Highlights of DISCOVER-AQ airborne observations of aerosol optical, microphysical, and chemical properties

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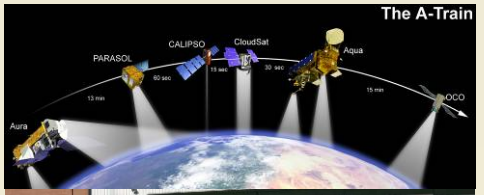
Investigation Overview

Deriving Information on Surface Conditions from Column and VERtically Resolved Observations Relevant to Air Quality

A NASA Earth Venture campaign intended to improve the interpretation of satellite observations to diagnose near-surface conditions relating to air quality

Objectives:

1. Relate column observations to surface conditions for aerosols and key trace gases O_3, NO_2, and CH_2O
2. Characterize differences in diurnal variation of surface and column observations for key trace gases and aerosols
3. Examine horizontal scales of variability affecting satellites and model calculations



Deployments and key collaborators

Maryland, July 2011 (EPA, MDE, UMd, and Howard U.)

Potential Futue Deployments and key collaborators

California, January 2013 (EPA and CARB)

Texas, September 2013 (EPA, TCEQ, and U. of Houston)

TBD, Summer 2014

Deployment Strategy

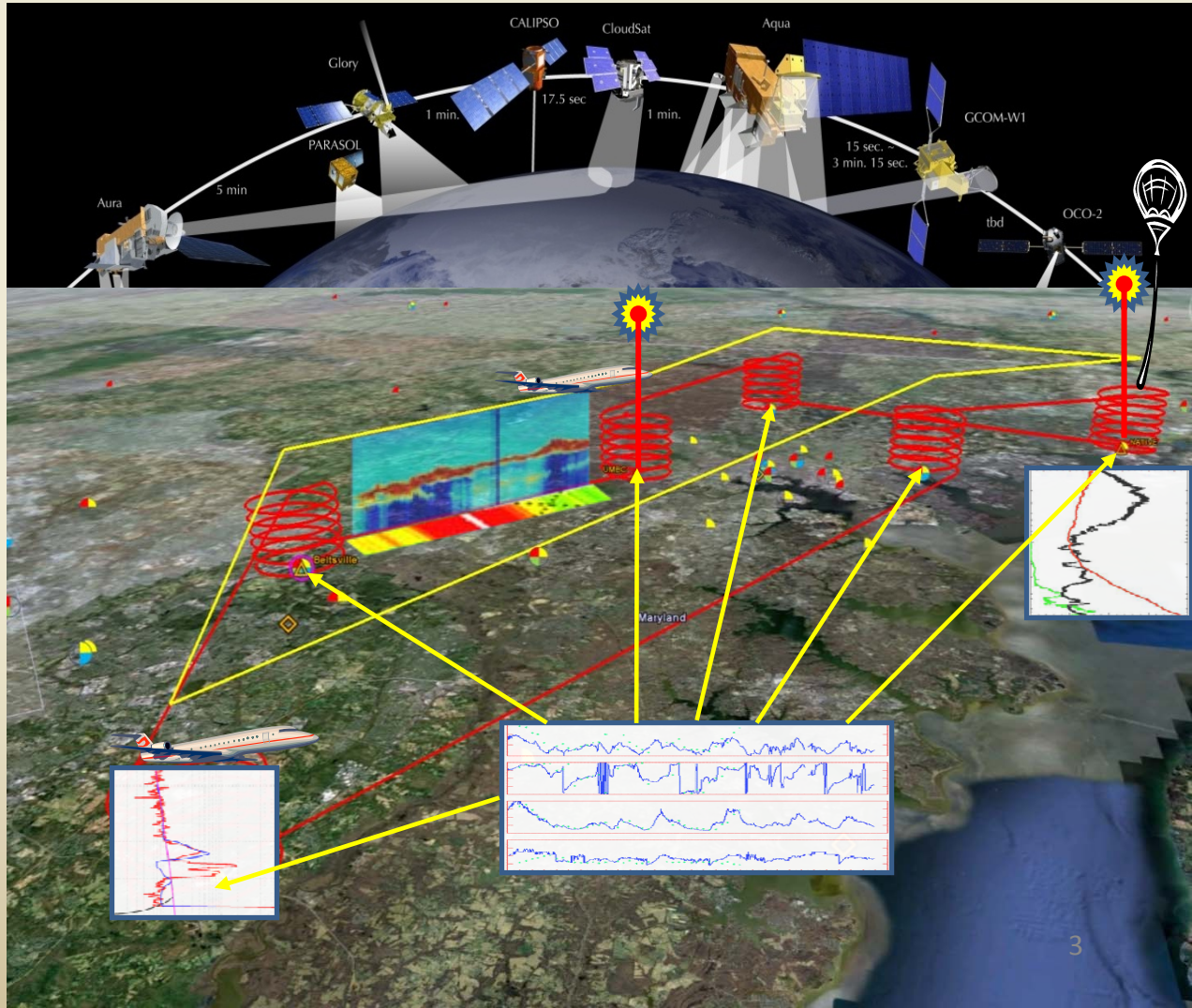
Systematic and concurrent observation of column-integrated, surface, and vertically-resolved distributions of aerosols and trace gases relevant to air quality as they evolve throughout the day.

Three major observational components:

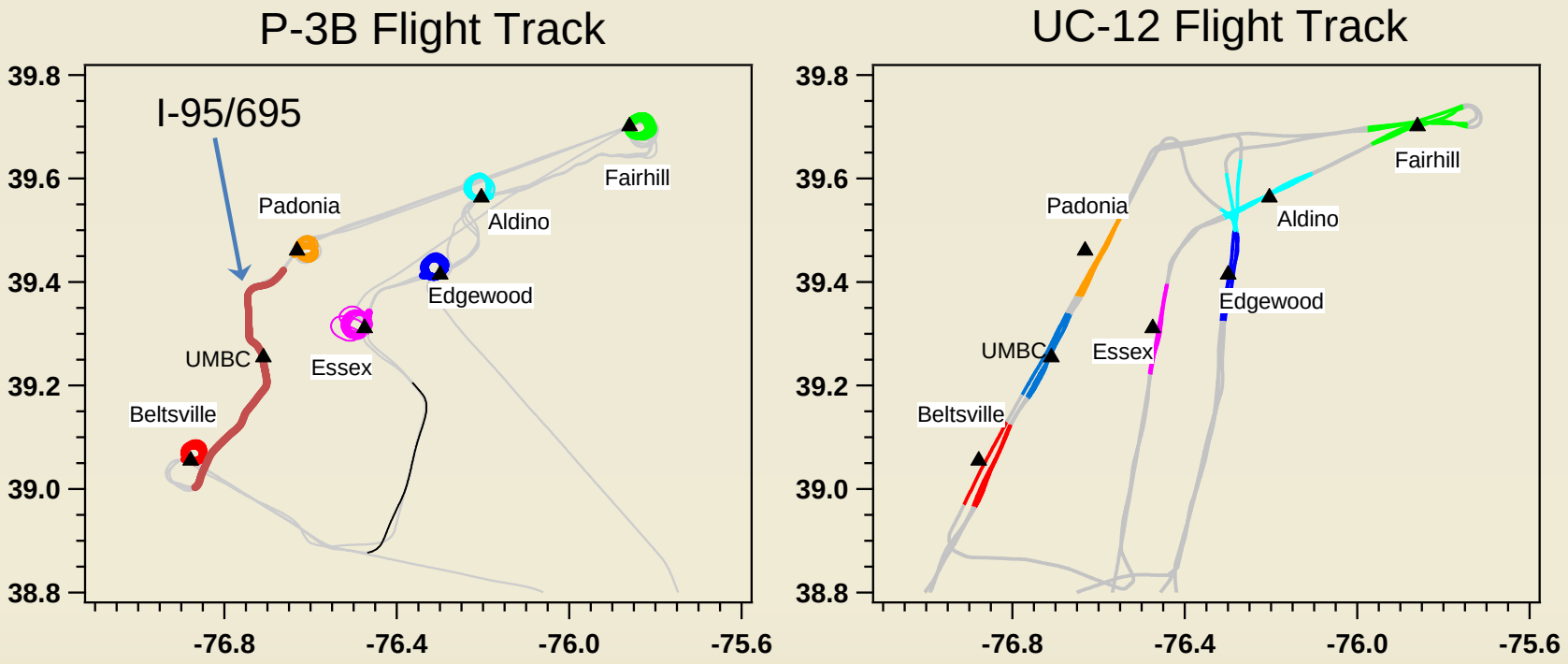
NASA UC-12 (Remote sensing)
Continuous mapping of aerosols with HSRL and trace gas columns with ACAM

NASA P-3B (in situ meas.)
In situ profiling of aerosols and trace gases over surface measurement sites

Ground sites
In situ trace gases and aerosols
Remote sensing of trace gas and aerosol columns
Ozonesondes
Aerosol lidar observations



Coordinated Flight Plan
P-3B vs. UC-12



- ✓ *DISCOVER-AQ airborne sampling is primarily focused on a region of 1 x 2 degrees, including 6 AQS sites, I-95/295/695, and Chesapeake bay*
- ✓ *Typical flight day involves two UC-12 flights and an 8 hour P-3B flight*
- ✓ *Coordinated flight plan and constant aircraft-ground communication ensure UC-12 overlaps P-3B profiles several times each flight day*
- ✓ *A typical P-3B flight includes 3 profiles over each AQS site*

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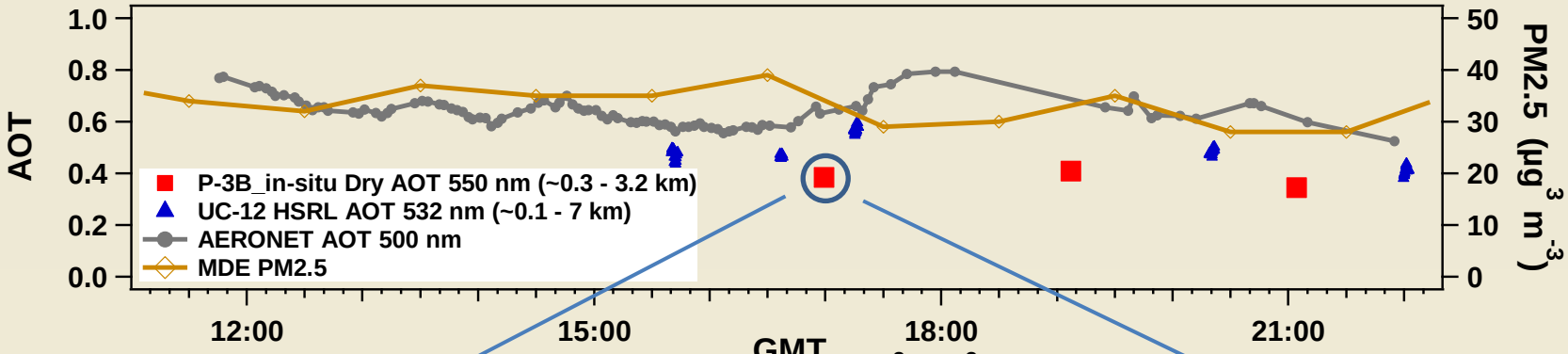
Trace Gas and Aerosol Observations

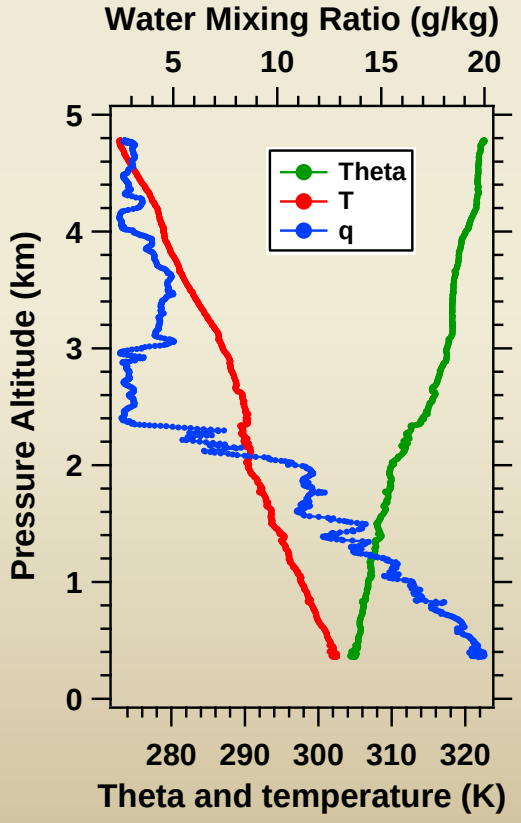
Trace Gas Observations	O_3	NO_2	CH_2O	NO	NO_y	CO	CO_2	CH_4	H_2O	VOC
Pandora, total column (12 sites)	X	X	X						X	
ACAM, nadir column (UC-12)	X	X	X							
In situ airborne profiles (P-3B)	X	X	X	X	X	X	X	X	X	X
In situ surface observations (AQS)	X	X			X	X			X	X
NATIVE in situ surface observations	X			X	X	X			X	
NATIVE sondes	X								X	
Aeronet									X	

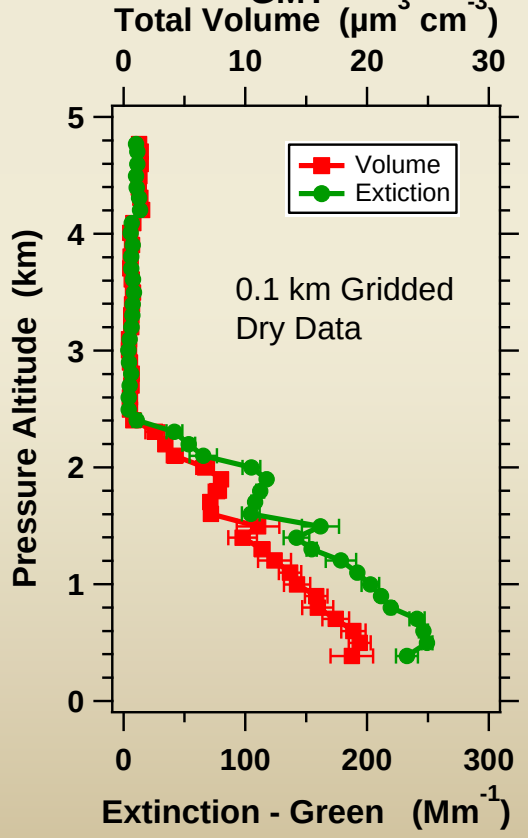
Aerosol Observations (X) = dry aerosol measurement	AOD	PM2.5	Scattering	Absorption	Extinction	Non-Sphericity	f(RH)	Black Carbon	Soluble Ions	Size Distribution	PBL Height
HSRL, nadir aerosol profiles (UC-12)	X		X		X	X					X
In situ airborne profiles (P-3B)	(X)		(X)	(X)	(X)		X	X	X	(X)	X
In situ surface observations (AQS)		(X)									
NATIVE lidar			X								X
UMBC UMAP site with AERI	X	X	X		X		X			X	X
Aeronet	X			X						X	
MPLnet			X		X						X
Pandora	X										

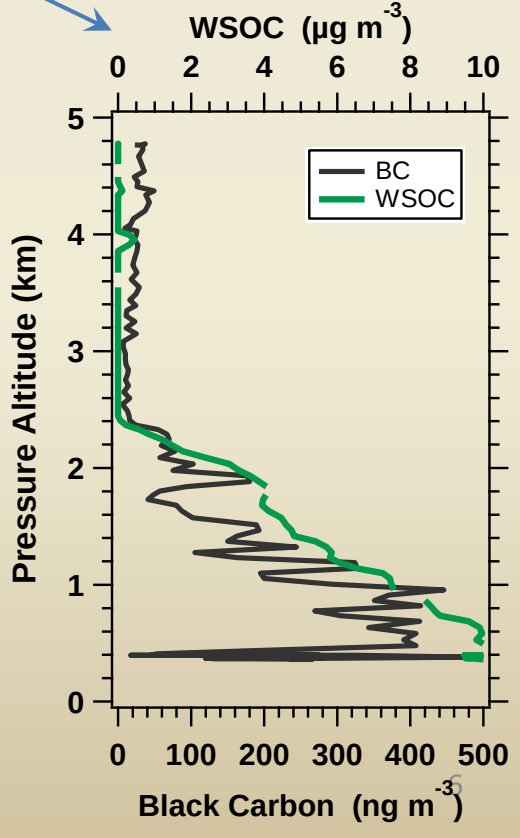
Integrating Observations

Ground and Aircraft: Edgewood, 7/21/2011



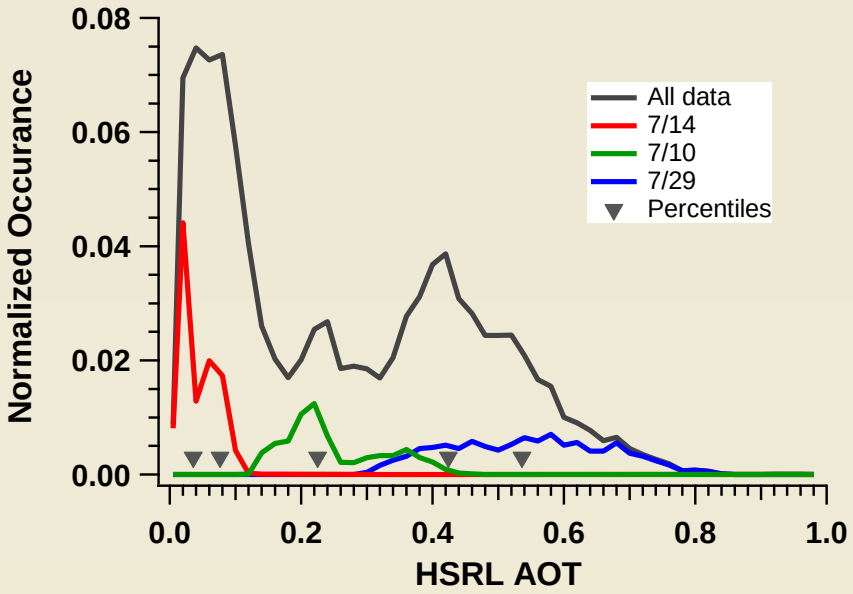


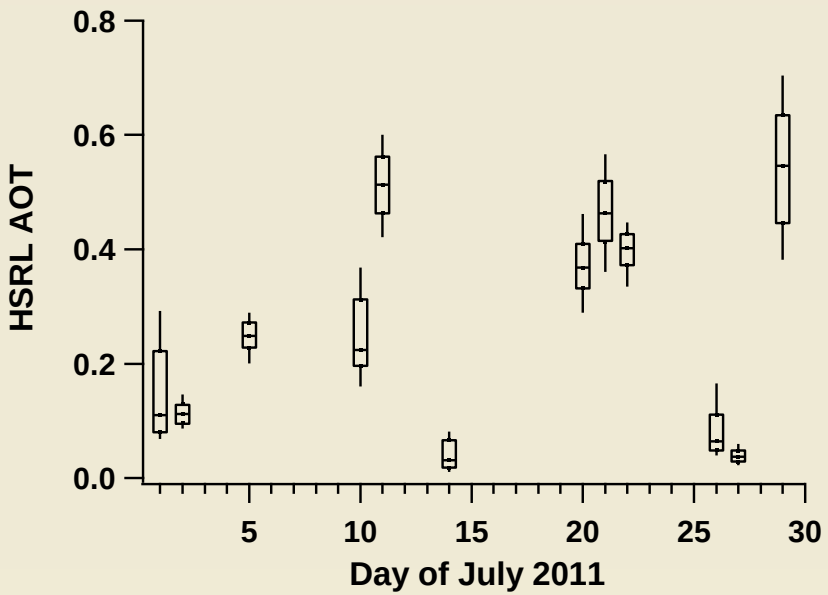


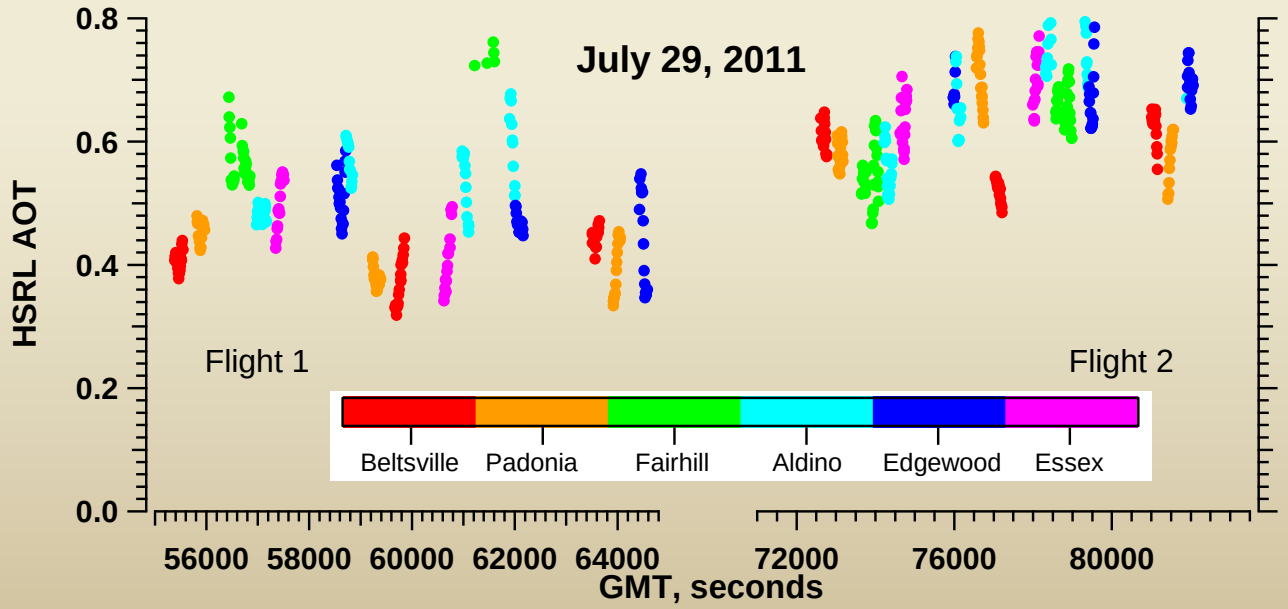


AOT Observation Overview

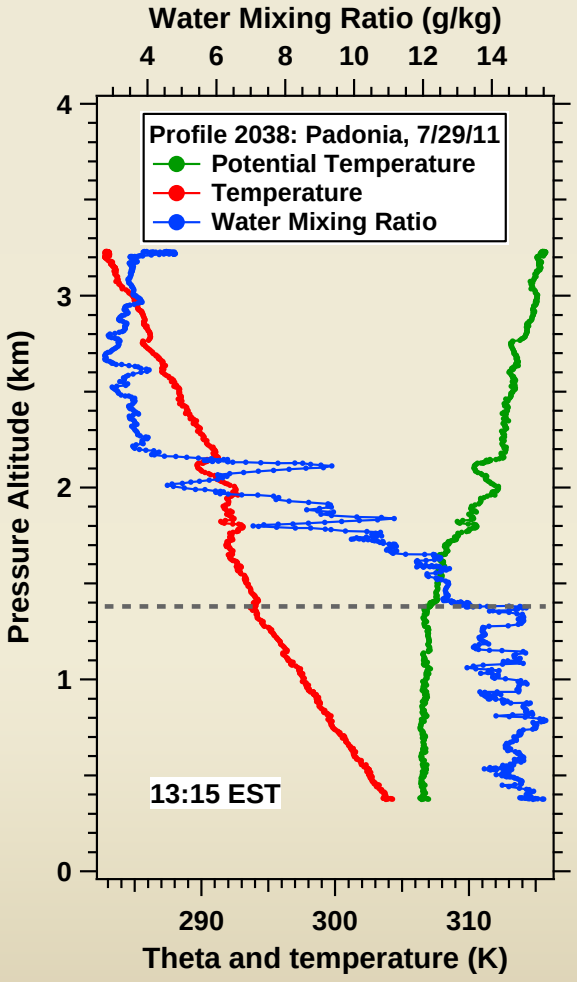
Spatiotemporal Variability

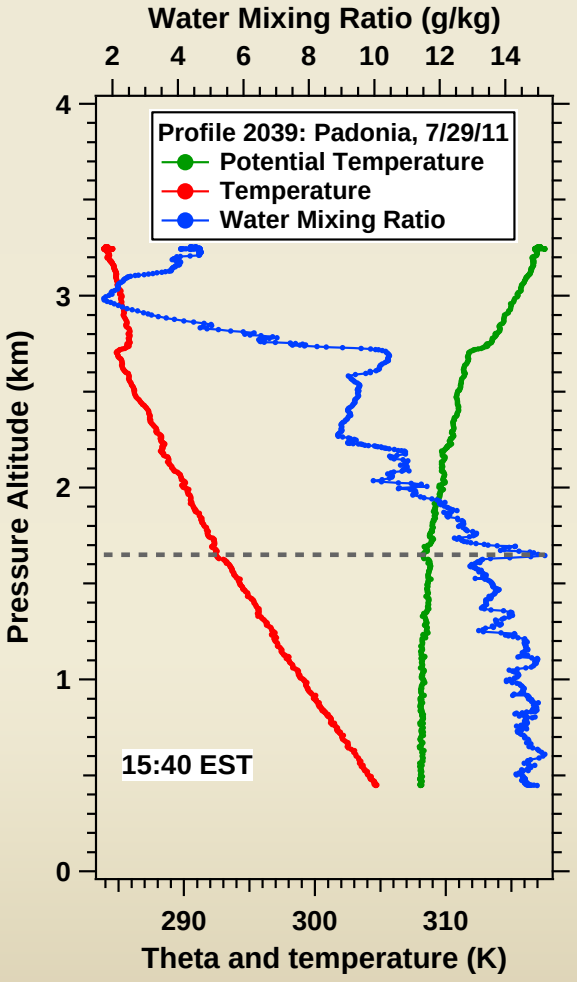


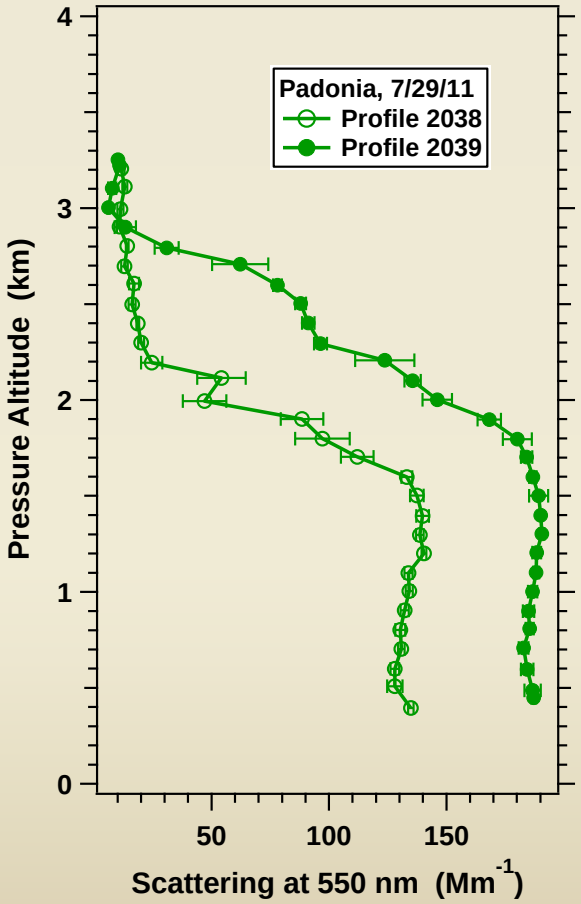




Vertical Profile Comparison
Temporal Variability

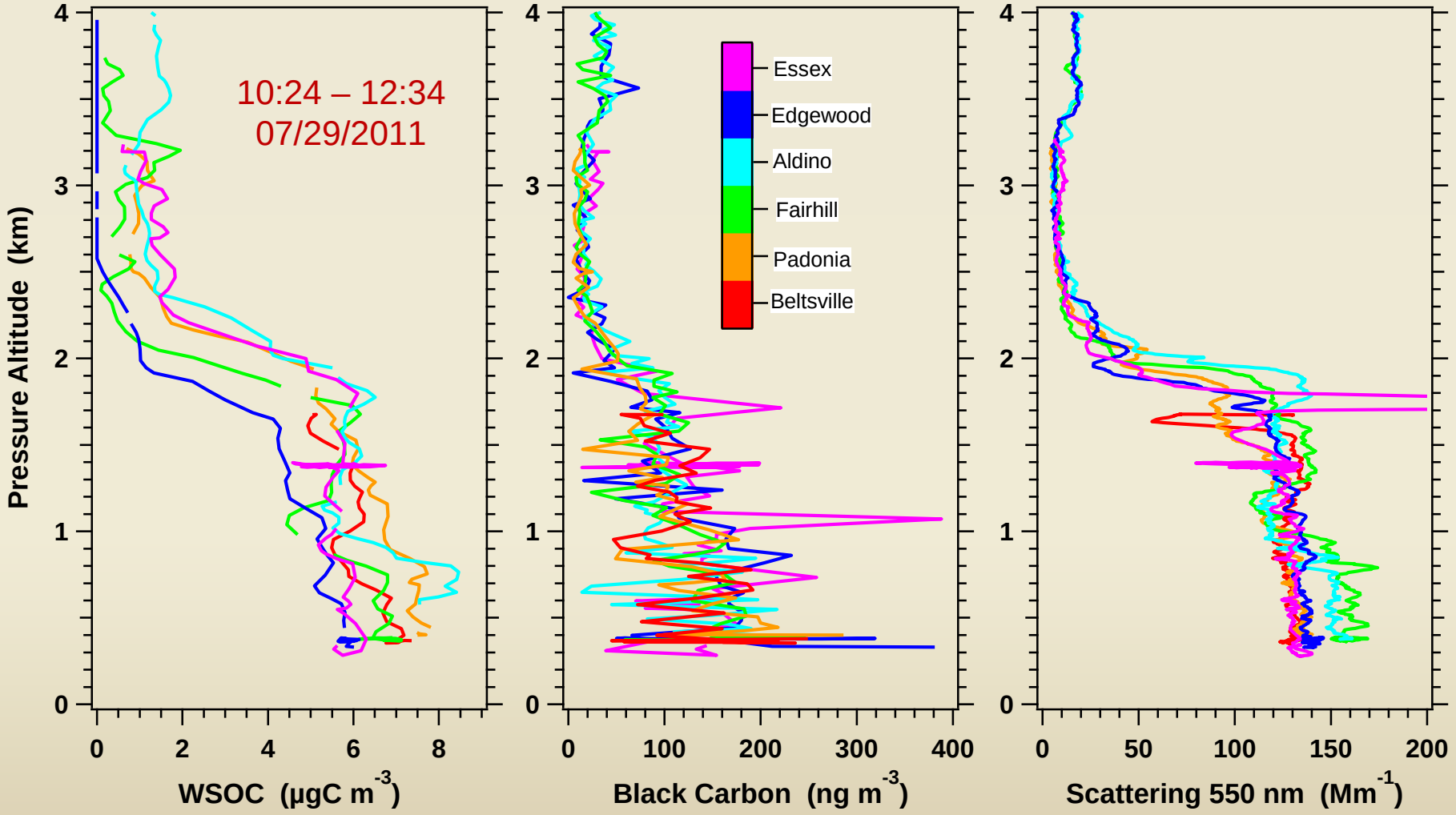




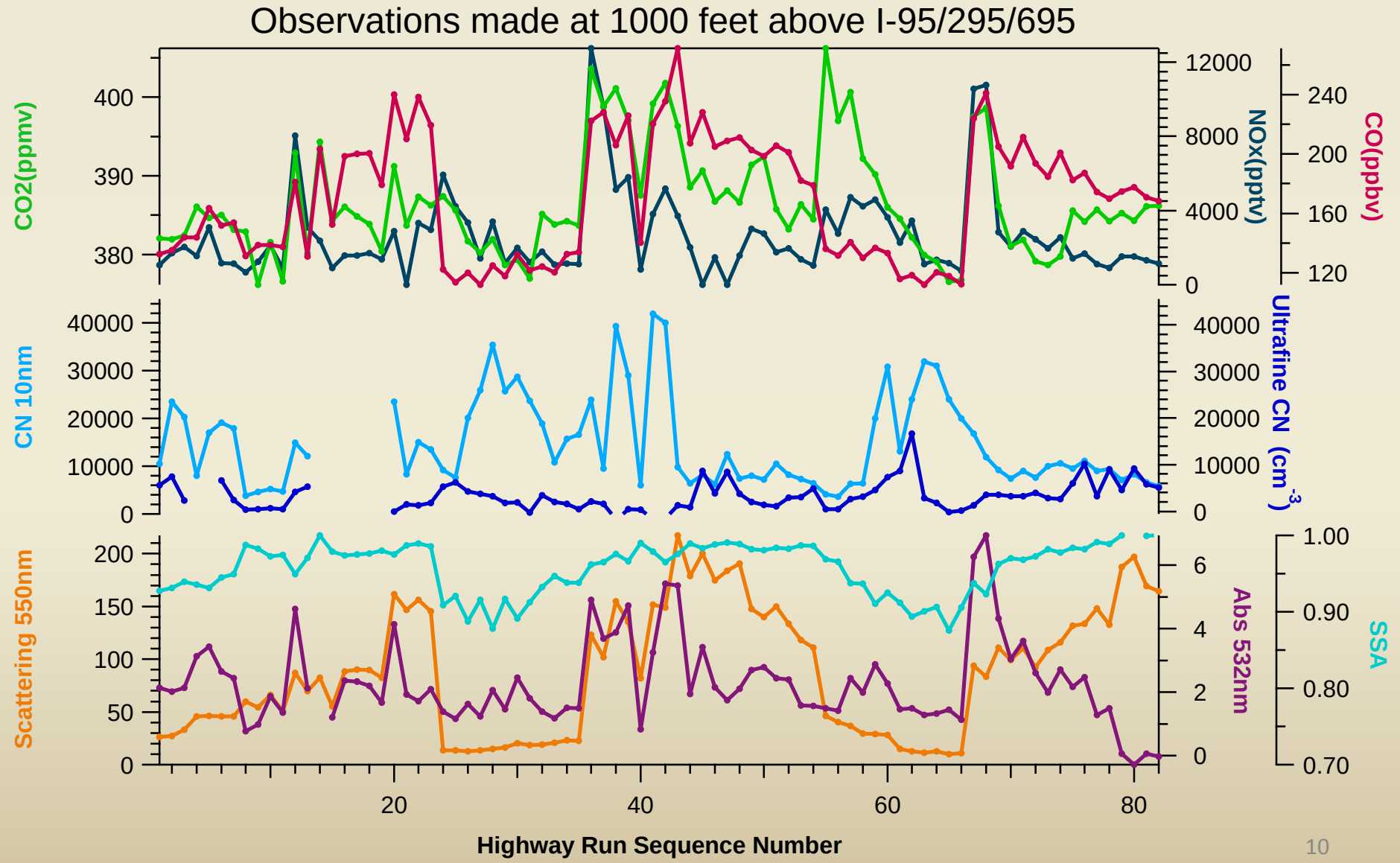


A total of 250 vertical profiles were flown during the DISCOVER-AQ Washington/Baltimore deployment

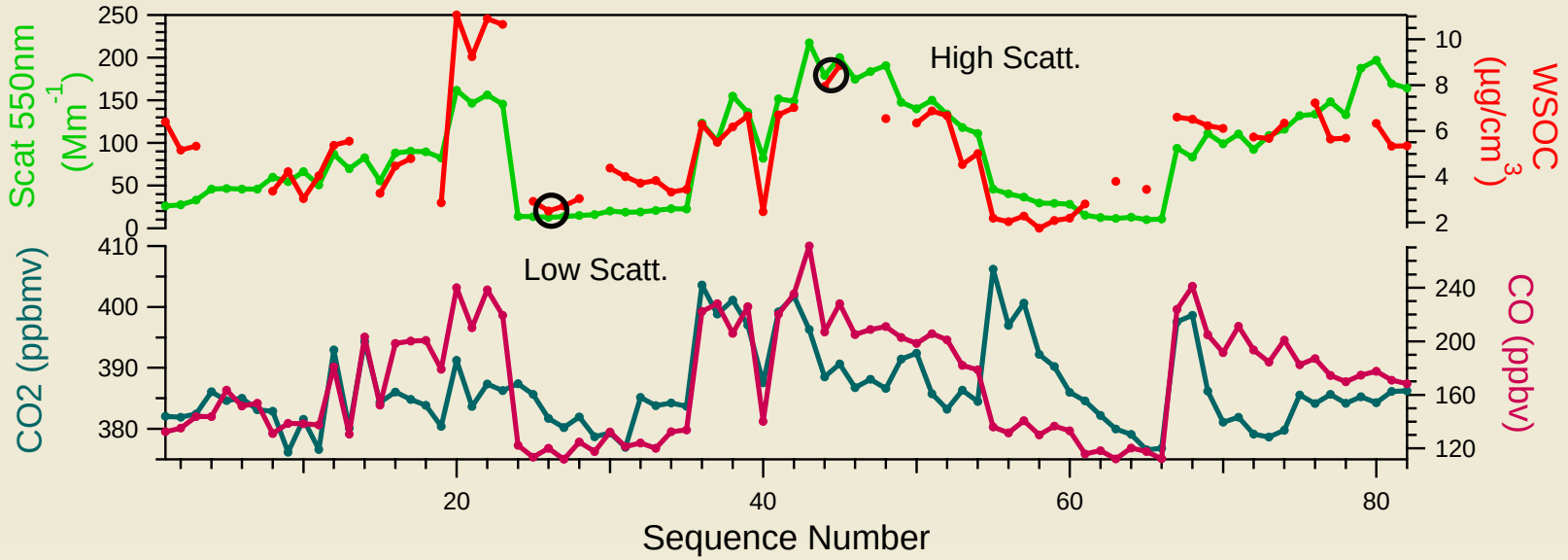
Vertical Profile Comparison
Spatial Variability

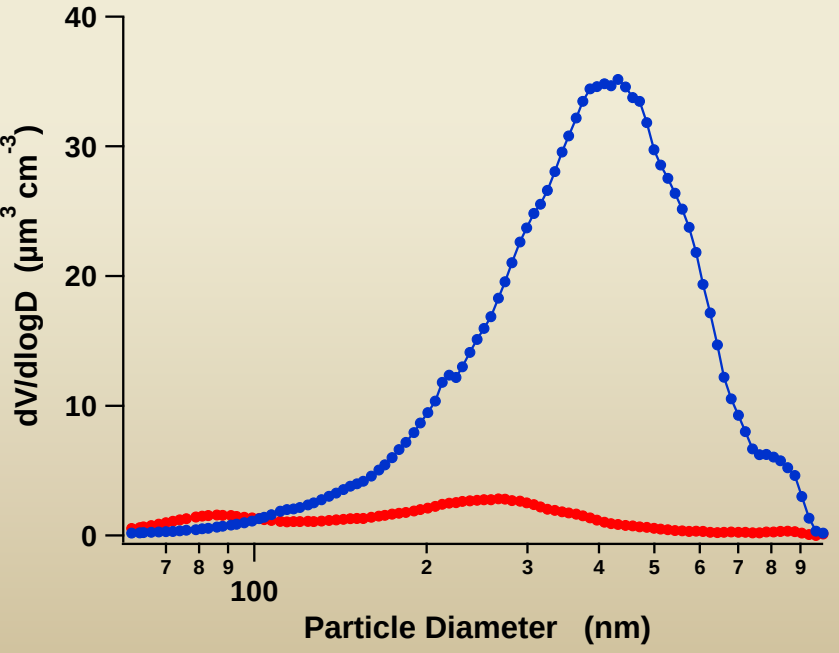


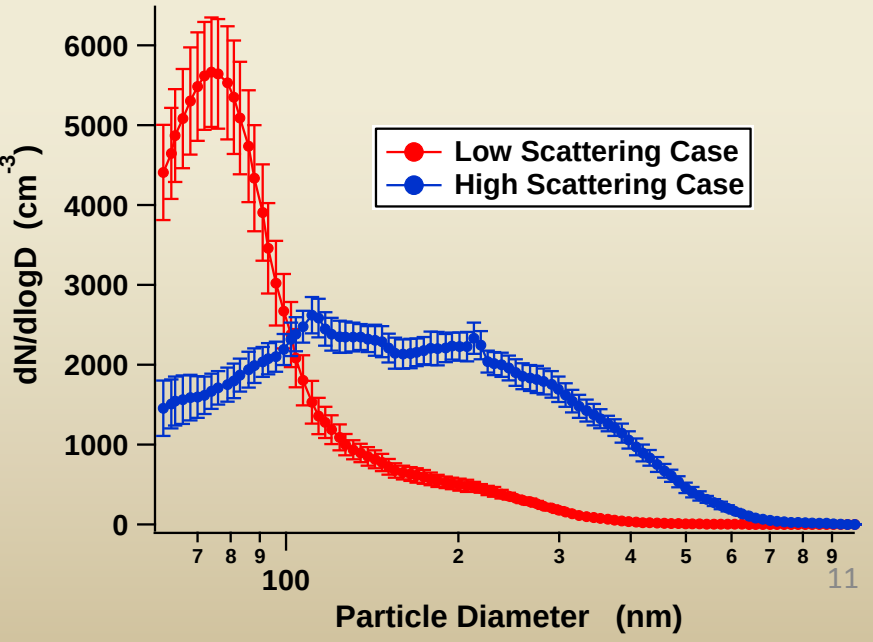
P-3B Highway Observations
Overview



P-3B Highway Observations
Size Distribution Comparison

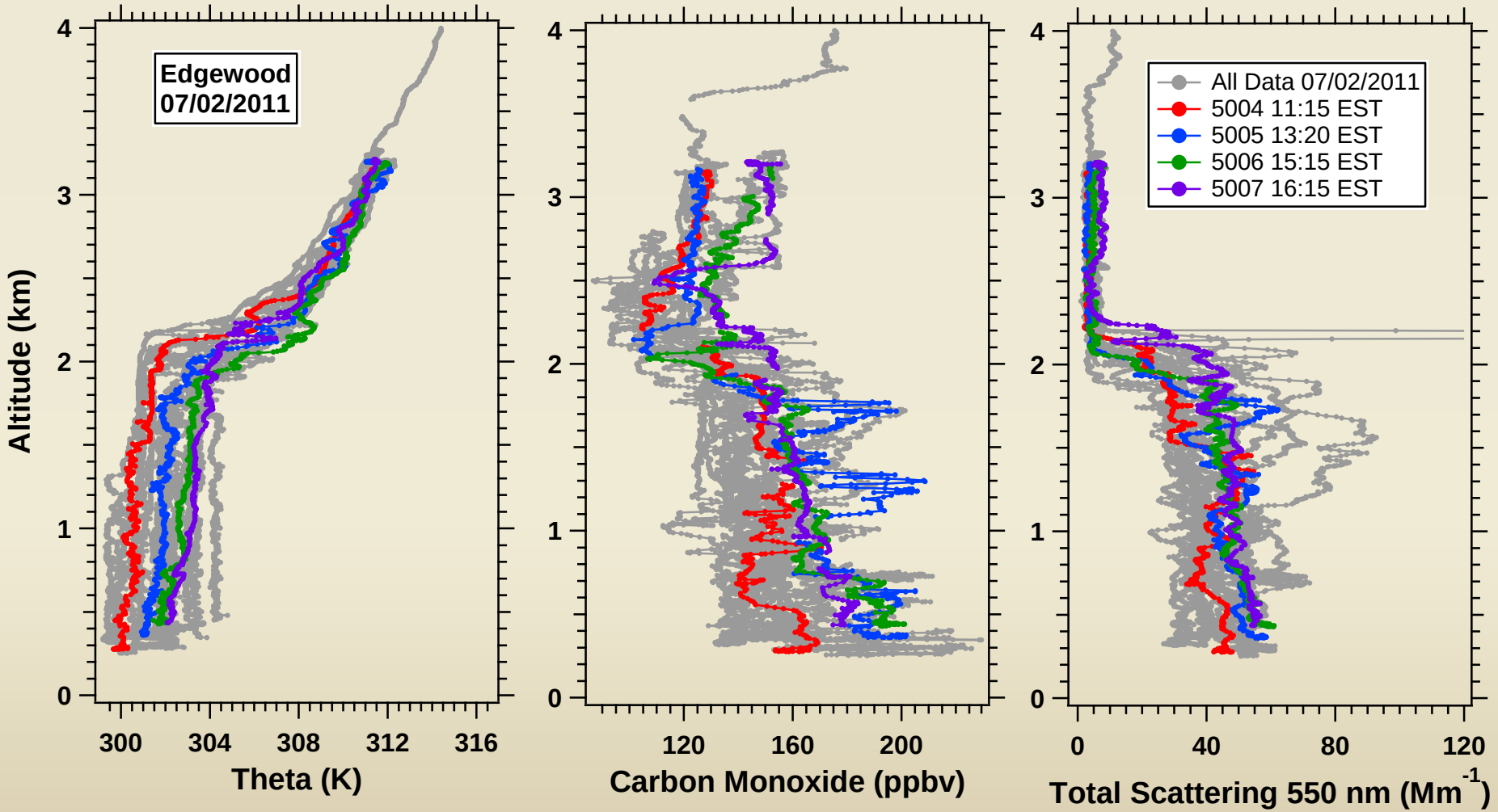






DISCOVER-AQ Data Products

Vertical Profile Plots



DISCOVER-AQ Data Products

- DISCOVER-AQ data release date: December 1, 2011
- DISCOVER-AQ data website:

http://www-air.larc.nasa.gov/missions/discover-aq/discover-aq.html

- DRAGON data website:

http://aeronet.gsfc.nasa.gov/new_web/dragon.html#data

- Expected DISCOVER-AQ Data Products:
  - PI files, including in-situ measurement of wet scattering and dry particle size distribution
  - Merge files including profile flags
  - Gridded vertical profiles: 0.1 km
  - Integrated column data
  - BL height estimates from aircraft vertical profiles, ozonesondes, and lidar retrieval.

Acknowledgment

All data shown are preliminary and subject to changes

- ***Boundary layer vertical profile plots made by Amy Thornhill (SSAI)***
- ***Highway data analysis conducted by Gabriela Agostini (UNC USRP student intern)***
- ***HSRL data products provided by Amy Jo Swanson (SSAI)***