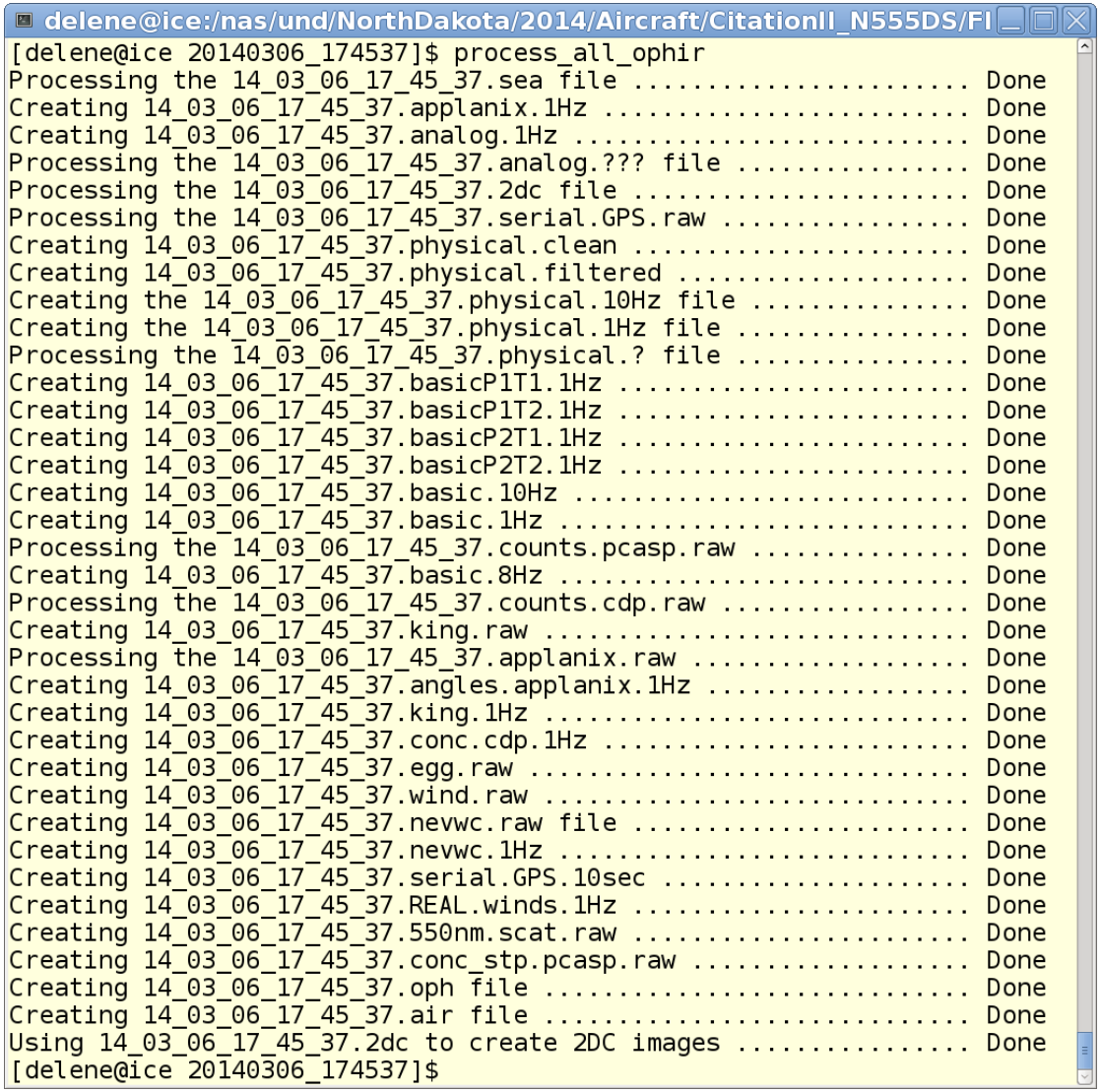
Flight Paths: CAPE2015

July 29
July 30
July 31
August 1-a
August 1-b
August 2
August 8



Data Processing

- Data Quality Control
  - Performance Checks
- Data Missing Values Codes
- Levels of Data Processing
  - Raw Recorded Data
  - Engineering to Physical Units
  - Single Instrument Data Files
  - Combined Instrument Data File
- Data Quality Assurance
  - Scientific Data Review
  - Scripts Search for Unrealistic Values



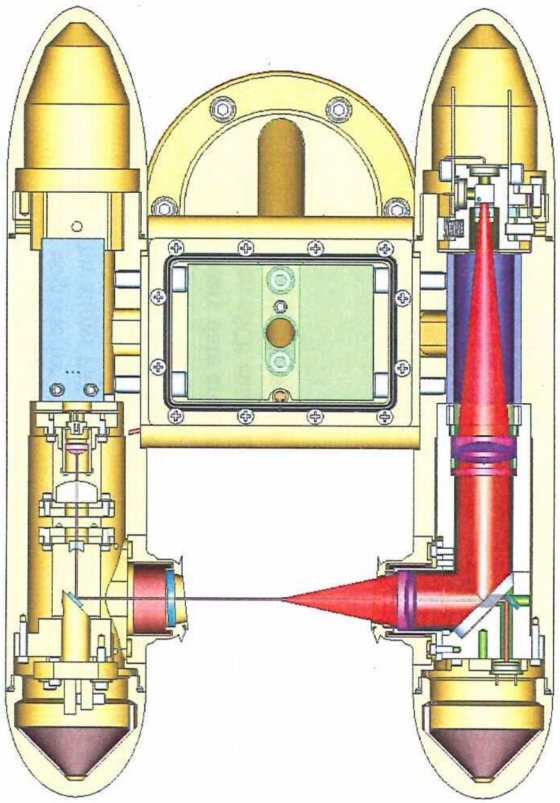
Comments on Scientific Data Set

- Quick visualization of data is very important.
  - Create a preliminary version of the data using automated processing scripts.
  - Create a final data set after the project is over by applying manual edits to the “raw” data files which replace “bad” data with missing value codes.
- Archive the raw data and any editing files.
- Work with ASCII data as much as possible.
  - Compress ASCII files to reduce storage space.
- Use a standard data format, which includes Meta data.
- Create science file for analysis (*.cap)

Cloud Droplet Probe

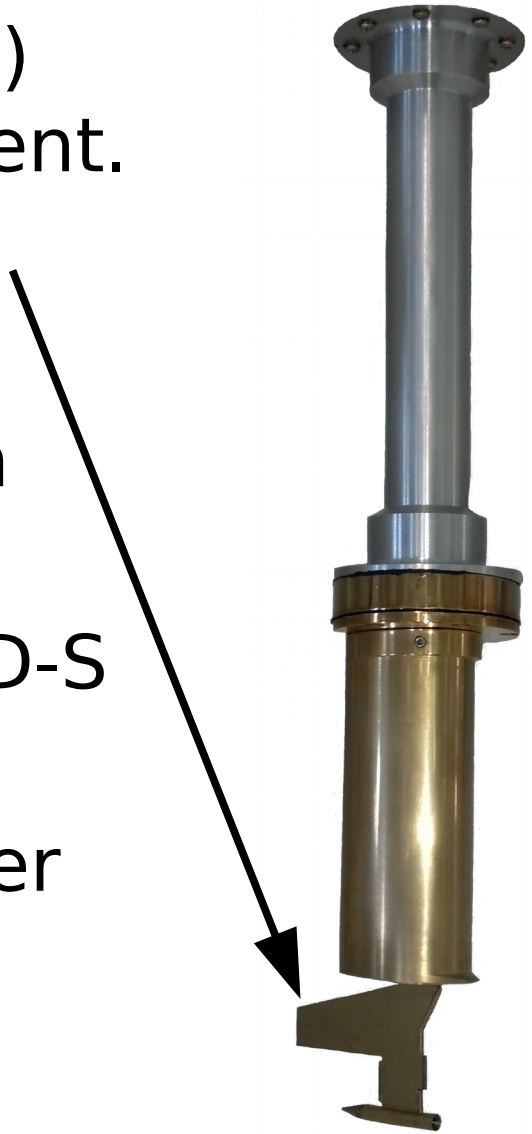
- Measurement of the cloud droplet spectrum in 30 channels between 2 and 50 um diameter.
- Forward scattering between 3-12 degrees.
- Uses Mie scattering to determine particle diameter by assuming spherical water droplets.
- 10 Hz sampling frequency with particle-by-particle information on first 256 particles per sampling interval.
- 0.24 cm^3 sample Volume

  (0.024 cm^2 * 100 m/s * 0.1 s)



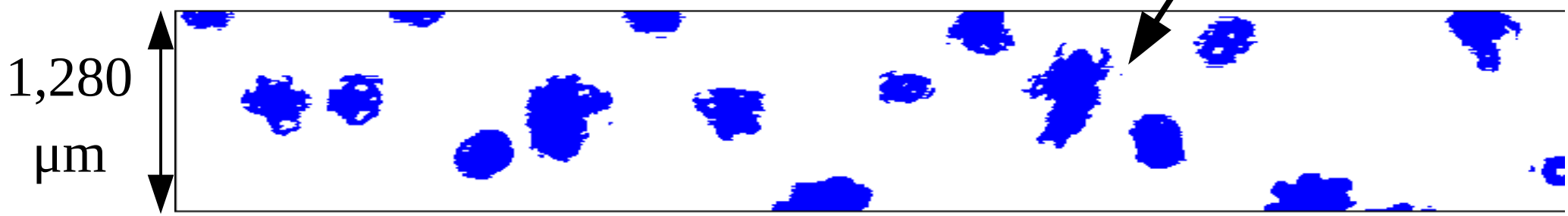
Nevzorov Probe - Water Content

- Measurement of total (ice and liquid) and liquid water content measurement.
- Maintain constant temperature on a hot (125 C) wire sensor head.
- Measure power required to maintain constant temperature.
- Direct measurements to compare 2D-S derived measurements with.
- High altitude clouds so total ice water is used for ice water content measurements.
- Comparison at frequency of up to one second.



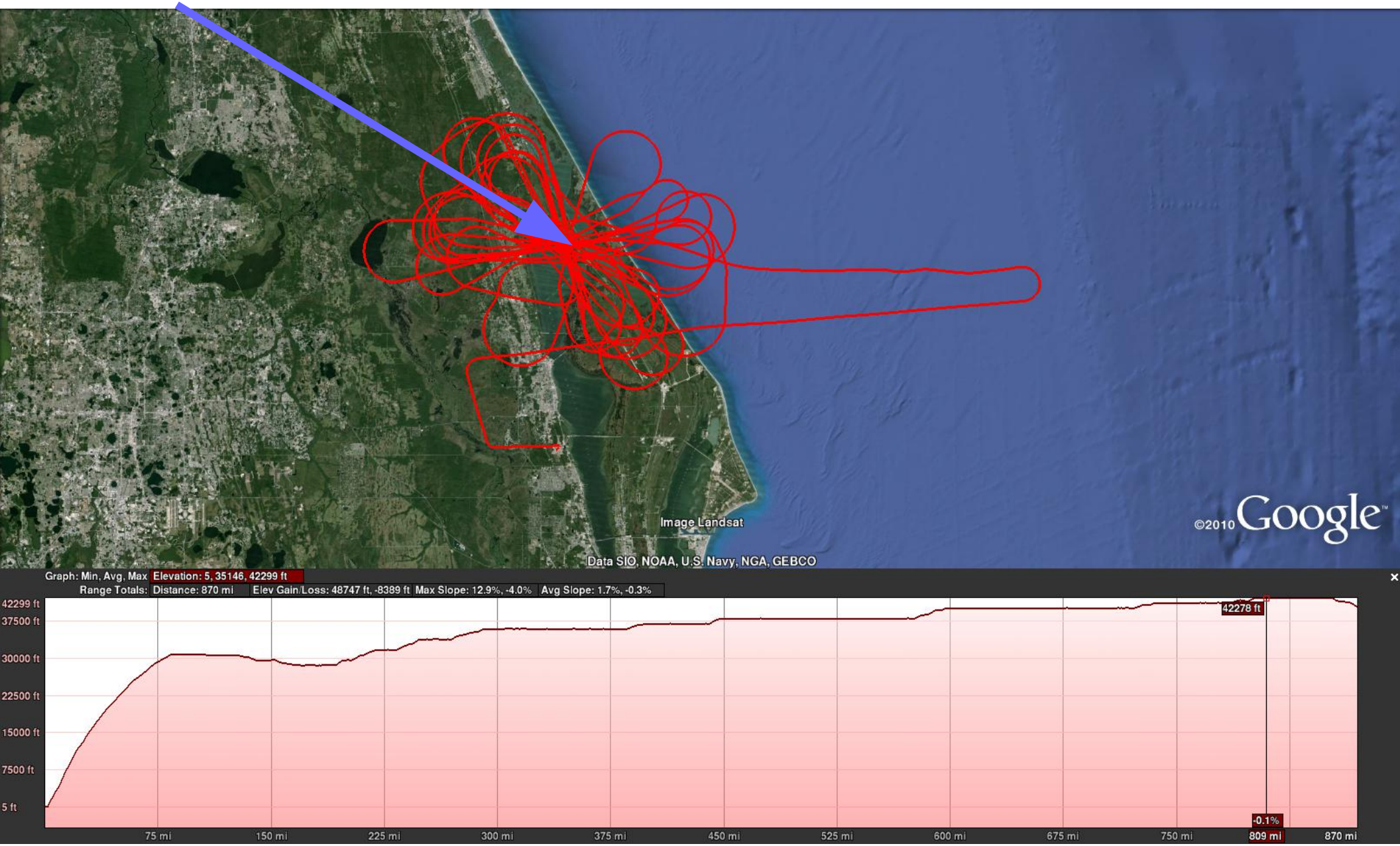
Two-Dimensional Stereographic (2D-S) Probe

- Horizontal and vertically oriented laser.
- 128 Diodes, 10 µm each.
- Captures images of shadows from cloud particles.
- Orthogonal laser light sheet ~ 0.793 cm^2.
  - Data post-processing uses 29 size bins, 10 to 2,000 µm diameter.
  - Use one second-averaged data.
    - 0.00793 m^3 Sample Volume



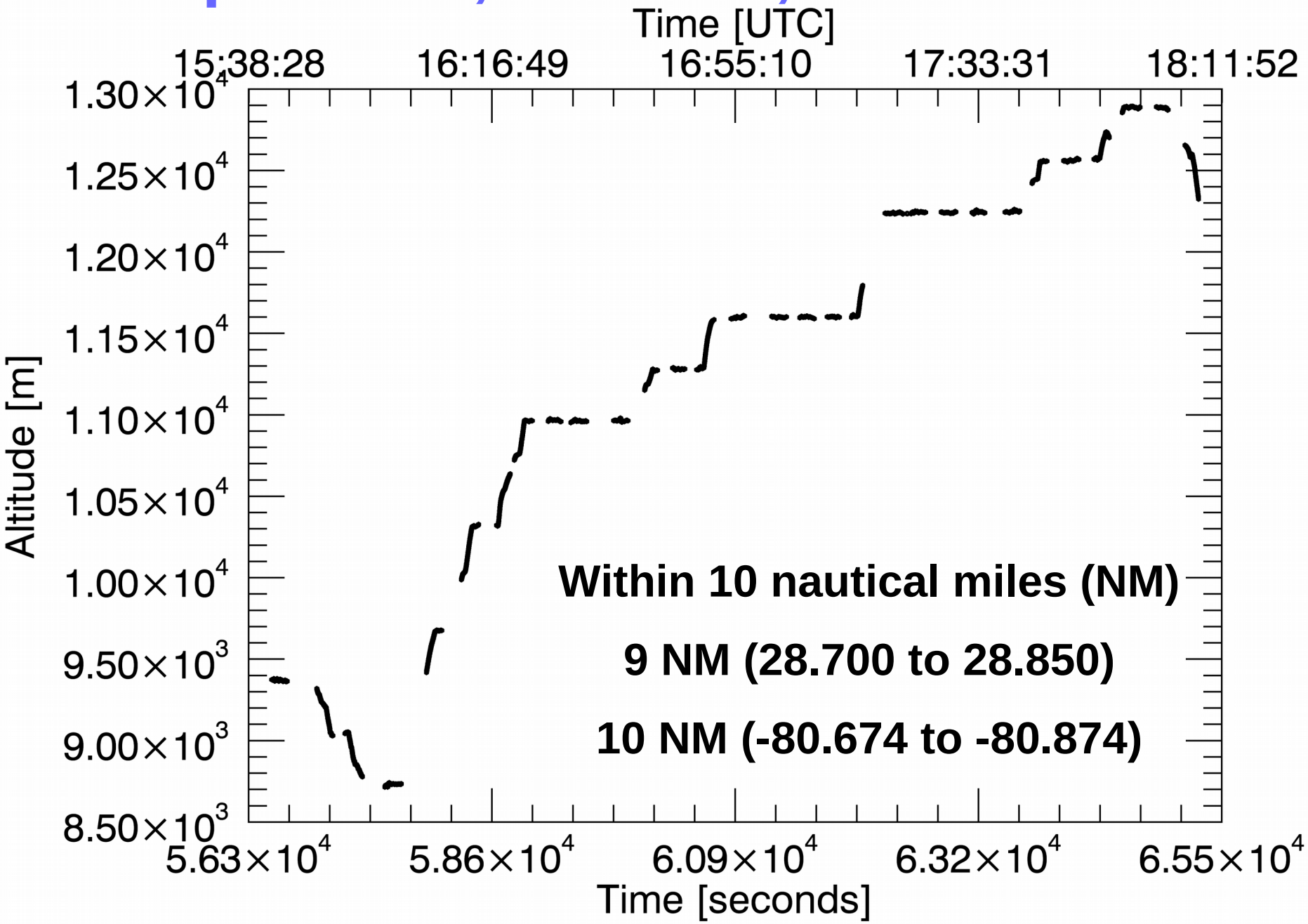
August 8, 2015 Flight Path

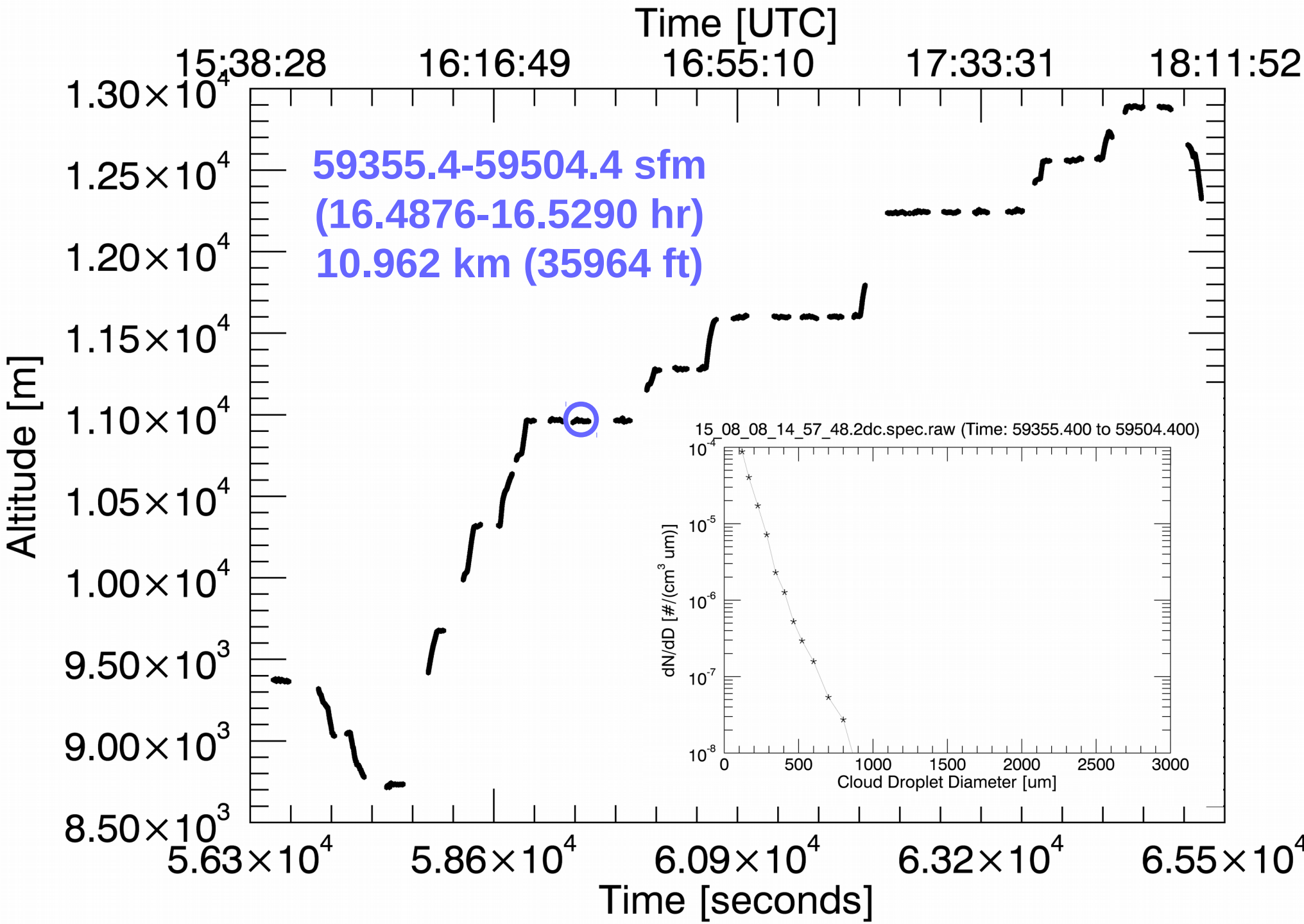
MCR at 28.7550265 N and -80.7743669 W

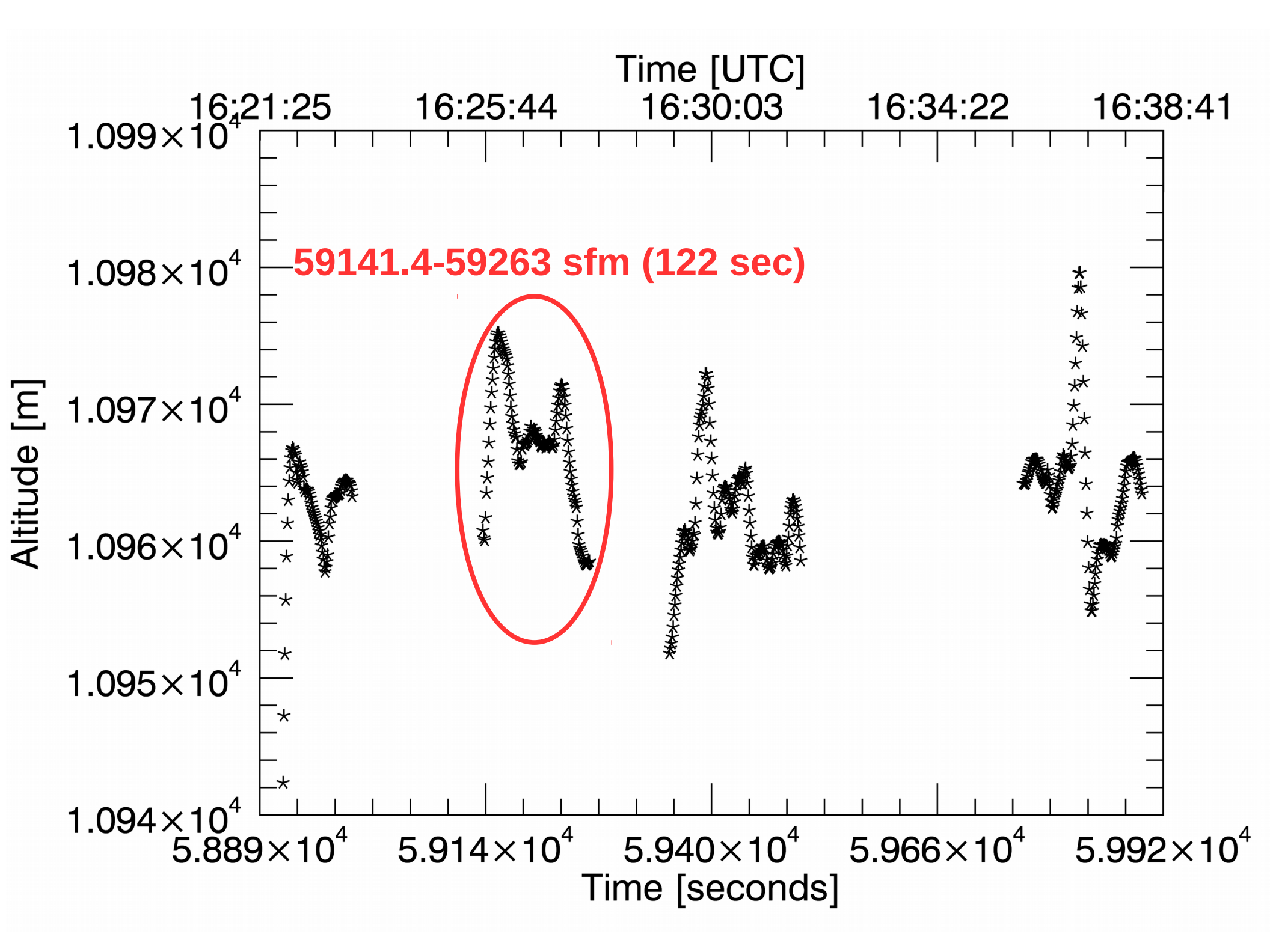


*cap Science File

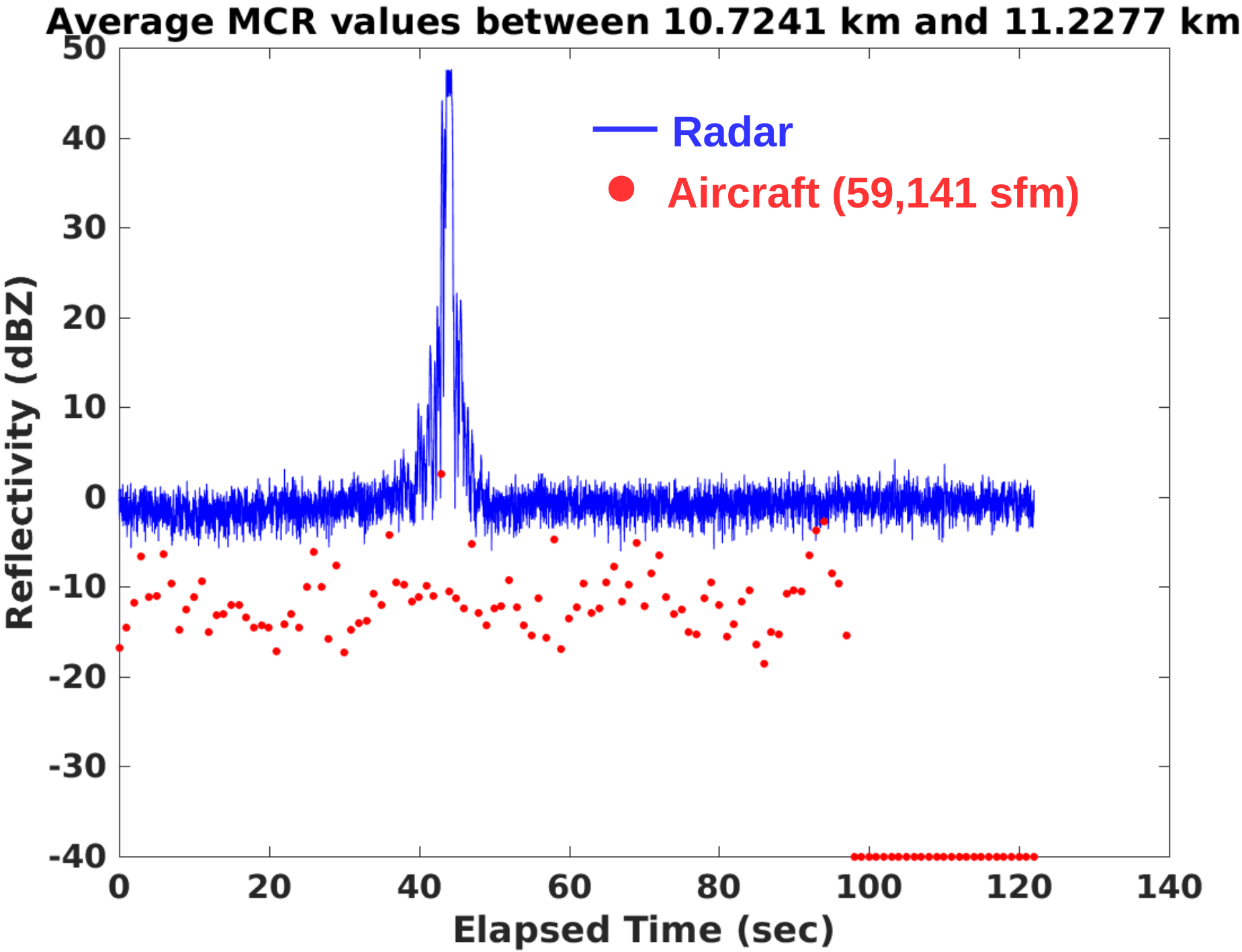
Temperature, Position, Water Content




Time [UTC]
15:38:28
16:16:49
16:55:10
17:33:31
18:11:52
59355.4-59504.4 sfm
(16.4876-16.5290 hr)
10.962 km (35964 ft)
Altitude [m]
1.30×10^4
1.25×10^4
1.20×10^4
1.15×10^4
1.10×10^4
1.05×10^4
1.00×10^4
9.50×10^3
9.00×10^3
8.50×10^3
5.63×10^4
5.86×10^4
6.09×10^4
6.32×10^4
6.55×10^4
Time [seconds]
15_08_08_14_57_48.2dc.spec.raw (Time: 59355.400 to 59504.400)
dN/dD [#/(cm^3 um)]
10^-4
10^-5
10^-6
10^-7
10^-8
0
500
1000
1500
2000
2500
3000
Cloud Droplet Diameter [um]


Time [UTC]
16:21:25
16:25:44
16:30:03
16:34:22
16:38:41
1.099×10^4
1.098×10^4
1.097×10^4
1.096×10^4
1.095×10^4
1.094×10^4
Altitude [m]
59141.4-59263 sfm (122 sec)
5.889×10^4
5.914×10^4
5.940×10^4
5.966×10^4
5.992×10^4
Time [seconds]

Reflectivity Comparison: 2015/08/08



Poster

Gapp, Nicholas J. Paul R. Harasti, David J. Delene, Jerome Schmidt, and Jshua Hoover, Observations of Ice Particles in using Concurrent Radar and Aircraft Measurements, Poster (Board Number **AS5.2**) given (**17:30-19:00 on Monday 9 April 2018**) at the Atmospheric and Meteorological Instrumentation session of the 2018 European Geosciences Union General Assembly in Vienna Austria.

Future Work / Discussion Points

What is method should be used to account for the difference between the 504 m^3 MCR sample volume and the 0.00793 m^3 2D-S sample volume?