Transport of CO and O_3 into the TexAQS II Study Area as Observed by the Atmospheric InfraRed Sounder (AIRS)

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Supported by the NASA Tropospheric Chemistry Program

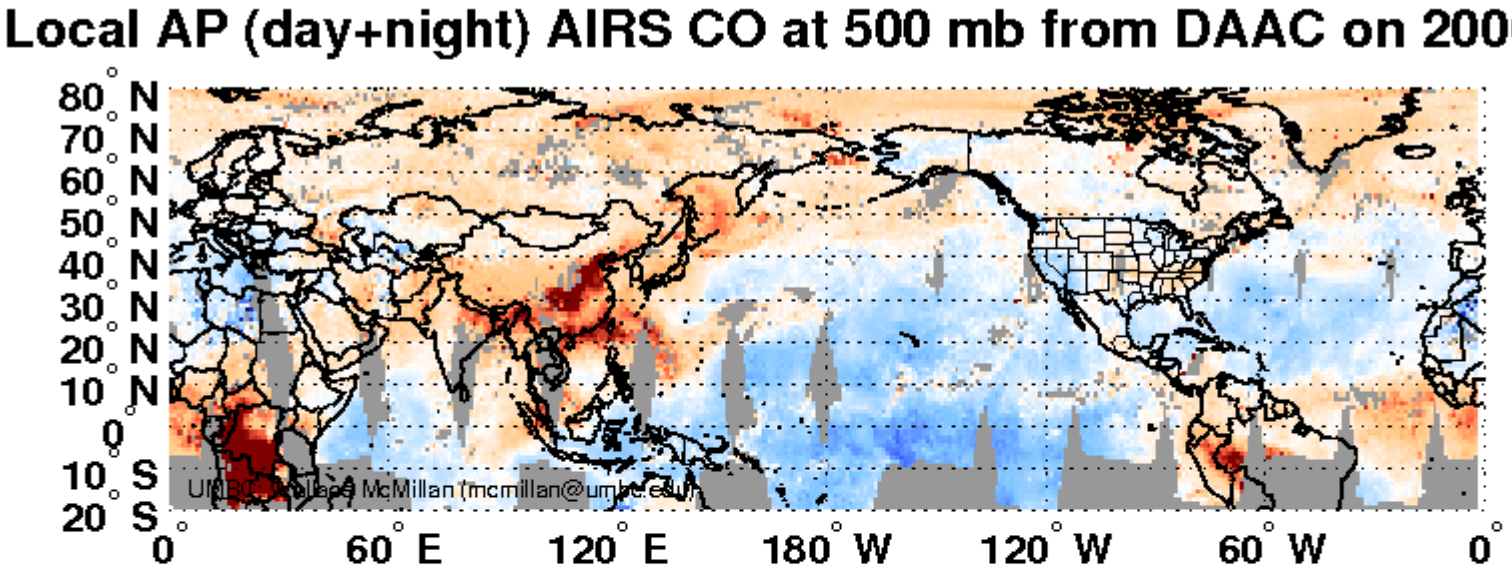
Thanks to the P-3 and AIRS Teams

AIRS:

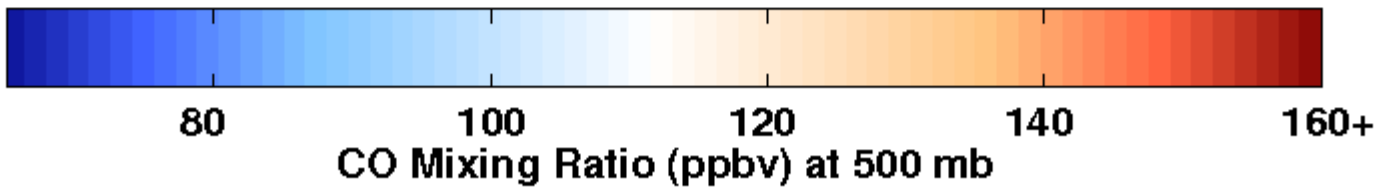
daily satellite BIG view

Questions G and H:

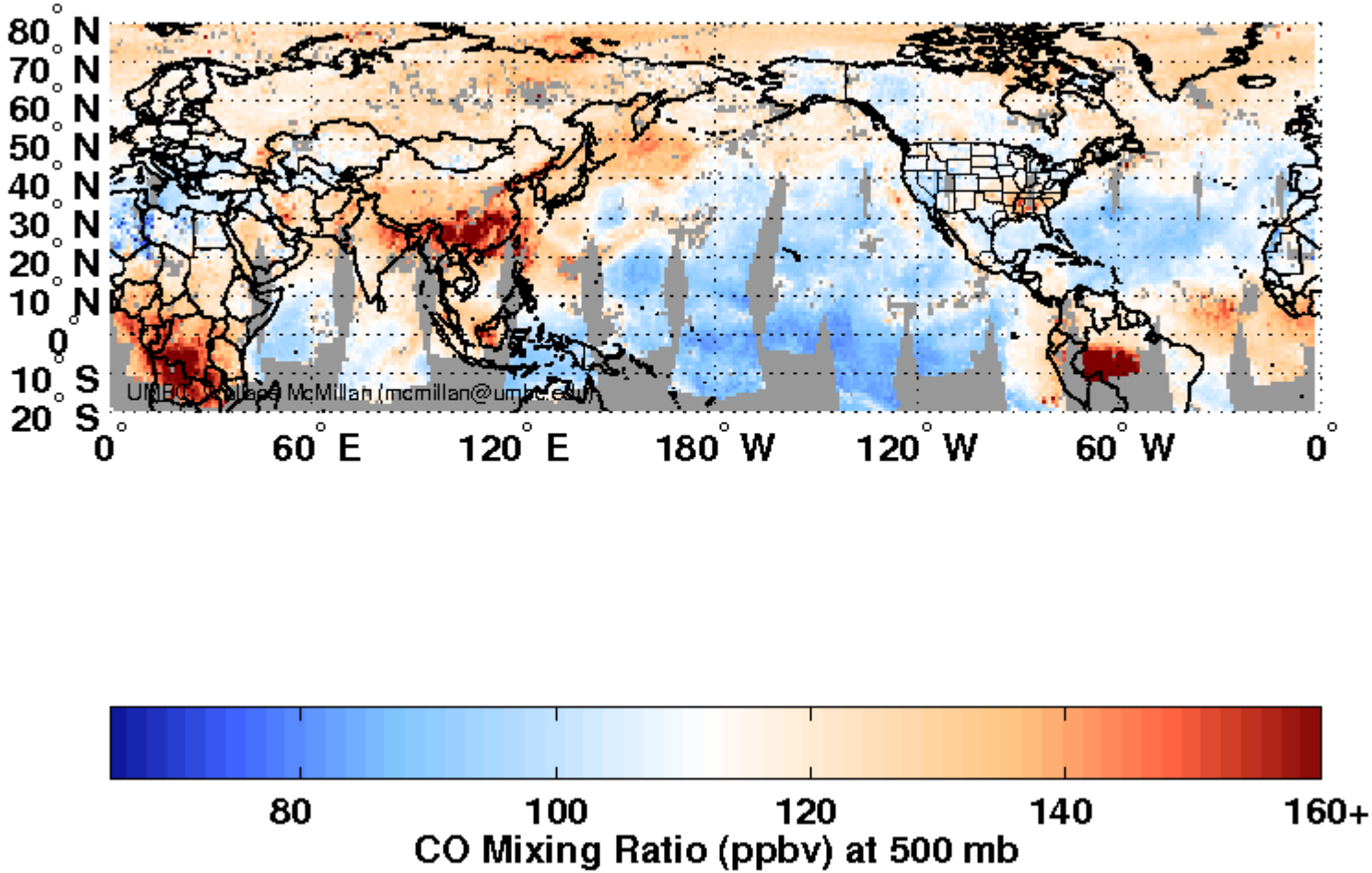
Distant sources and transport impacts



AIRS daily overview product v4.0.9.0



Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060821



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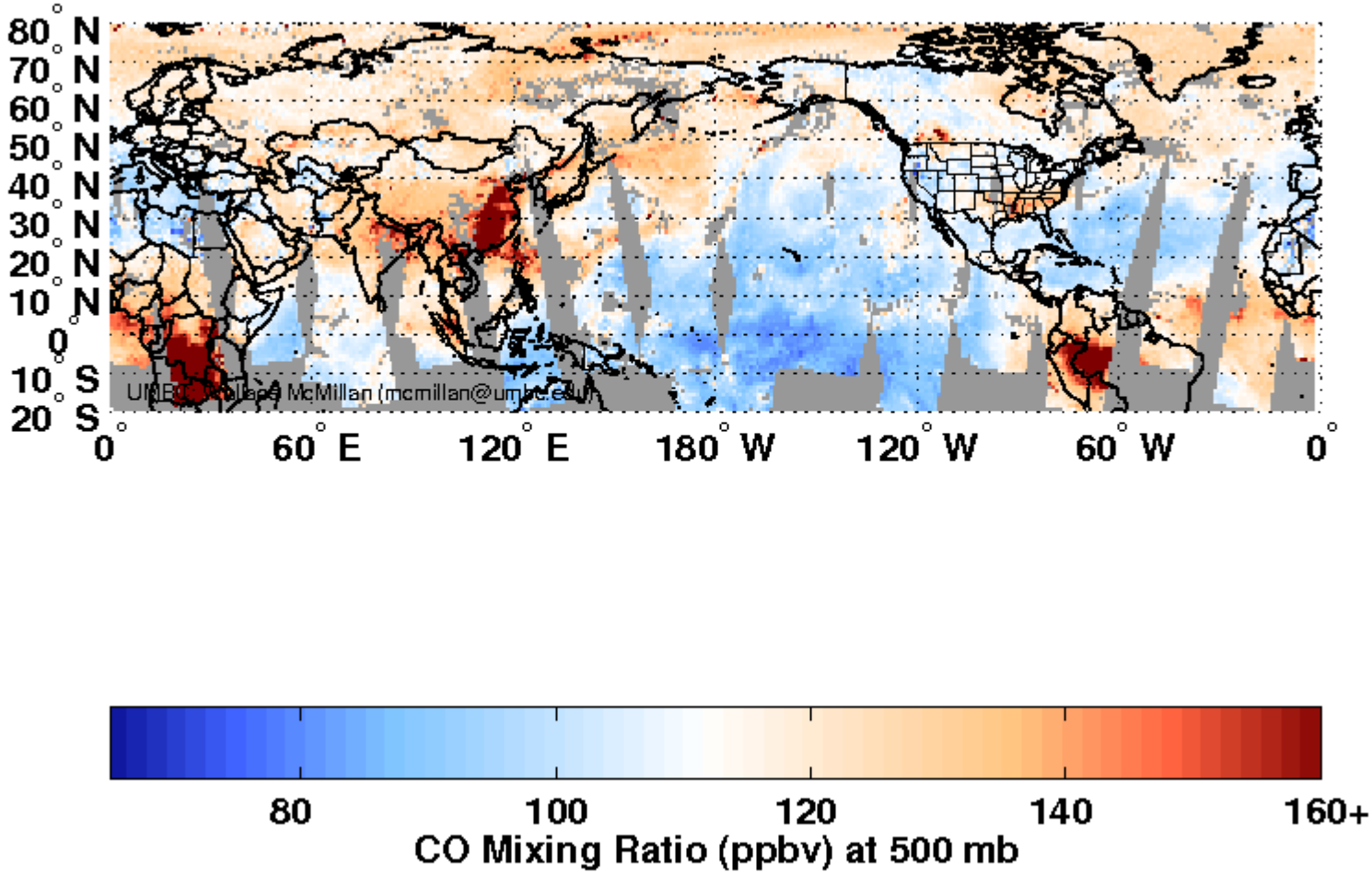

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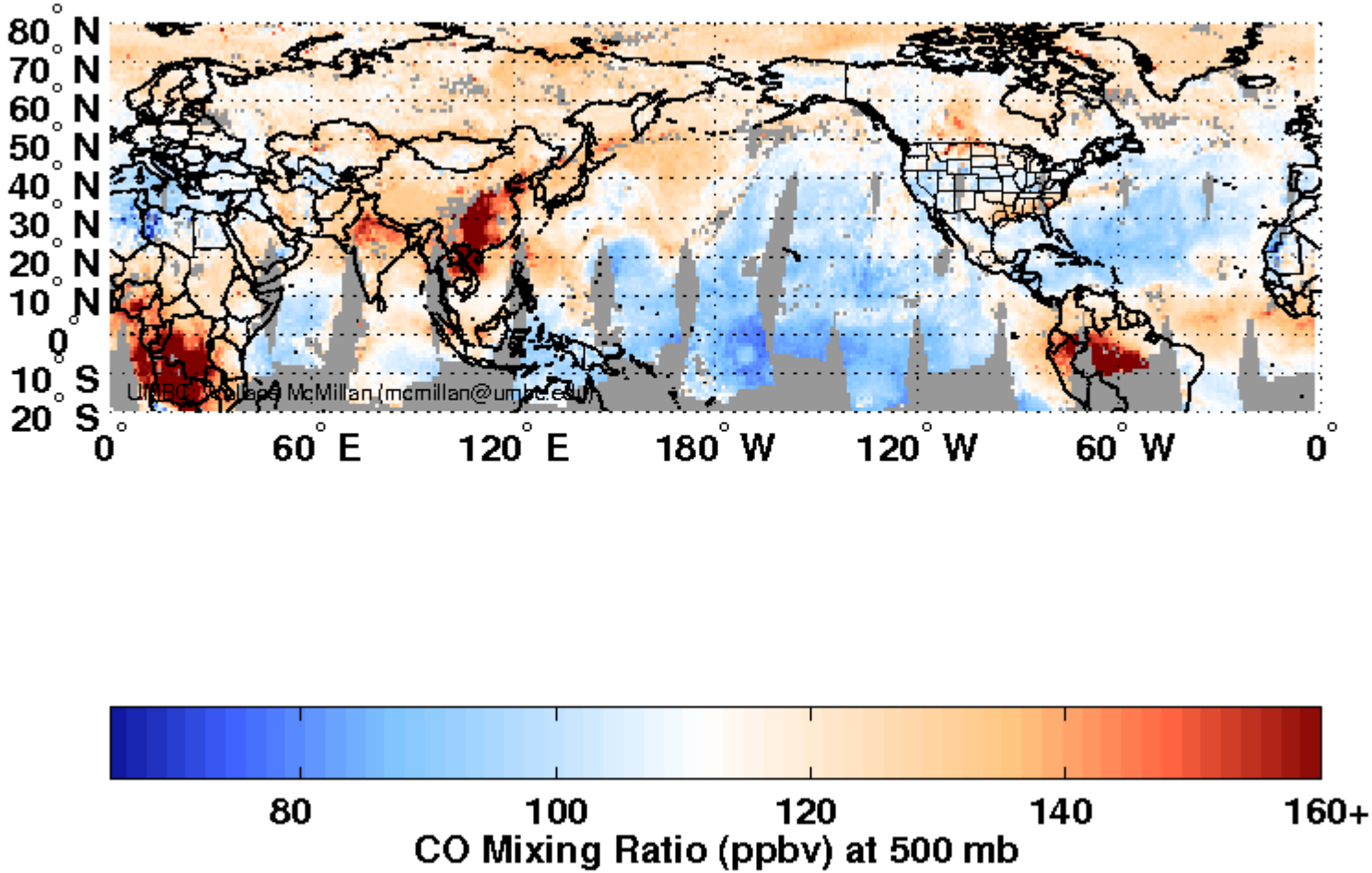

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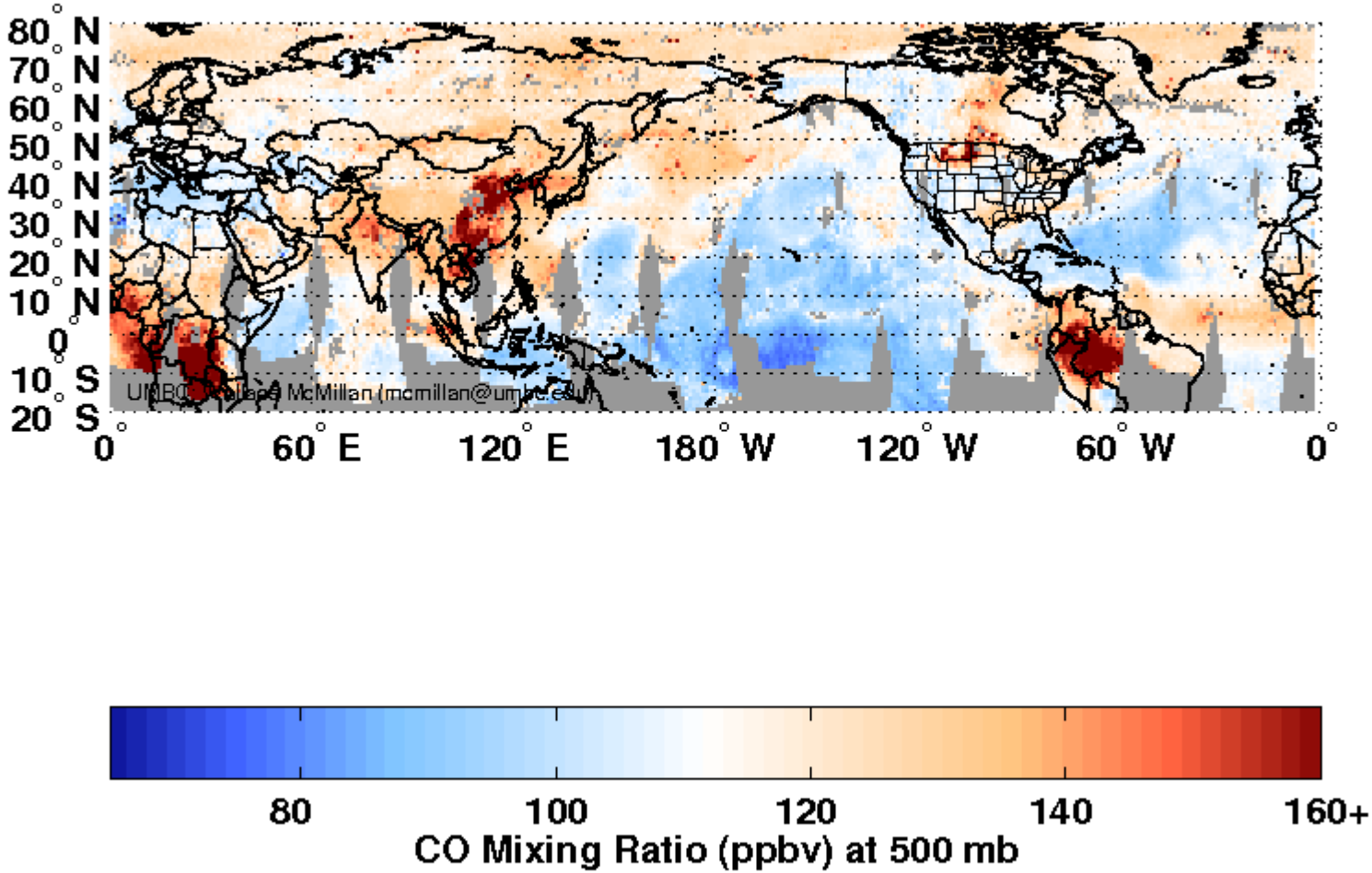

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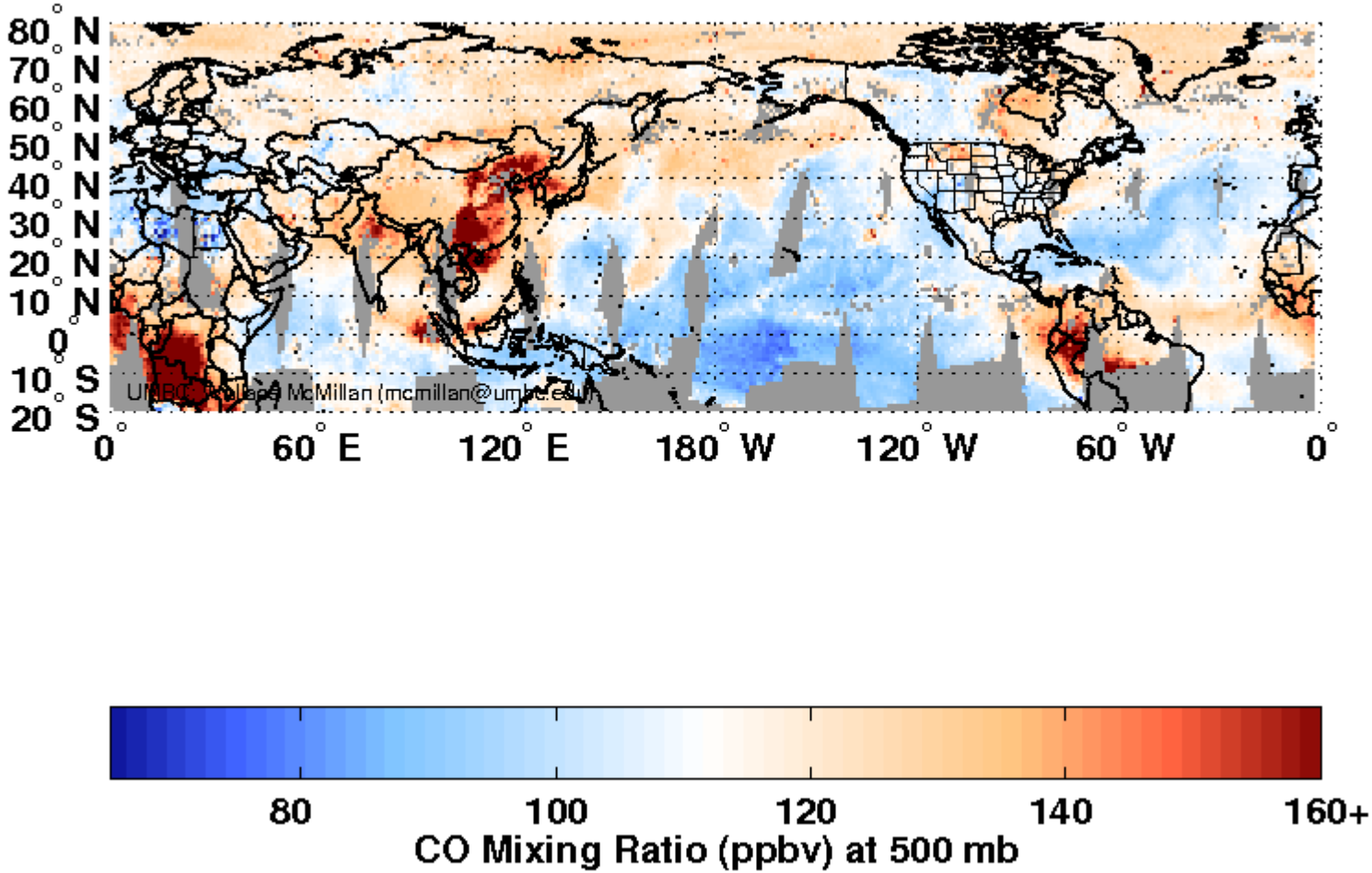
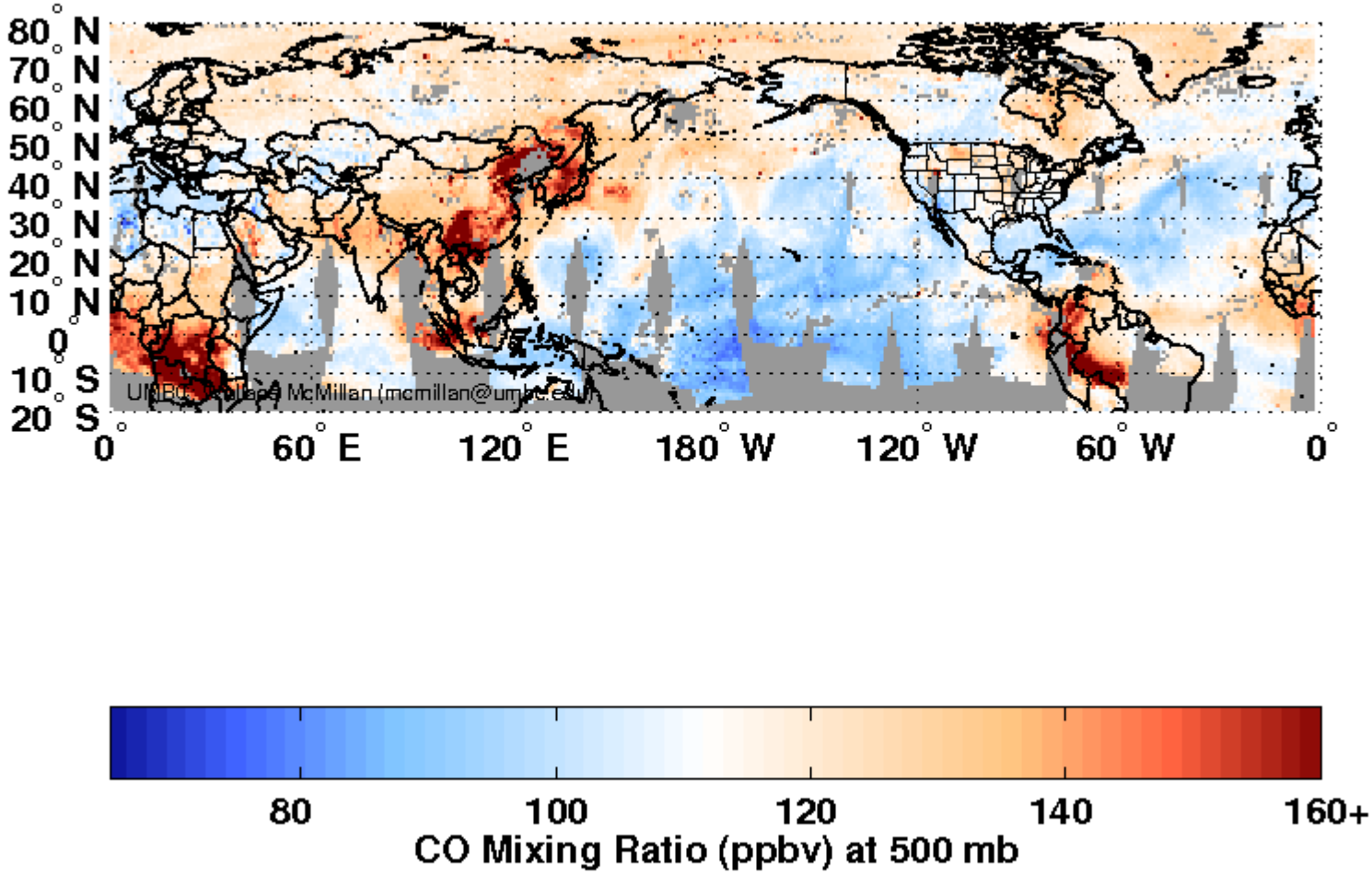
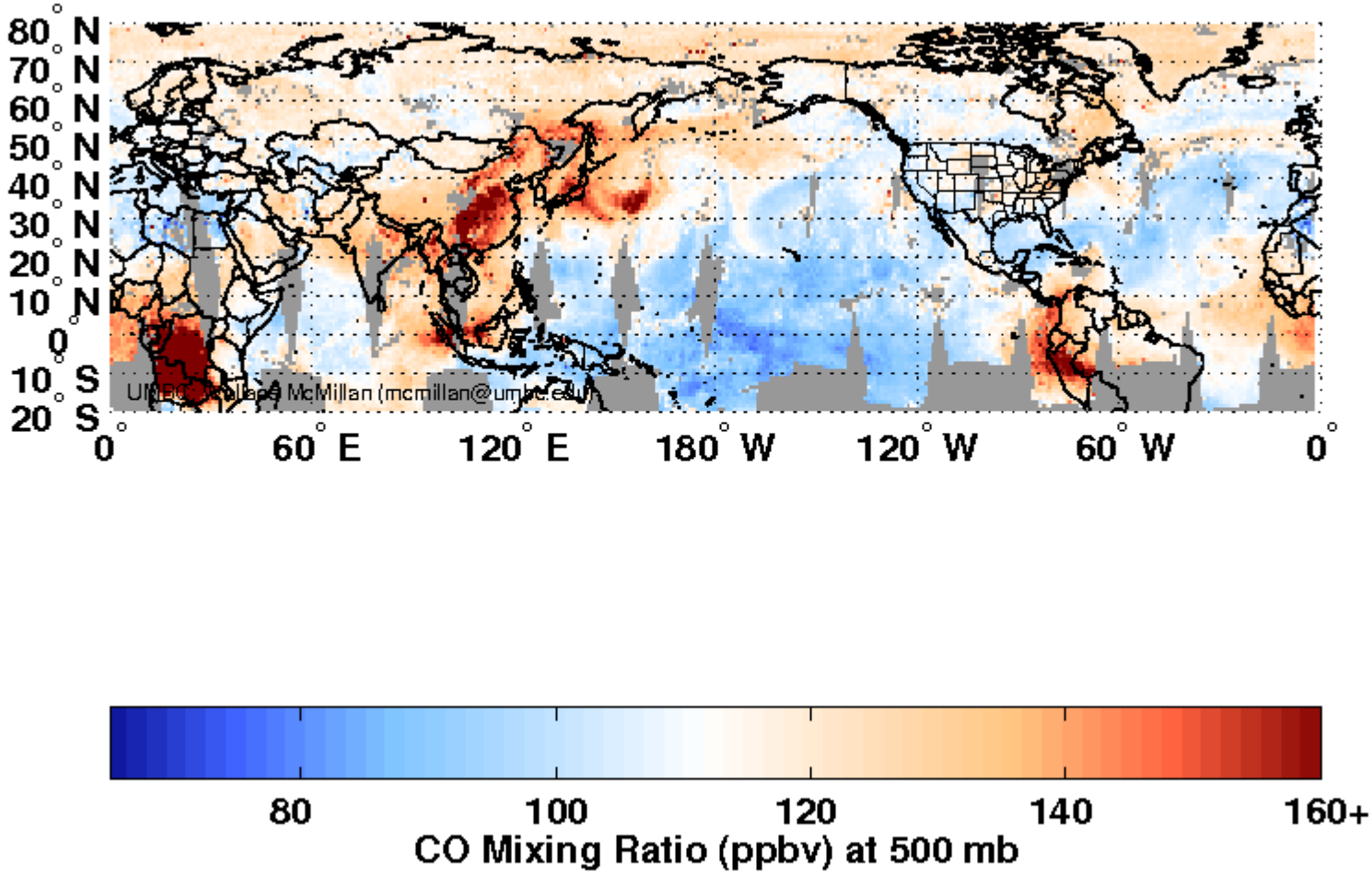


Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060826



Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060827



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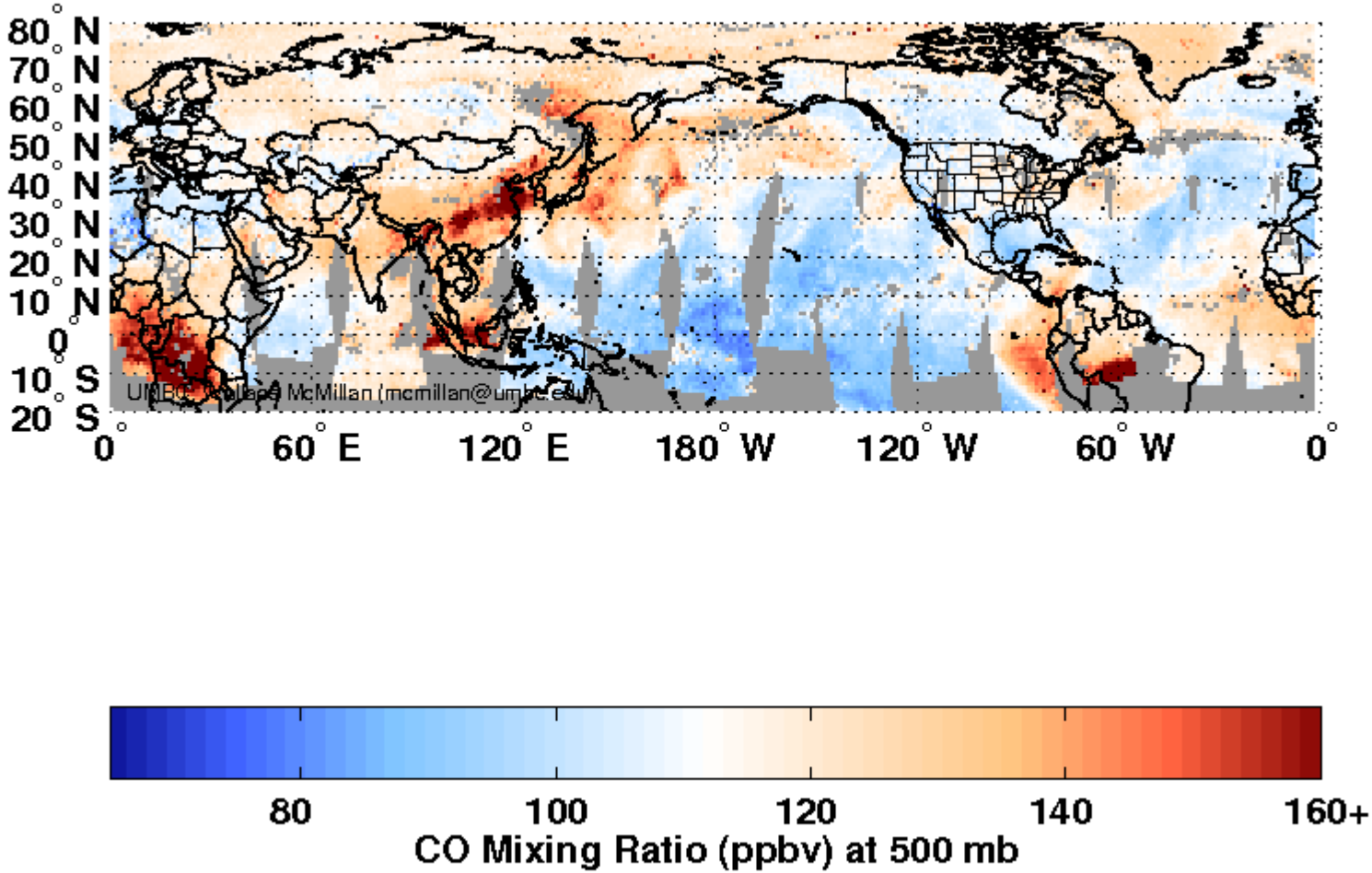
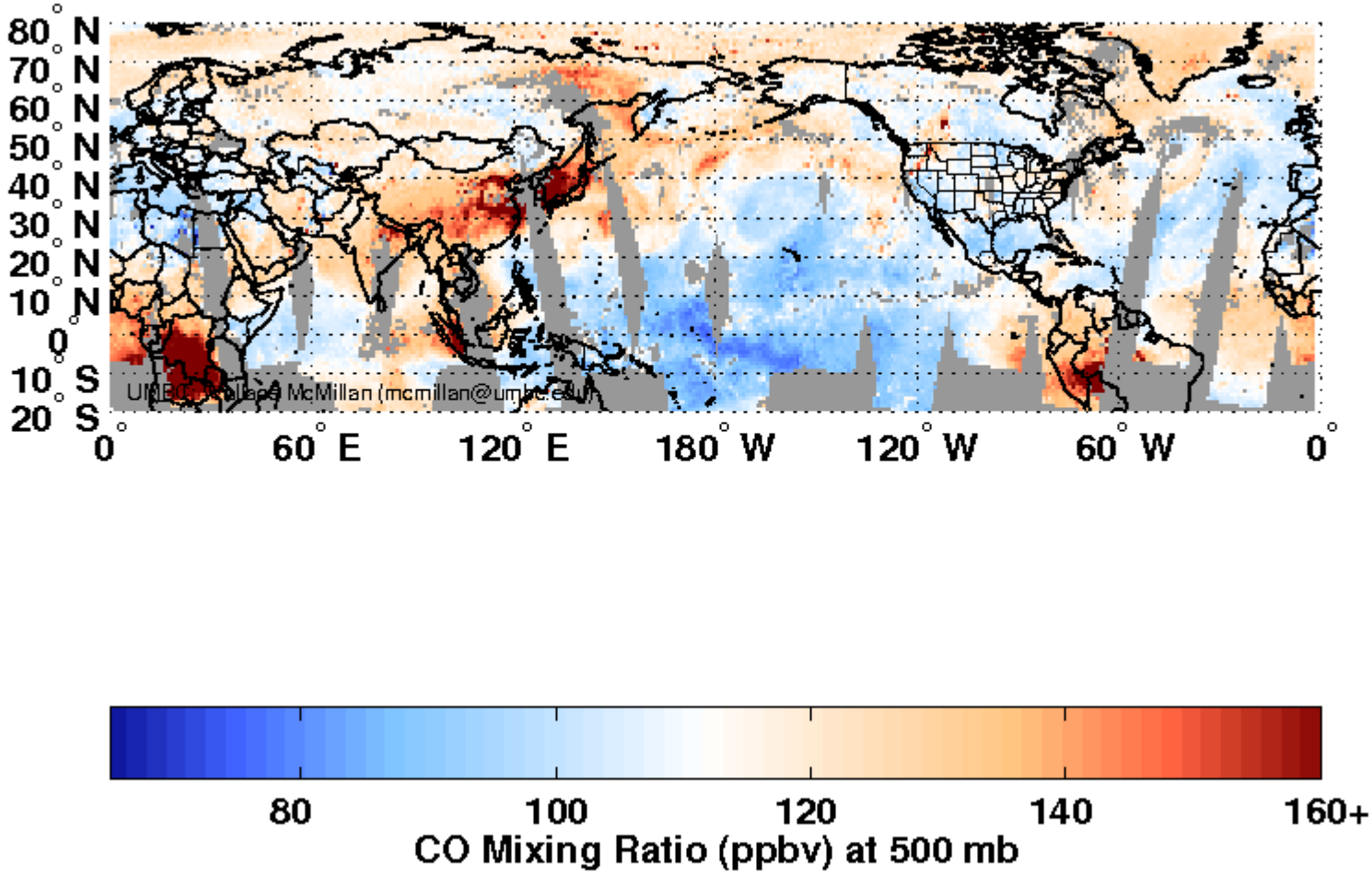
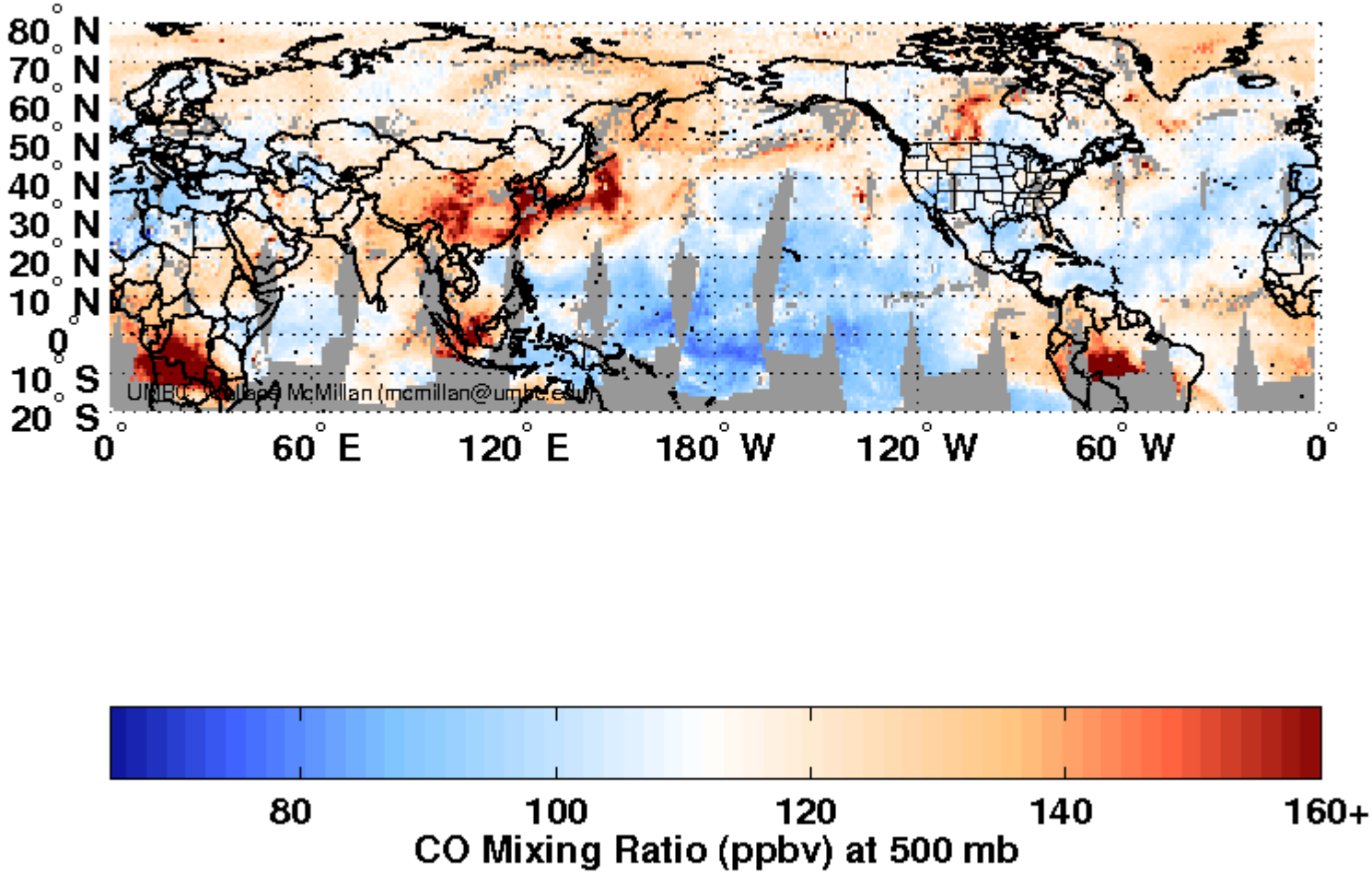


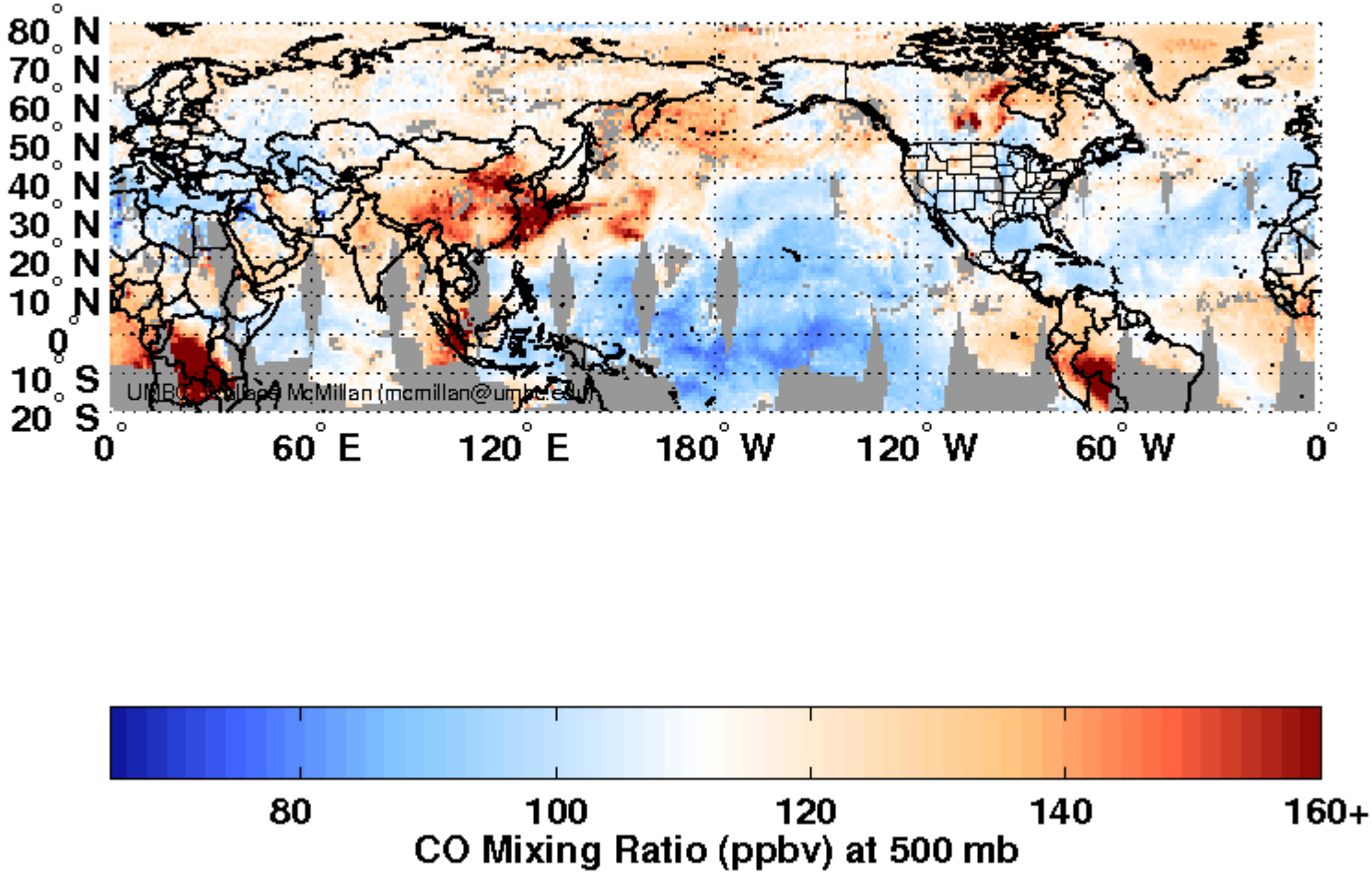
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060829



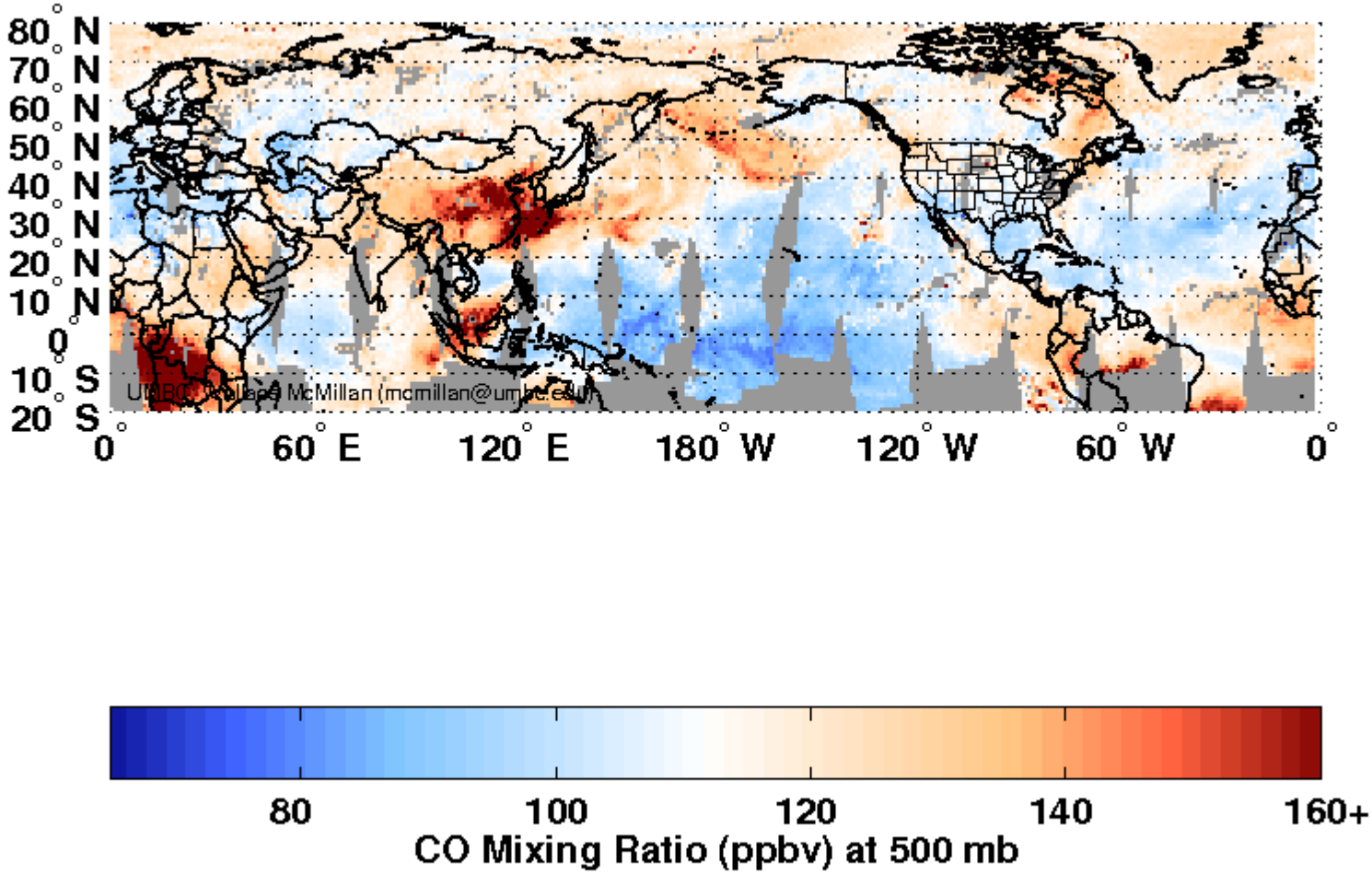
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060830



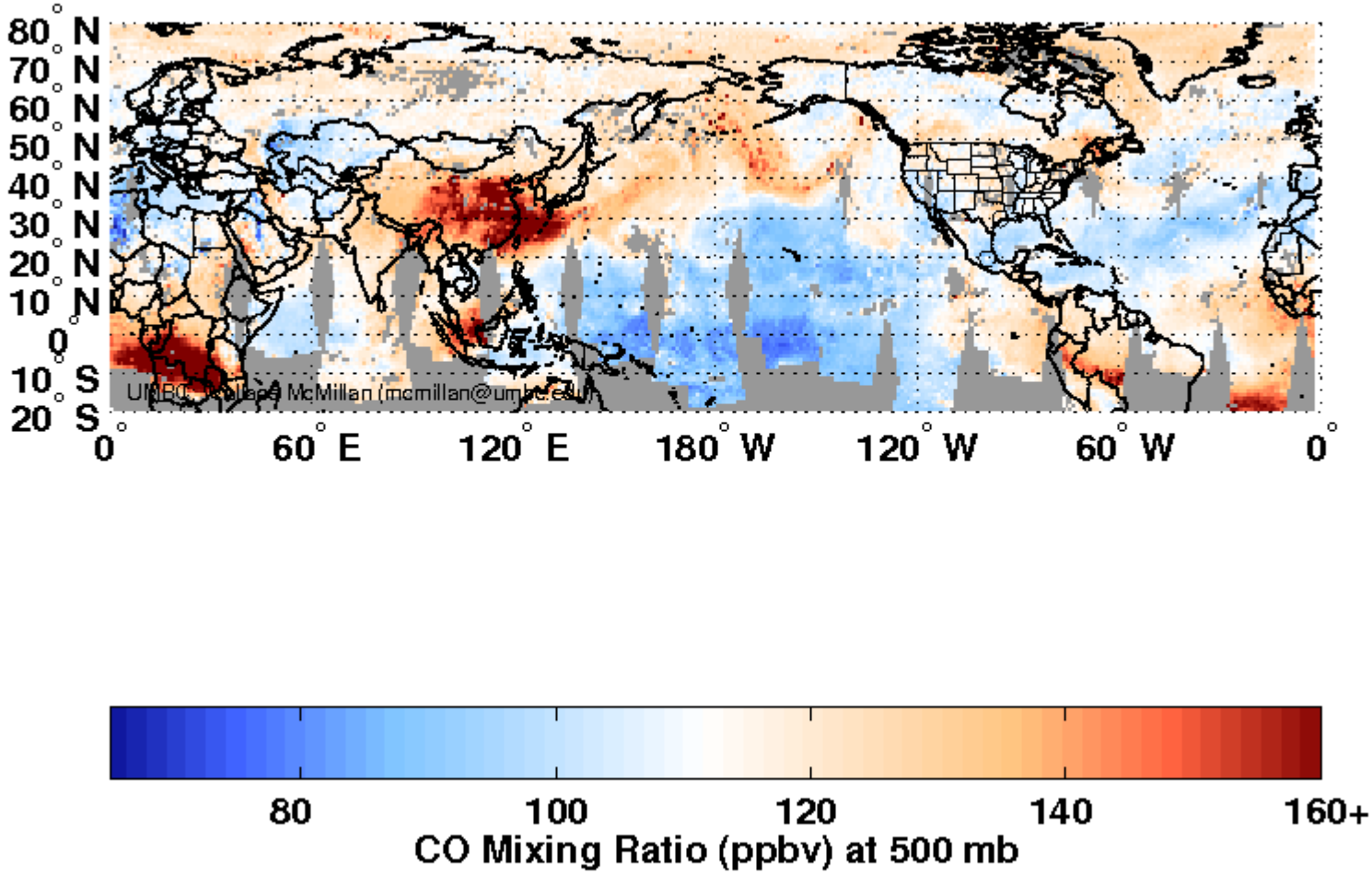
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060831



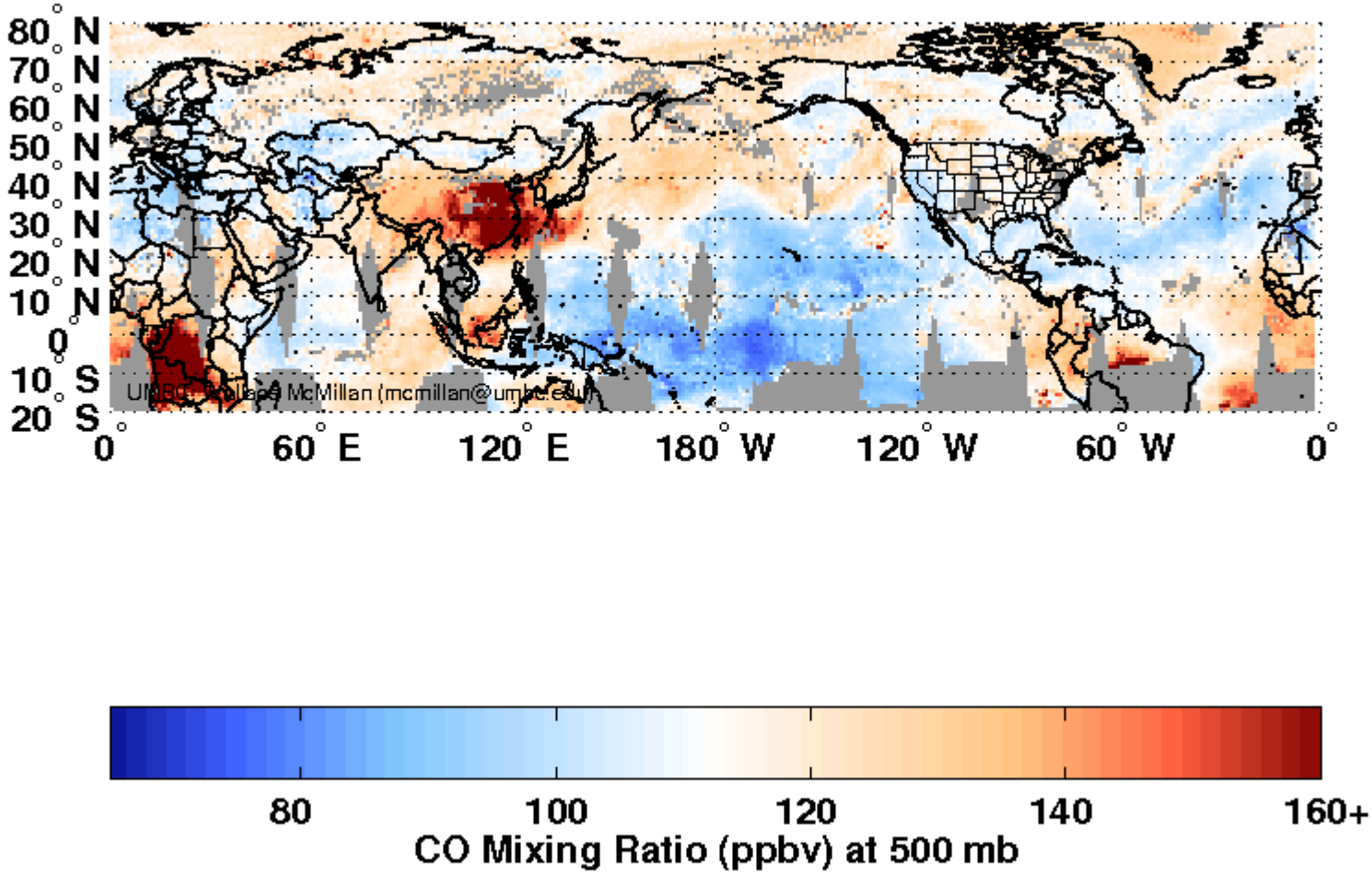
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060901



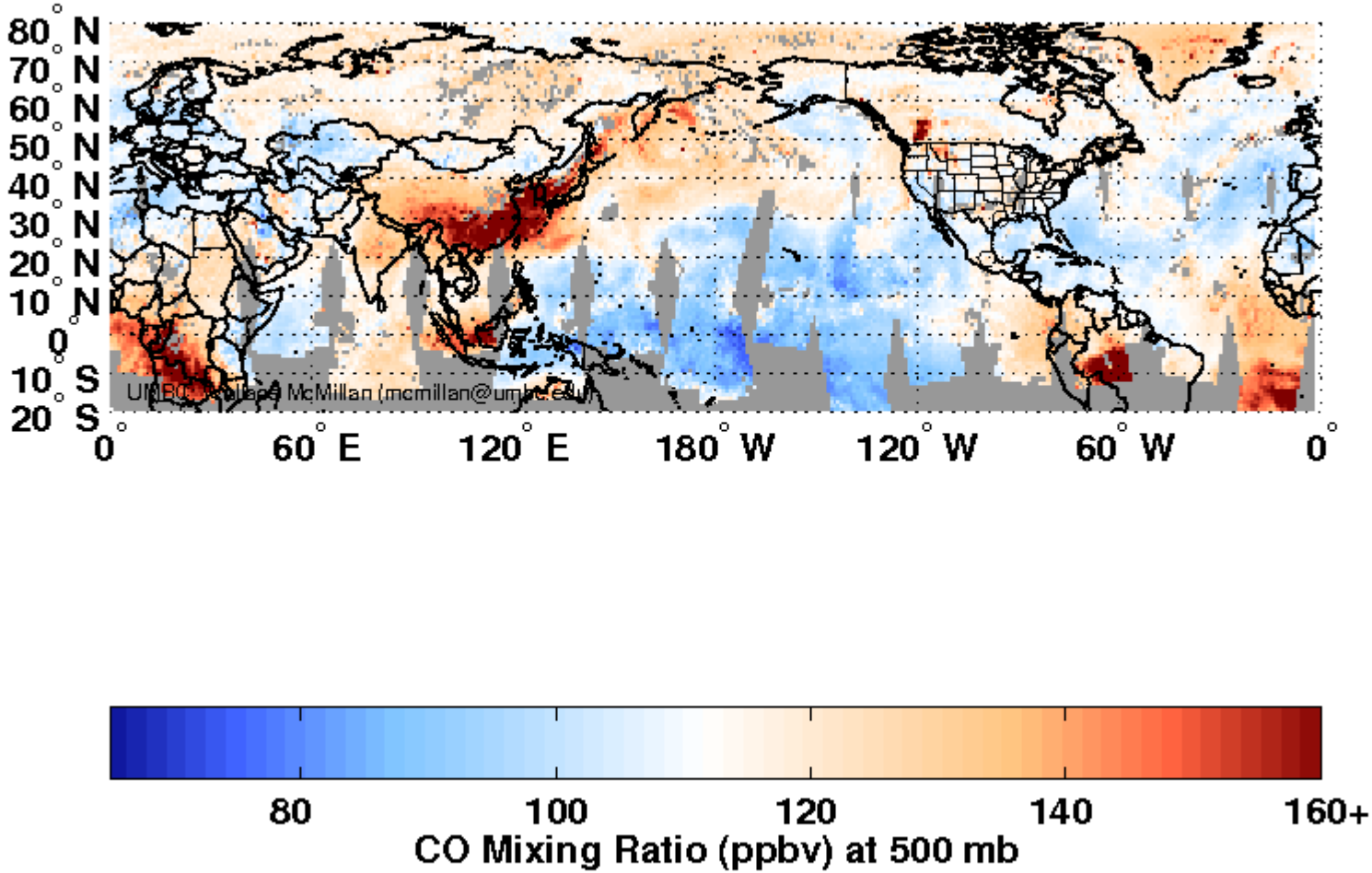
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060902



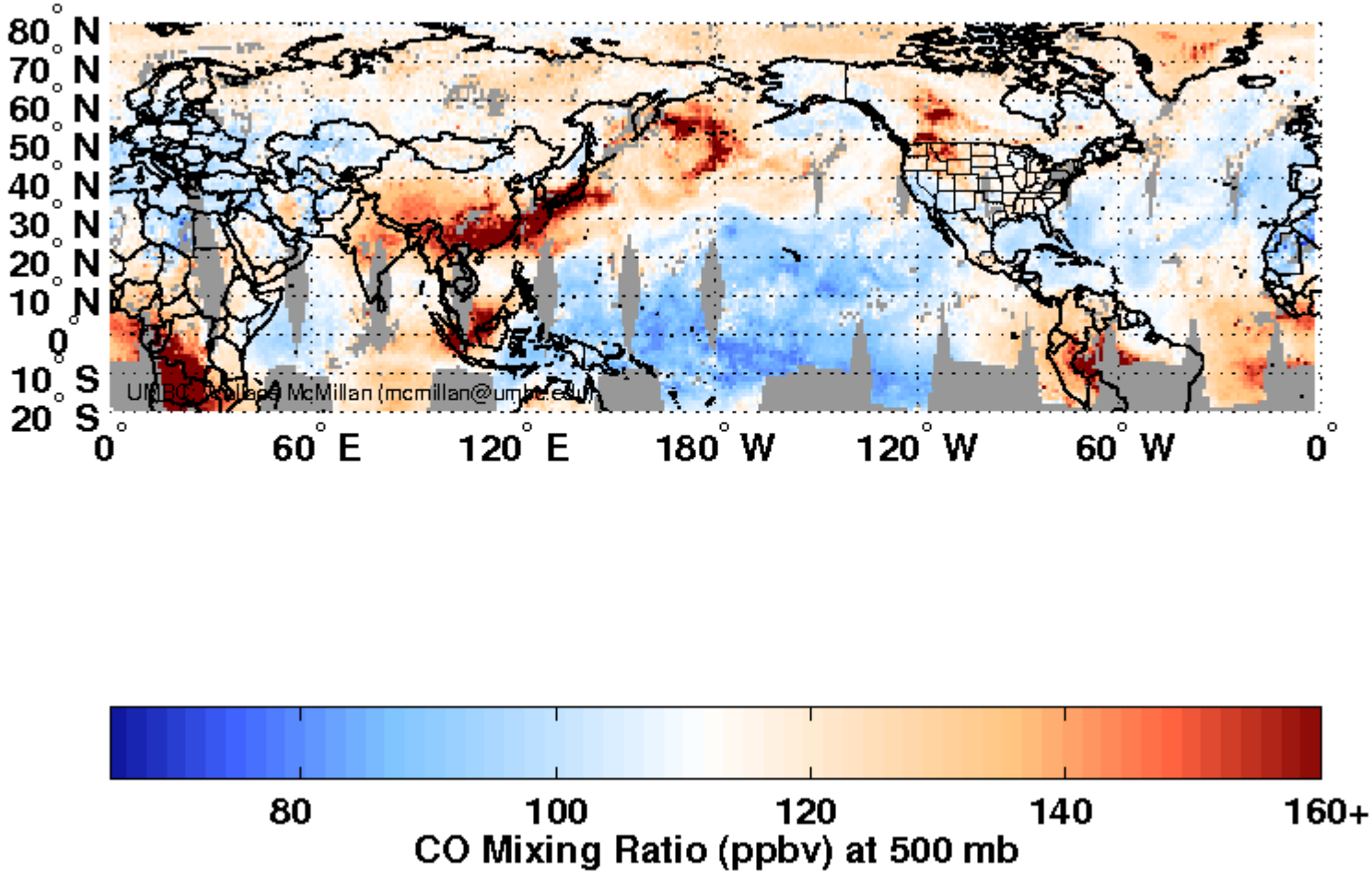
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060903



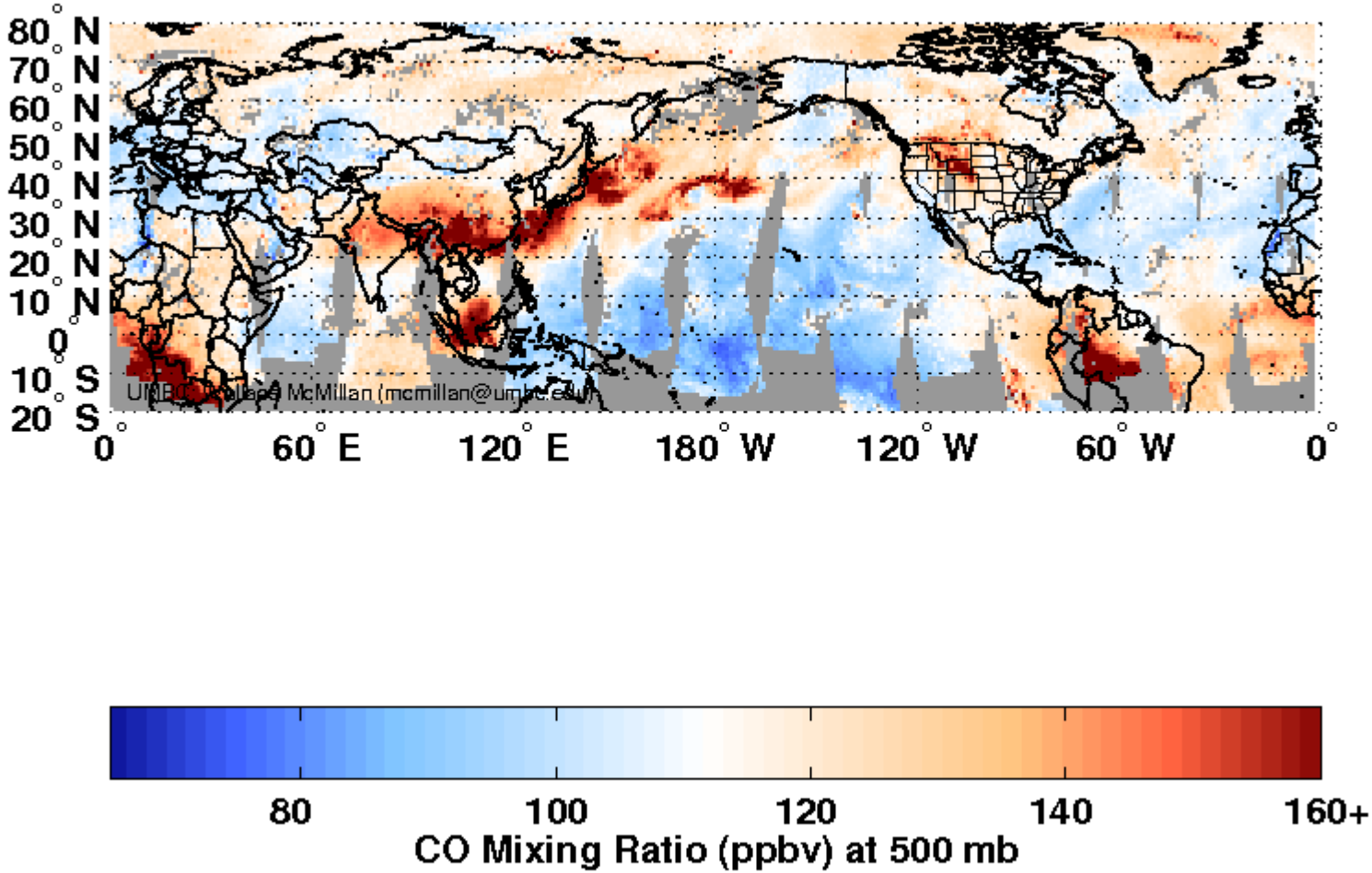
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060904



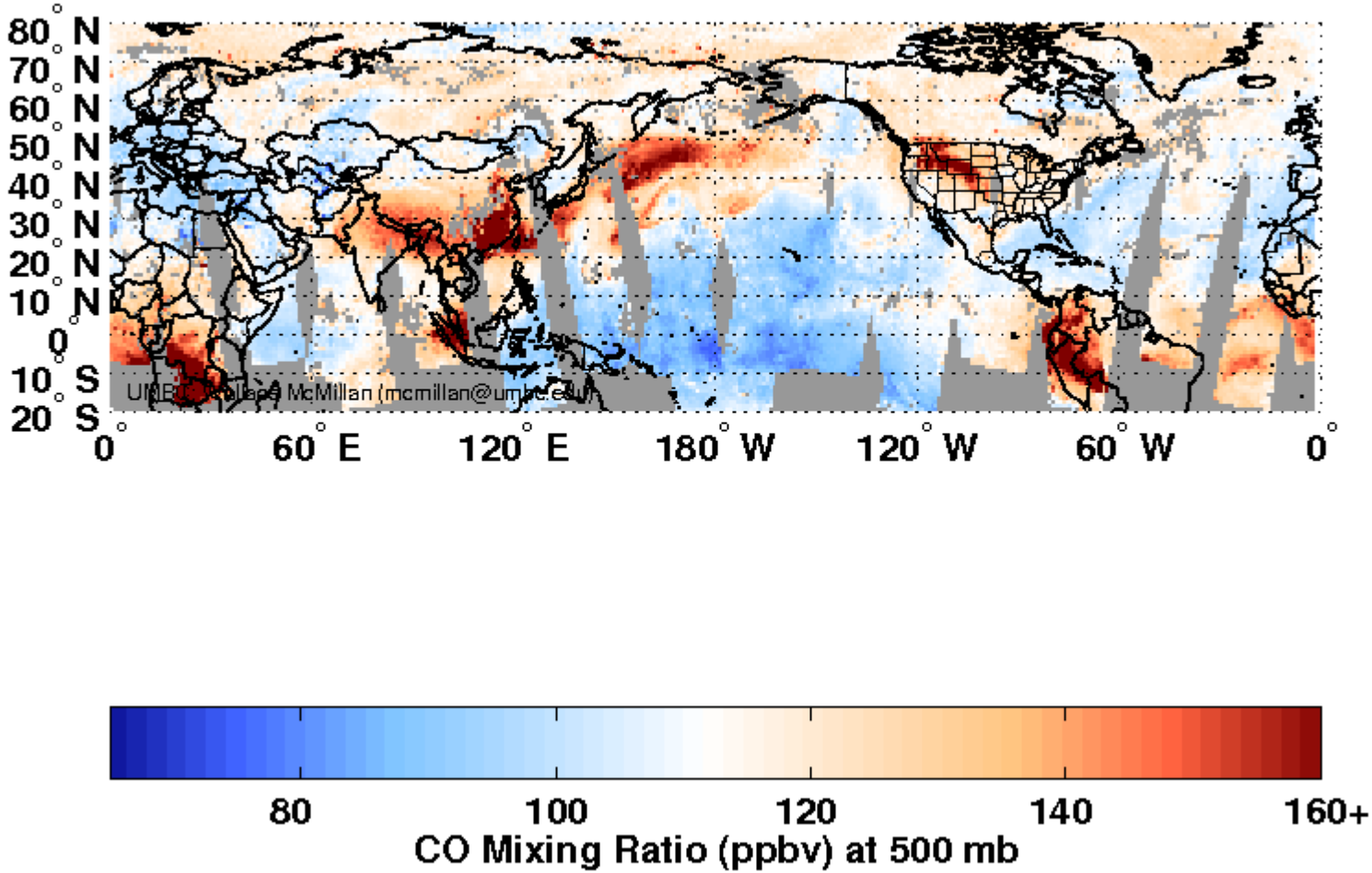
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060905



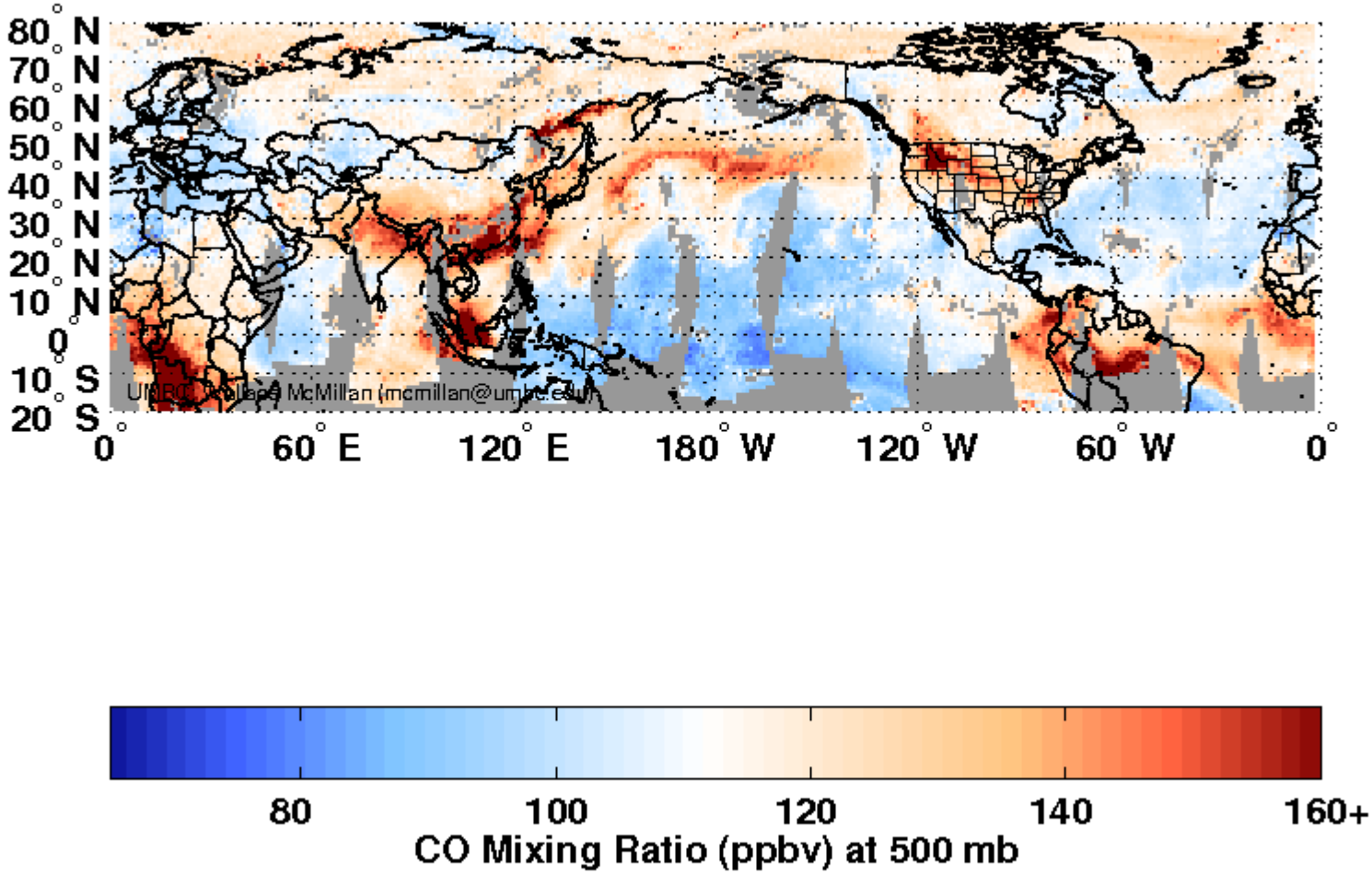
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060906



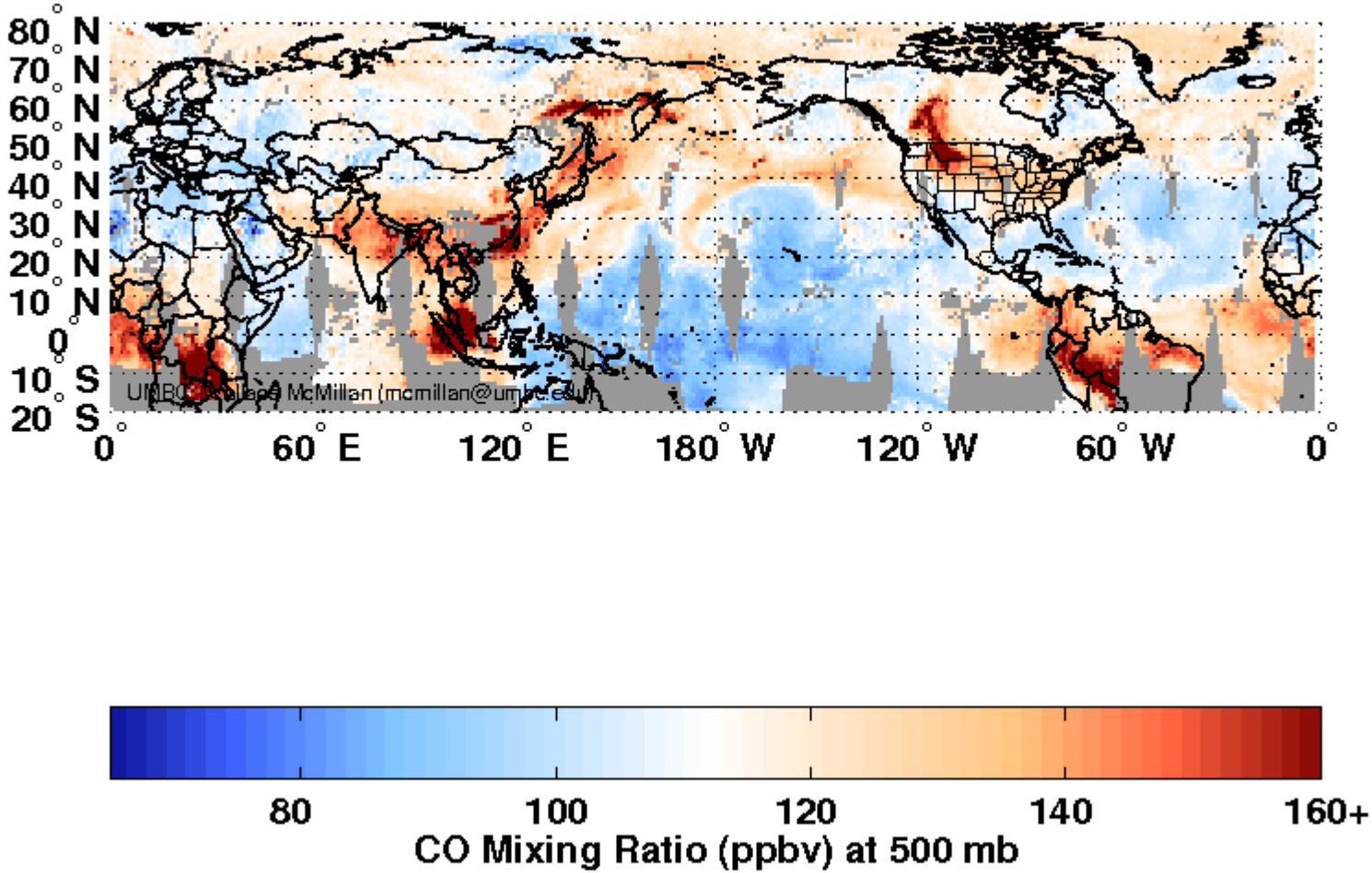
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060907



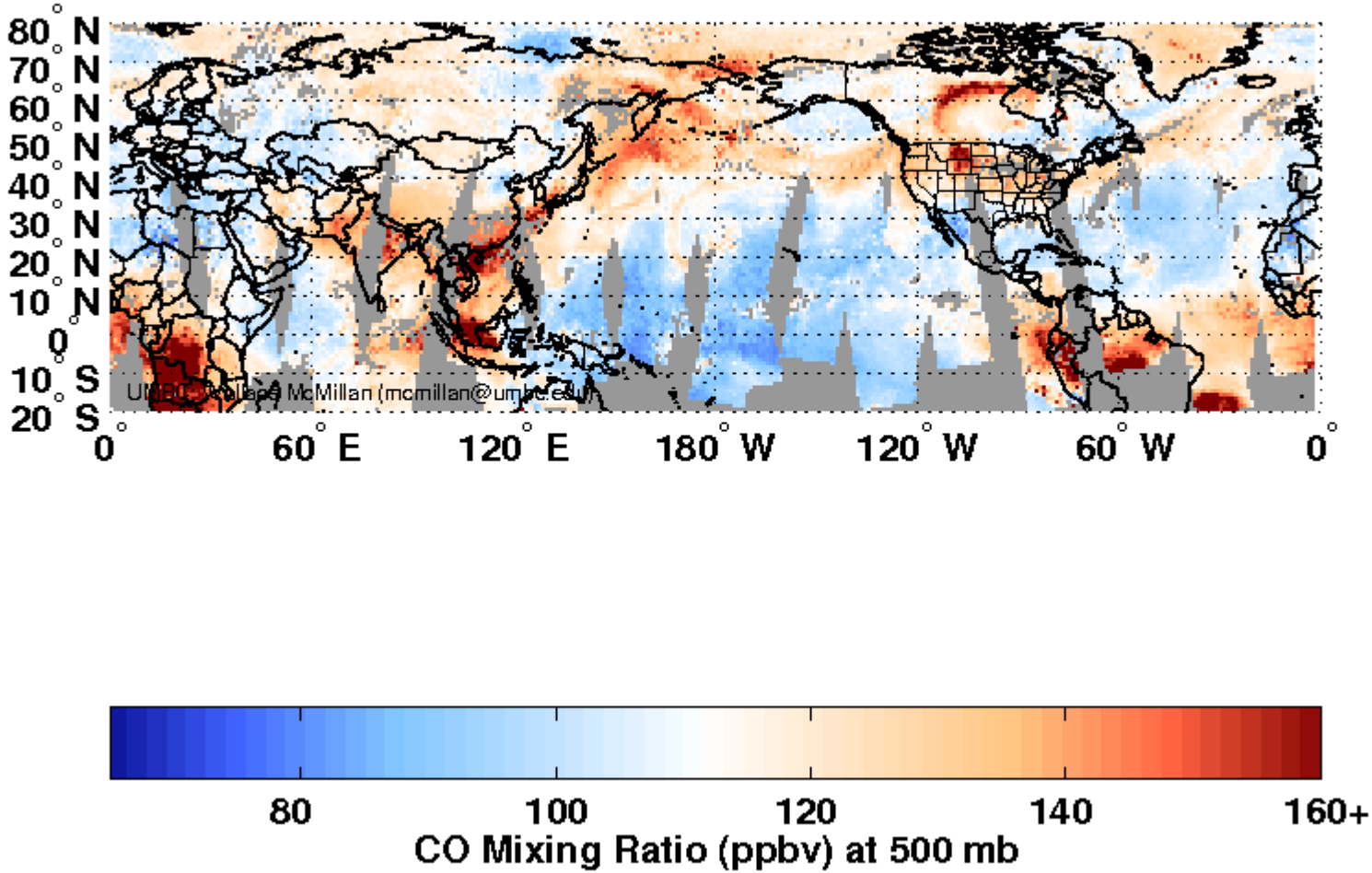
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060908



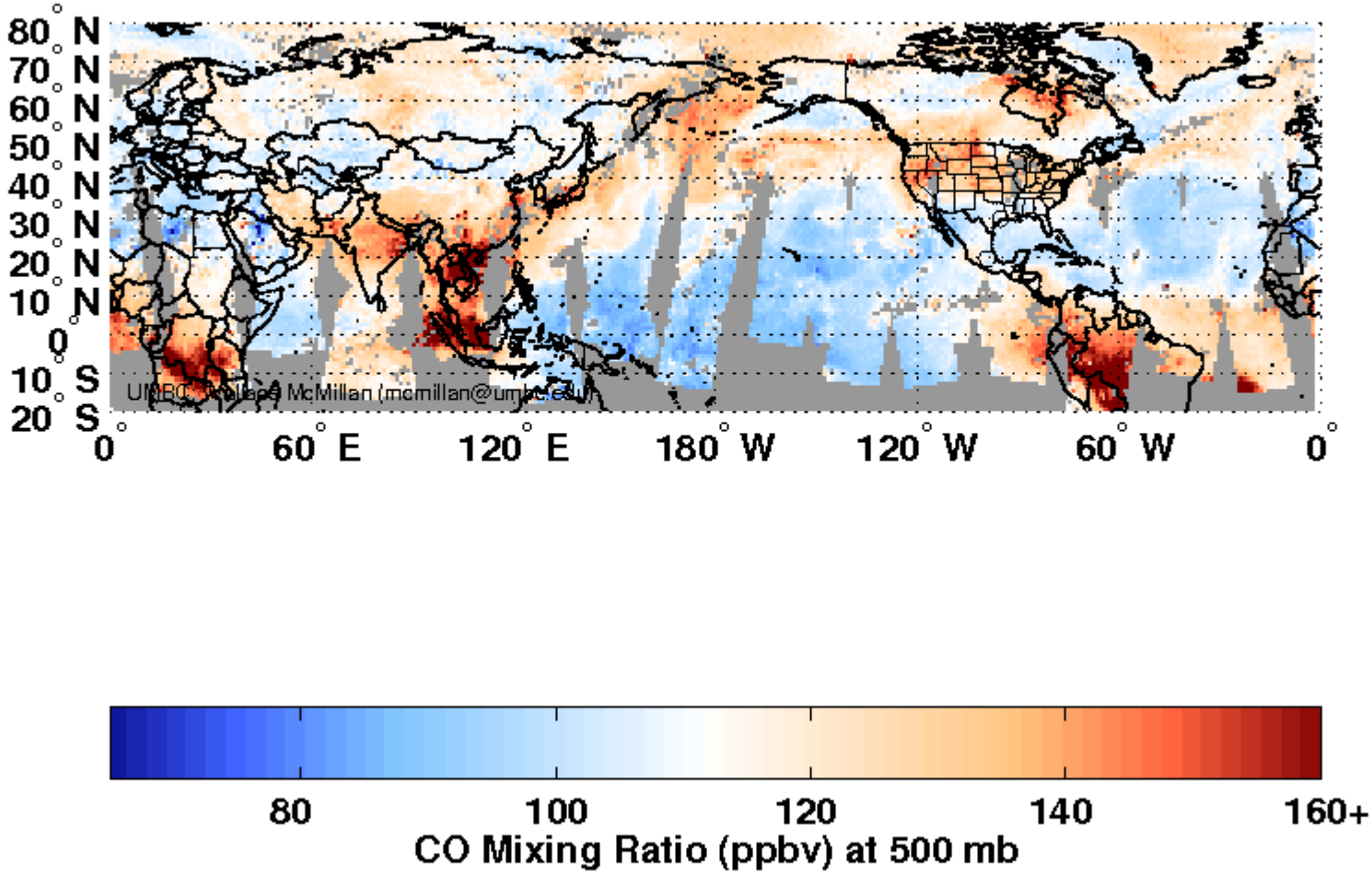
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060909



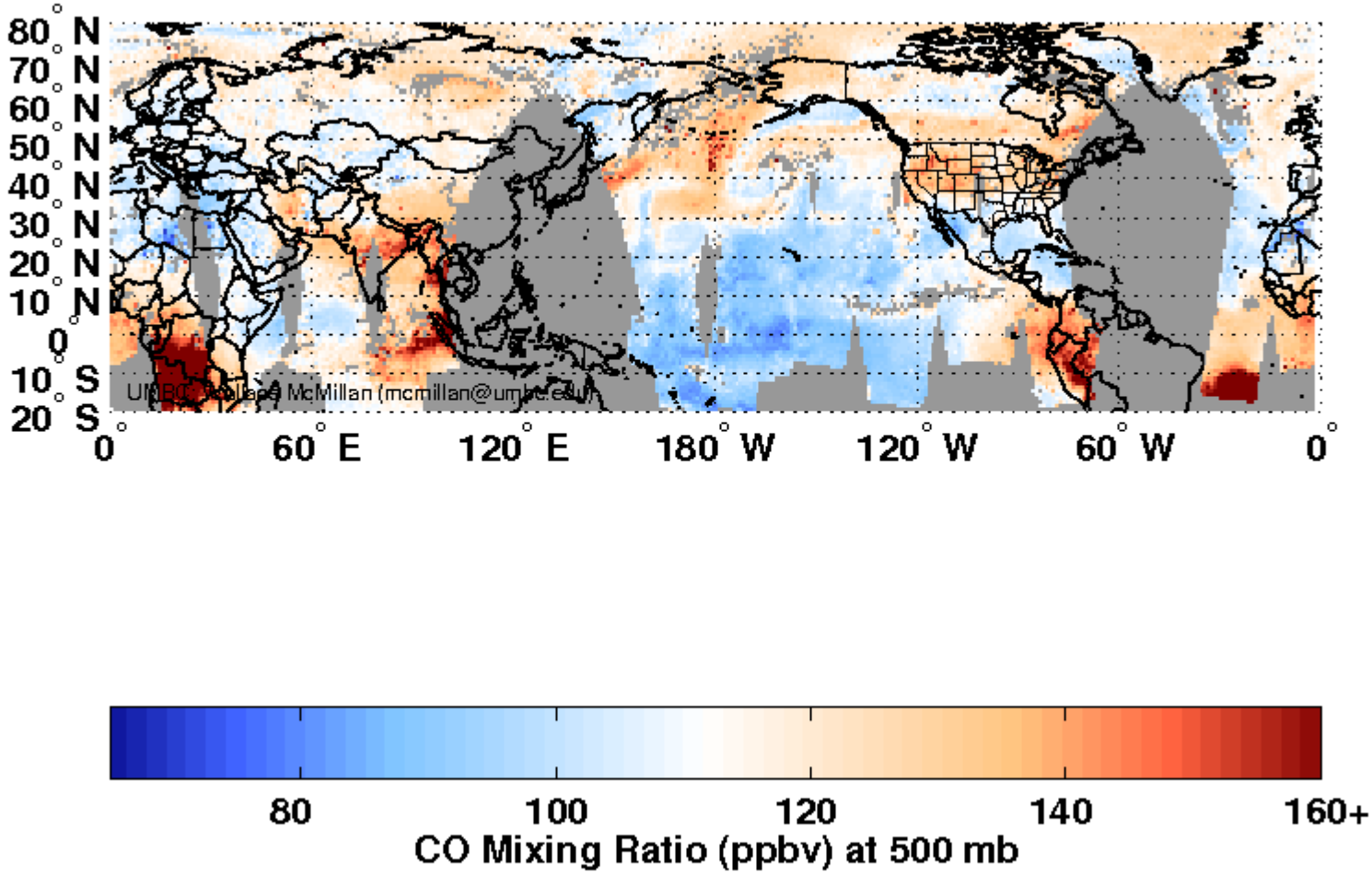
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060910



Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060911



Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060912



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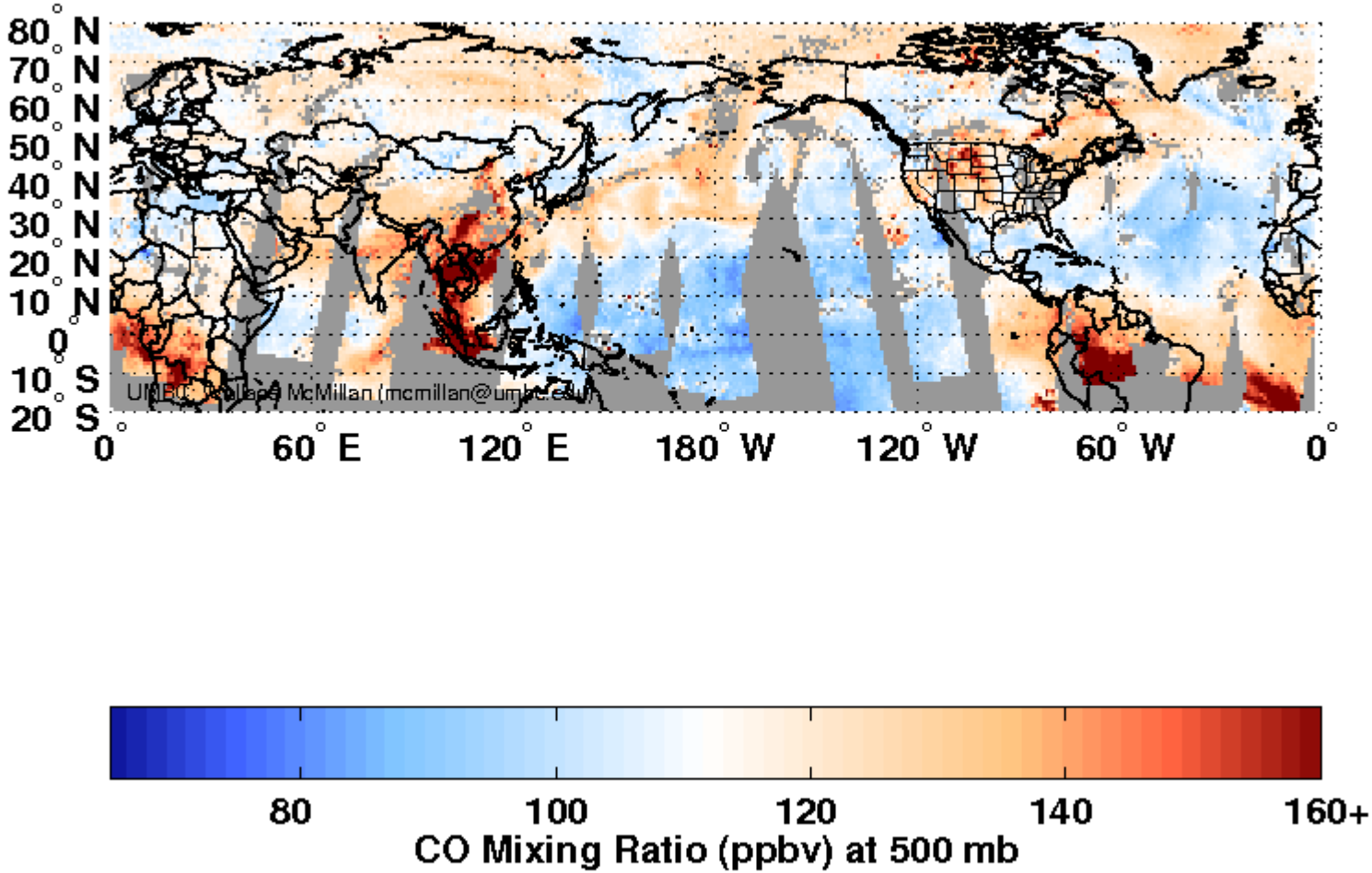
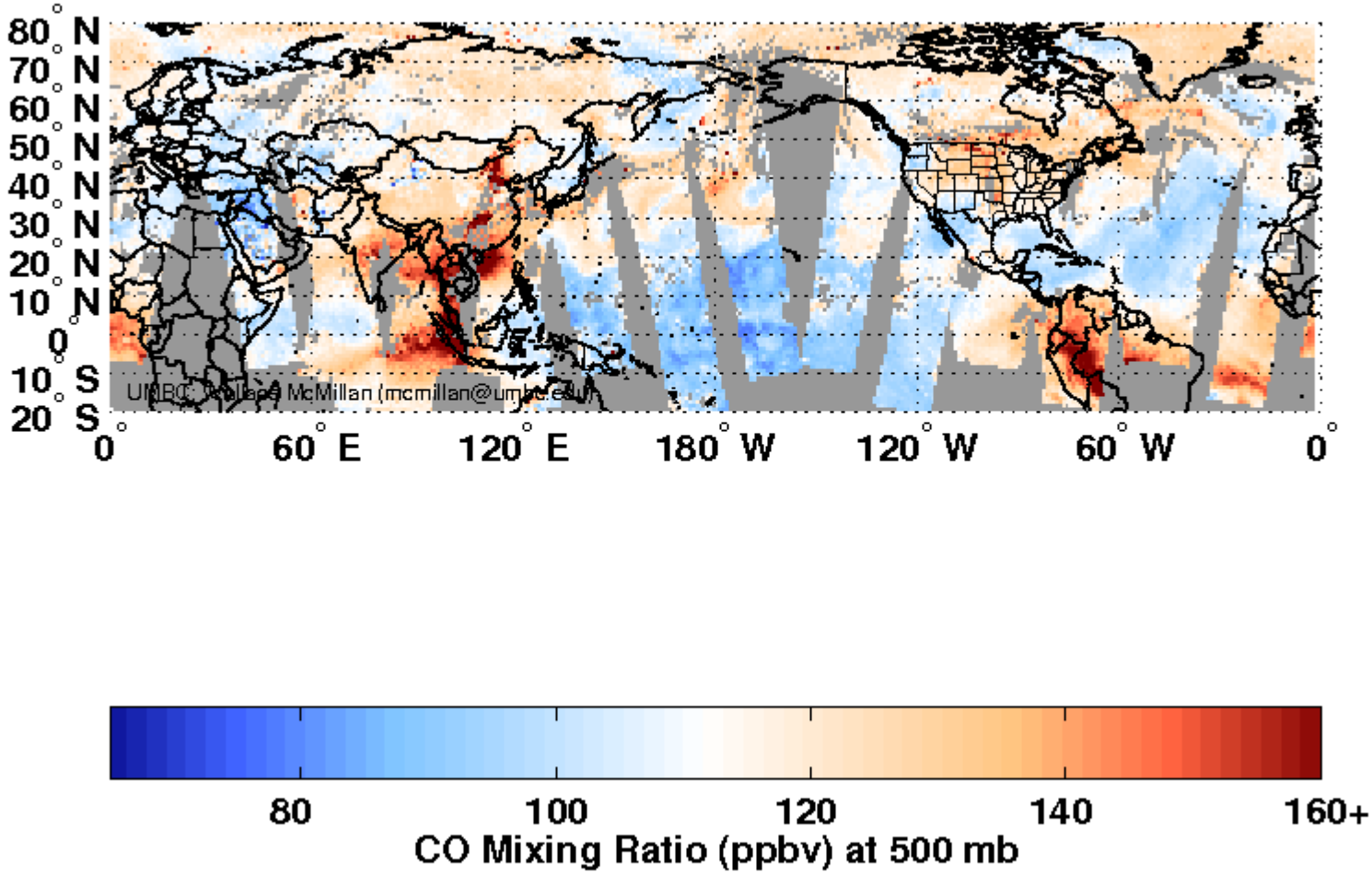
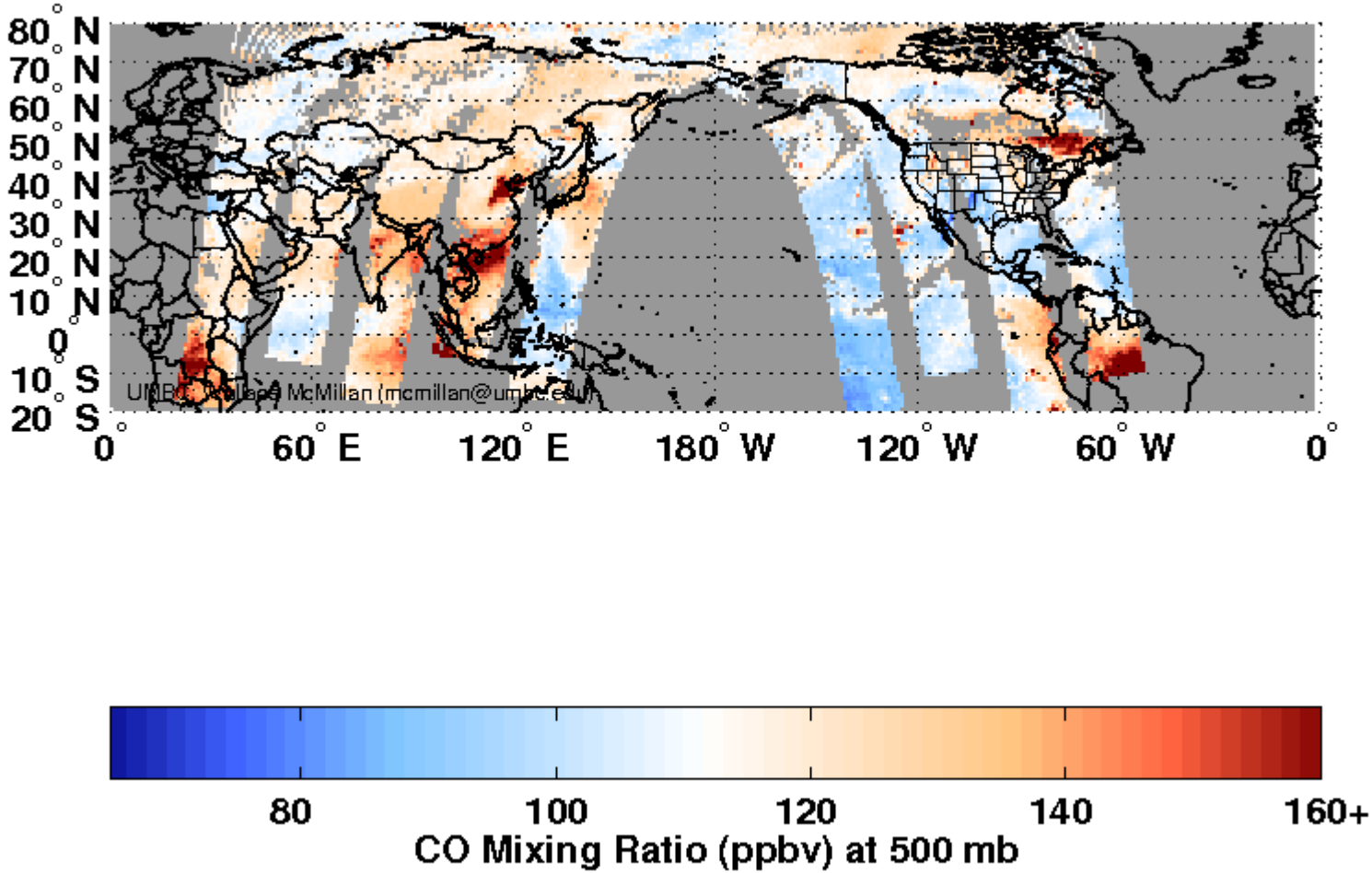


Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060914



Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060915



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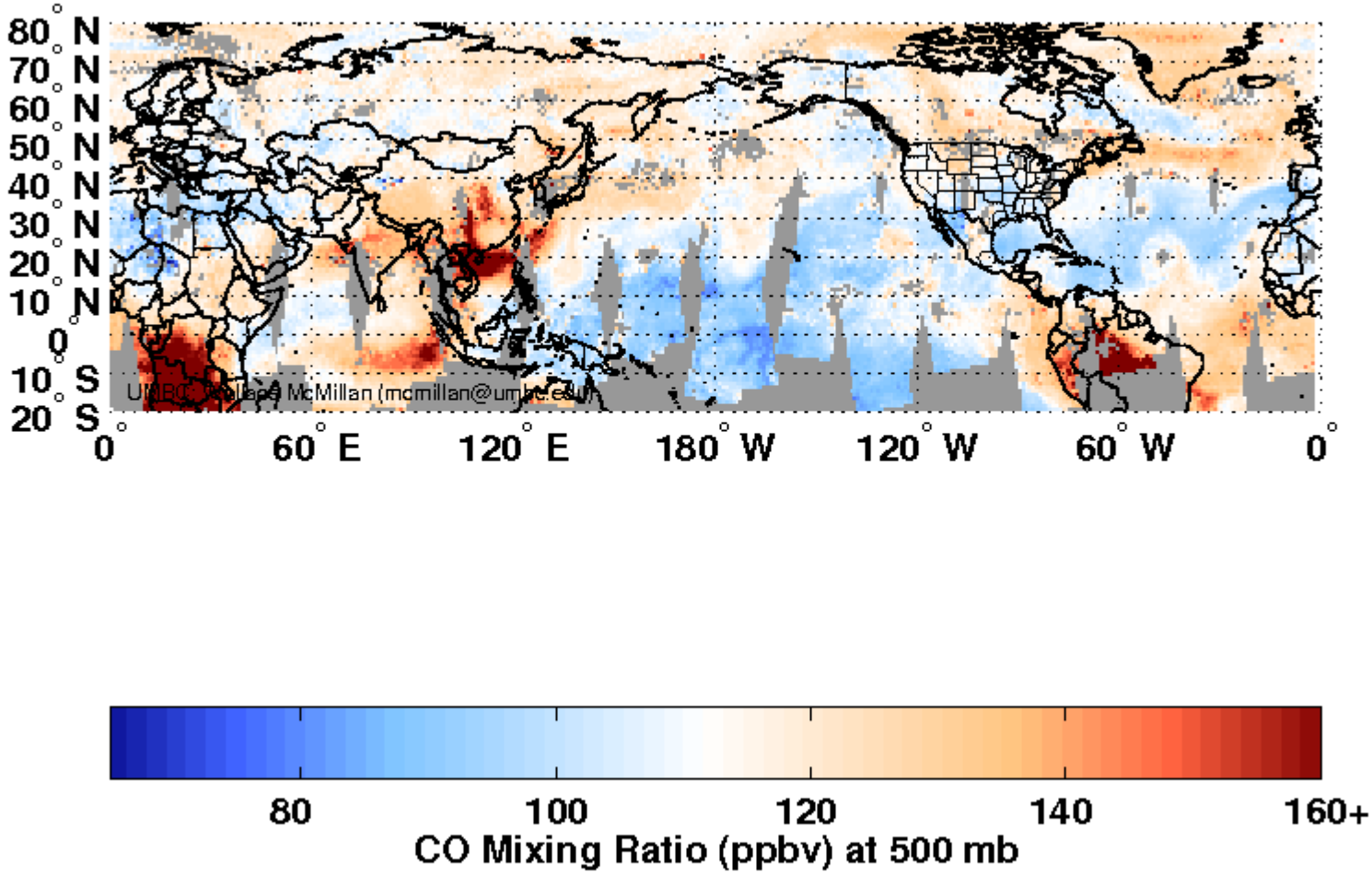
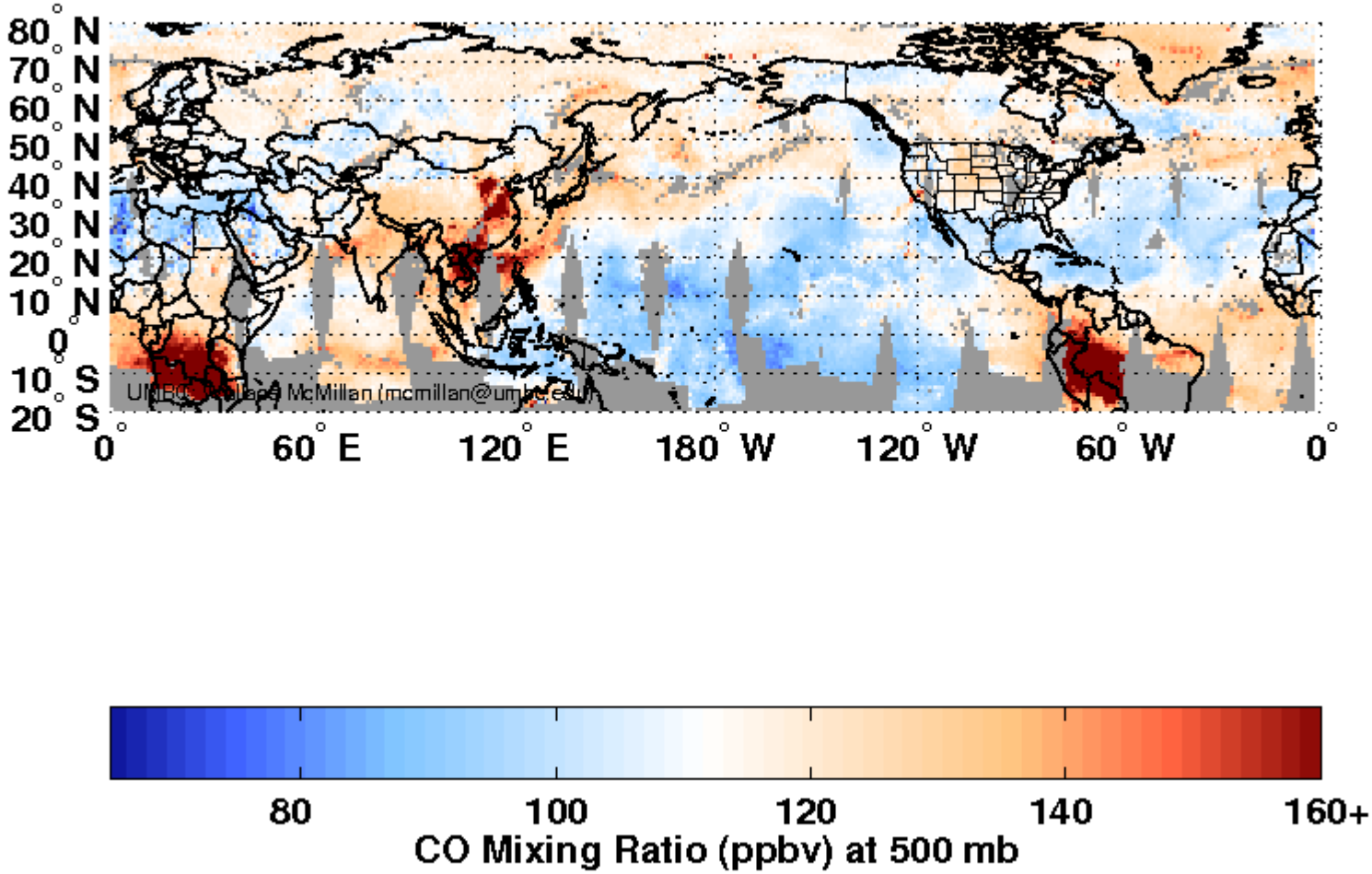
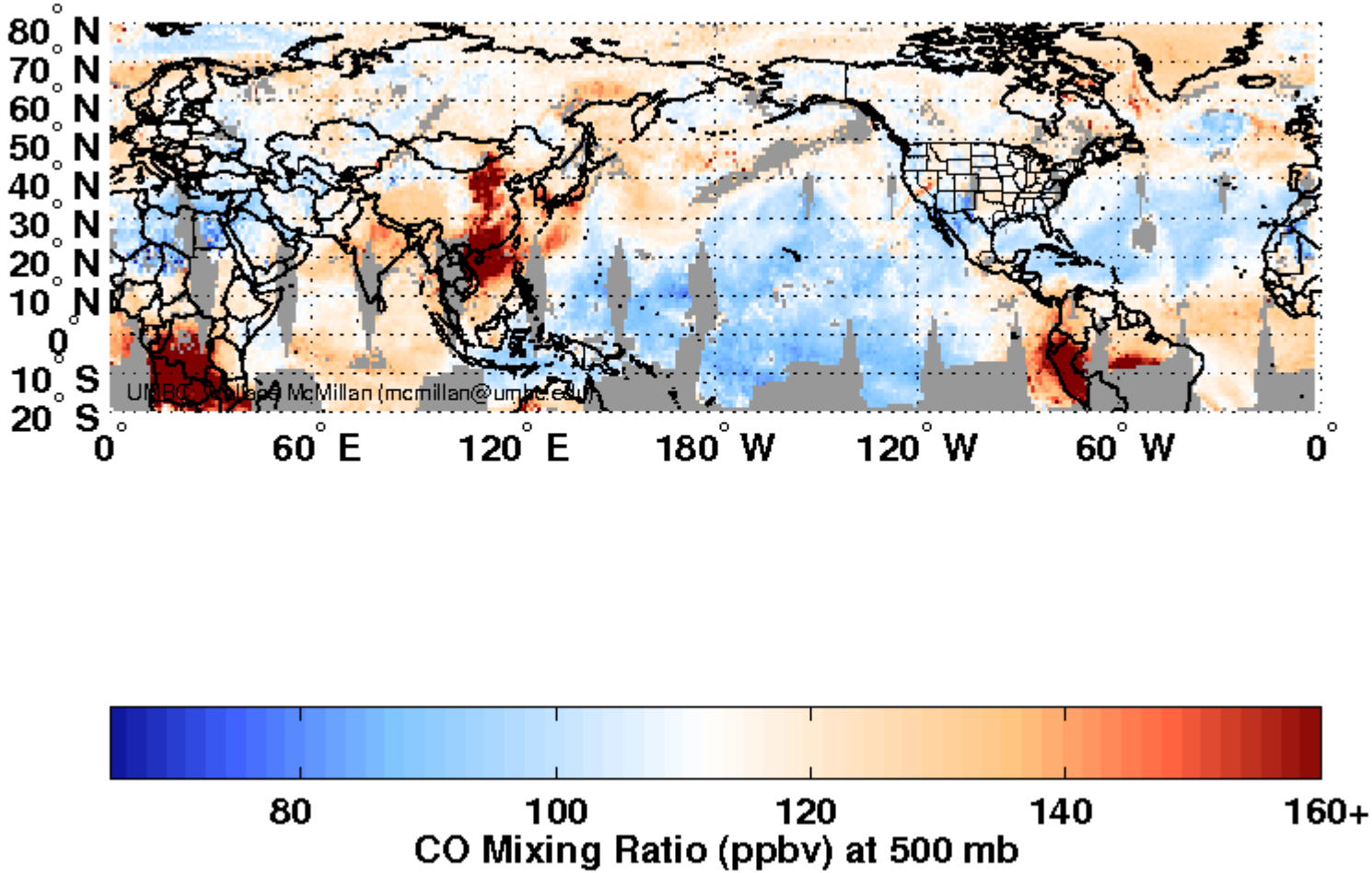


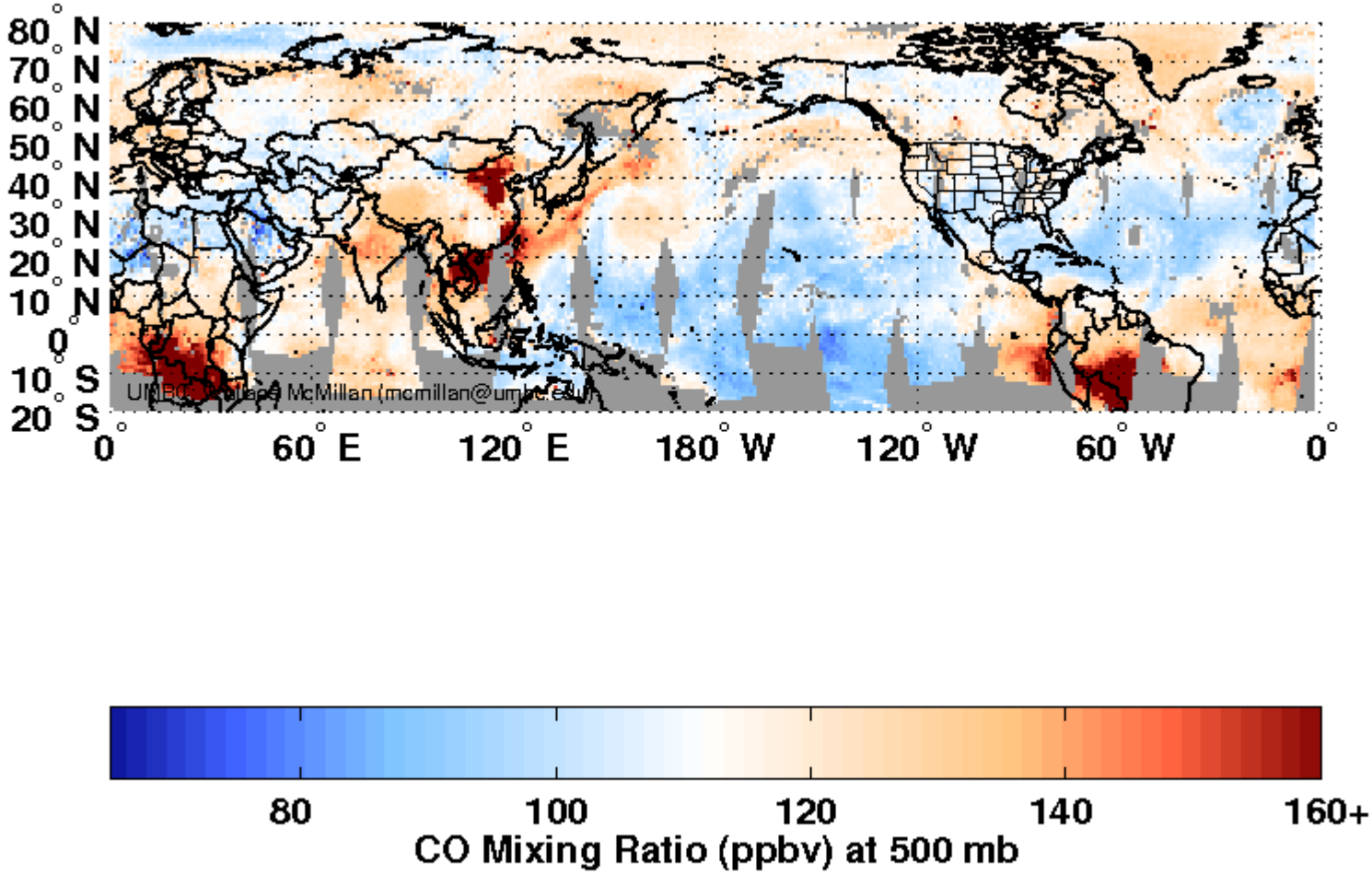
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060918



Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060919

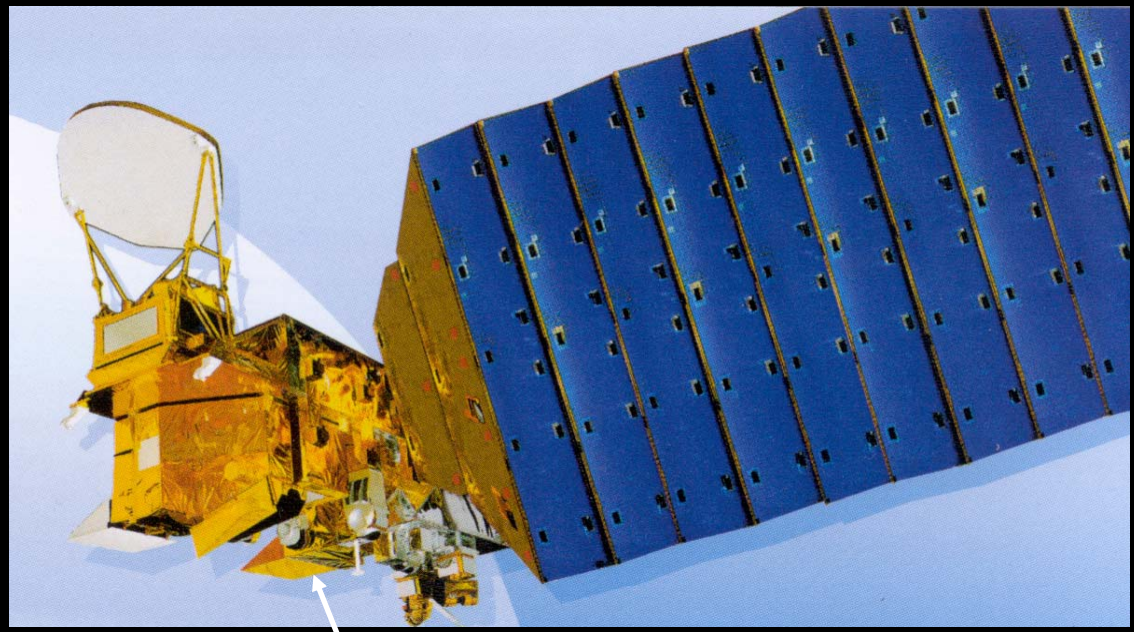


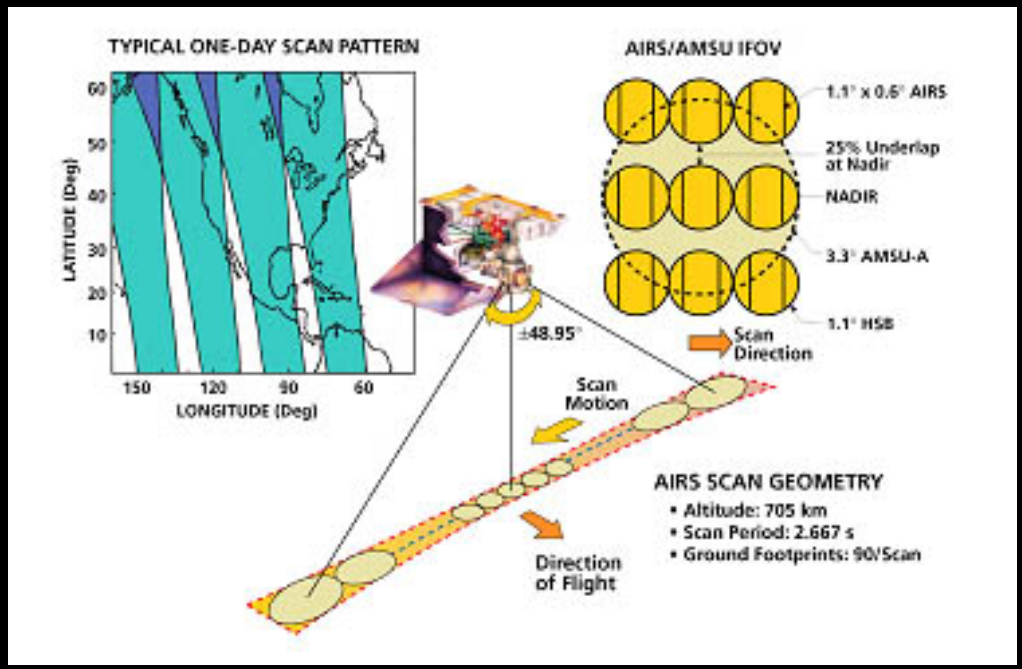
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060920



Launched May 4, 2002, onboard Aqua

- 13.5 km nadir IR FOV 1650 km swath
- 45 km nadir μwave FOV (AMSU)
- 324,000 AIRS retrievals per day
- 2378 channels

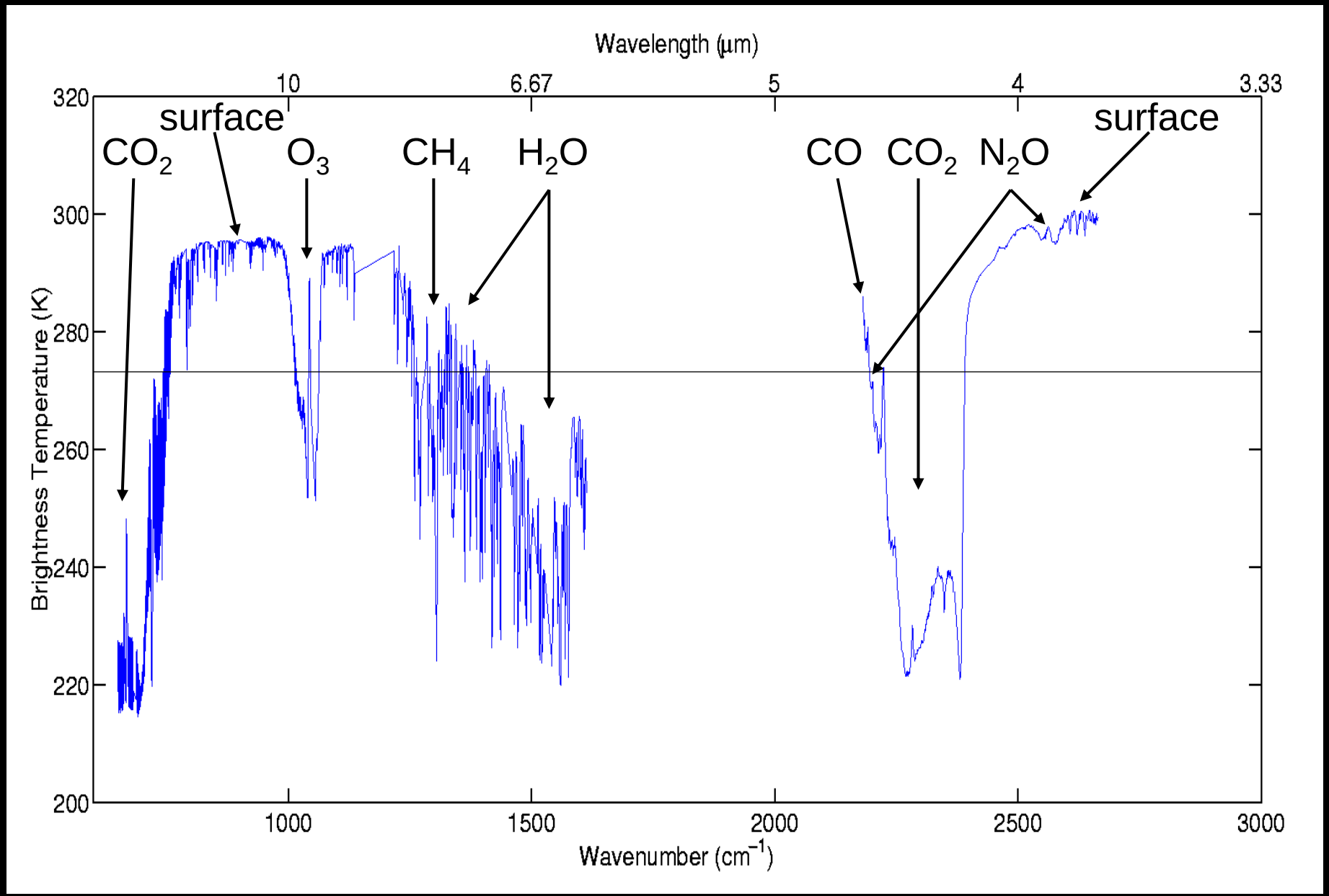




Atmospheric InfraRed Sounder onboard NASA Aqua

(JPL depictions)

AIRS Spectrum on 9/5/2002 @ 1830 UTC



AIRS/AMSU/HSB DATA PRODUCTS

Radiance Products (Level 1B)	RMS Uncertainty*	Horizontal Resolution
AIRS IR Radiance	3%	15 x 15 km
AIRS VIS/NIR Radiance	20%	2.3 x 2.3 km
AMSU Radiance	0.25-1.2 K	45 x 45 km
HSB Radiance	1.0-1.2 K	15 x 15 km
Standard Core Products (Level 2)		
Cloud Cleared IR Radiance	1.0K	45 x 45 km
Sea Surface Temperature	0.5K	45 x 45 km
Land Surface Temperature	1.0K	45 x 45 km
Temperature Profile	1K	45 x 45 km
Humidity Profile	15%	45 x 45 km
Total Precipitable Water	5%	45 x 45 km
Fractional Cloud Cover	5%	45 x 45 km
Cloud Top Height	0.5 km	45 x 45 km
Cloud Top Temperature	1.0 K	45 x 45 km

Vertical Resolution

Temperature Profile: 1 km below 700 mb, 2 km 700-30 mb

Humidity Profile: 2 km in troposphere

New Standard Products

Product	Desired RMS Uncertainty	Expected Footprint
O_3	< 10% total column	45 km x 45 km
O_3	mid-upper tropospheric	45 km x 45 km
CO	**< 15% for column**	**45 km x 45 km**
SO_2	volcanic eruption detector	45 km x 45 km
CH_4	1-5% for column	135 km x 135 km

UMBC

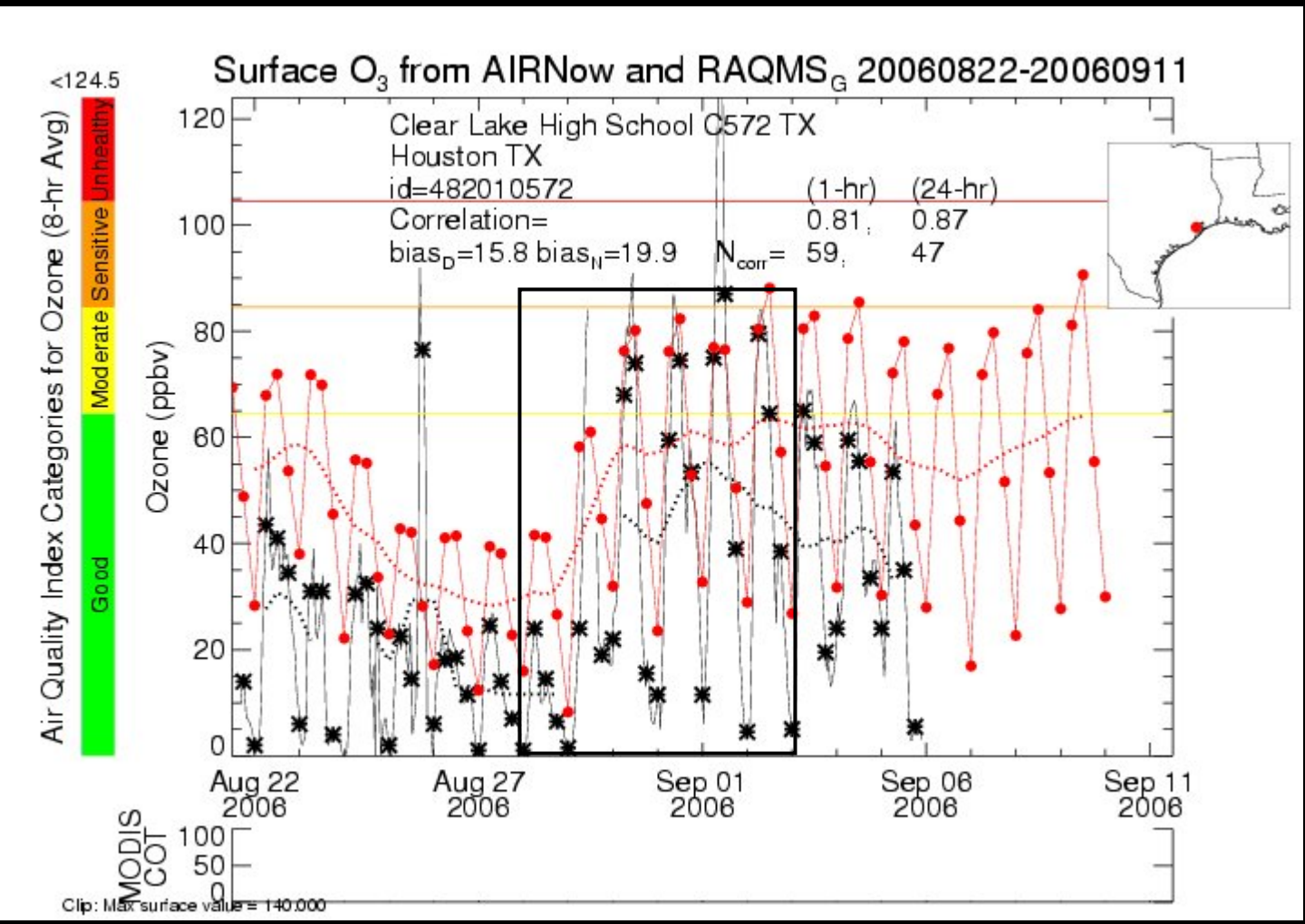
SUMMARY: AIRS

2006 The Texas Air Quality Study

- Simultaneous retrieval for all products
  - 45 km horizontal resolution
  - Temperature (2 km vertical resolution)
  - Water vapor (3 km vertical resolution)
- Map 70-80% of the planet every day!
- CO (UMBC) operational next month
  - Total column + changes in vertical sensitivity
- O_3 (JPL) operational next month
- Data reprocessing underway
- See poster 37

Regional Influences During Aug 30 - Sep 02, 2006
Houston Ozone AQ event – from REALTIME forecasts

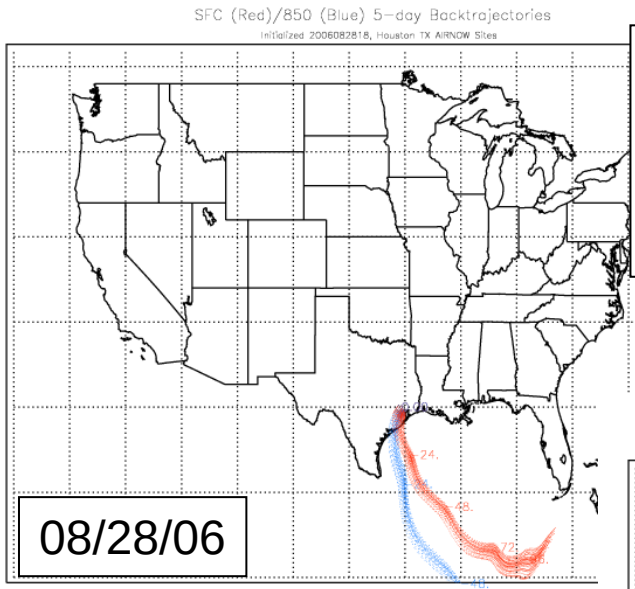
Synthesis of EPA AIRNOW, NOAA P3, NASA AIRS measurements and RAQMS chemical analyses



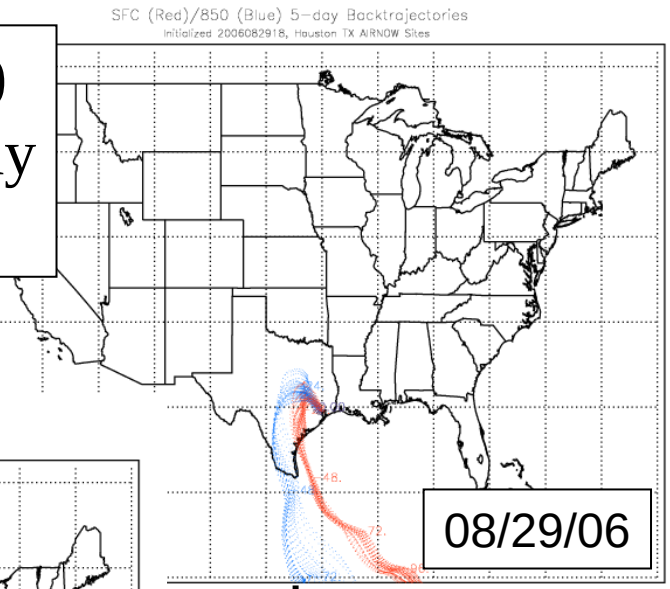
24hr averaged ozone shows 30ppbv enhancement during the period that could be due to regional transport

Brad Pierce (NOAA)
From 9/15/06 RSS talk

Houston surface (red) and 850mb (blue) 5-day back trajectories



08/28/06



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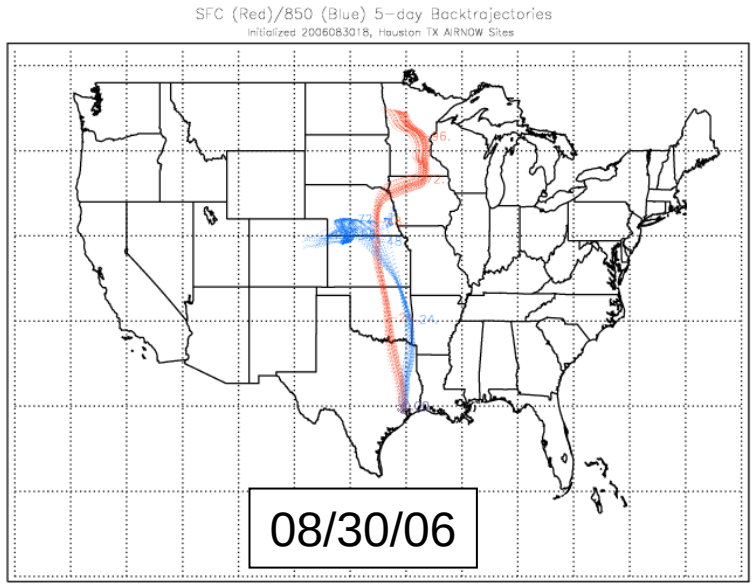

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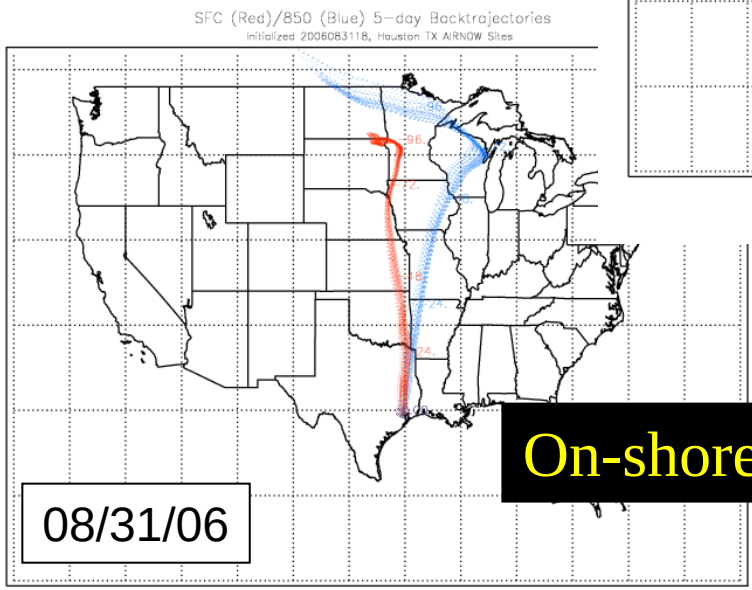

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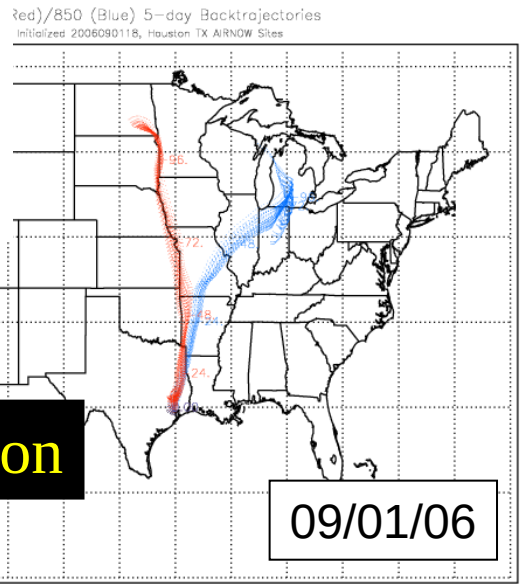


09/01/06

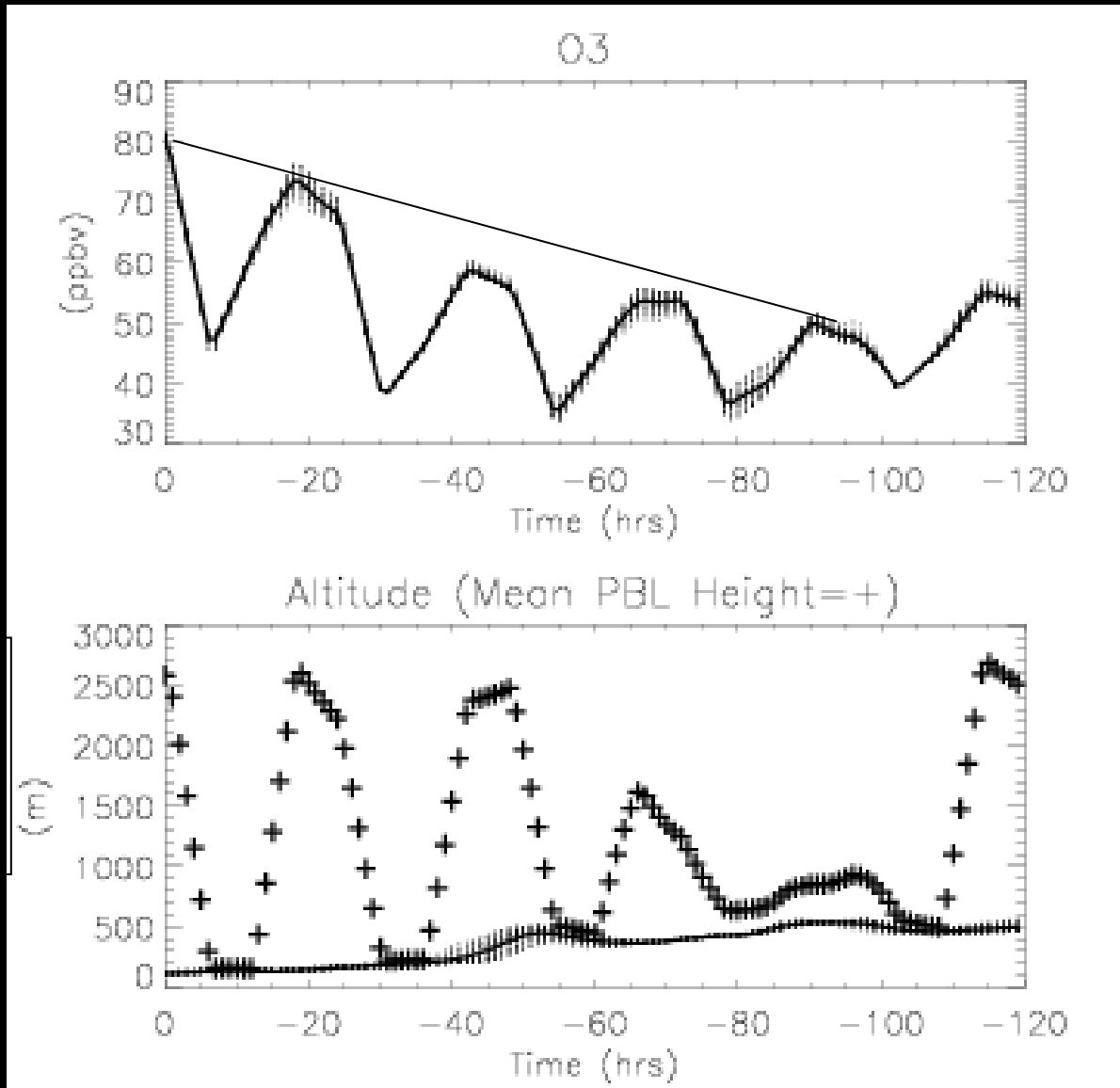
On-shore to Northeasterly transition

Brad Pierce (NOAA)

5-day Lagrangian mean ozone mixing ratio, altitude, and pbl height Houston AIRNOW sites 09/01/06

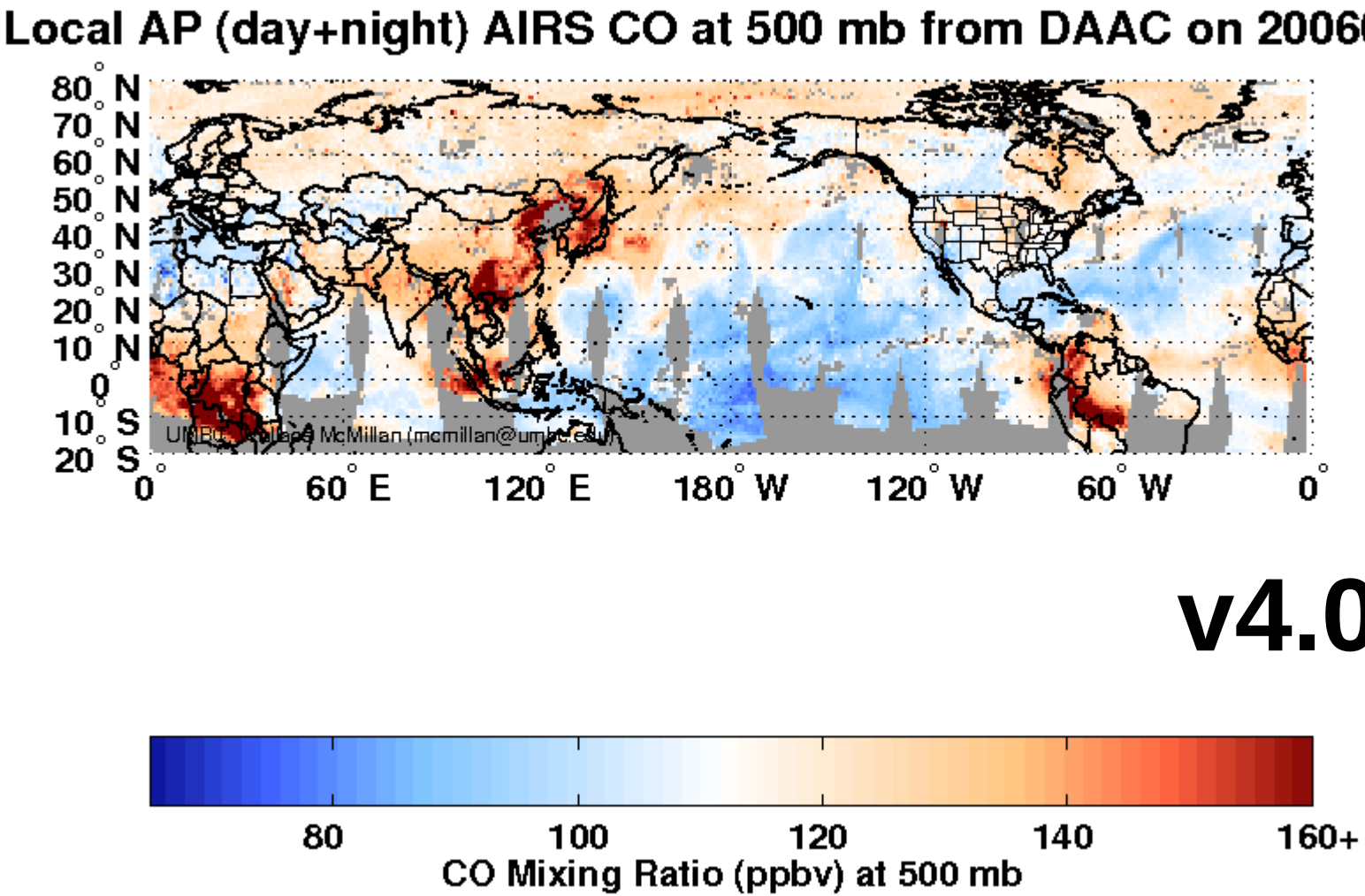
Daily ozone production along back trajectories results in Lagrangian mean ozone increase of nearly 30ppbv during previous 4 days

Trajectories remain within boundary layer during the previous 5 days



Brad Pierce (NOAA)

AIRS: Daily BIG view



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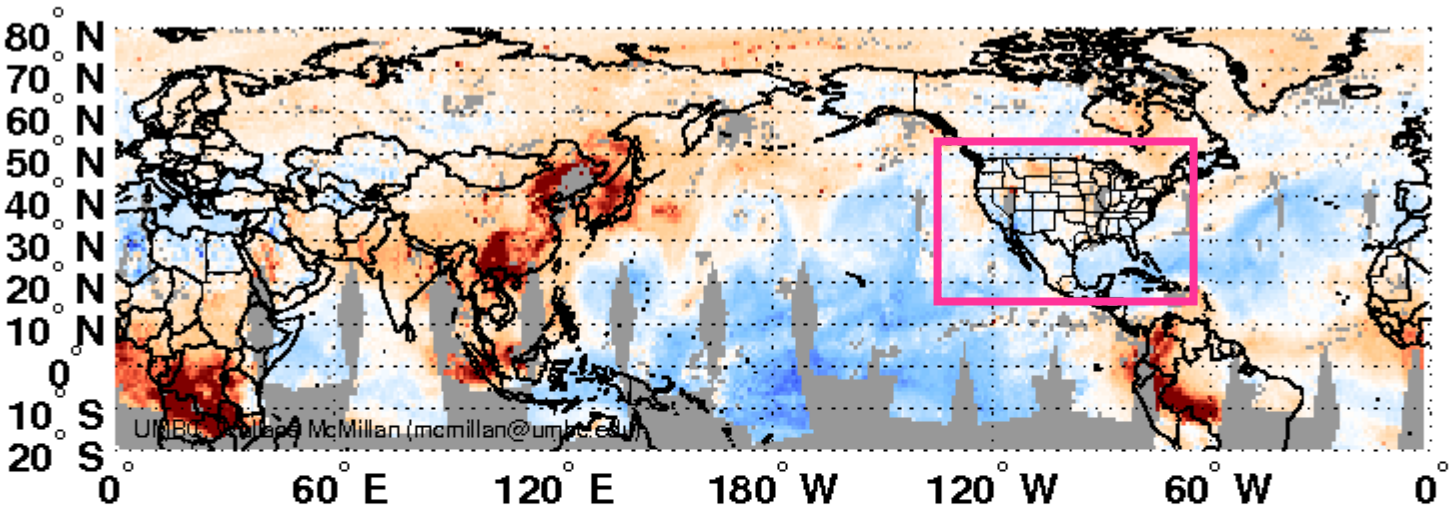
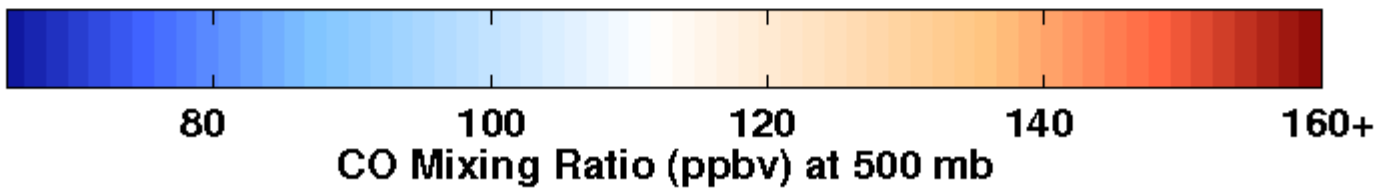
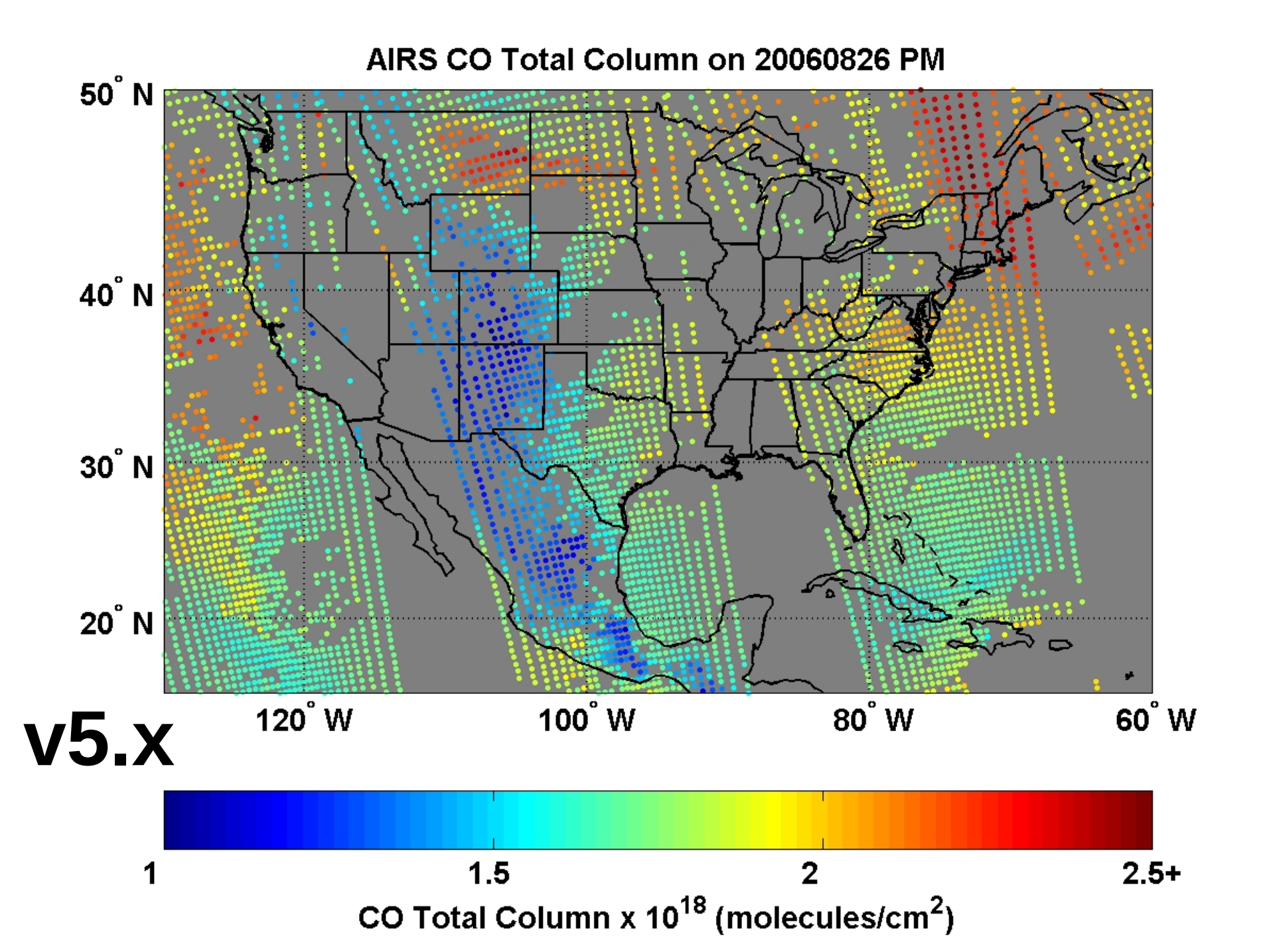
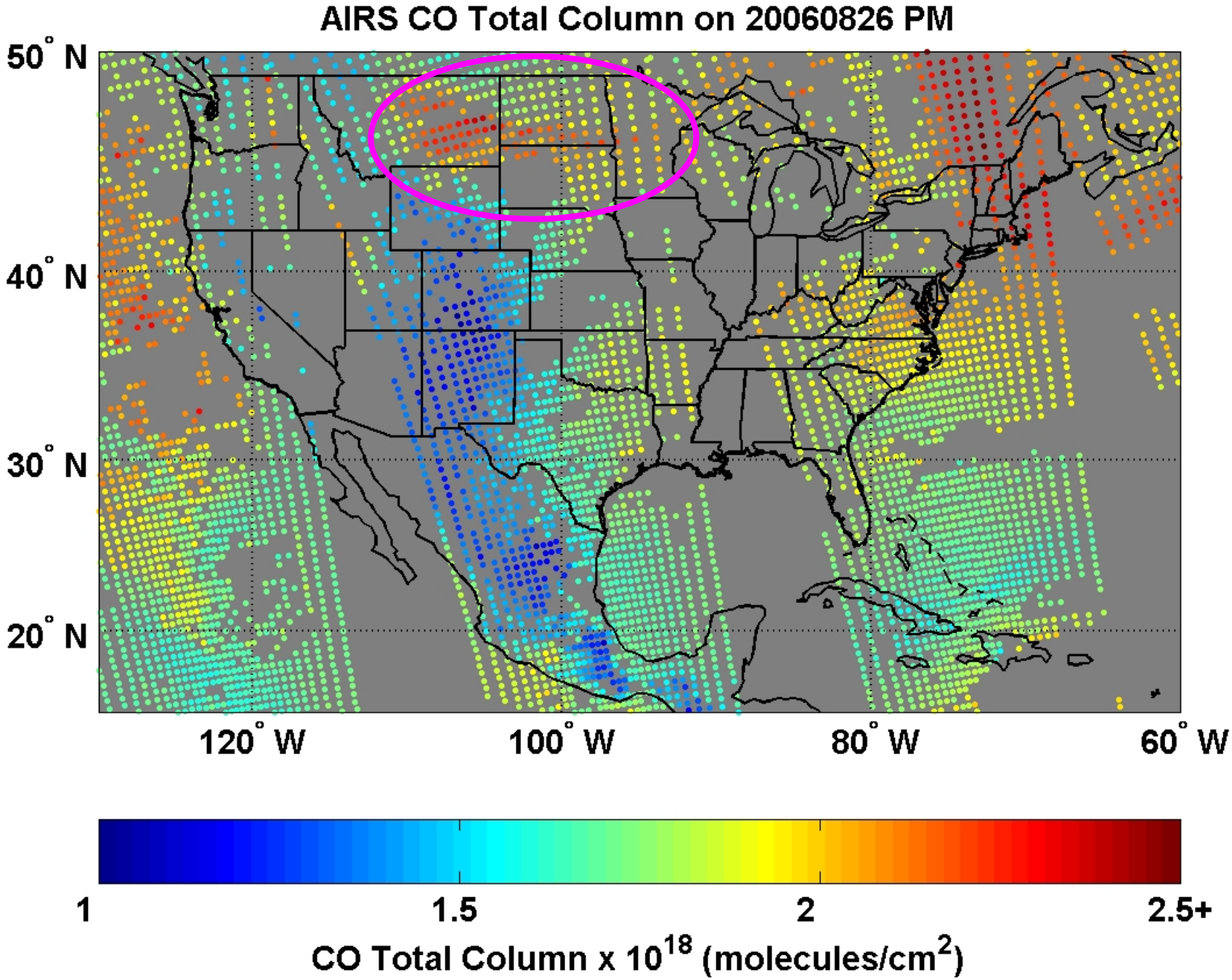
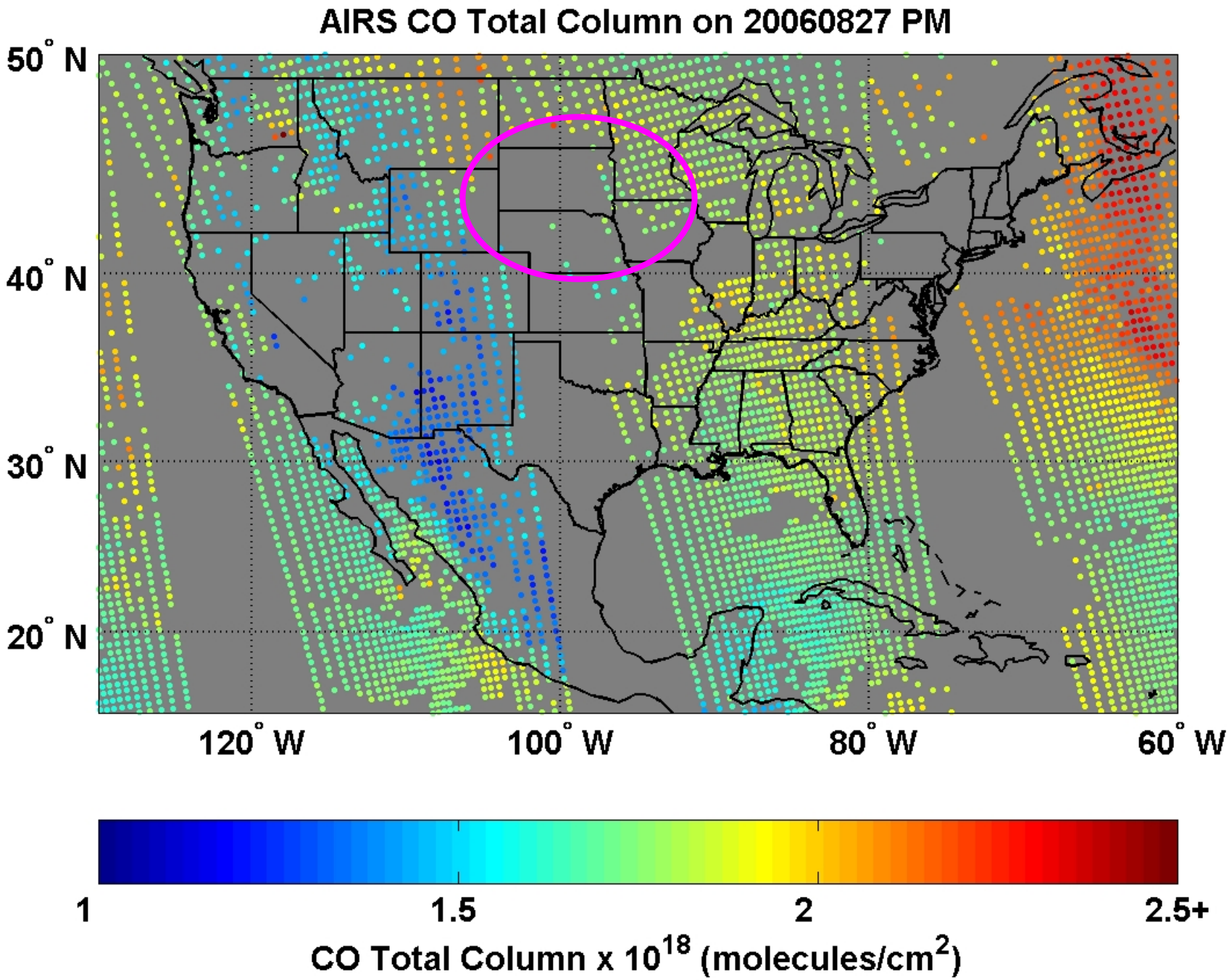

Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060826
80° N
70° N
60° N
50° N
40° N
30° N
20° N
10° N
0°
10° S
20° S
0°
60° E
120° E
180° W
120° W
60° W
0°
McMillan (mcmillan@umbc.edu)

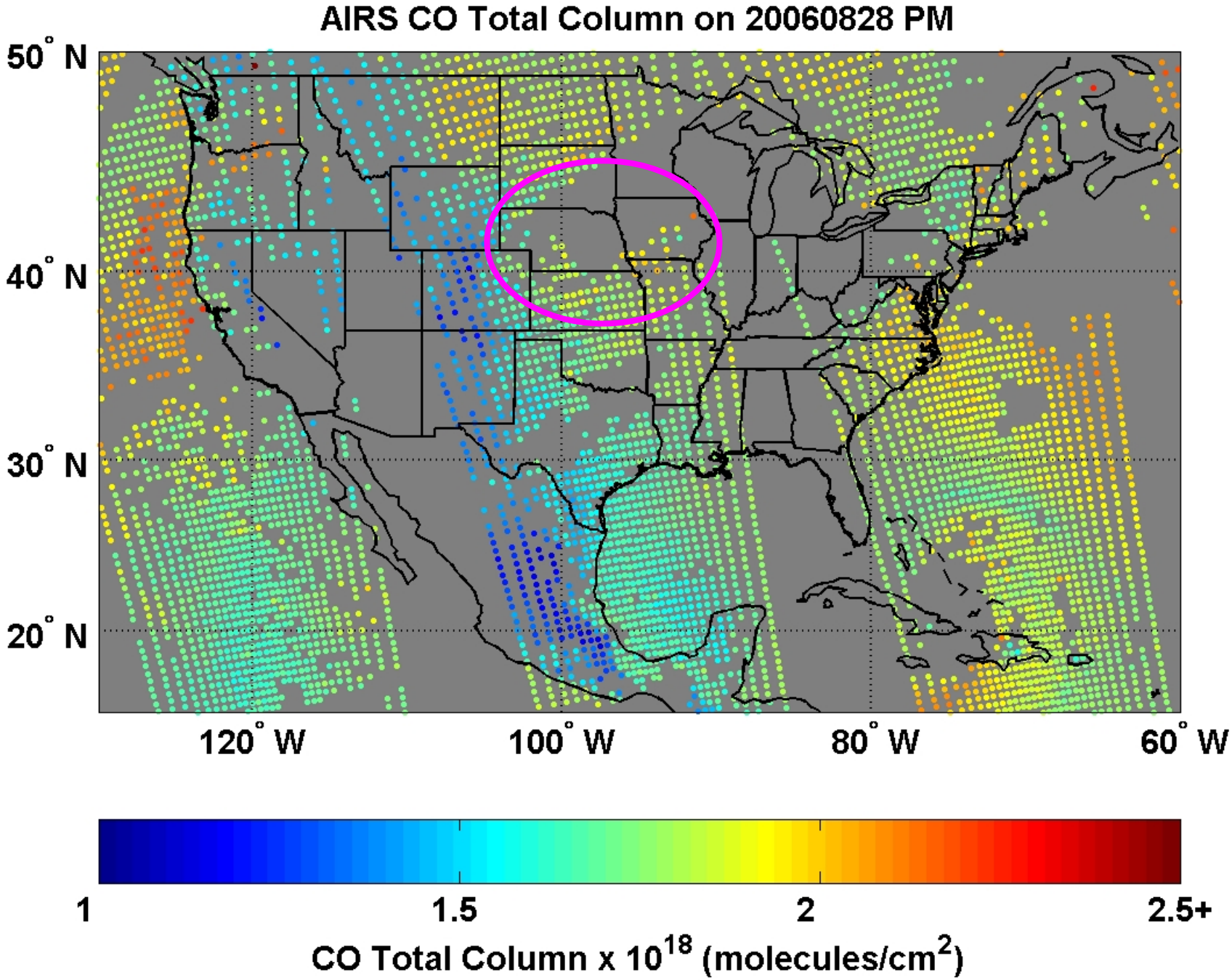
v4.0.9.0

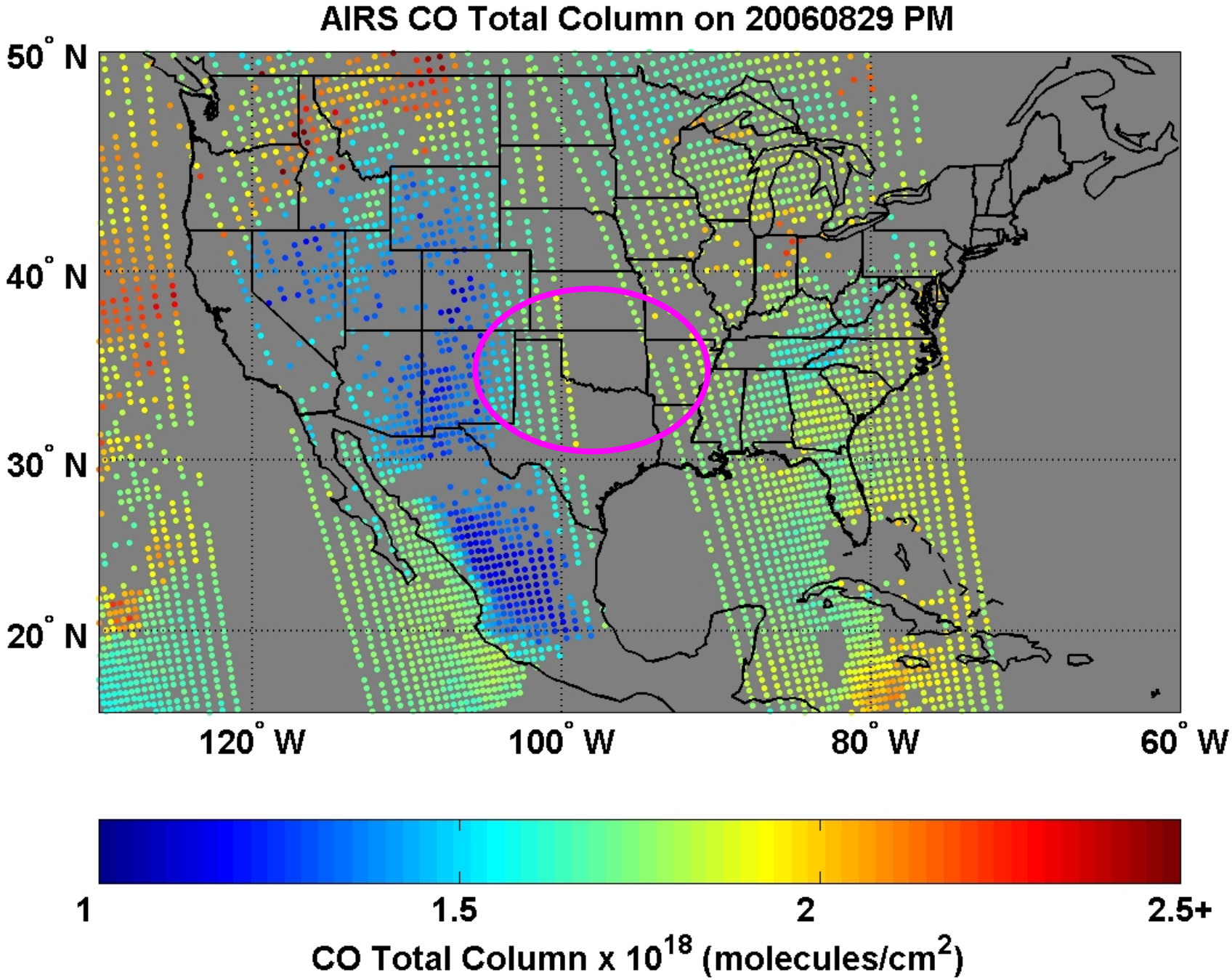

80
100
120
140
160+
CO Mixing Ratio (ppbv) at 500 mb

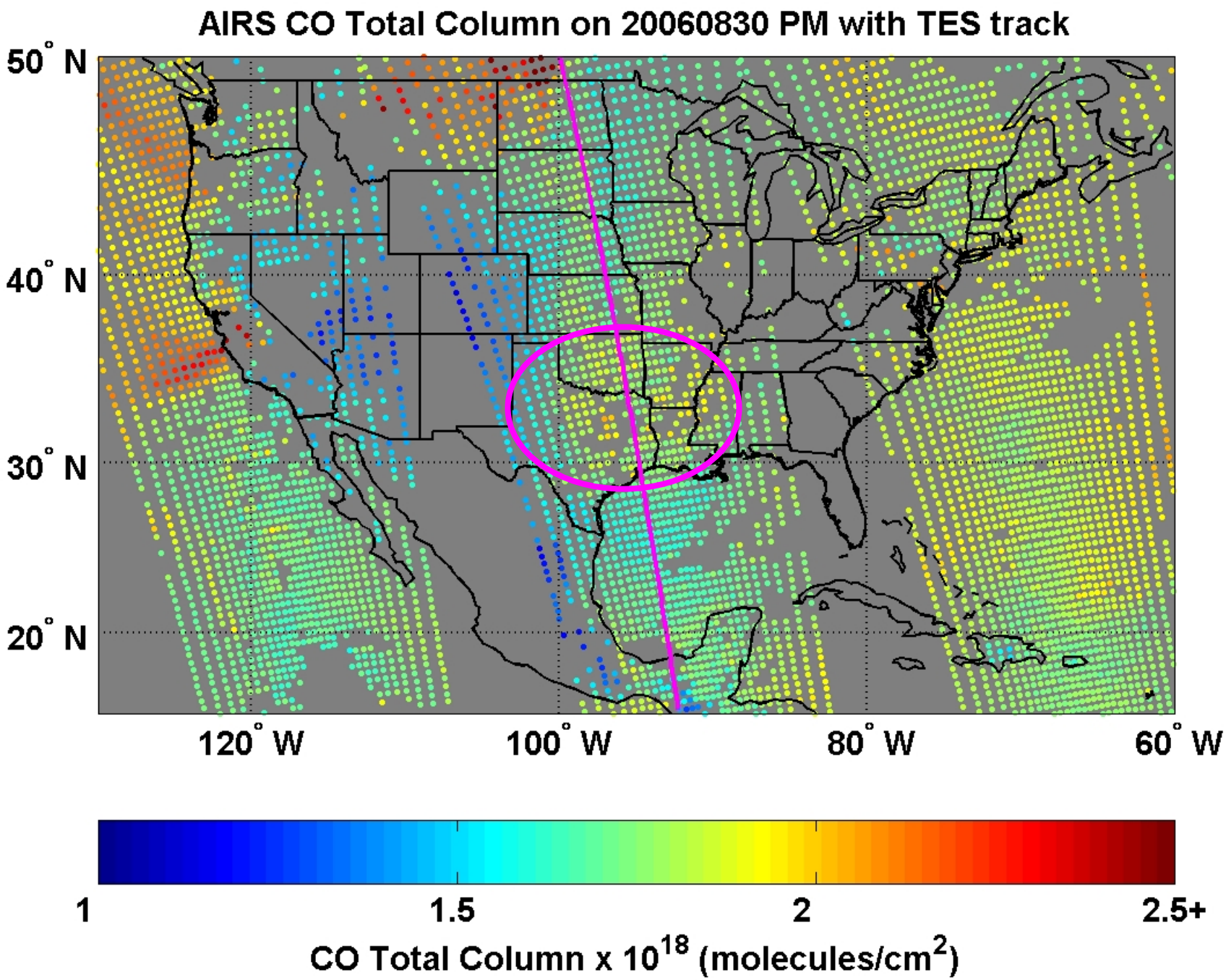

AIRS CO Total Column on 20060826 PM
50° N
40° N
30° N
20° N
120° W
100° W
80° W
60° W
v5.x
1
1.5
2
2.5+
CO Total Column x 10^18 (molecules/cm^2)

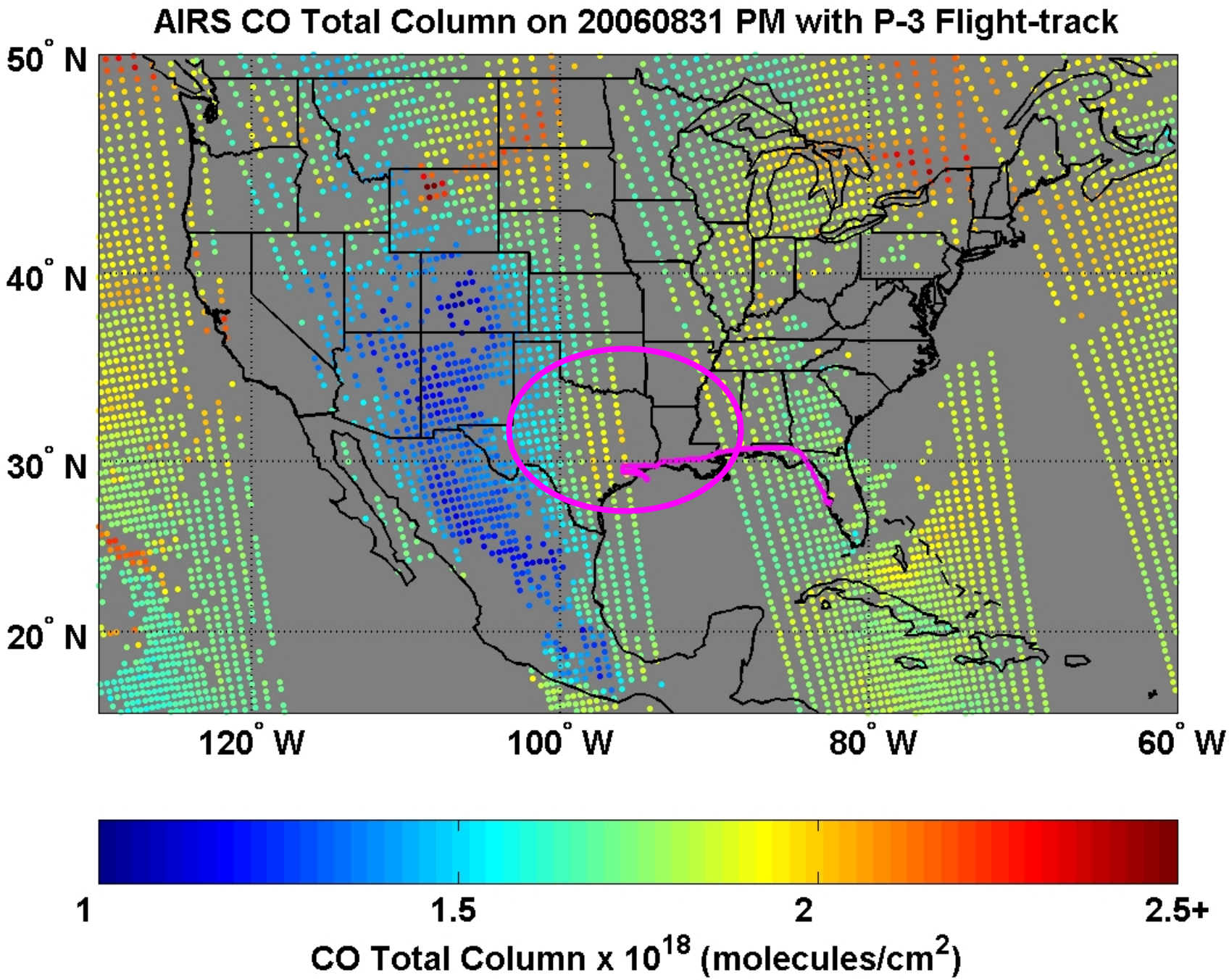

AIRS CO Total Column on 20060826 PM
50° N
40° N
30° N
20° N
120° W
100° W
80° W
60° W
1
1.5
2
2.5+
CO Total Column x 10^18 (molecules/cm^2)

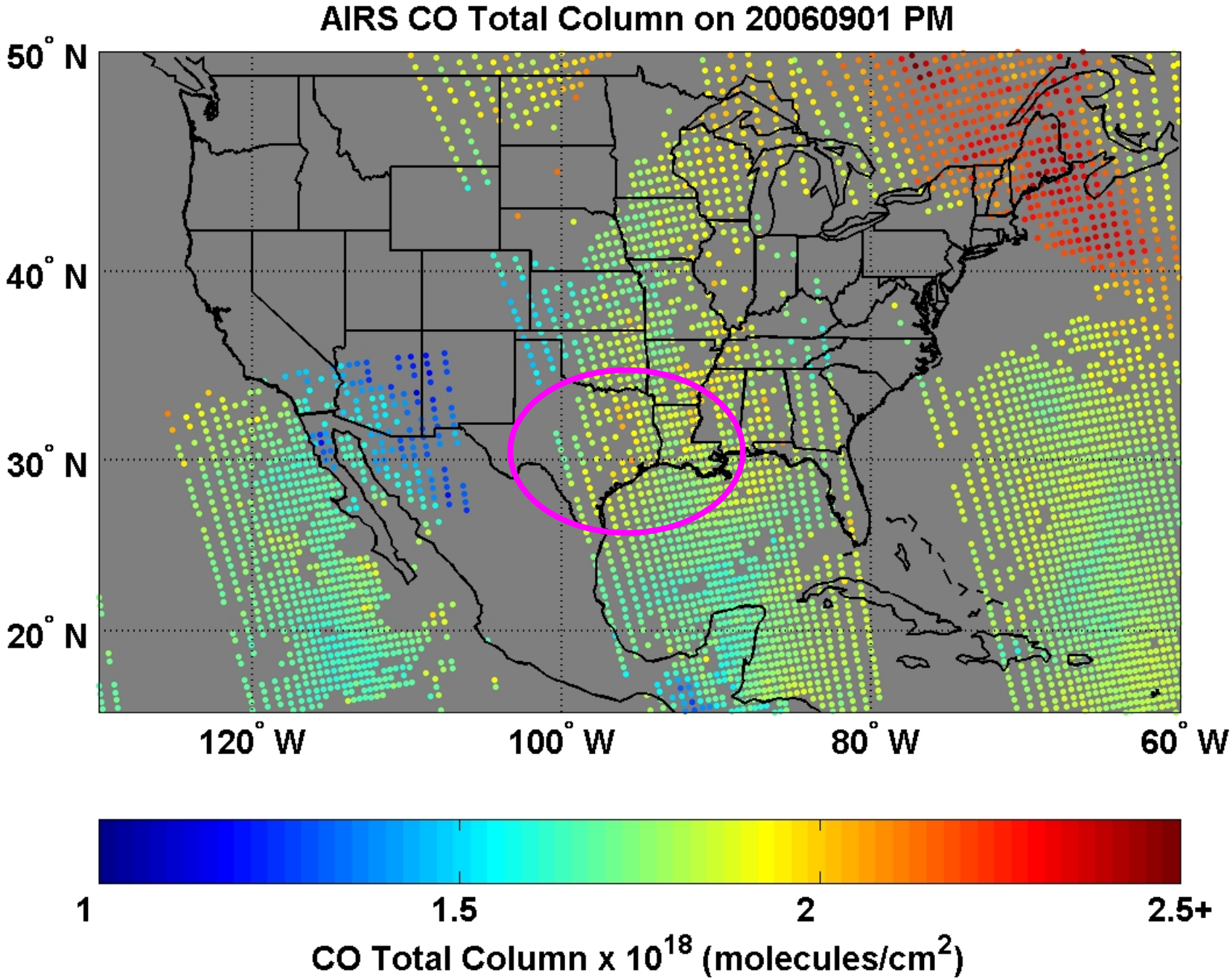

AIRS CO Total Column on 20060827 PM
50° N
40° N
30° N
20° N
120° W
100° W
80° W
60° W
1
1.5
2
2.5+
CO Total Column x 10^18 (molecules/cm^2)


AIRS CO Total Column on 20060828 PM
50° N
40° N
30° N
20° N
120° W
100° W
80° W
60° W
1
1.5
2
2.5+
CO Total Column x 10^18 (molecules/cm^2)


AIRS CO Total Column on 20060829 PM
50° N
40° N
30° N
20° N
120° W
100° W
80° W
60° W
1
1.5
2
2.5+
CO Total Column x 10^18 (molecules/cm^2)

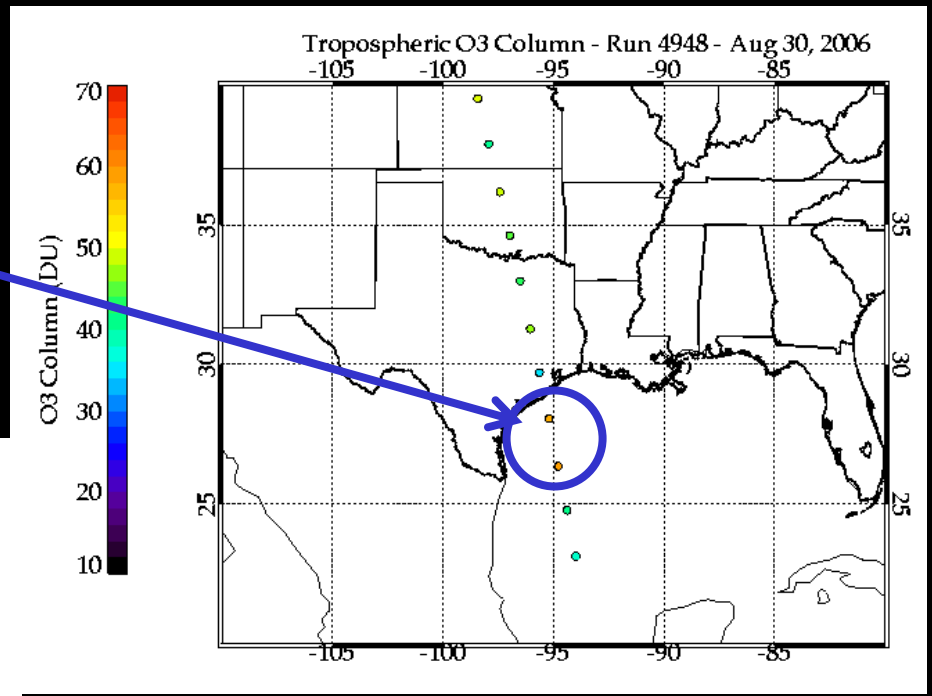

AIRS CO Total Column on 20060830 PM with TES track
50° N
40° N
30° N
20° N
120° W
100° W
80° W
60° W
1
1.5
2
2.5+
CO Total Column x 10^18 (molecules/cm^2)

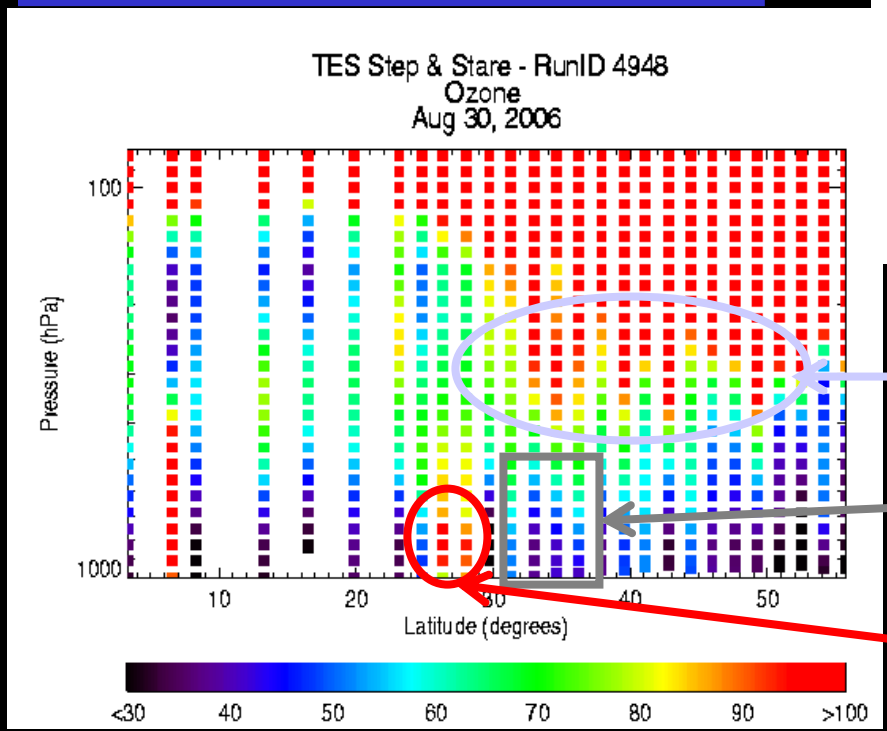

AIRS CO Total Column on 20060831 PM with P-3 Flight-track
50° N
40° N
30° N
20° N
120° W
100° W
80° W
60° W
1
1.5
2
2.5+
CO Total Column x 10^18 (molecules/cm^2)


AIRS CO Total Column on 20060901 PM
50° N
40° N
30° N
20° N
120° W
100° W
80° W
60° W
1
1.5
2
2.5+
CO Total Column x 10^18 (molecules/cm^2)

TES Observations – Aug 30, 2006

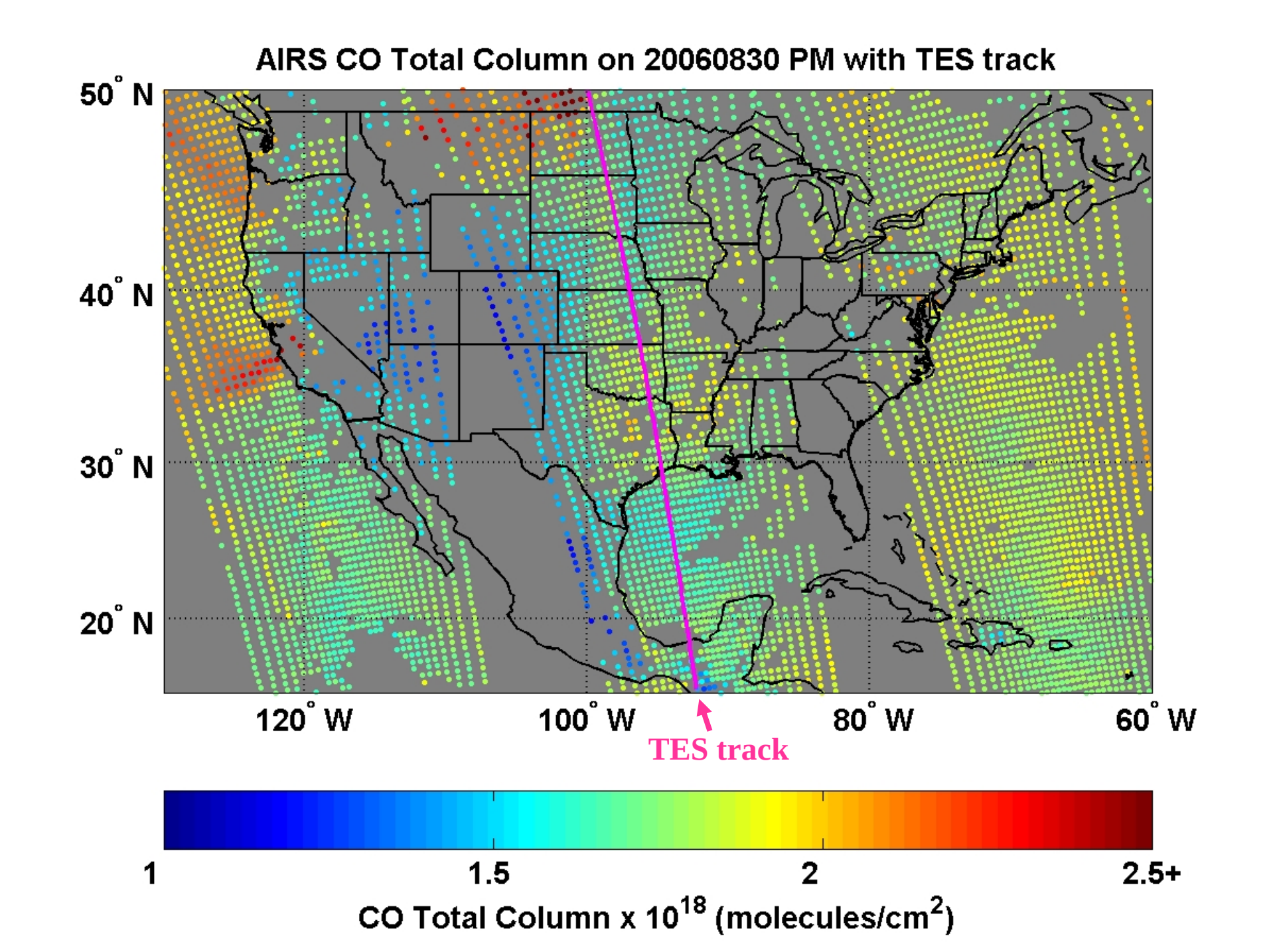
- TES Global Survey
- High ozone in the troposphere over the Gulf of Mexico seen in Trop Column
- Lower values over East TX



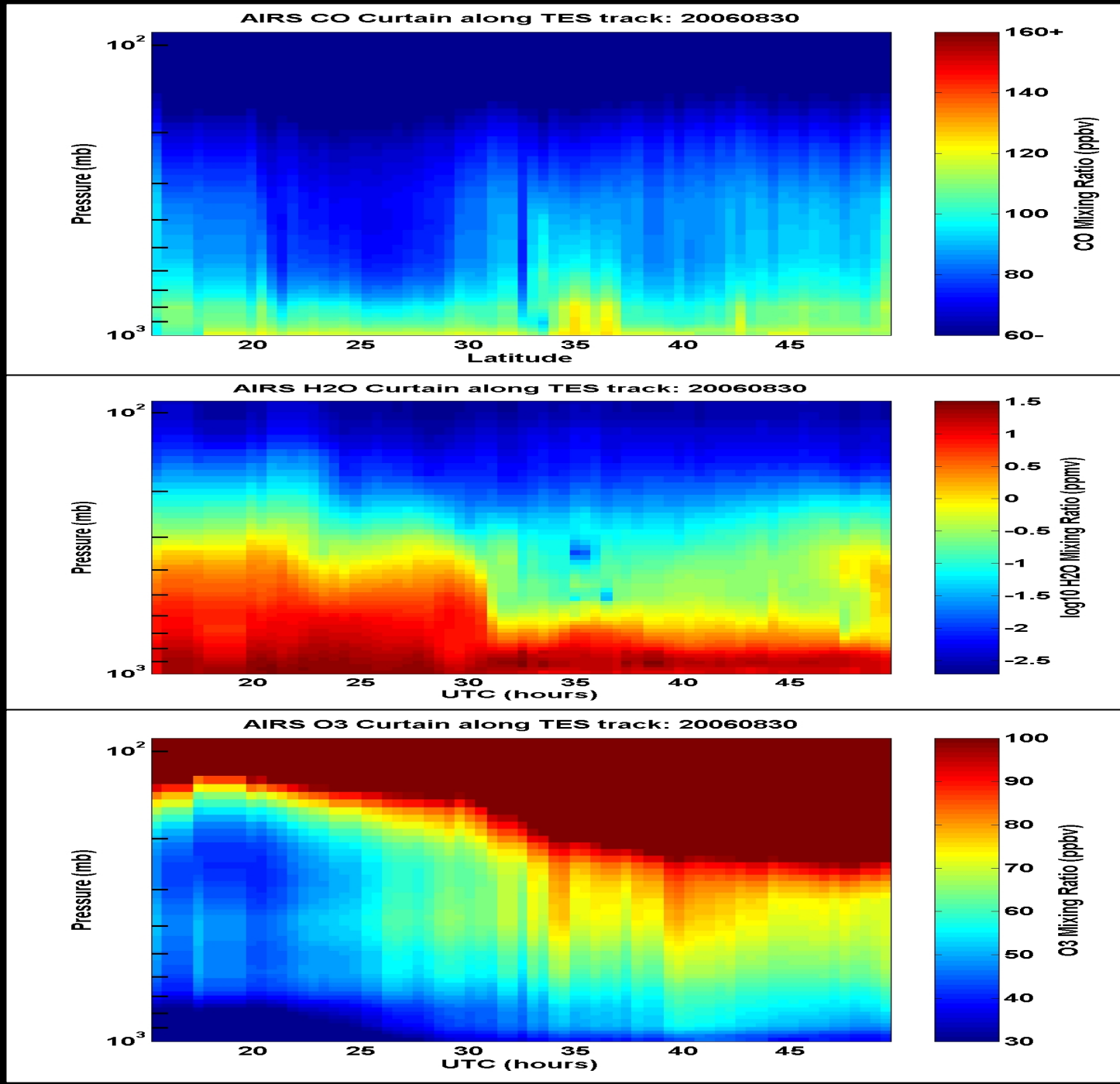


- Enhancement in ozone in middle troposphere over TX, OK, KA
- Low ozone in lower troposphere over East Texas, Central Oklahoma
- High ozone in lower troposphere over the Gulf (still under investigation)

Greg Osterman (JPL)

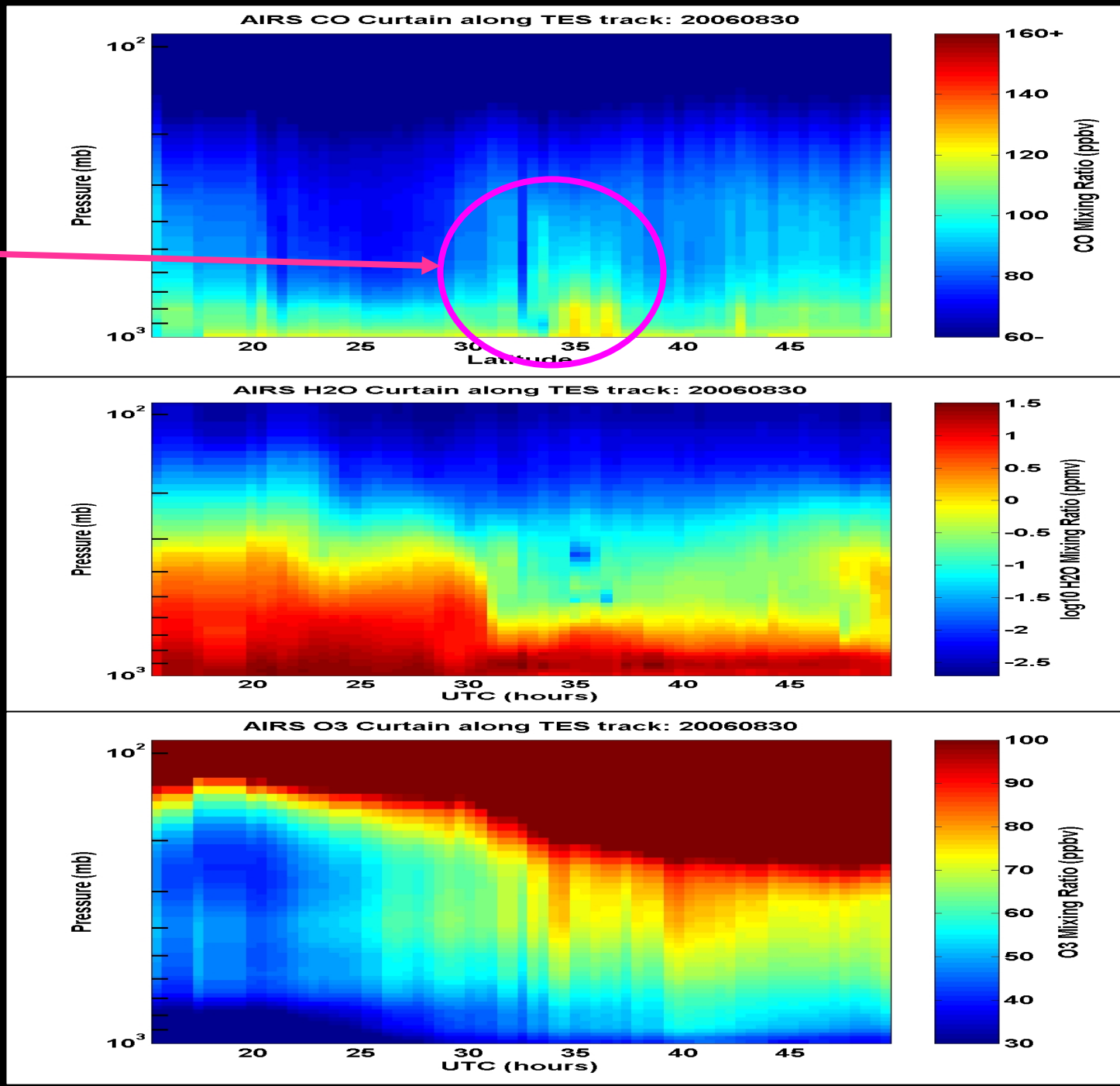

AIRS CO Total Column on 20060830 PM with TES track
50° N
40° N
30° N
20° N
120° W
100° W
80° W
60° W
TES track
1
1.5
2
2.5+
CO Total Column x 10^18 (molecules/cm^2)

August 30, 2006



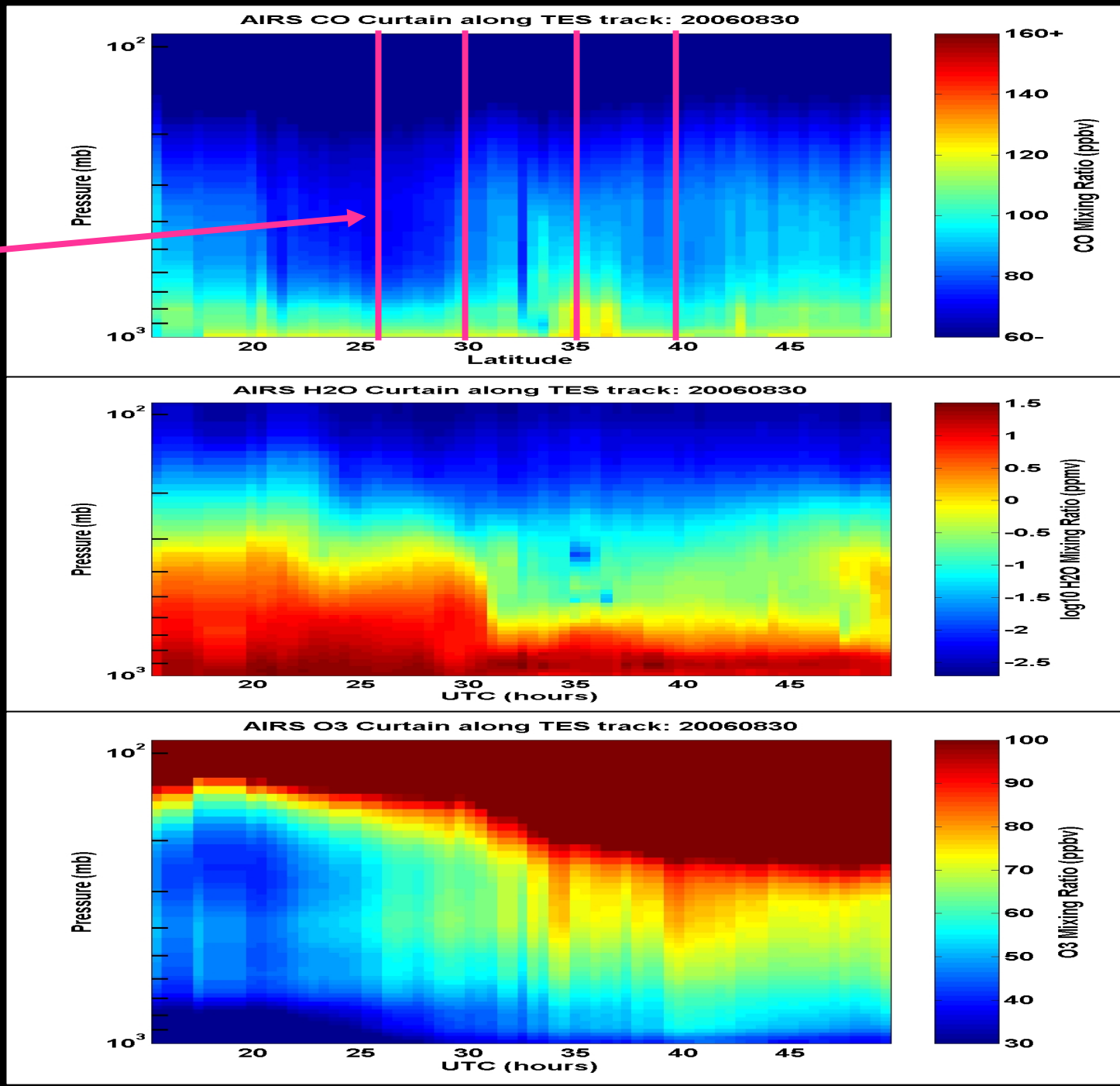
August 30, 2006

CO enhancement in lower troposphere

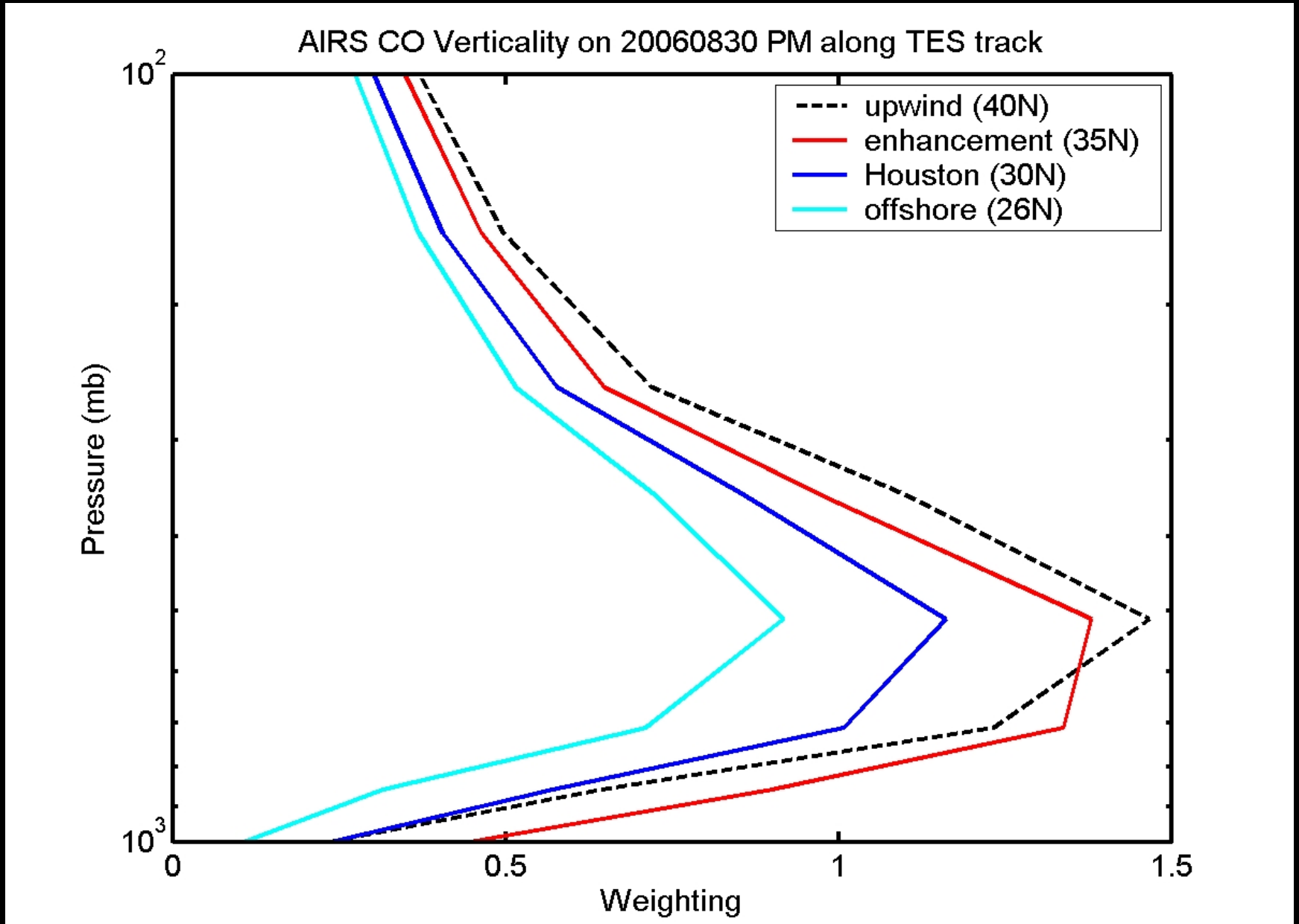


August 30, 2006

CO vertical sensitivity profiles

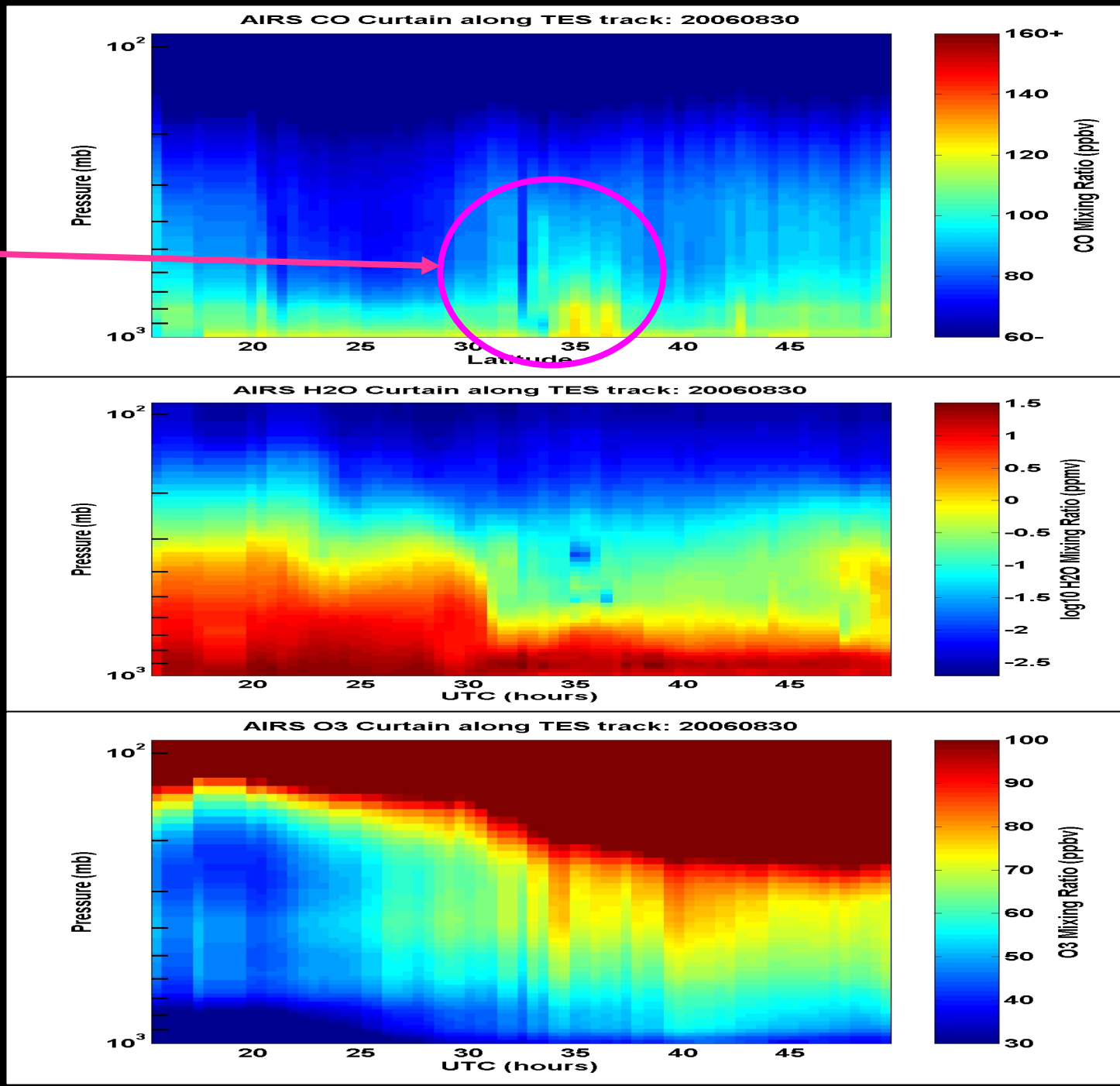


AIRS CO Column Averaging Kernels



August 30, 2006

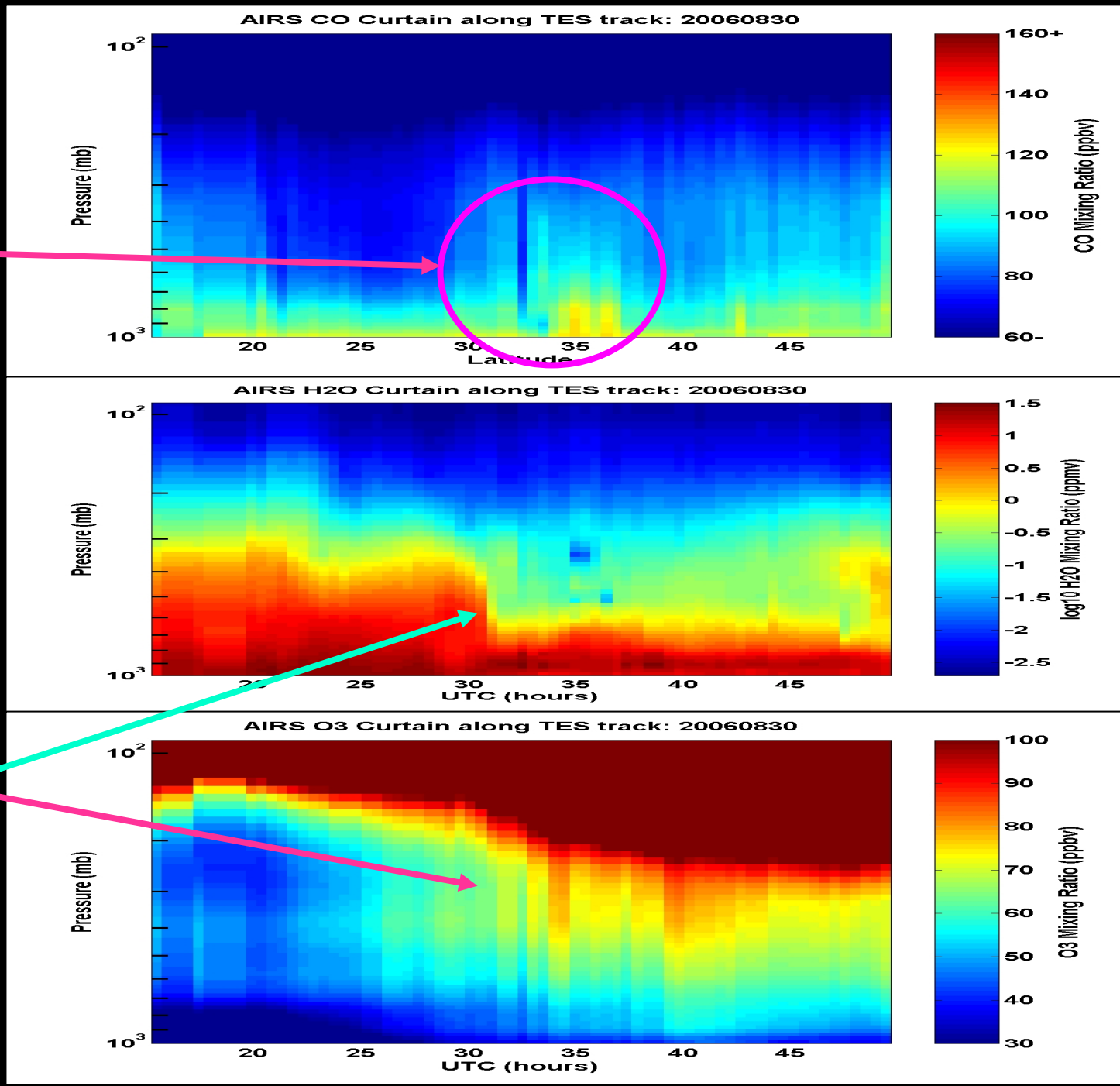
CO enhancement in lower troposphere



August 30, 2006

CO enhancement in lower troposphere

Stratospheric intrusion

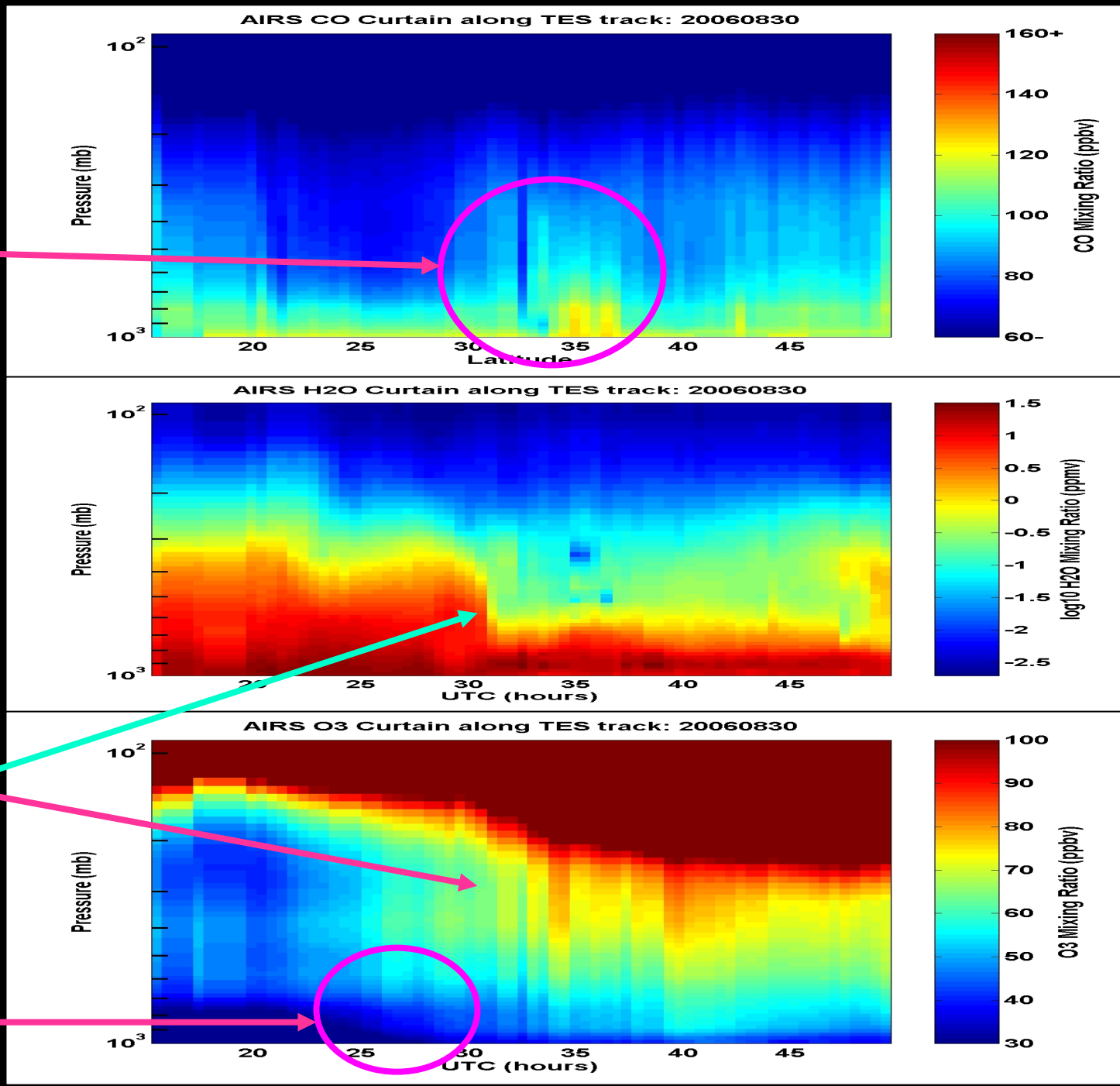


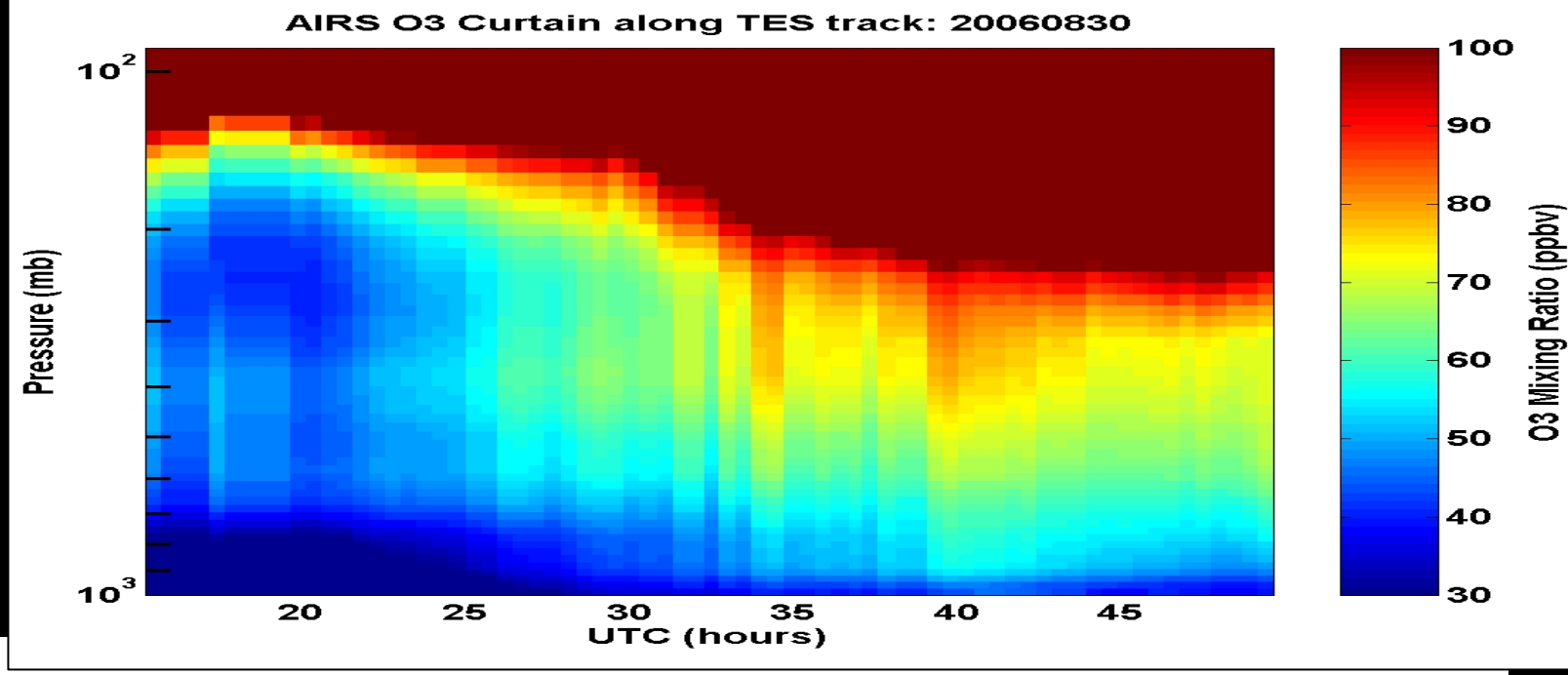
August 30, 2006

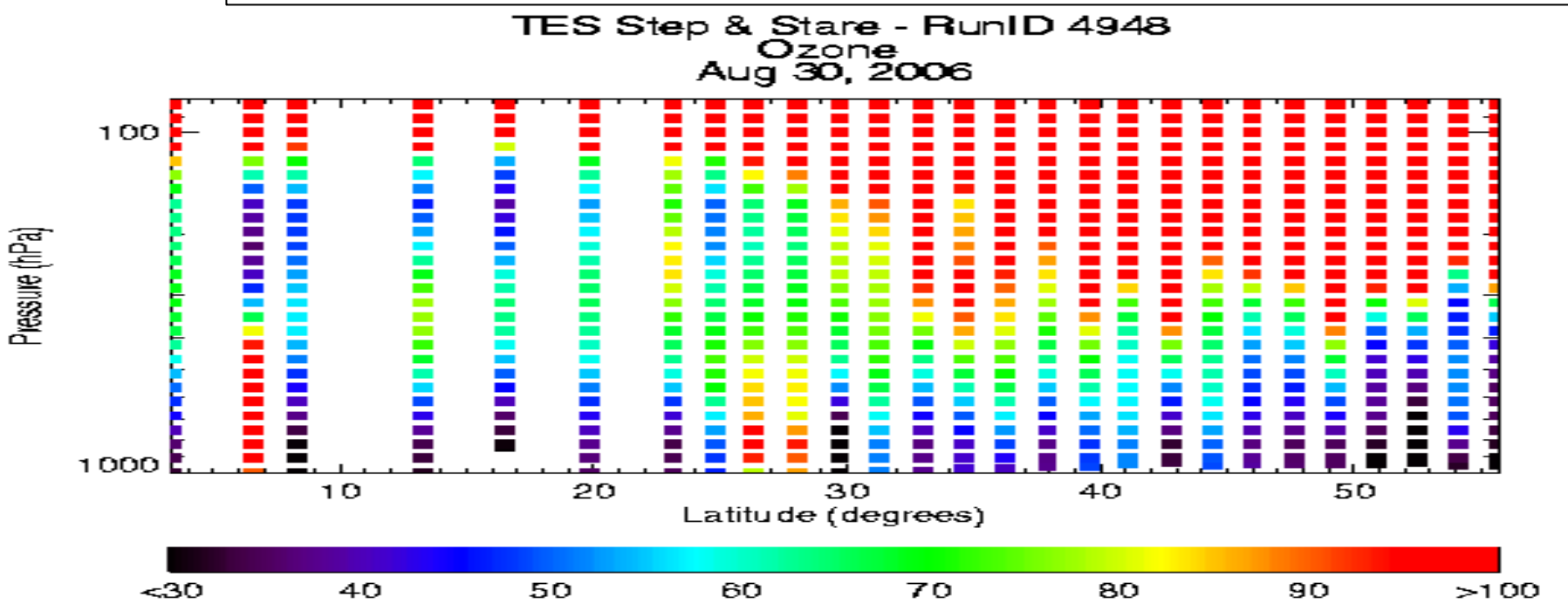
CO enhancement in lower troposphere

Stratospheric intrusion

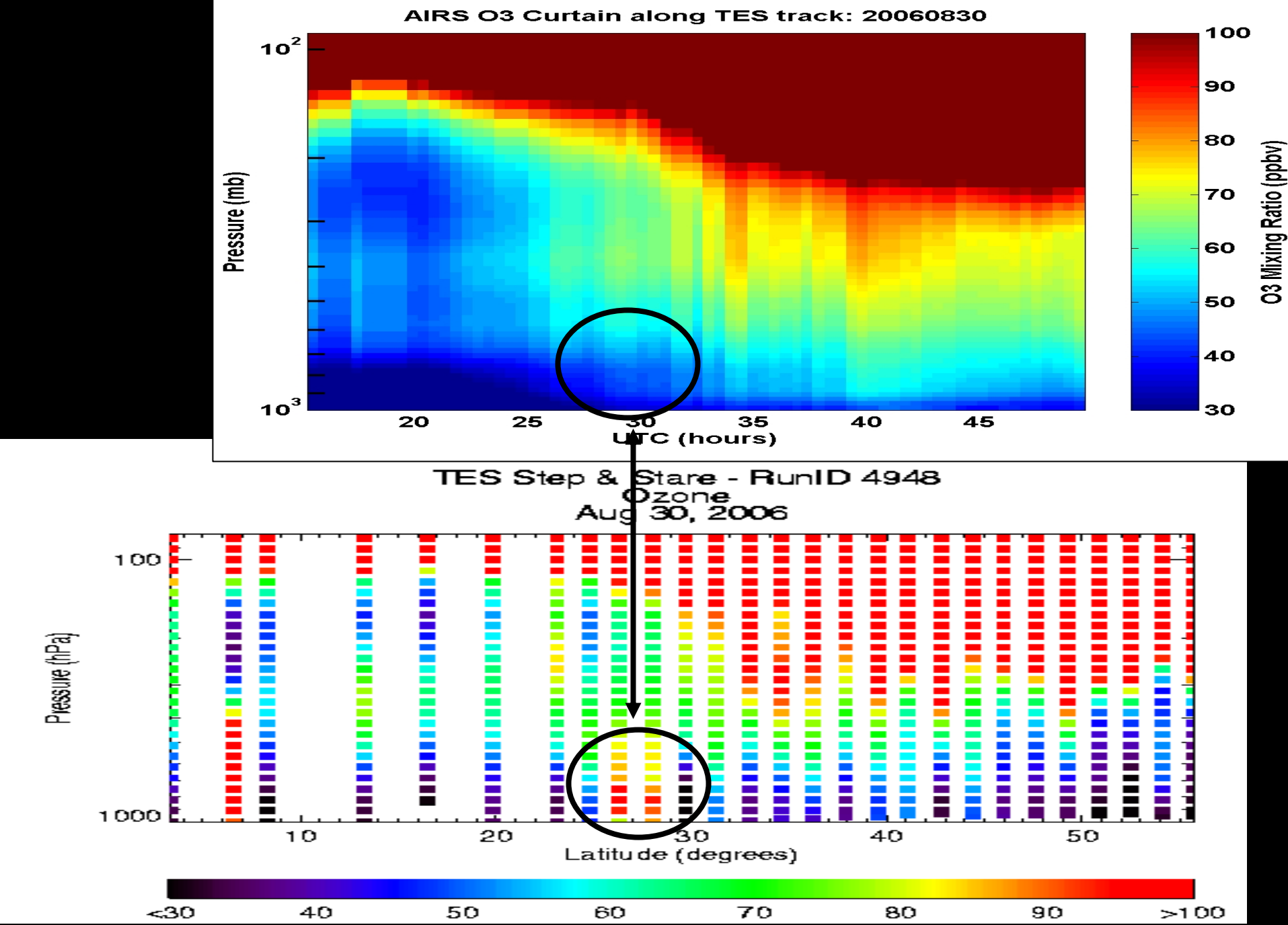
AIRS cannot see O3 near surface



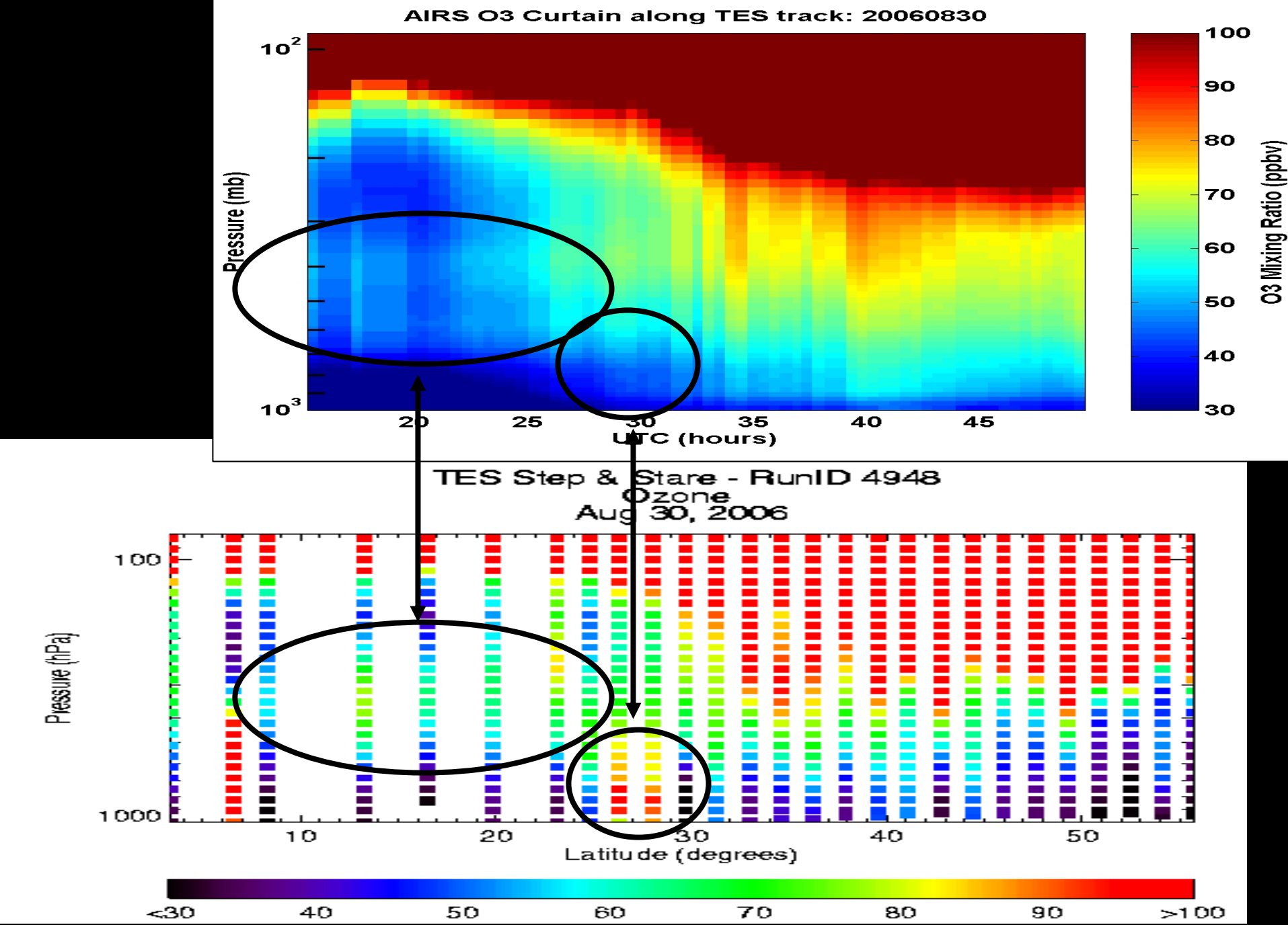




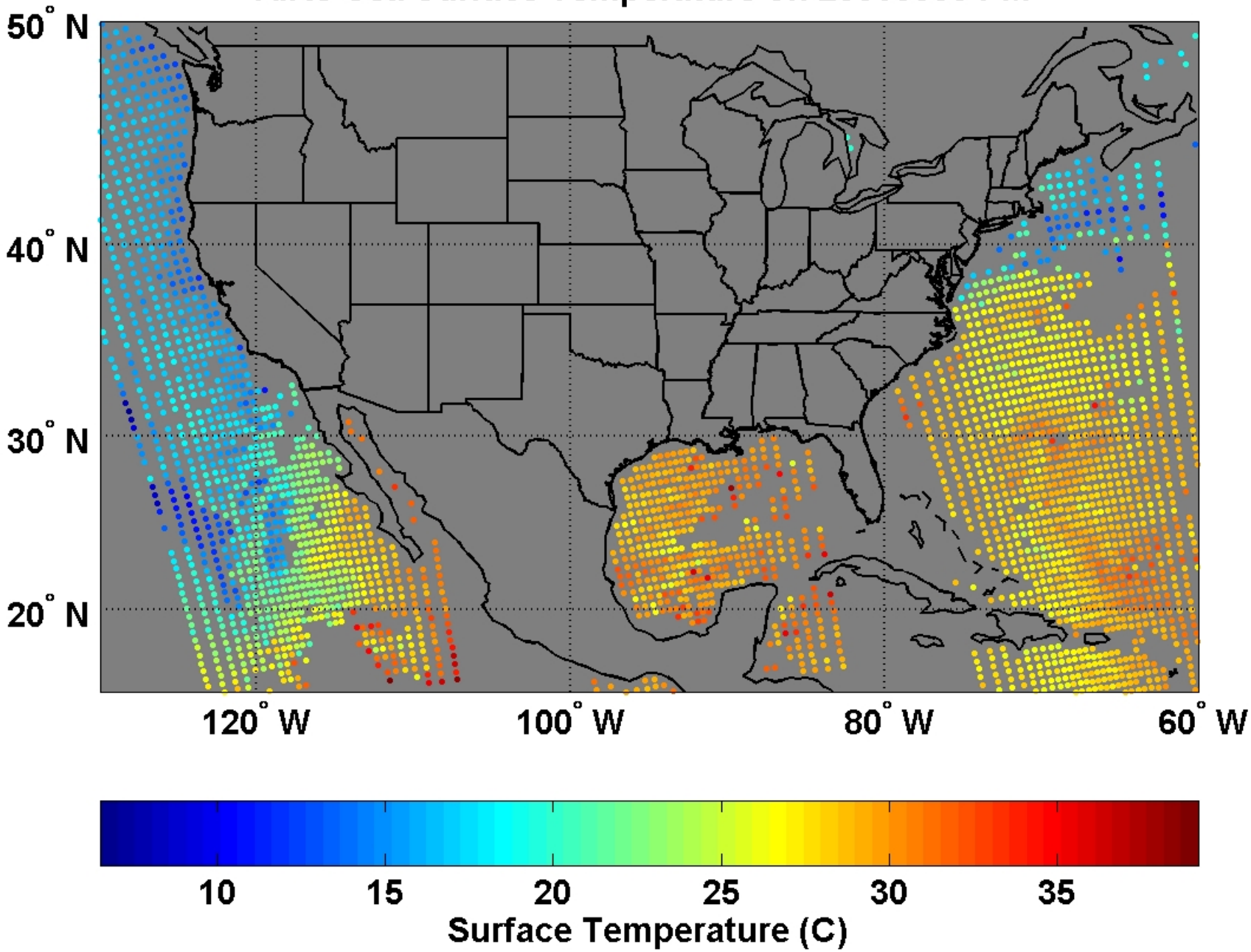
Greg Osterman (JPL)

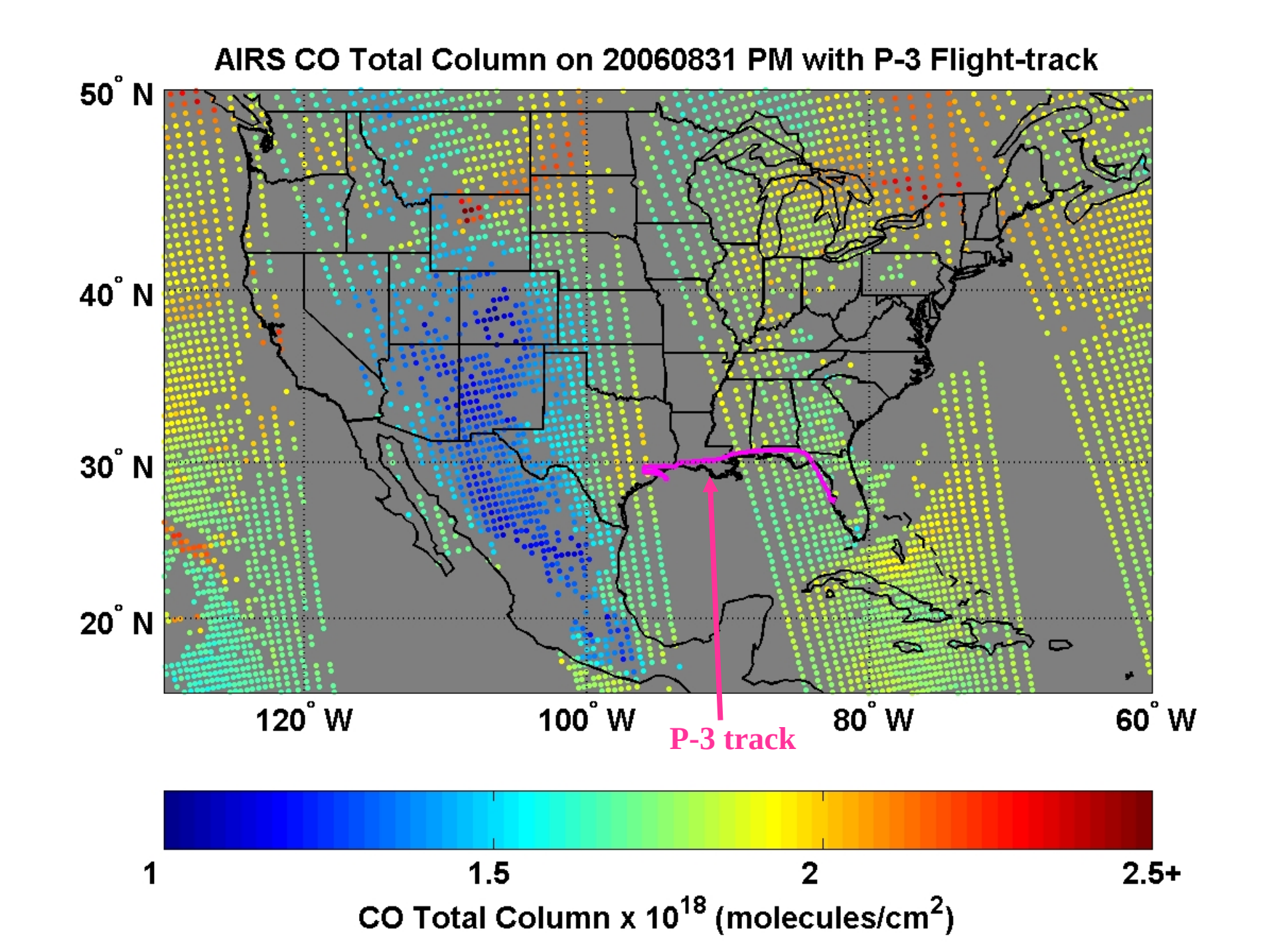


Greg Osterman (JPL)

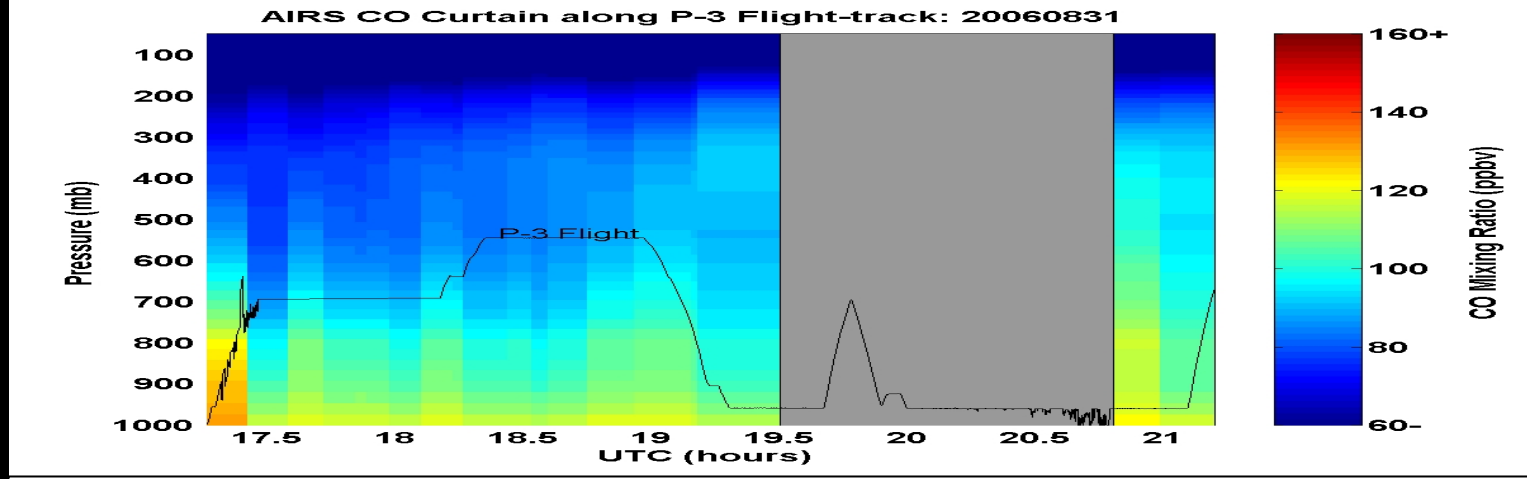


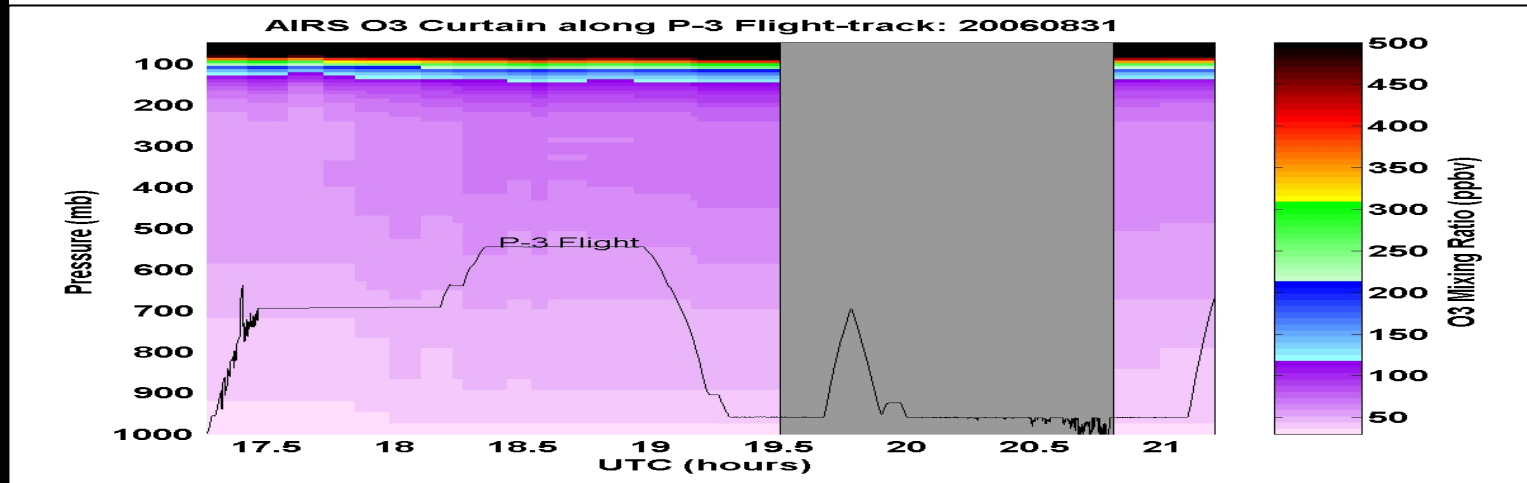
Greg Osterman (JPL)

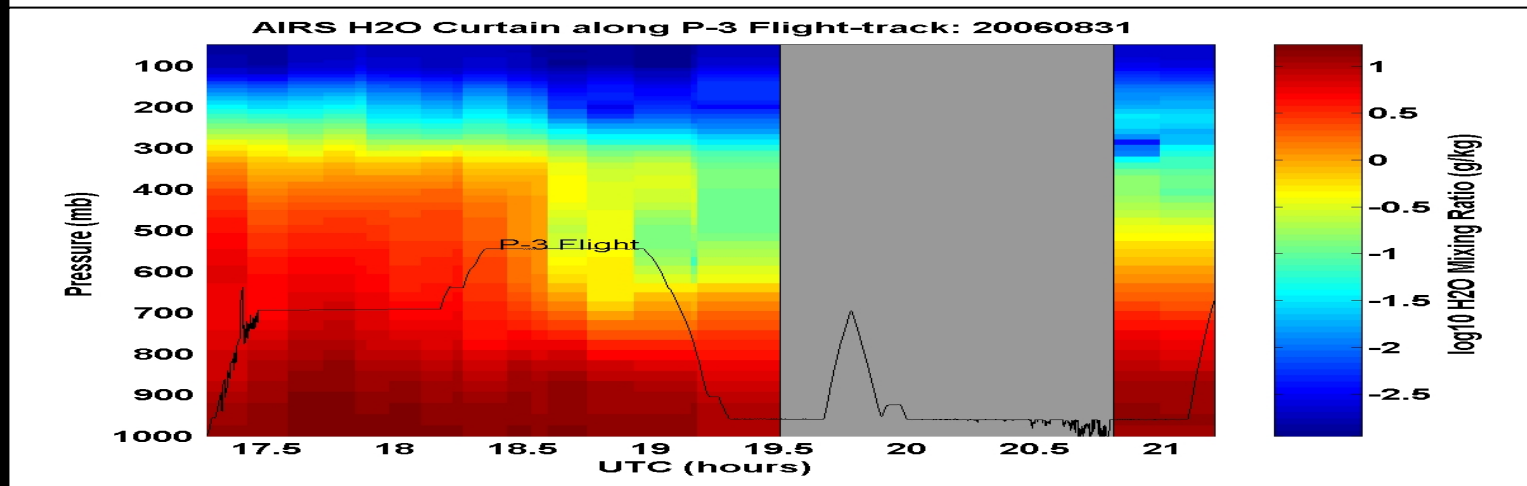

AIRS Sea Surface Temperature on 20060830 PM
50° N
40° N
30° N
20° N
120° W
100° W
80° W
60° W
10
15
20
25
30
35
Surface Temperature (C)


AIRS CO Total Column on 20060831 PM with P-3 Flight-track
50° N
40° N
30° N
20° N
120° W
100° W
80° W
60° W
P-3 track
1
1.5
2
2.5+
CO Total Column x 10^18 (molecules/cm^2)

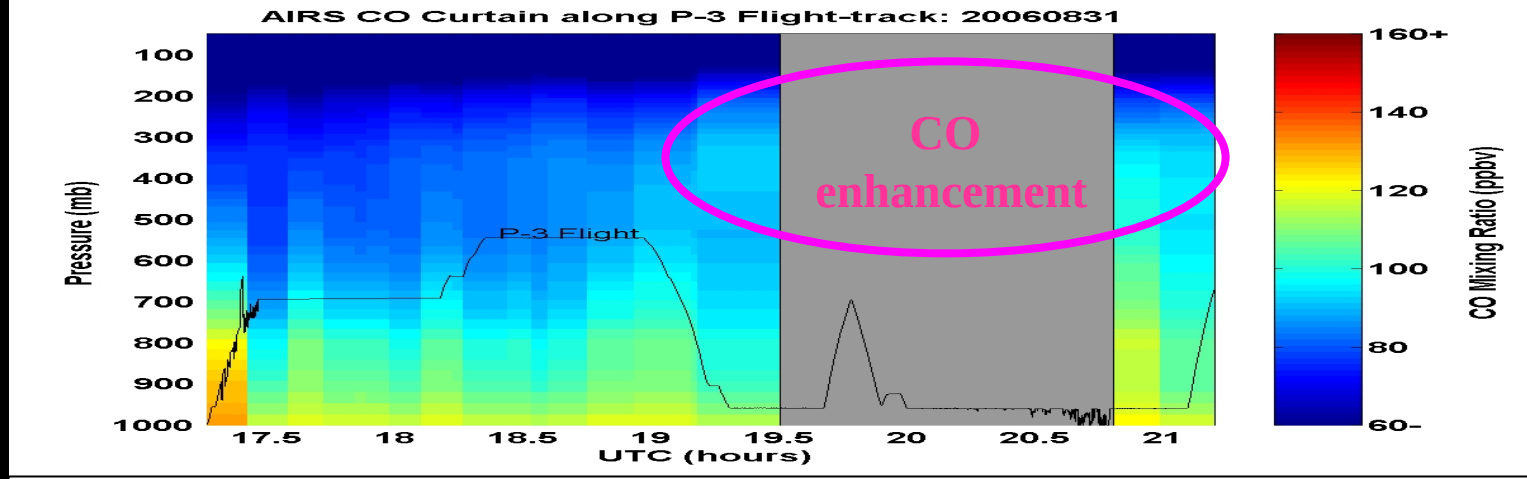
August 31, 2006

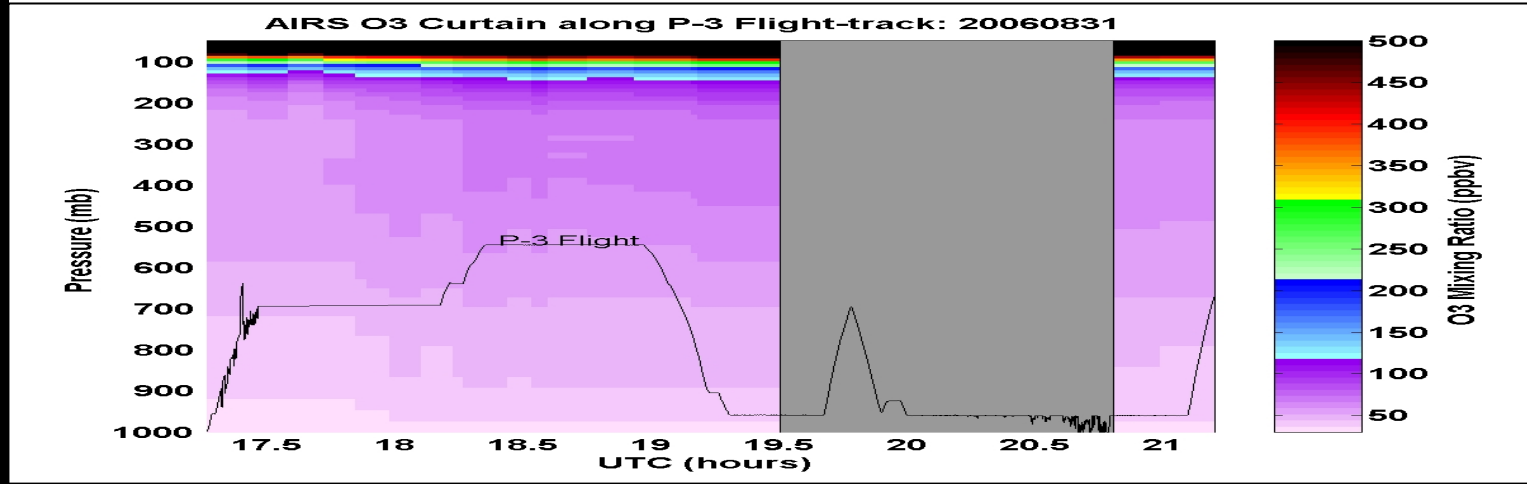


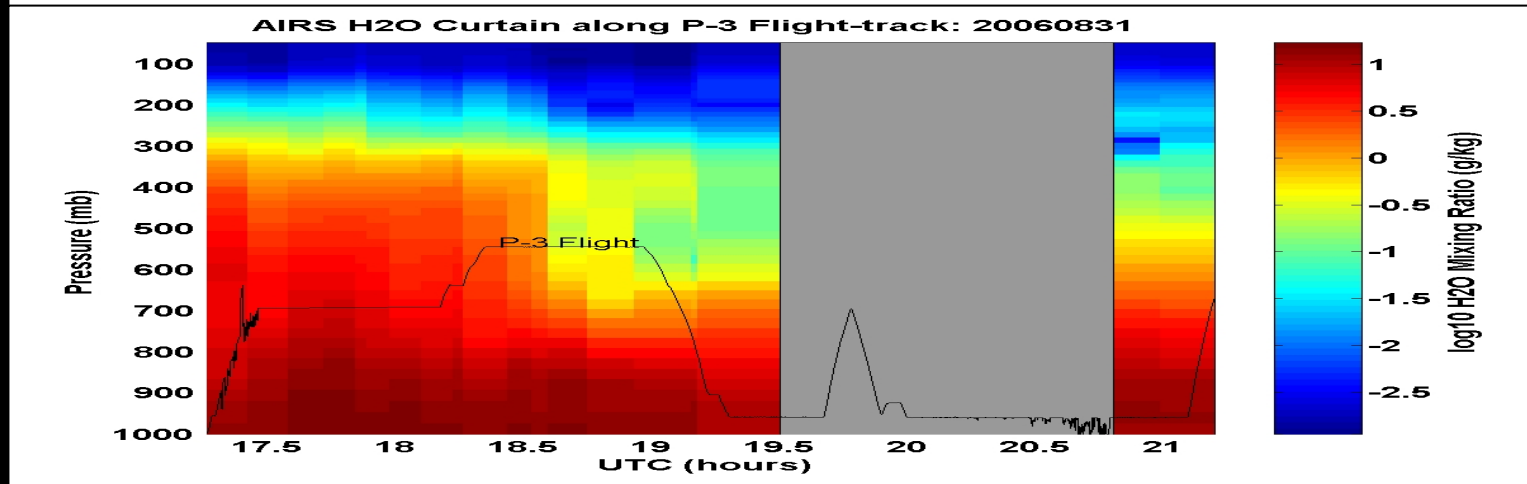




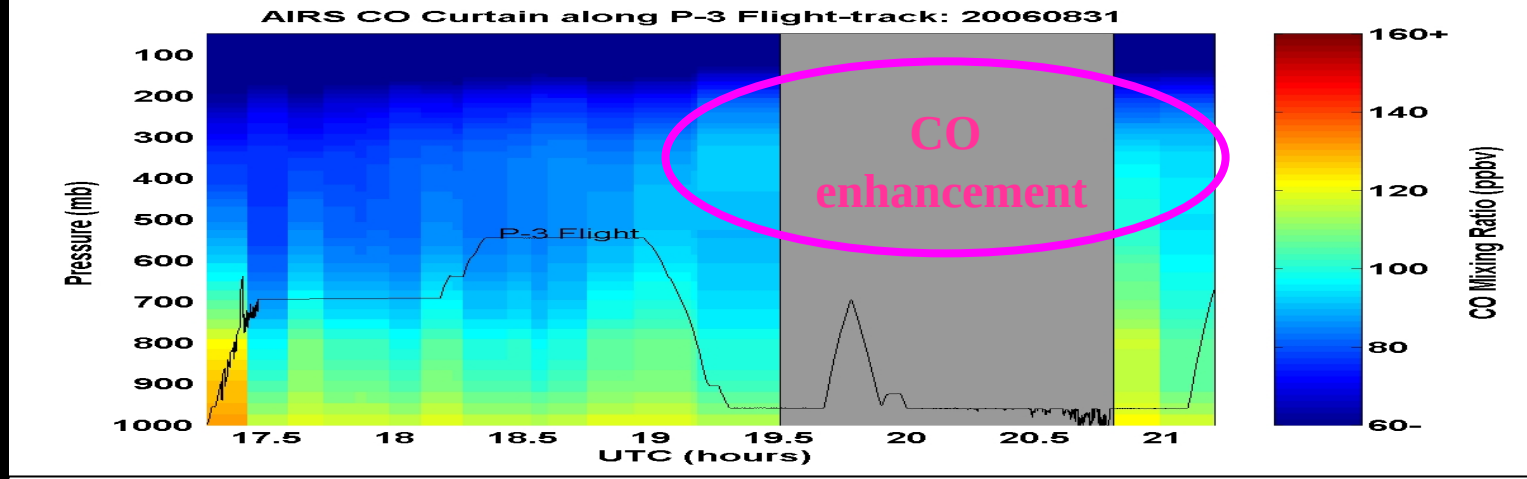
August 31, 2006

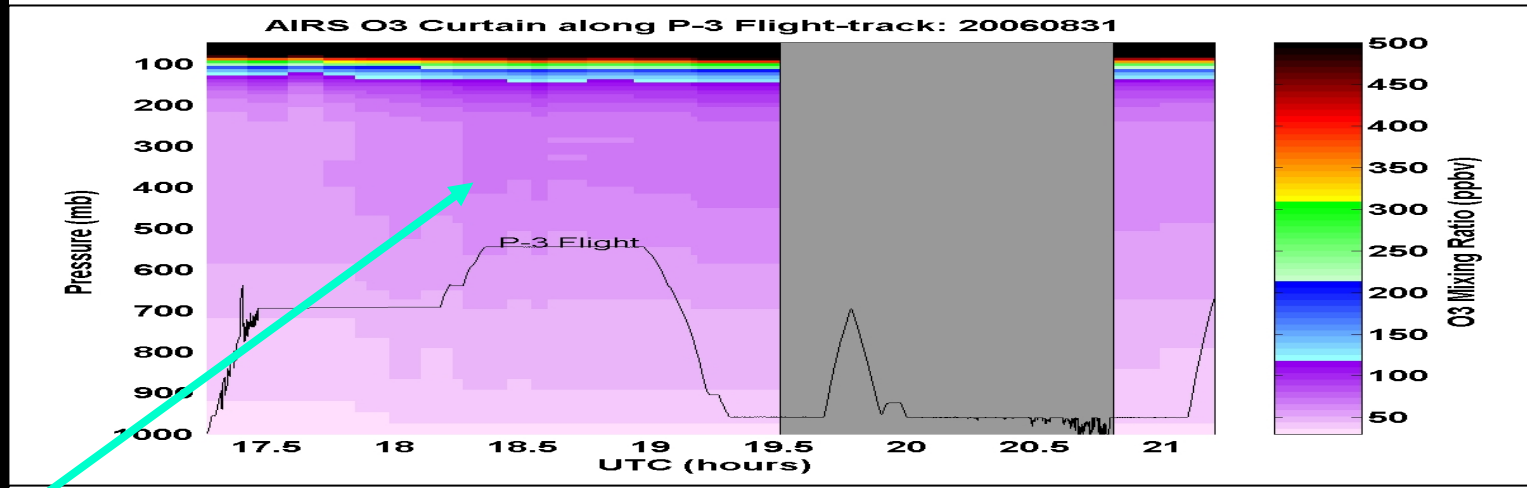


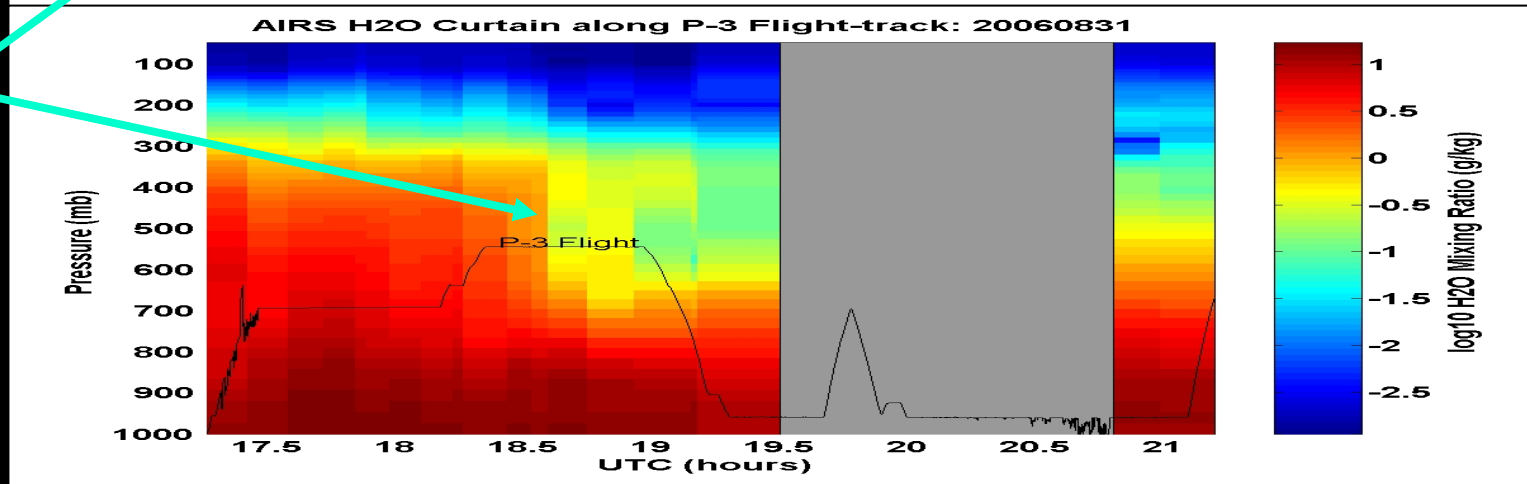




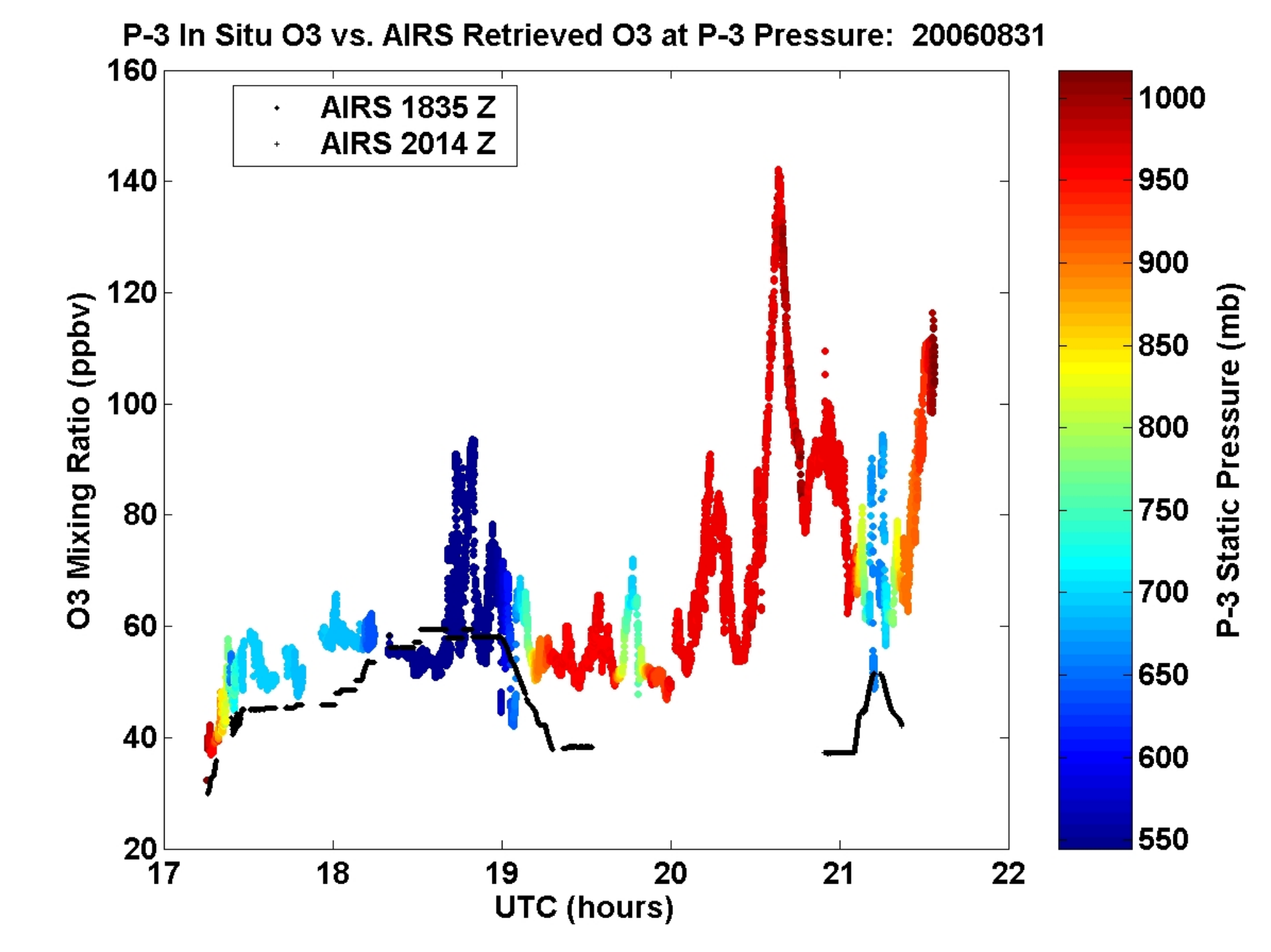
August 31, 2006

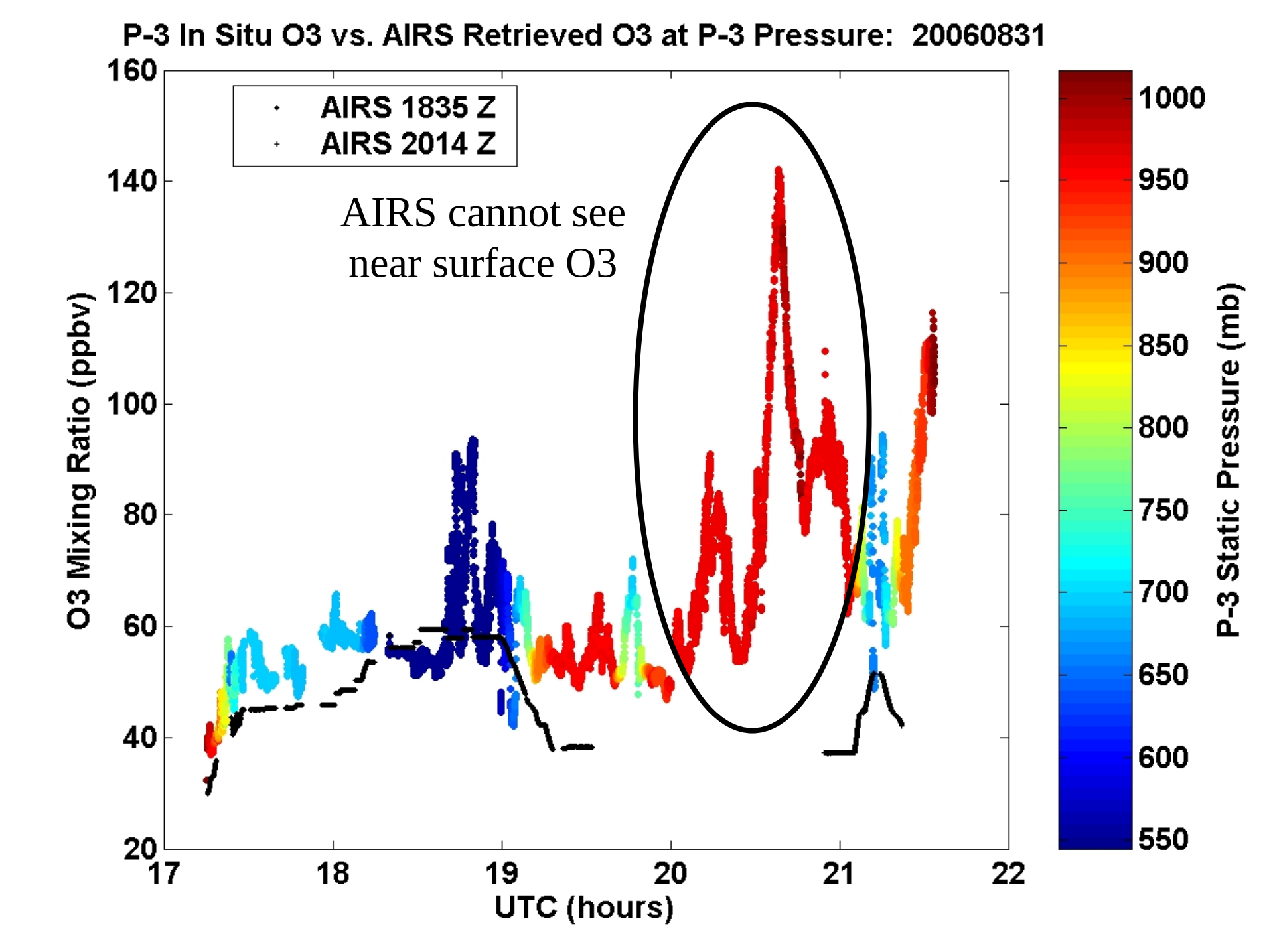


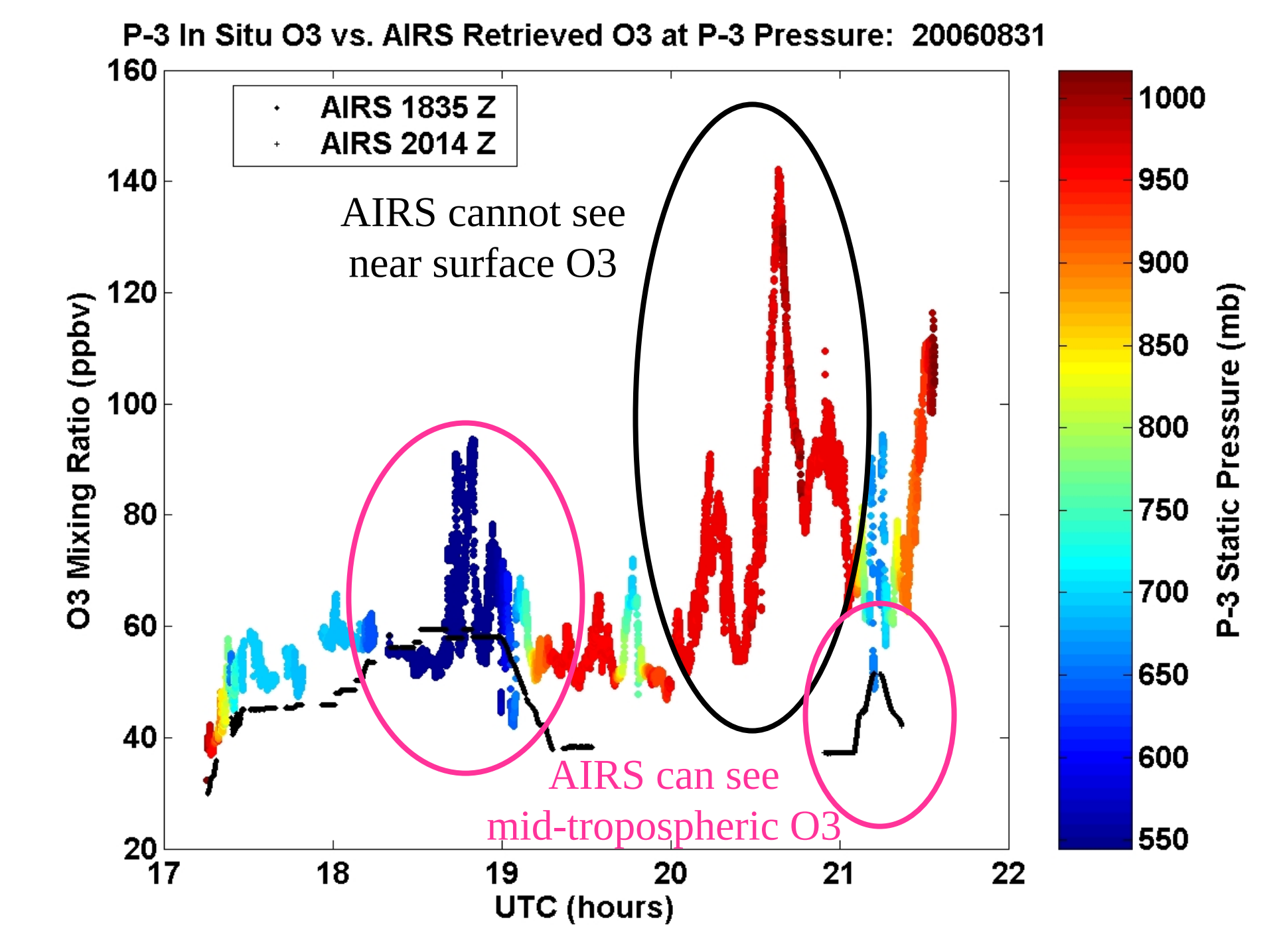




Stratospheric intrusion


P-3 In Situ O3 vs. AIRS Retrieved O3 at P-3 Pressure: 20060831
AIRS 1835 Z
AIRS 2014 Z
O3 Mixing Ratio (ppbv)
UTC (hours)
P-3 Static Pressure (mb)
160
140
120
100
80
60
40
20
17
18
19
20
21
22
1000
950
900
850
800
750
700
650
600
550


P-3 In Situ O3 vs. AIRS Retrieved O3 at P-3 Pressure: 20060831
AIRS 1835 Z
AIRS 2014 Z
AIRS cannot see
near surface O3
O3 Mixing Ratio (ppbv)
UTC (hours)
P-3 Static Pressure (mb)
160
140
120
100
80
60
40
20
17
18
19
20
21
22
1000
950
900
850
800
750
700
650
600
550


P-3 In Situ O3 vs. AIRS Retrieved O3 at P-3 Pressure: 20060831
AIRS 1835 Z
AIRS 2014 Z
AIRS cannot see near surface O3
AIRS can see mid-tropospheric O3
O3 Mixing Ratio (ppbv)
UTC (hours)
P-3 Static Pressure (mb)
160
140
120
100
80
60
40
20
17
18
19
20
21
22
1000
950
900
850
800
750
700
650
600
550

UMBC

SUMMARY: AIRS

2006 The Texas Air Quality Study

- Simultaneous retrieval for all products
  - 45 km horizontal resolution
  - Temperature (2 km vertical resolution)
  - Water vapor (3 km vertical resolution)
- Map 70-80% of the planet every day!
- CO (UMBC) operational next month
  - Total column + changes in vertical sensitivity
- O_3 (JPL) operational next month
- Data reprocessing underway
- See poster 37