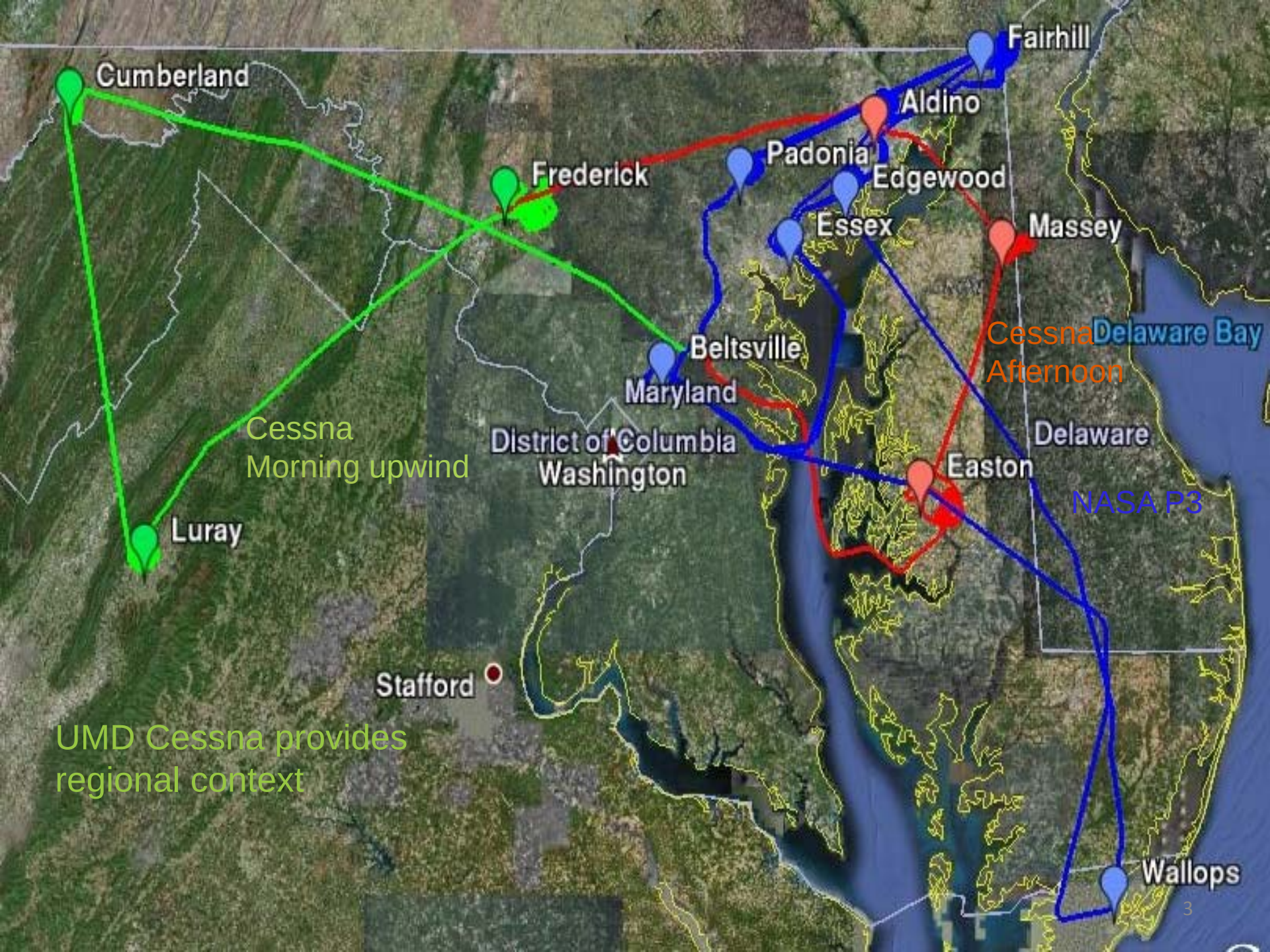
Dickerson Cessna 9:55-10:10

Russell R. Dickerson; Heather Arkinson; Lacey C. Brent; Daniel Goldberg; Hao He; Tamba L. Marufu; Jeffrey W. Stehr.

UMD/URF Cessna
Photo by J. Stehr


Fairhill
Cumberland
Aldino
Padonia
Frederick
Edgewood
Essex
Massey
Cessna
Afternoon
Delaware Bay
Beltsville
Maryland
Cessna
Morning upwind
District of Columbia
Washington
Delaware
Easton
NASA P3
Luray
Stafford
UMD Cessna provides
regional context
Wallops

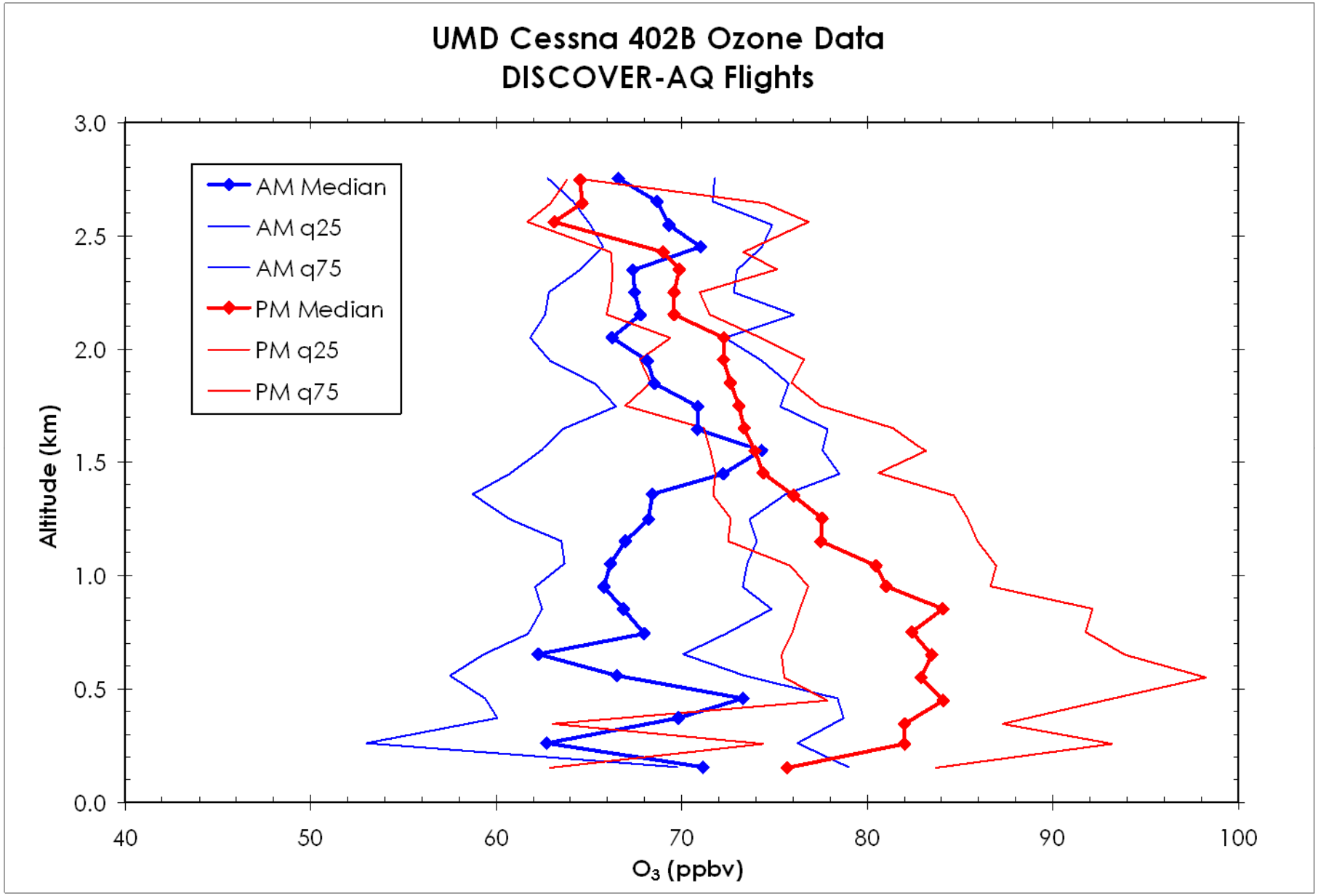
From **Tad Aburn**, MDE: Key Policy-Relevant Science Questions

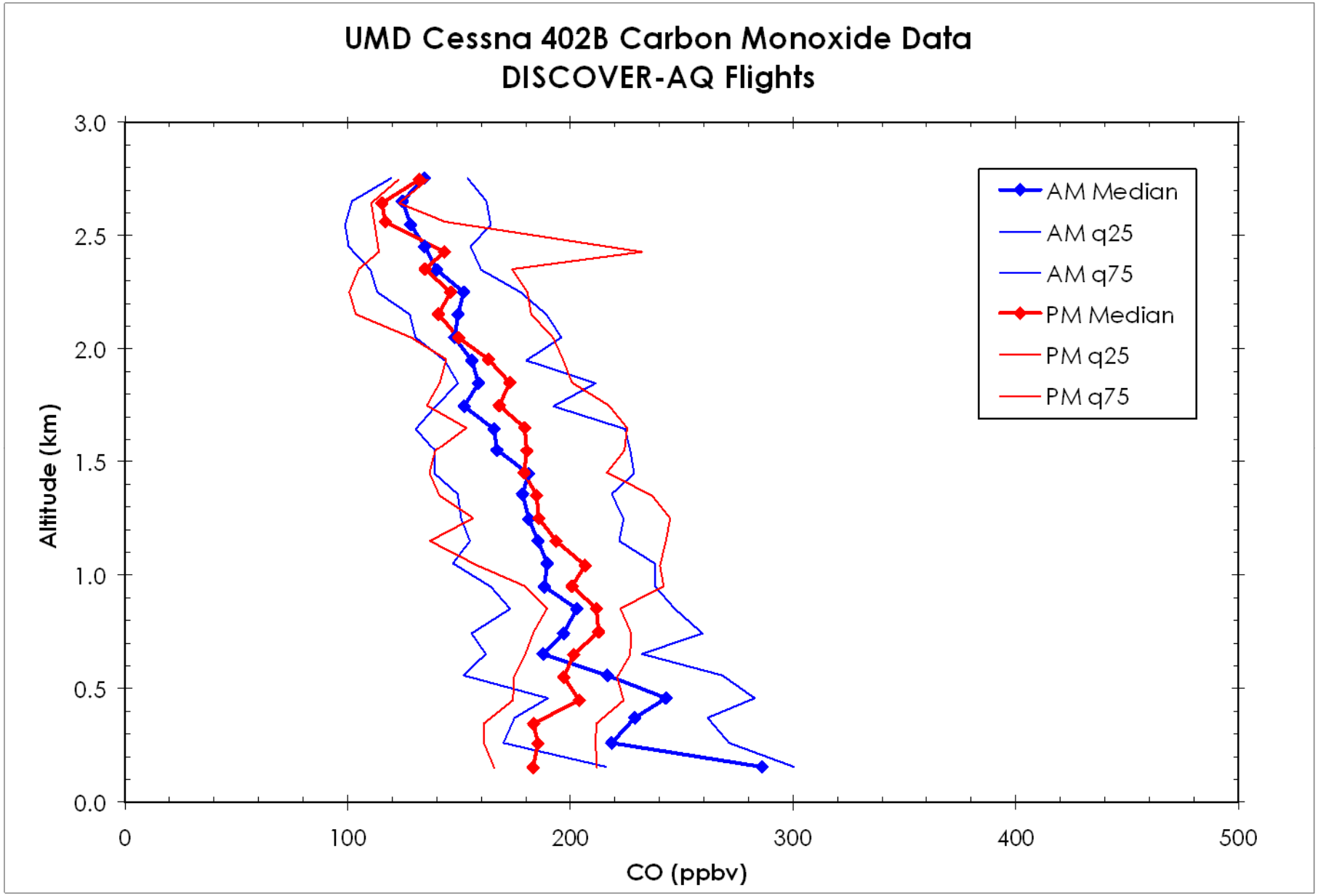
What does the science tell us about the pollutants and **scale** of the control areas (local, super-regional, national) needed to address the new ozone and fine particle standards over the next ten years? How does this relate to the controls needed to address other key concerns like NO_2, SO_2, Hg and regional haze?

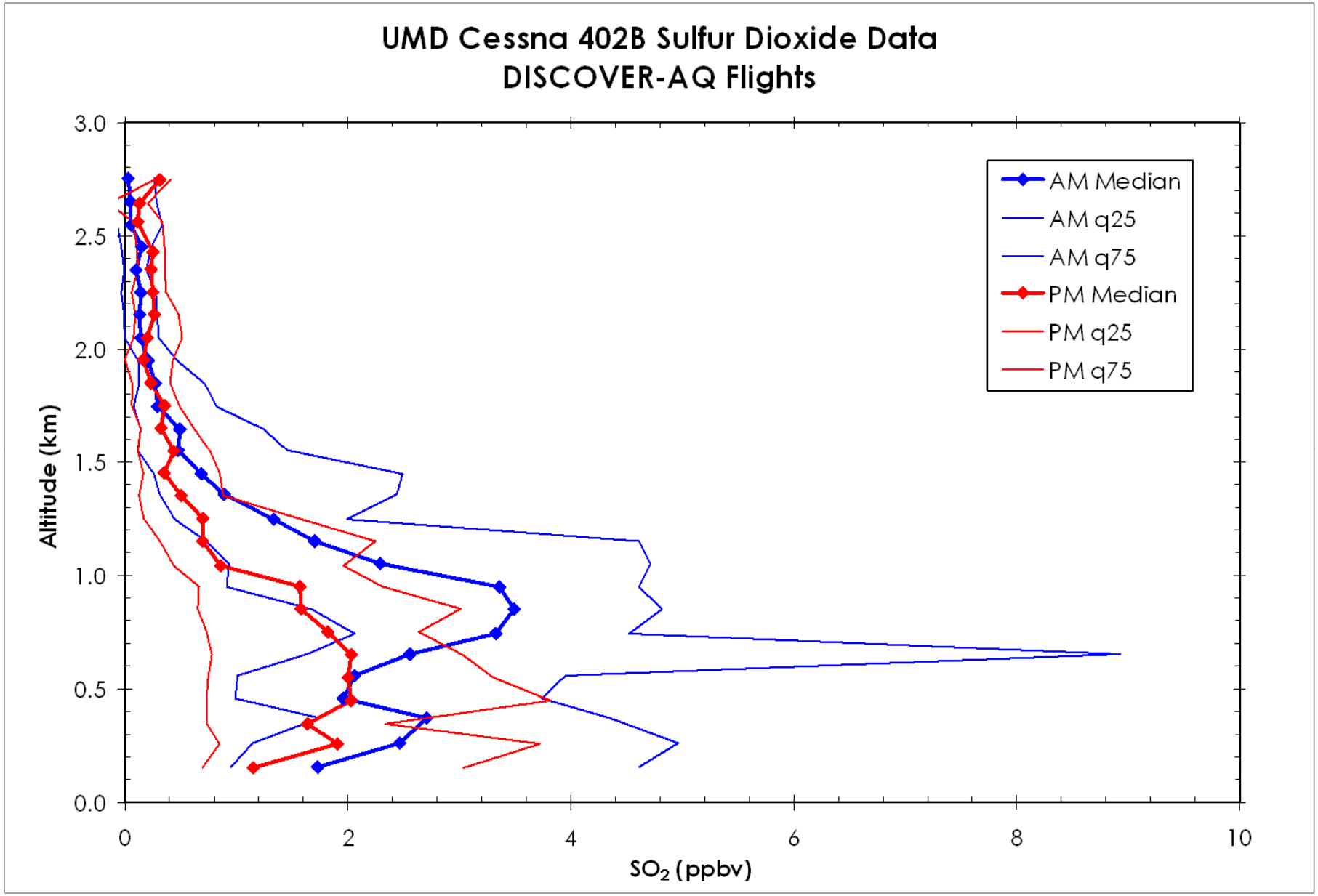
We compare upwind morning flights(Cumberland, Frederick, and Luray) to downwind afternoon (Aldino, Easton, Massey) flights.

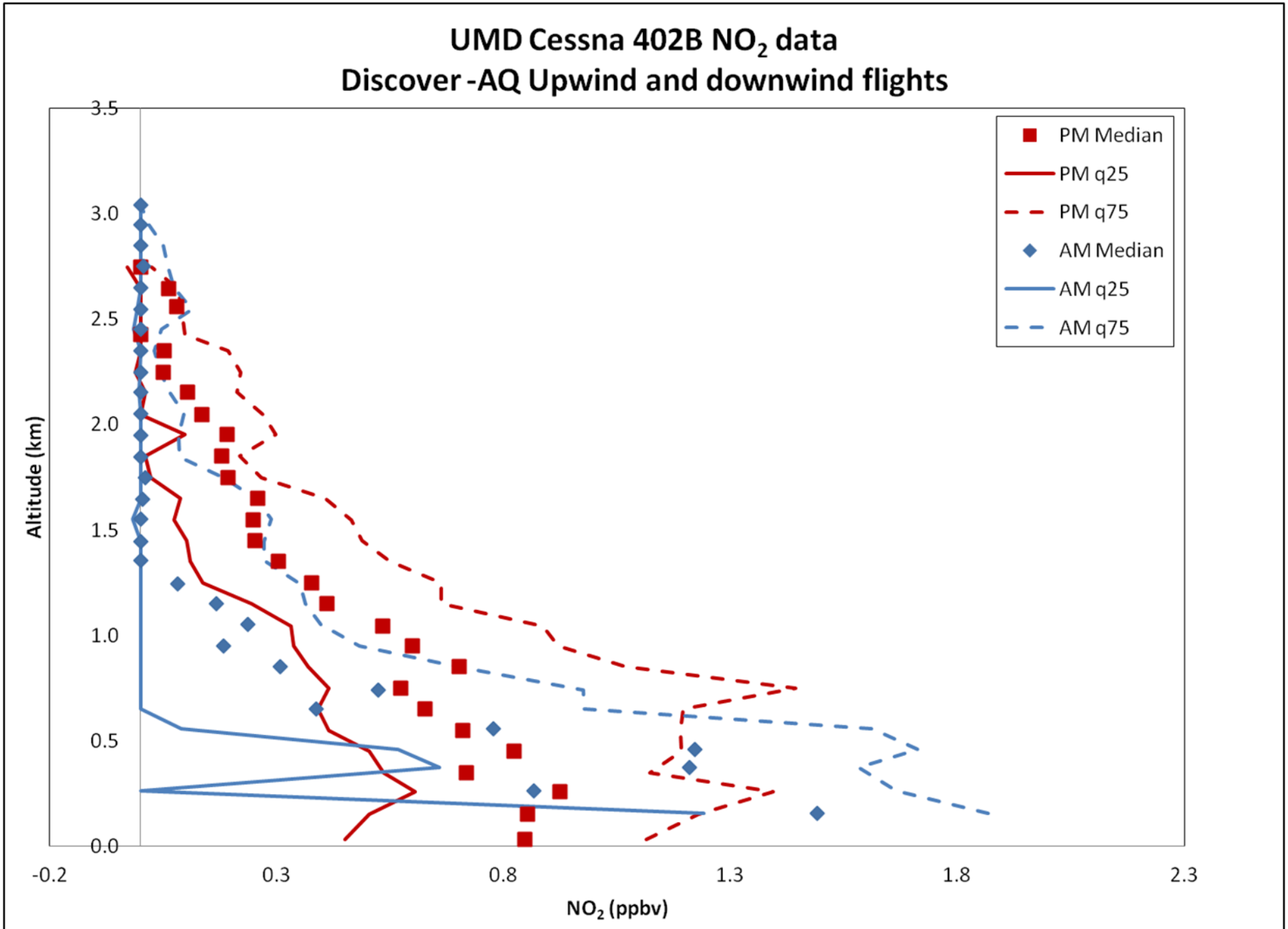
Will show O_3, CO, SO_2, and NO_2.

Also have met, aerosol counts, b_{sp}, BC, and VOC's.


UMD Cessna 402B Ozone Data
DISCOVER-AQ Flights
AM Median
AM q25
AM q75
PM Median
PM q25
PM q75
Altitude (km)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
40
50
60
70
80
90
100
O3 (ppbv)


UMD Cessna 402B Carbon Monoxide Data
DISCOVER-AQ Flights
Altitude (km)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
100
200
300
400
500
CO (ppbv)
AM Median
AM q25
AM q75
PM Median
PM q25
PM q75


UMD Cessna 402B Sulfur Dioxide Data
DISCOVER-AQ Flights
Altitude (km)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
2
4
6
8
10
SO2 (ppbv)
AM Median
AM q25
AM q75
PM Median
PM q25
PM q75


UMD Cessna 402B NO2 data
Discover -AQ Upwind and downwind flights
PM Median
PM q25
PM q75
AM Median
AM q25
AM q75
Altitude (km)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.2
0.3
0.8
1.3
1.8
2.3
NO2 (ppbv)

Conclusions:

1. Pollutant concentrations change from upwind to downwind (of Balt.) and from morning to afternoon.

- Greater concentrations of primary pollutants (CO, SO_2, NO_2) in the shallow morning PBL.
- Greater concentrations aloft in afternoon, downwind.
- Greater concentrations of O_3 (5-15 ppb) at all altitudes below ~2000 m in afternoon, downwind.

2. NO_2 was much greater (~150 vs <50ppt) in LFT in afternoon downwind. Baltimore and Washington are pumping NOx into LFT and exporting it downwind.

3.The Baltimore urban area adds about 10 ppb to the incoming background of 65 ppb O_3. Policy-Relevant Regional Signature.

Next Steps:

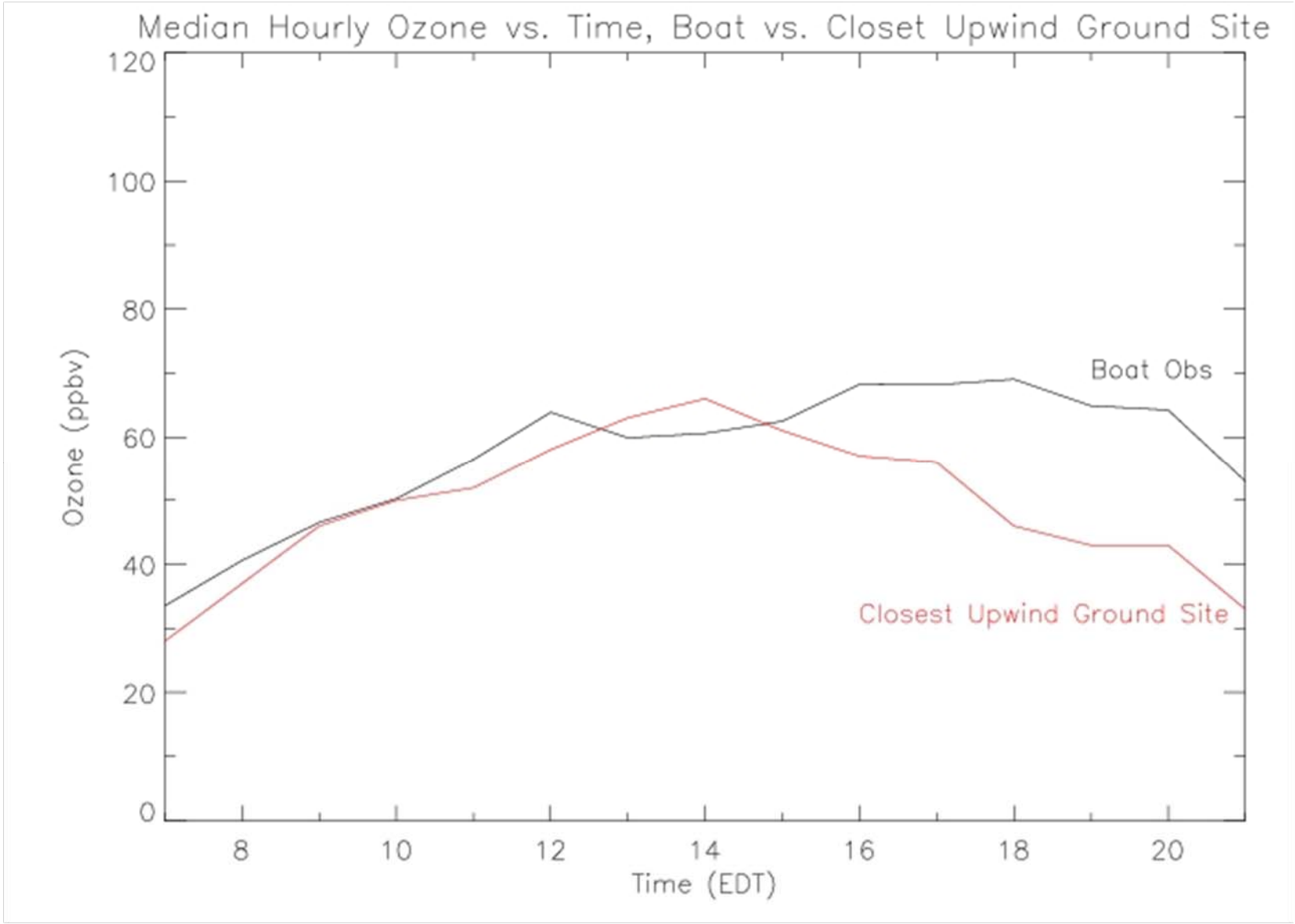
1. Examine P-3 profiles at fixed locations as a fnx of time of day.

2. Determine of NO_2 aloft is transport, chemistry or both.

3. Parse the data by back trajectories – where is air coming from?

4. See what CMAQ gives for the increase from Cumberland and Frederick to Aldino and Easton.

5. Why is there more O_3 over the Bay?

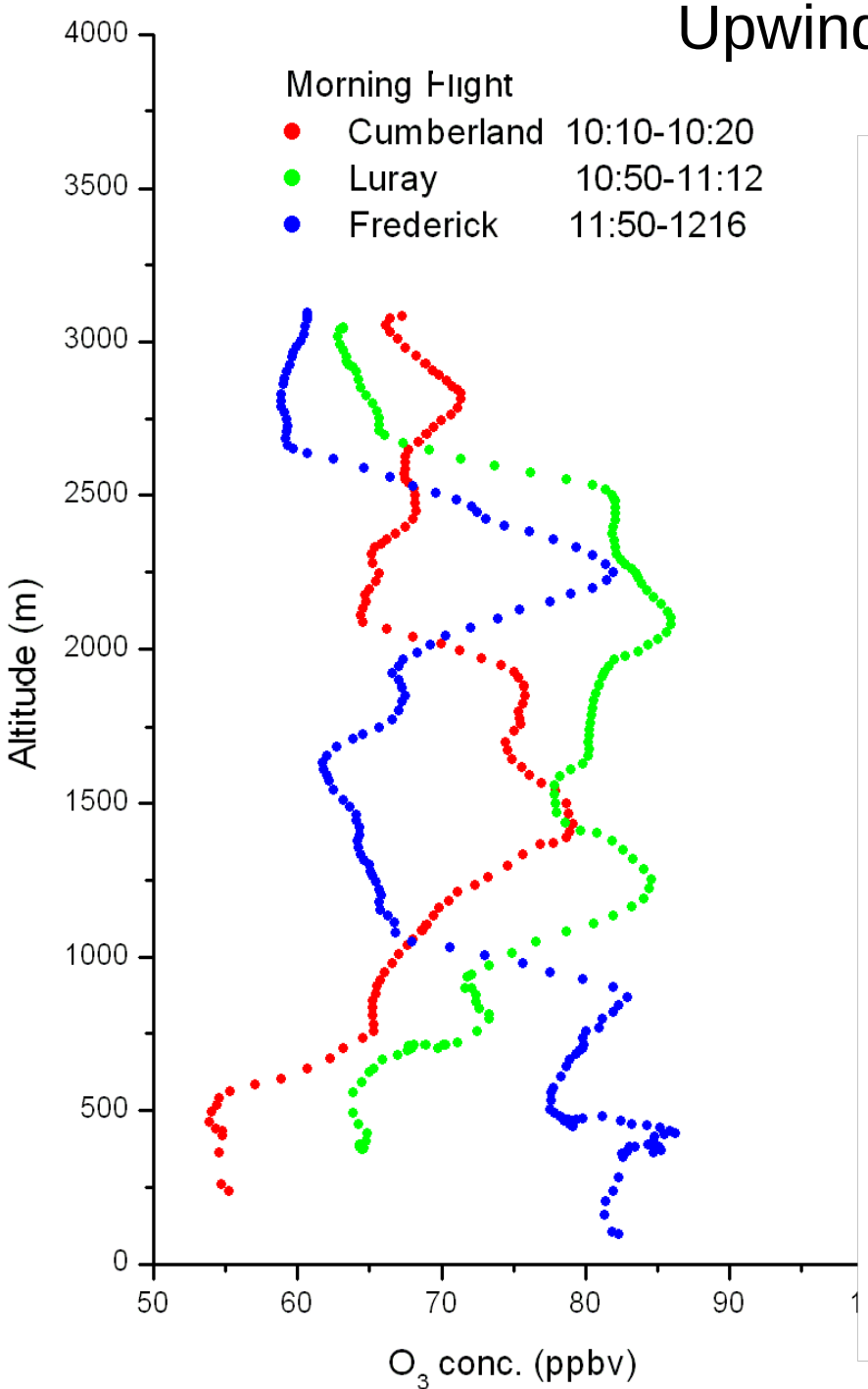

Median Hourly Ozone vs. Time, Boat vs. Closet Upwind Ground Site
Ozone (ppbv)
120
100
80
60
40
20
0
8
10
12
14
16
18
20
Time (EDT)
Boat Obs
Closest Upwind Ground Site

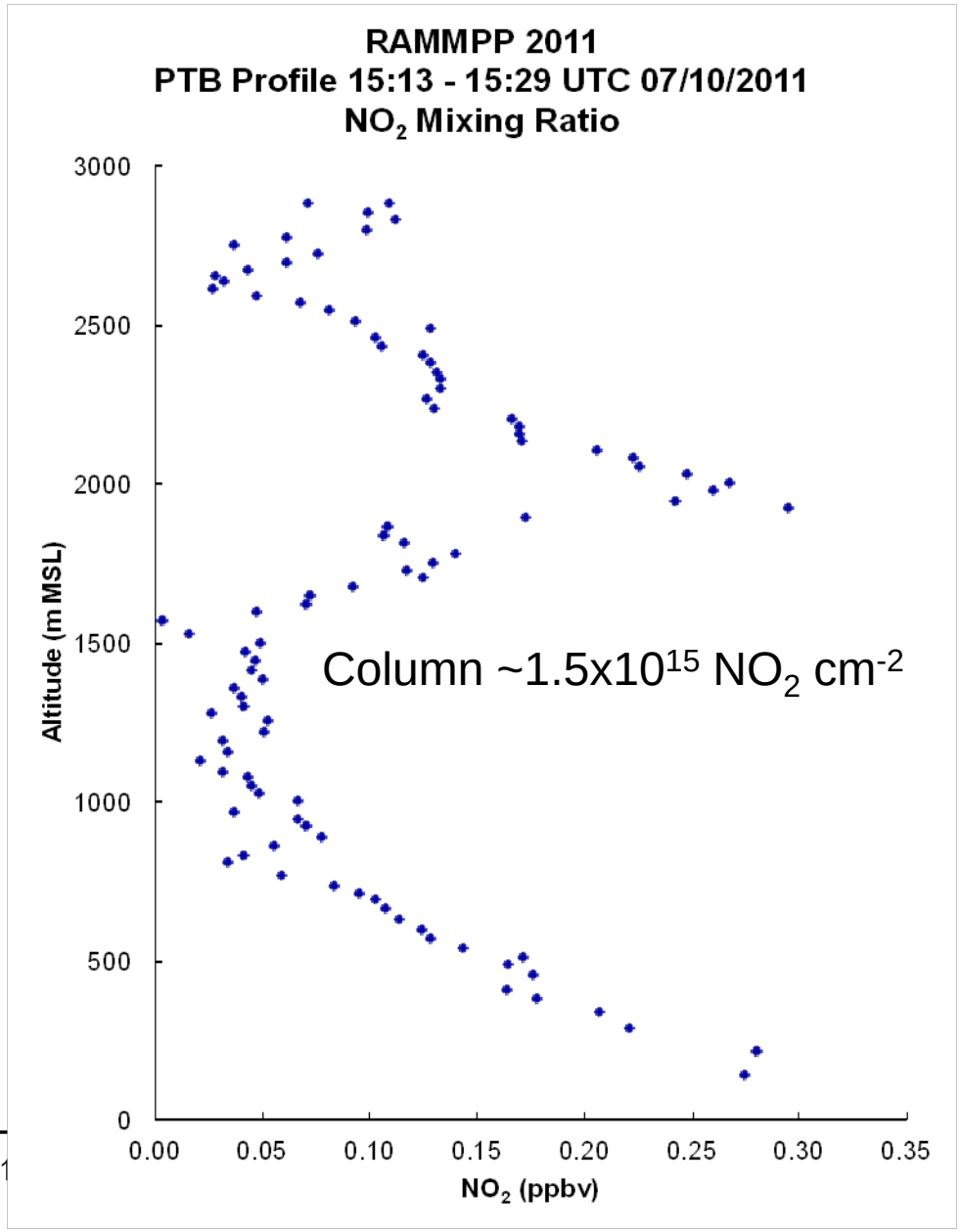
The End

Fear the Turtle!

Propene Dichlorodifluoromethane Chloromethane 1,2-Dichloro-1,1,2,2,tetrafluoroleth Chloroethene 1,3-Butadiene Bromomethane Chloroethane Trichlorofluoromethane Ethanol Acetonitrile Acrolein Acetone Acrylonitrile 1,1-Dichloroethene Methylene Chloride Carbon disulfide Isopropyl Alcohol 1,1,2-Trichloro-1,2,2-trifluoroethane Trans-1,2-Dichloroethene 1,1-Dichloroethane Vinyl Acetate 2-methoxy-2-methyl-Propane Methyl ethyl Ketone (2-butanone) Cis-1,2-Dichloroethene Hexane Chloroform Ethyl Acetate Tetrahydrofuran 1,2-Dichloroethane 1,1,1-Trichloroethane Benzene Carbon tetrachloride Cyclohexane 1,2-Dichloropropane Bromodichloromethane Trichloroethene 1,4-Dioxane Heptane Cis-1,3-Dichloro-1-Propene Methyl Isobutyl Ketone Trans-1,3-Dichloro-1-Propene 1,1,2-Trichloroethane Toluene Dibrochloromethane Methyl butyl Ketone (2-Hexanone) 1,2-Dibromoethane Tetrachloroethylene Chlorobenzene Ethylbenzene m & p- Xylene Bromoform (Tribromomethane) Styrene 1,1,2,2-Tetrachloroethane o-Xylene 1-Ethyl-4-Methylbenzene 1,3,5-Trimethylbenzene 1,2,4-Trimethylbenzene Benzyl Chloride 1,3-dichlorobenzene 1,4-Dichlorobenzene 1,2-Dichlorobenzene 1,2,4-Trichlorobenzene Hexachloro-1,3-Butadiene

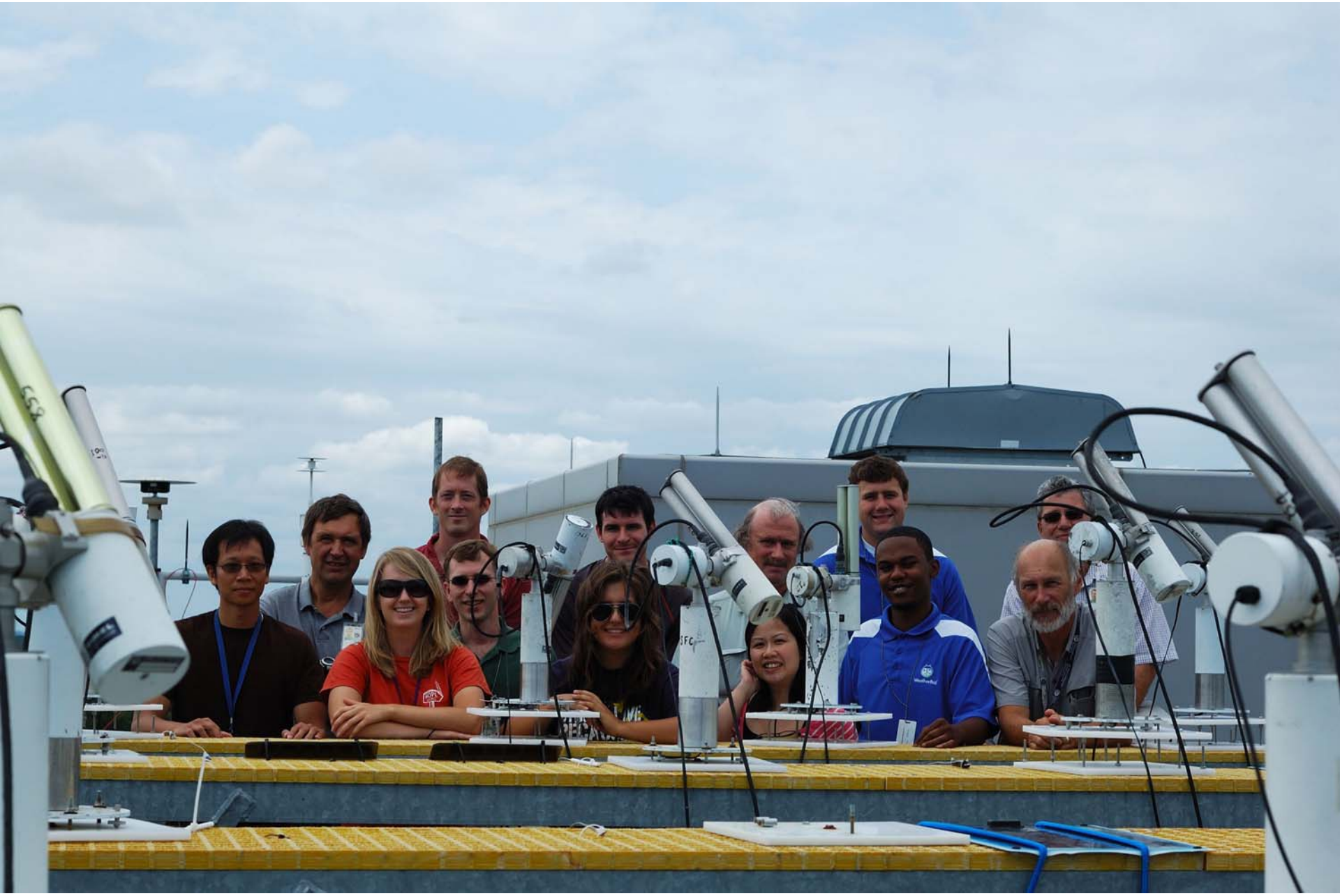
Upwind morning



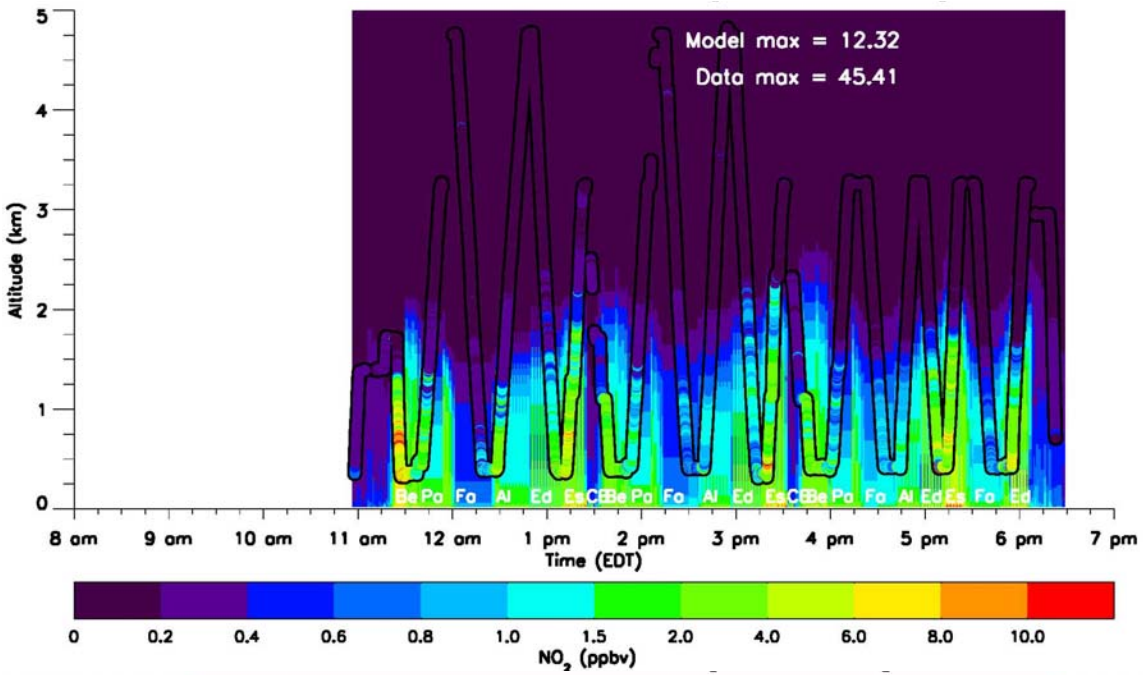


Thanks to many.

October 2011 RAMMPP meeting at MD Dept. Environ. on DISCOVER-AQ

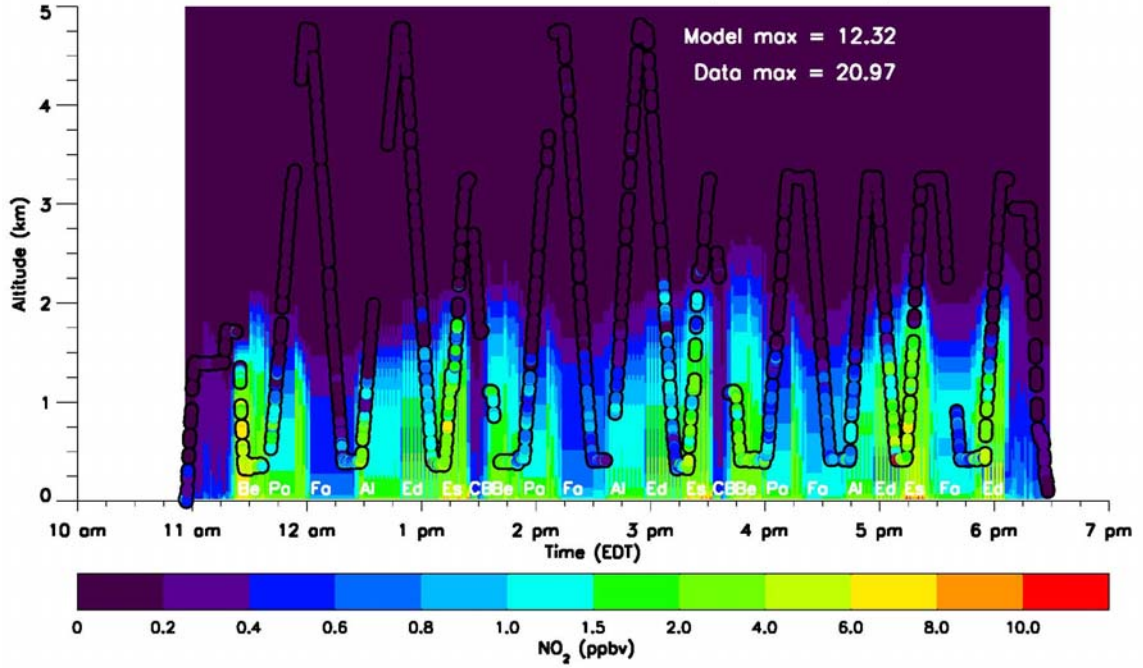


Flight #9 Thursday 7-21-2011



CMAQ NO_2 Curtain with Weinheimer NO_2

R=0.70



CMAQ NO_2 Curtain with Cohen NO_2

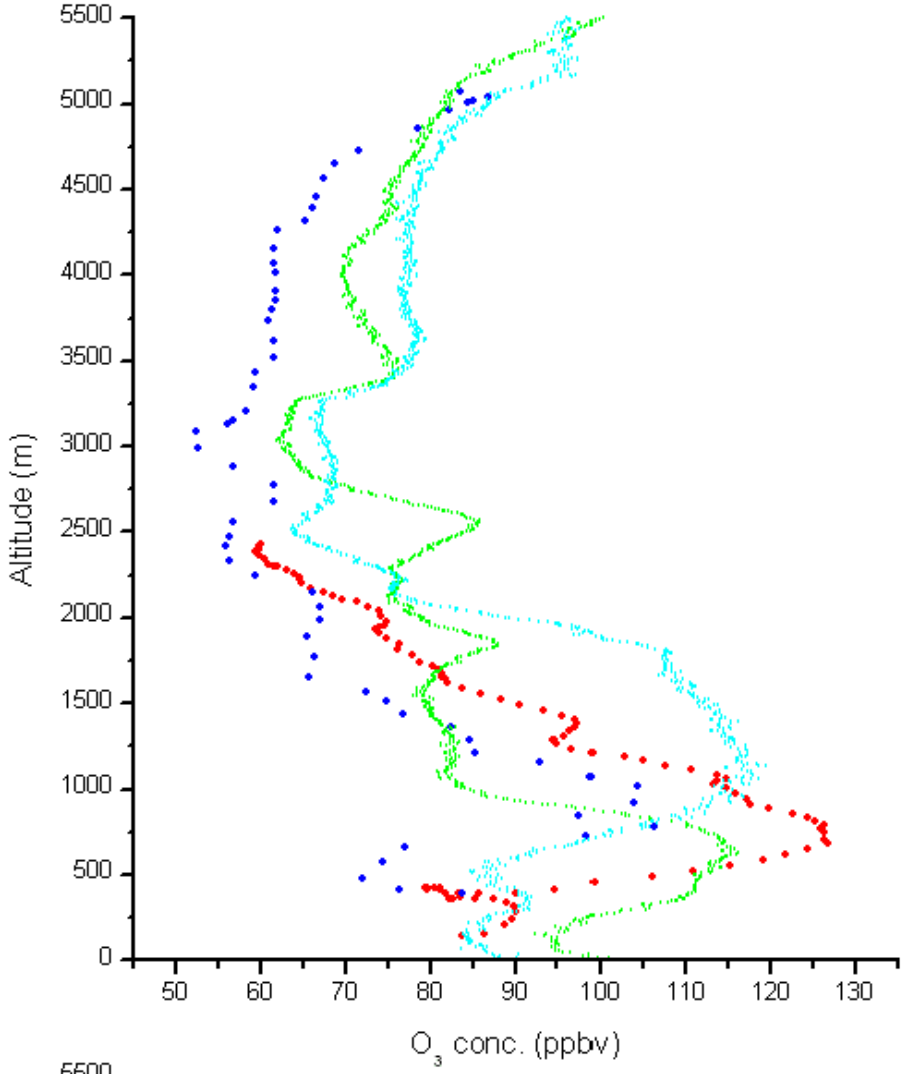
R=0.75

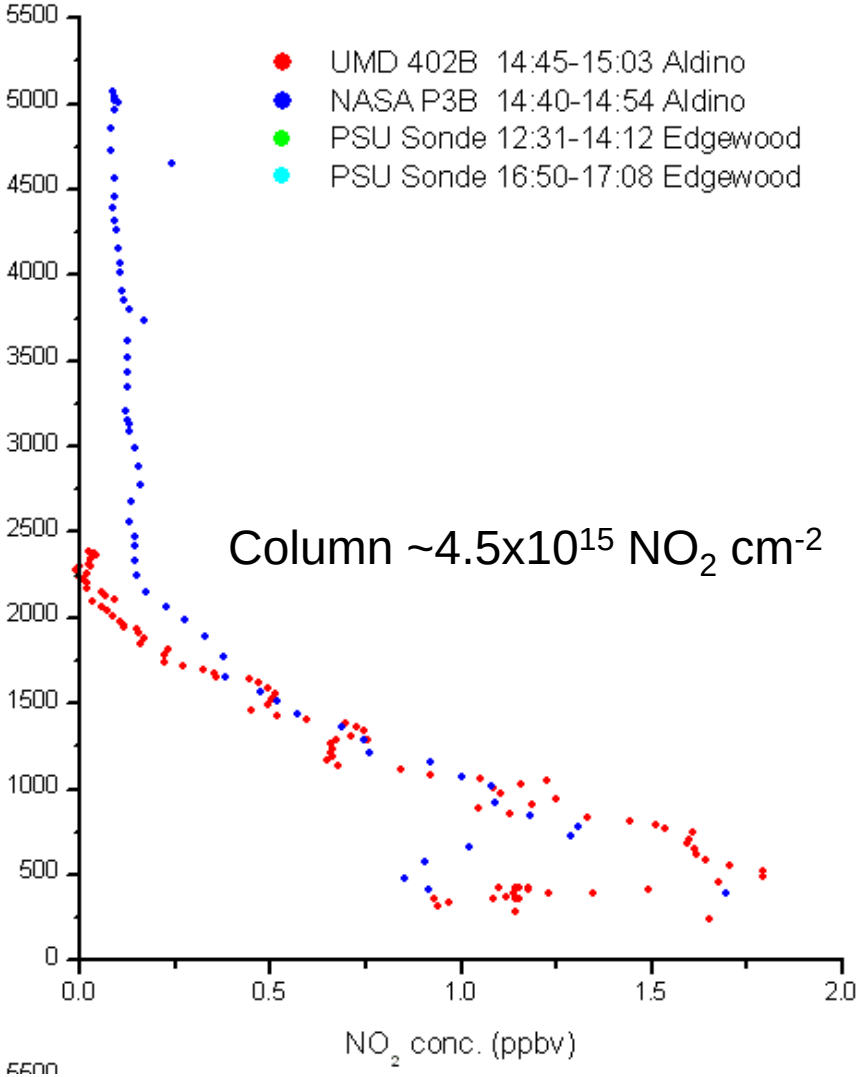
CMAQ agrees relatively well with both NO_2 datasets

Downwind afternoon,

Over Baltimore suburbs some, but not all of the elevated reservoir has mixed downward.

Brent et al. A13E-0363 Hao et al. A41C-0106.





Column ~4.5×10^{15} NO_2 cm^{-2}