UMBC

A-Train Tropospheric Chemistry Observations on 30 August 2006 over the 2006 TexAQS/GoMACCS Study Area

Wallace McMillan, Keith Evans, Ray Hoff, Tony Salemi,
Lynn Sparling, Debra Wicks Kollonige, Leonid Yurganov (UMBC)
Greg Osterman, Frederick W. Irion, Nathaniel Livesey (JPL)
Chris Barnet, Brad Pierce (NOAA), Ken Pickering (GSFC)

Supported by NASA AIRS, EOS Validation, and Tropospheric Chemistry Programs

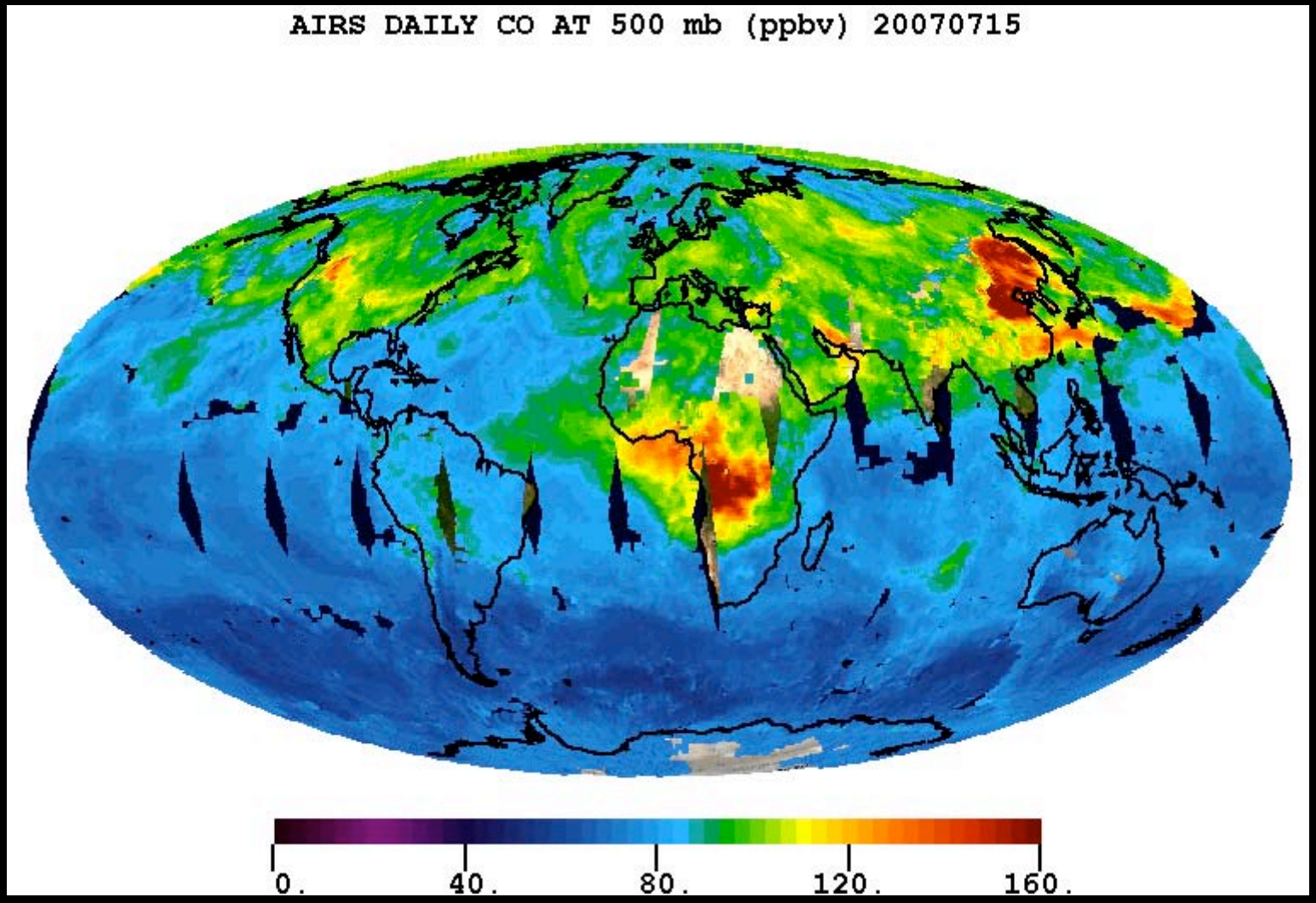
Thanks to the entire Aqua, Calipso, and Aura Teams!

UMBC

TexAQS2006

- Texas Air Quality Study 2006 (TexAQS)
  - mainly NOAA and State of Texas
  - Support new State Implementation Plan to meet EPA requirements
- AIRS, TES and MISR teams for NASA
  - AIRS in near-real-time for flight-planning
  - Satellites provided large-scale context
- Satellite air quality measurements contributed to Texas State Implementation Plan (SIP) to EPA.

AIRS: Daily Global view



V5.0.14.0 CO standard product (movie from Ed Olsen, JPL)

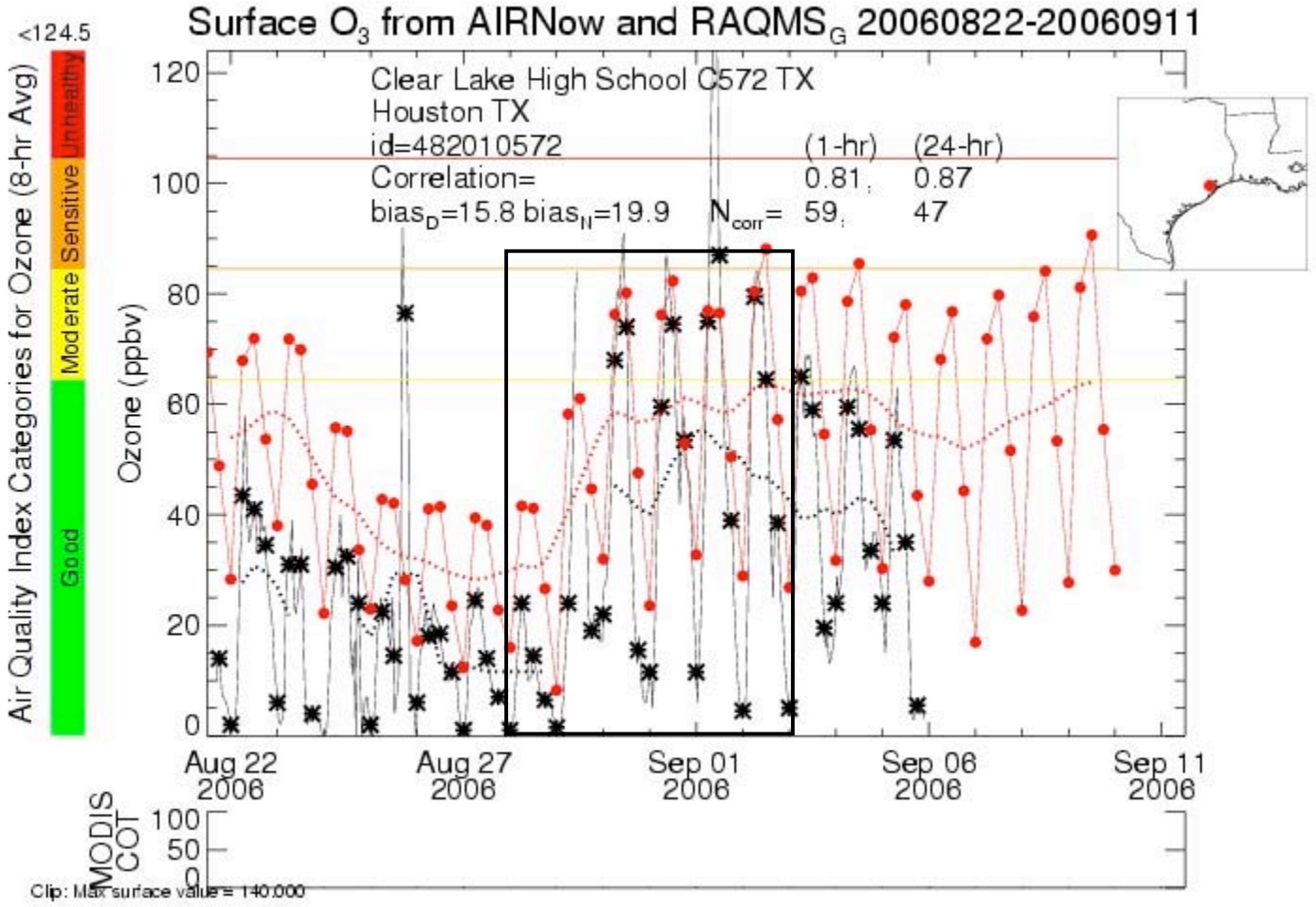
UMBC

Outline

- CO Observations for Air Quality
  - August 26-30, 2006 observations
  - faint CO feature for AIRS
- Stratospheric Intrusion
  - strong H_2O feature for AIRS
  - Interesting O_3 features
- Lightning O_3?
  - faint O_3 signal for AIRS
- AIRS v5.0.14.0 reprocessing at GES DISC:
  - CO, CH4, O3 with averaging kernels

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

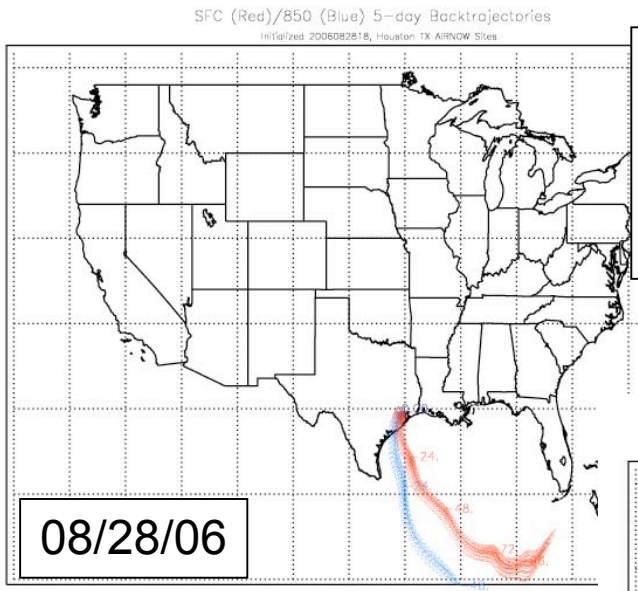
Synthesis of EPA AIRNOW, NOAA P3, NASA AIRS measurements and RAQMS chemical analyses



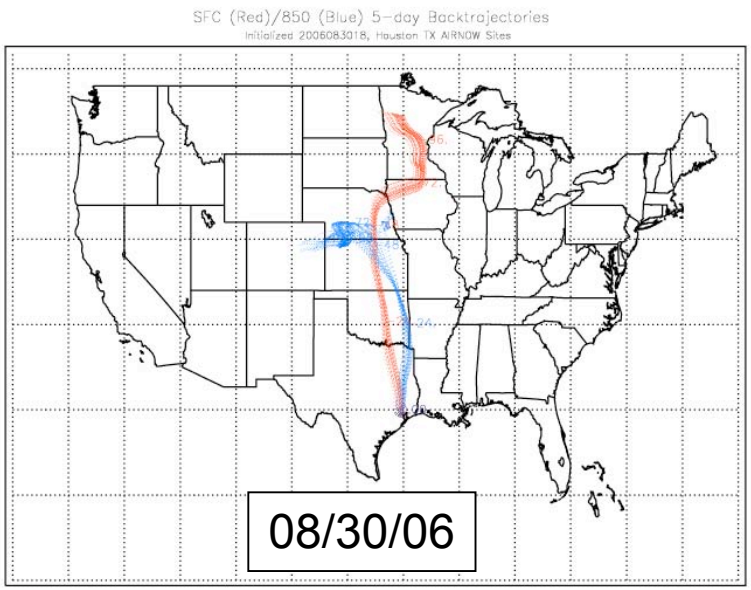
24hr averaged ozone shows 30ppbv enhancement during the period that could be due to regional transport

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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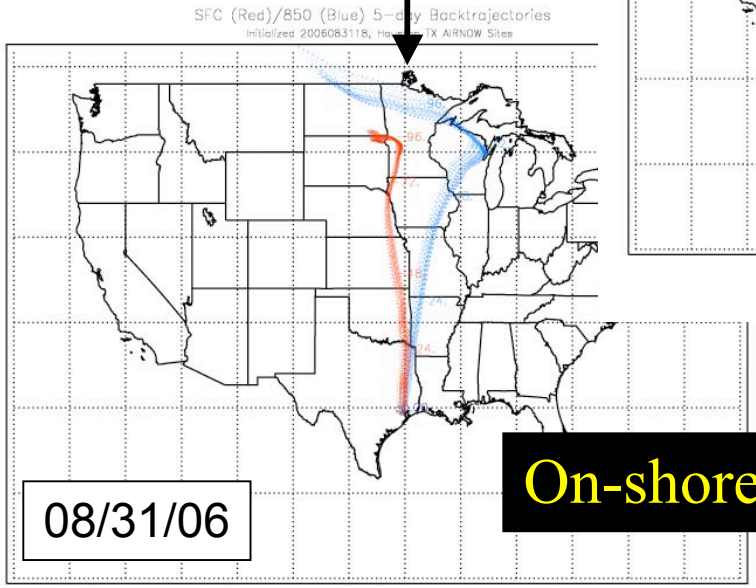

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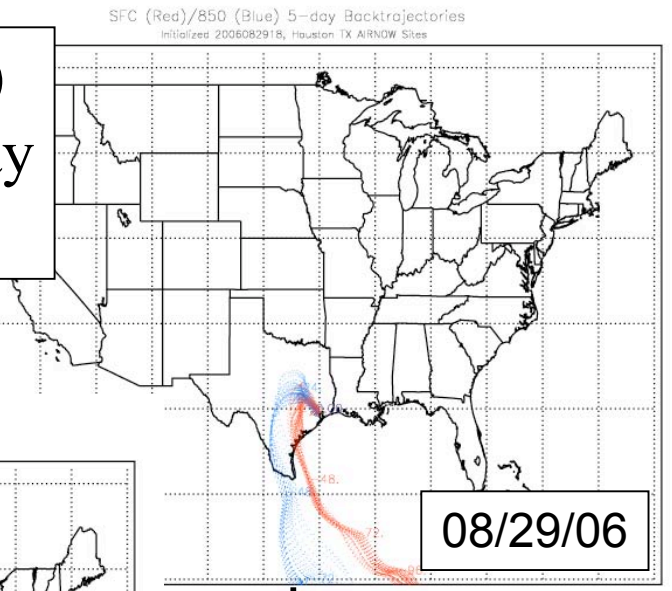

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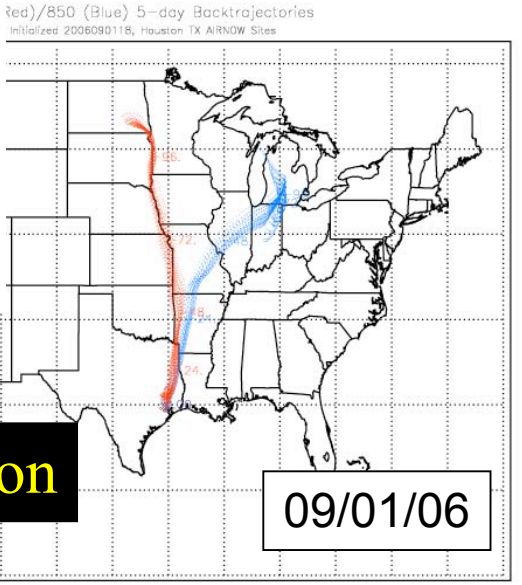


09/01/06

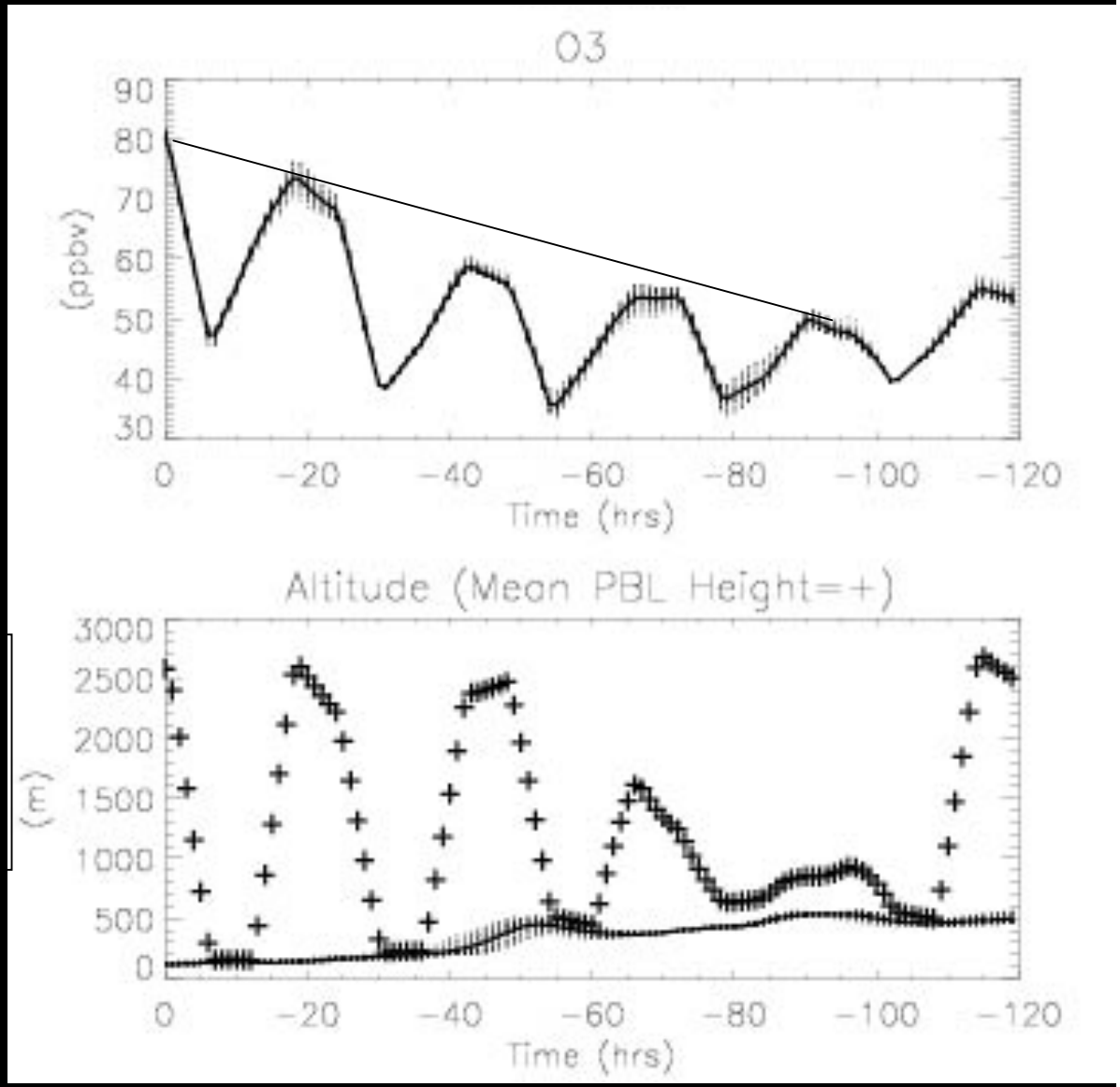
On-shore to Northeasterly transition

Brad Pierce (NOAA)

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

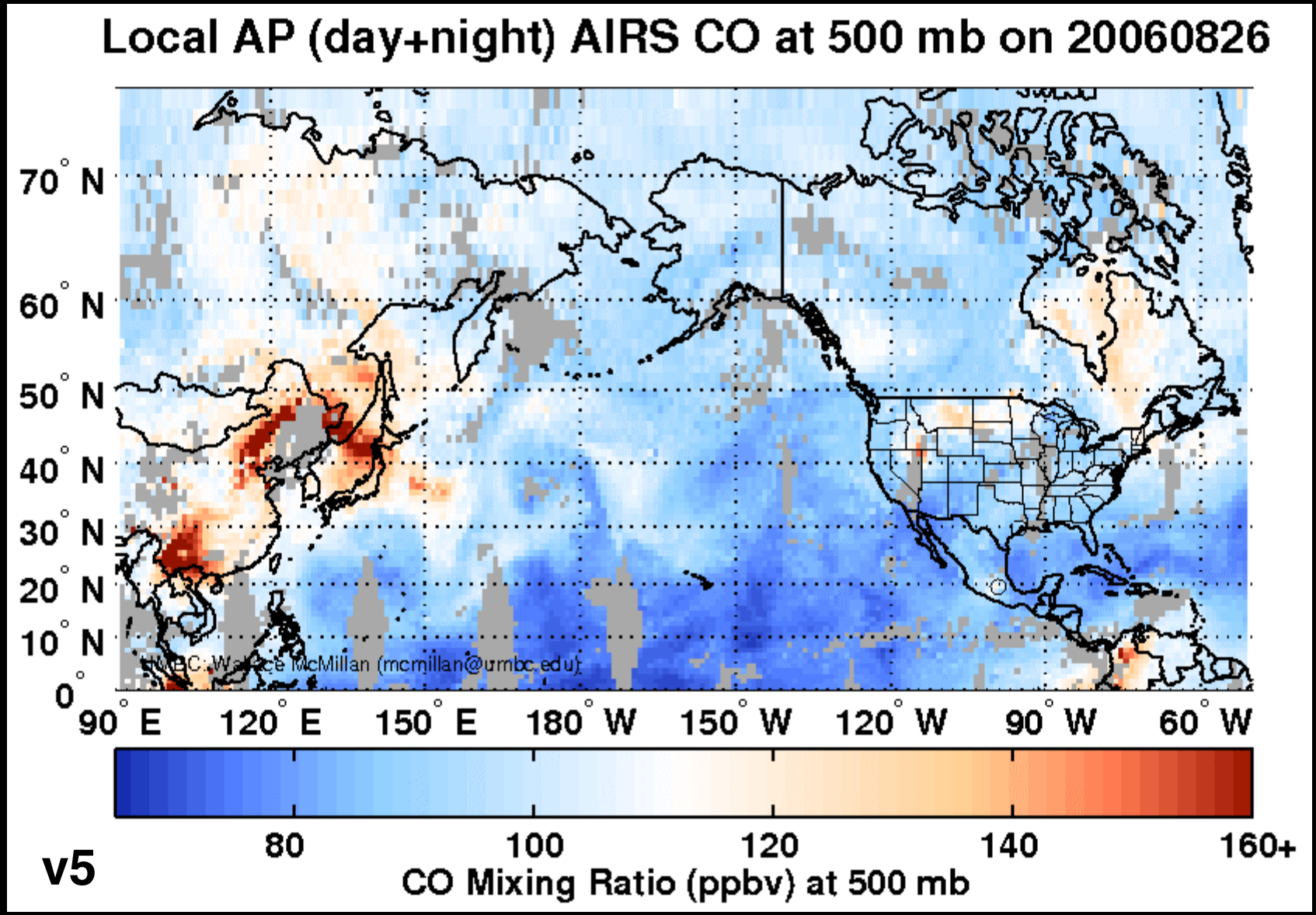
Daily ozone production along back trajectories results in Lagrangian mean ozone increase of nearly 30ppbv during previous 4 days

Trajectories remain within boundary layer during the previous 5 days

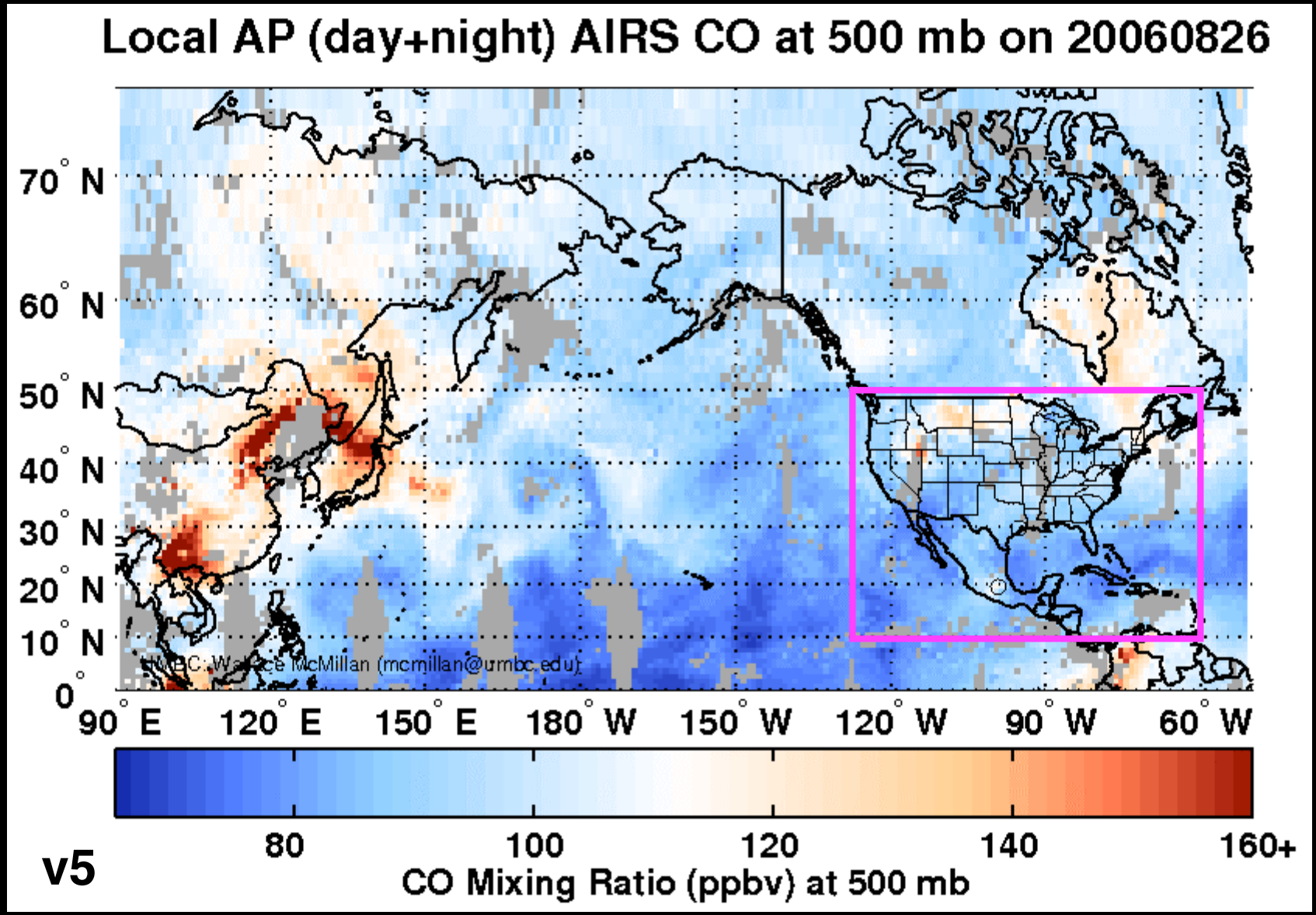


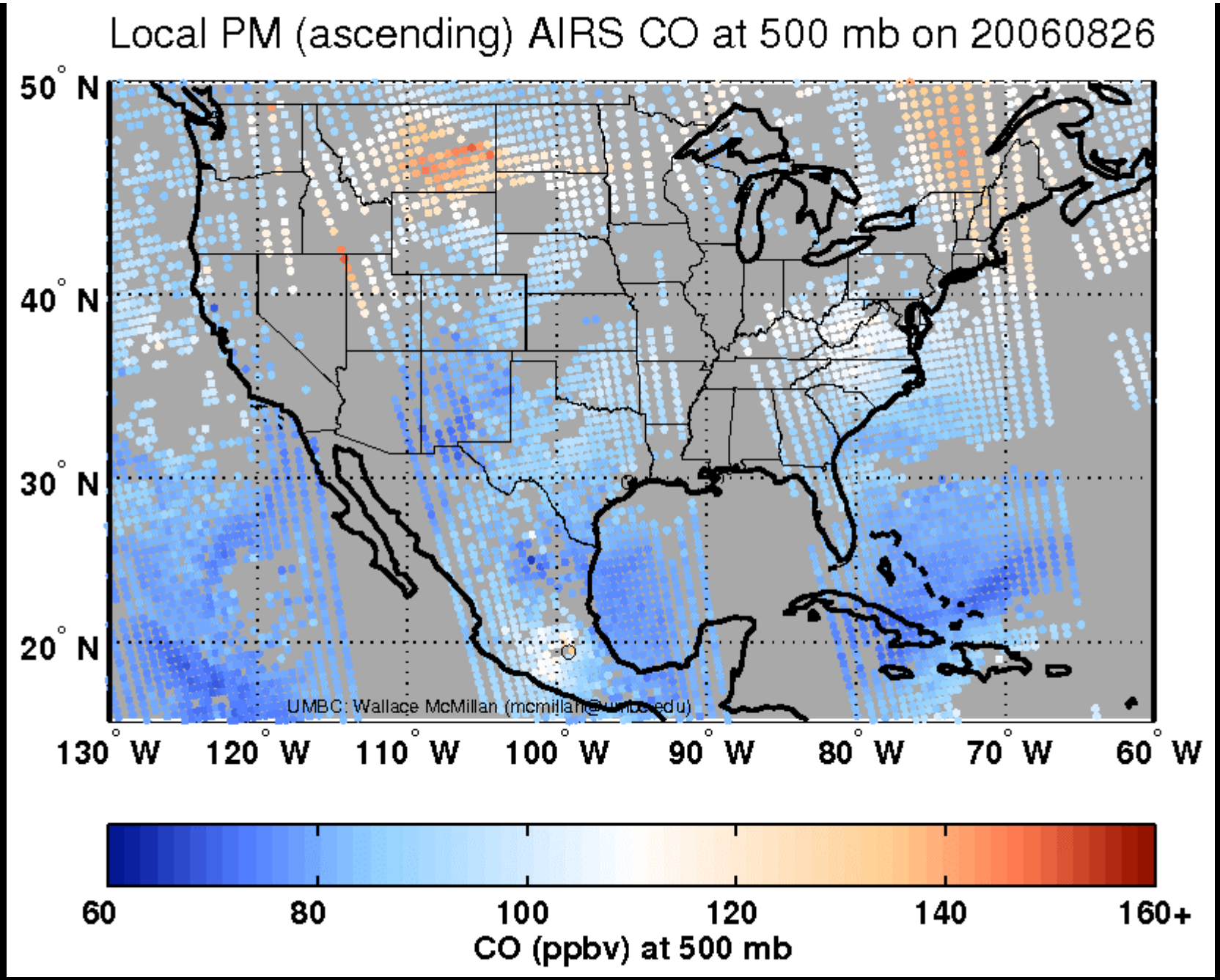
Brad Pierce (NOAA)

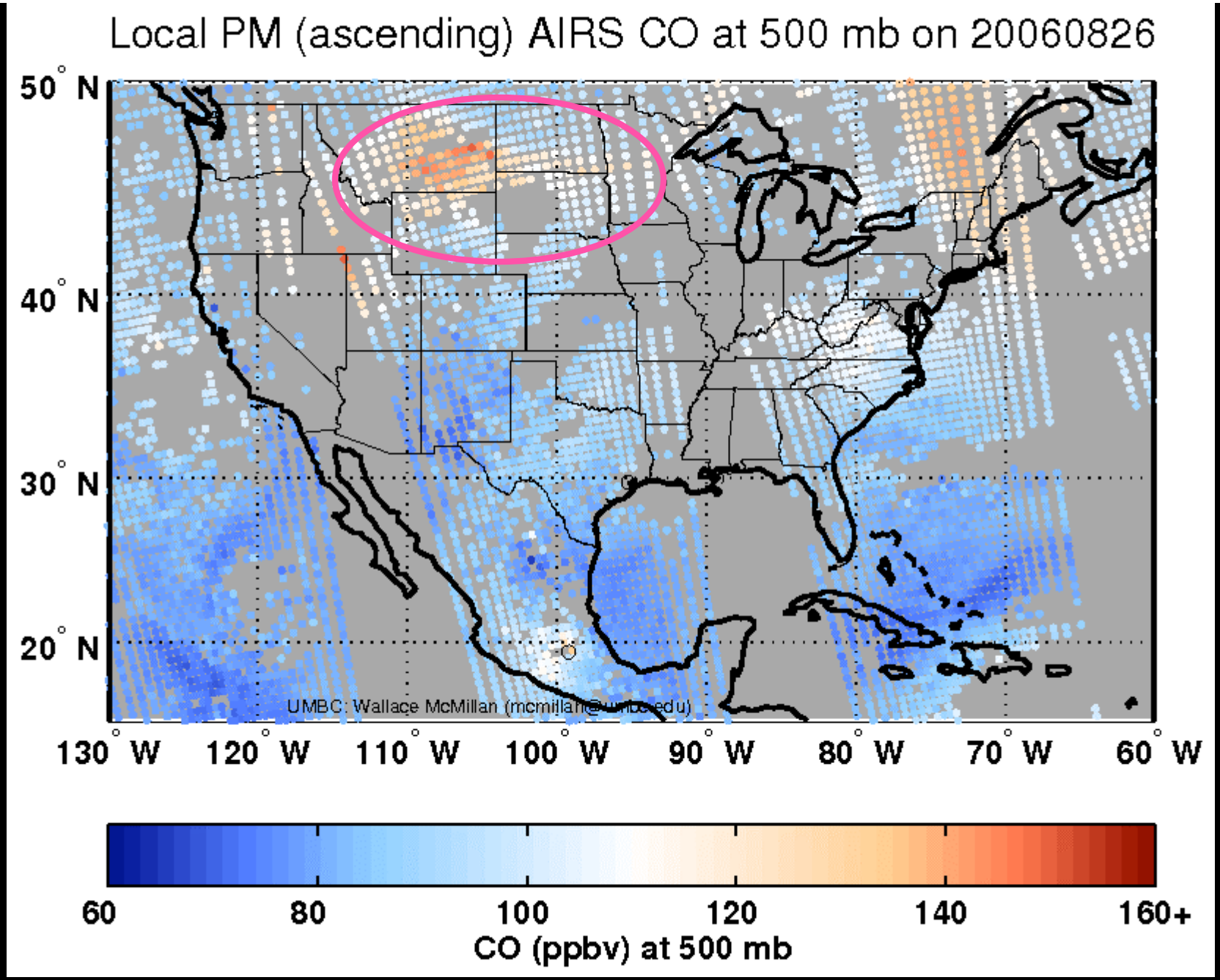
AIRS: Daily BIG view



AIRS: Daily BIG view




Local PM (ascending) AIRS CO at 500 mb on 20060826
50° N
40° N
30° N
20° N
UMBC: Wallace McMillan (mcmillan@umbc.edu)
130° W
120° W
110° W
100° W
90° W
80° W
70° W
60° W
60
80
100
120
140
160+
CO (ppbv) at 500 mb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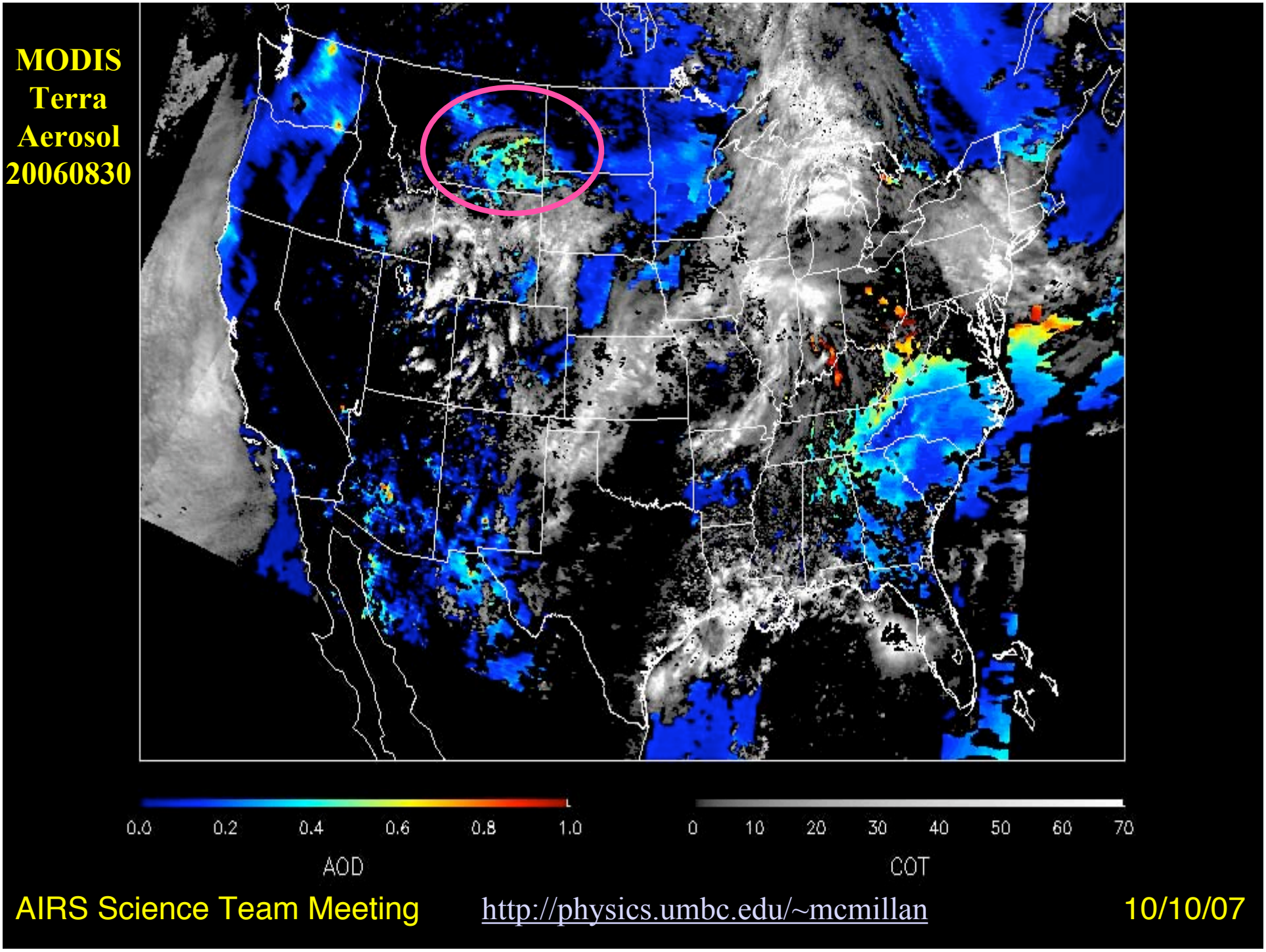
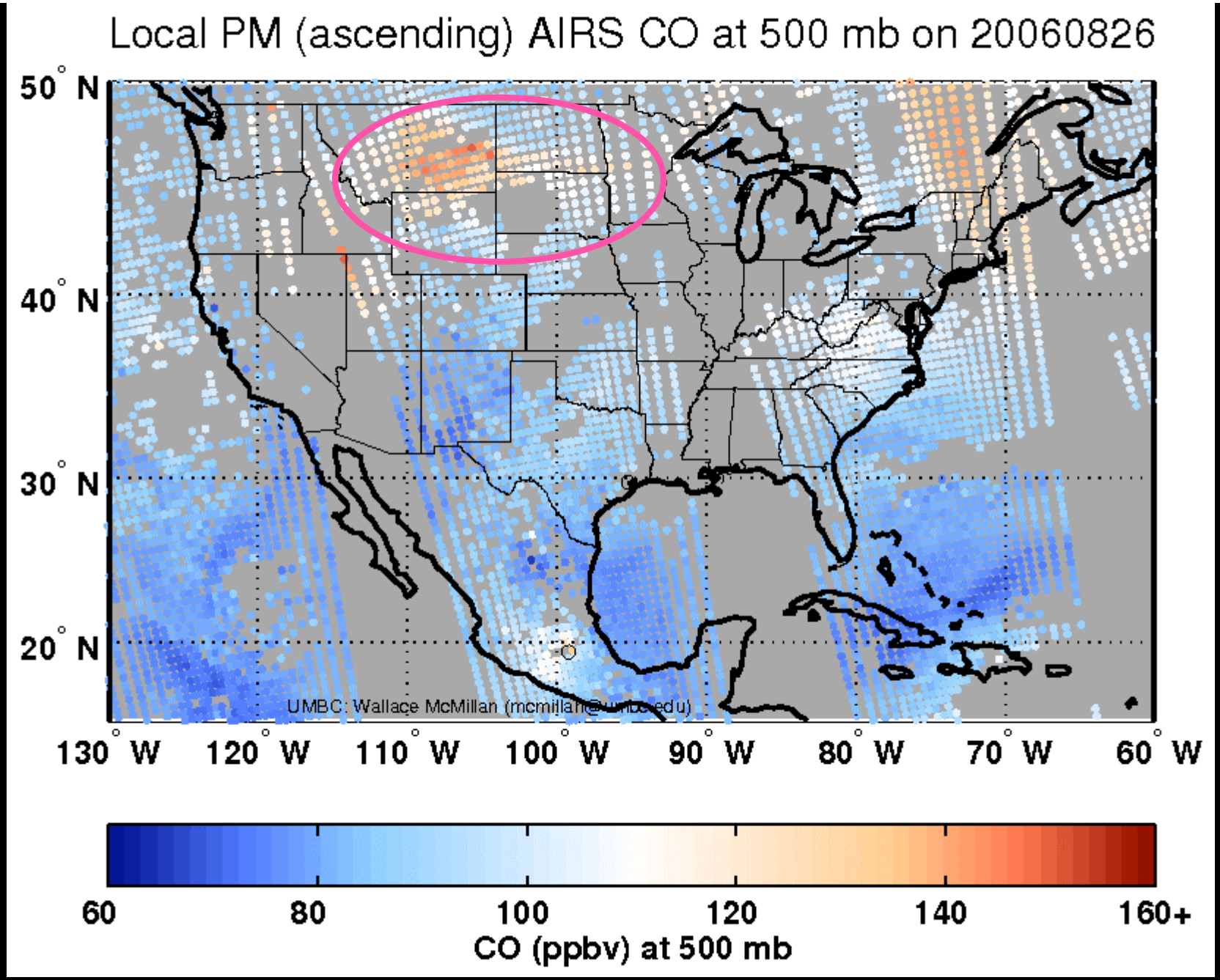
40° N
30° N
20° N
UMBC: Wallace McMillan (mcmillan@umbc.edu)
130° W
120° W
110° W
100° W
90° W
80° W
70° W
60° W
60
80
100
120
140
160+
CO (ppbv) at 500 mb



AIRS Science Team Meeting http://physics.umbc.edu/~mcmillan 10/10/07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120° W
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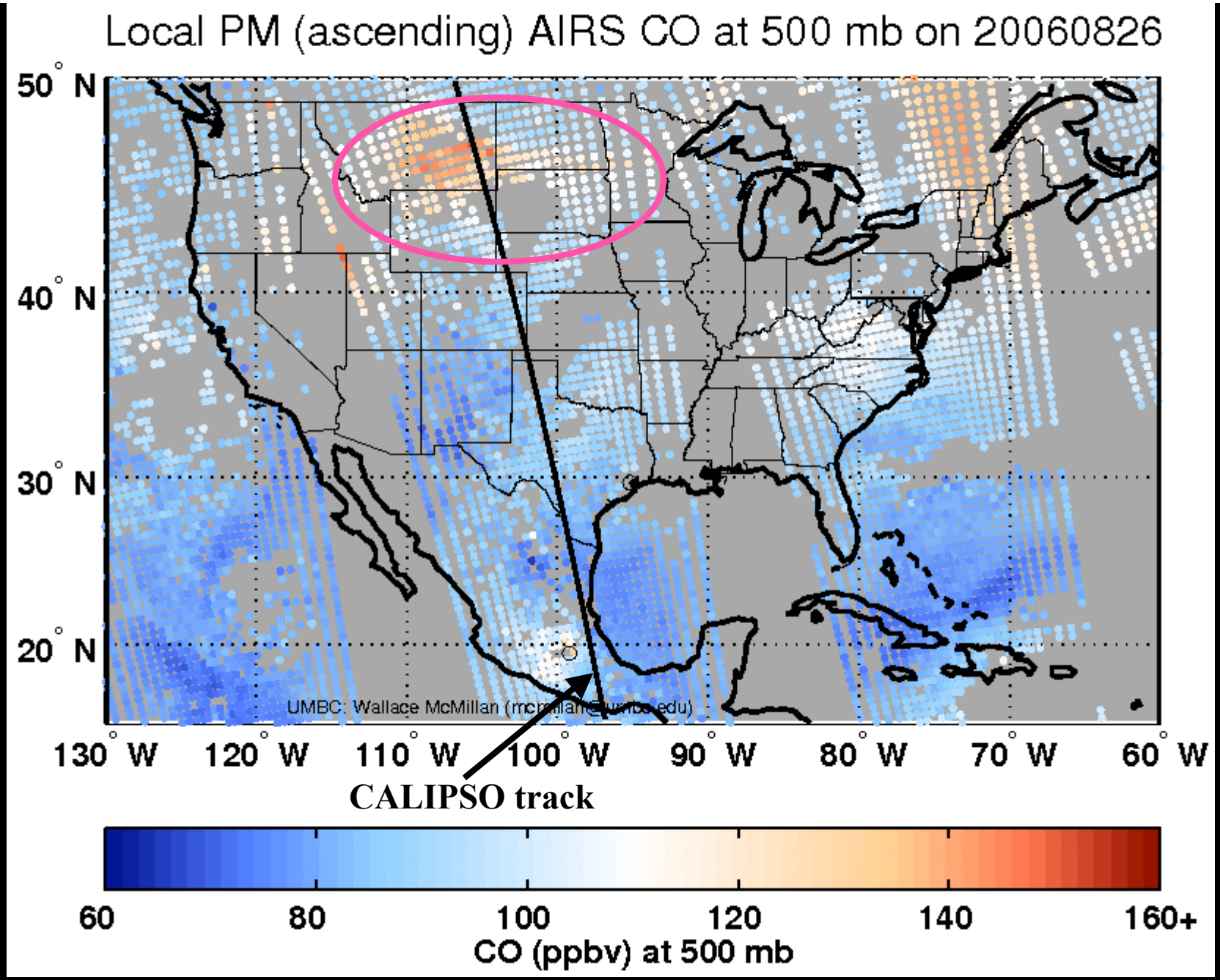
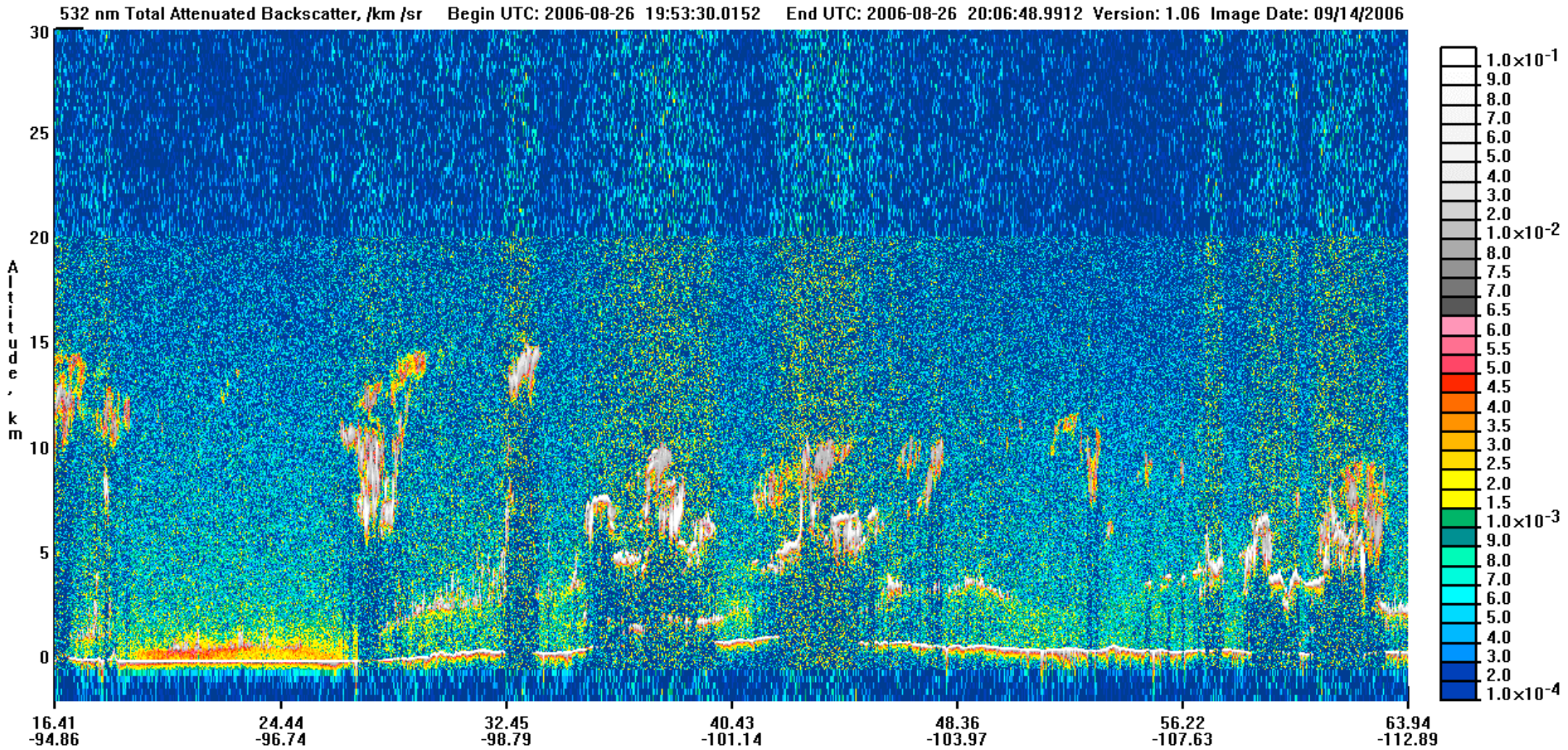
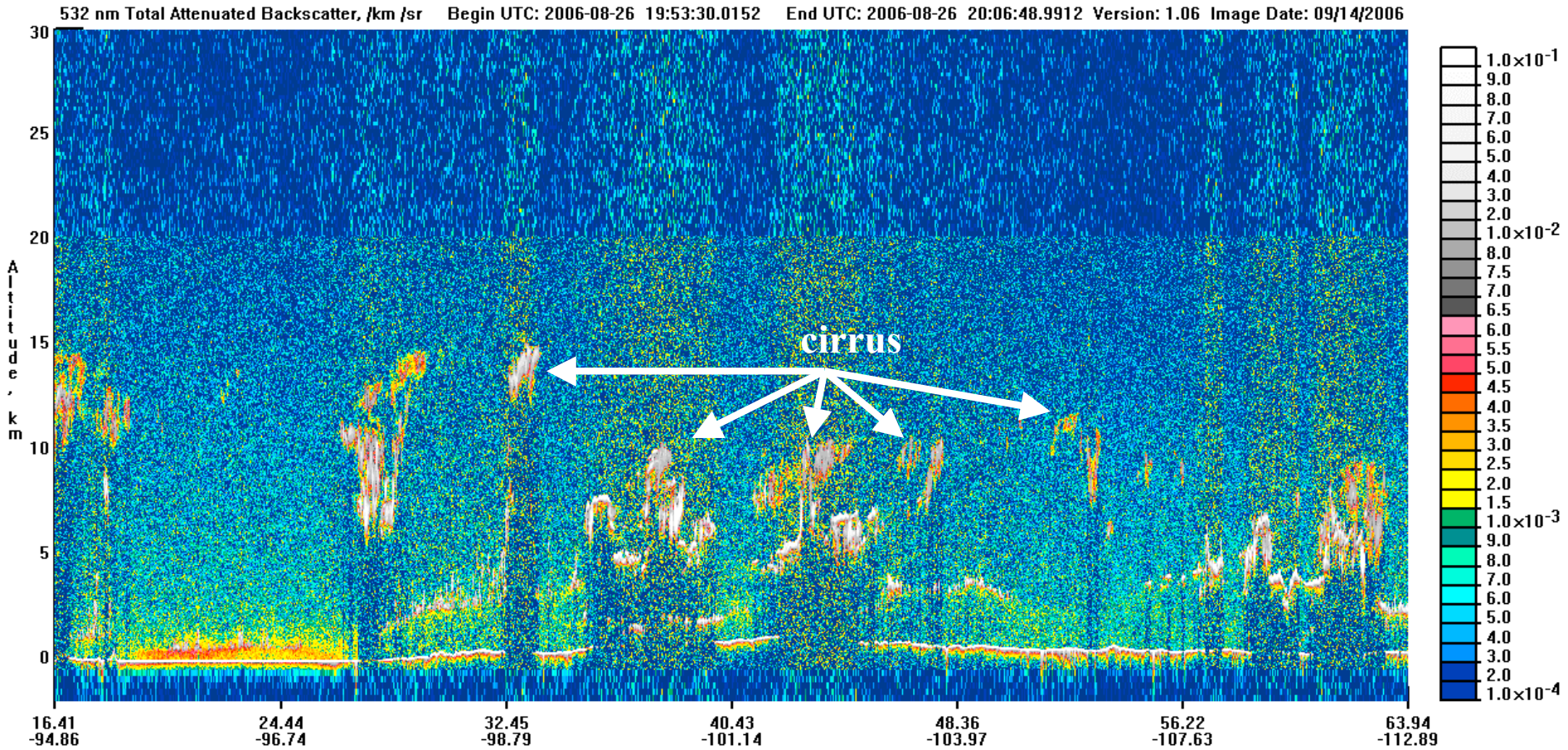
90° W
80° W
70° W
60° W
60
80
100
120
140
160+
CO (ppbv) at 500 mb


Local PM (ascending) AIRS CO at 500 mb on 20060826
50° N
40° N
30° N
20° N
130° W
120° W
110° W
100° W
90° W
80° W
70° W
60° W
UMBC: Wallace McMillan (mcmillan@umbc.edu)
CALIPSO track
60
80
100
120
140
160+
CO (ppbv) at 500 mb

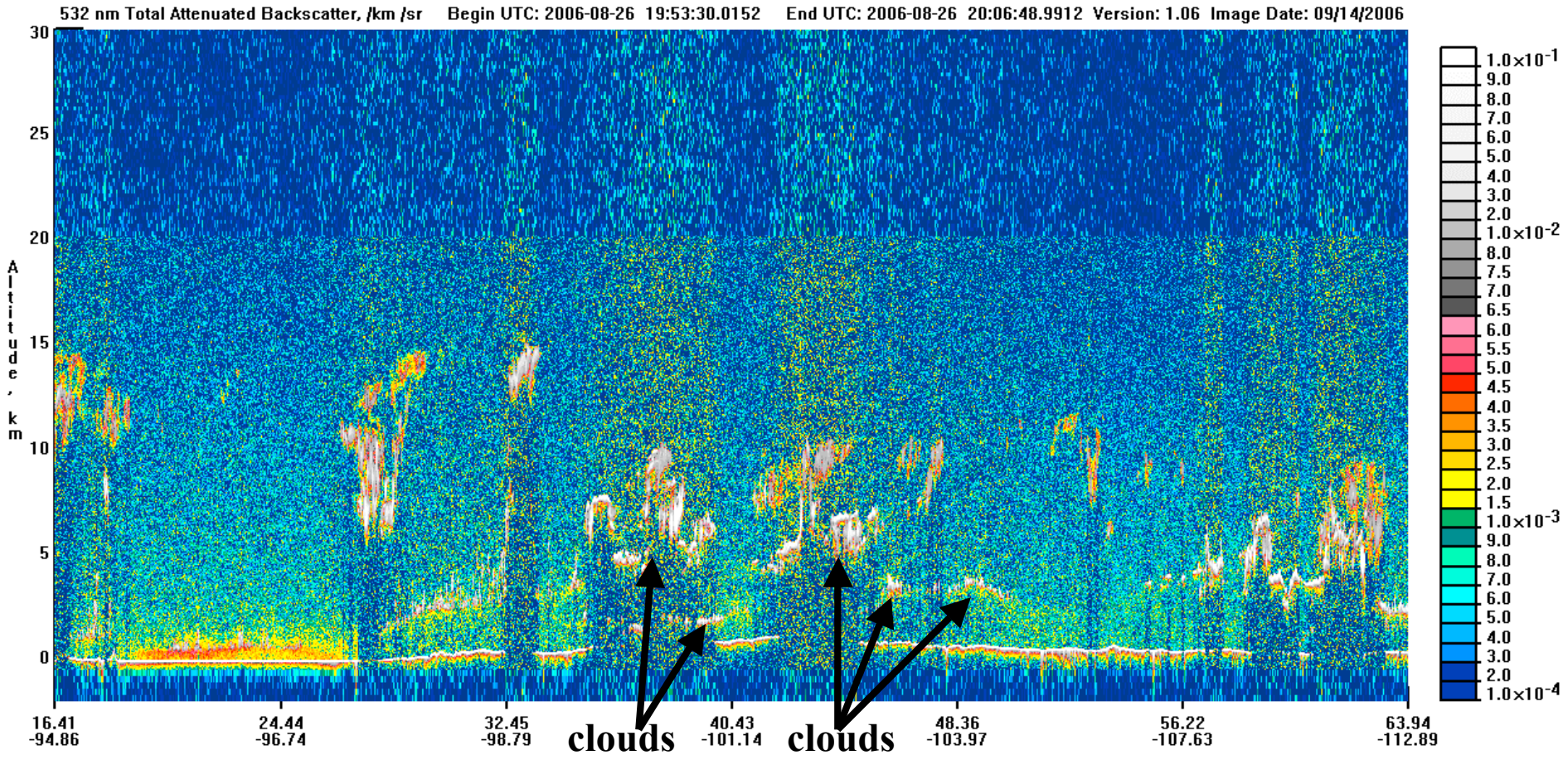
CALIPSO 532 nm backscatter - day



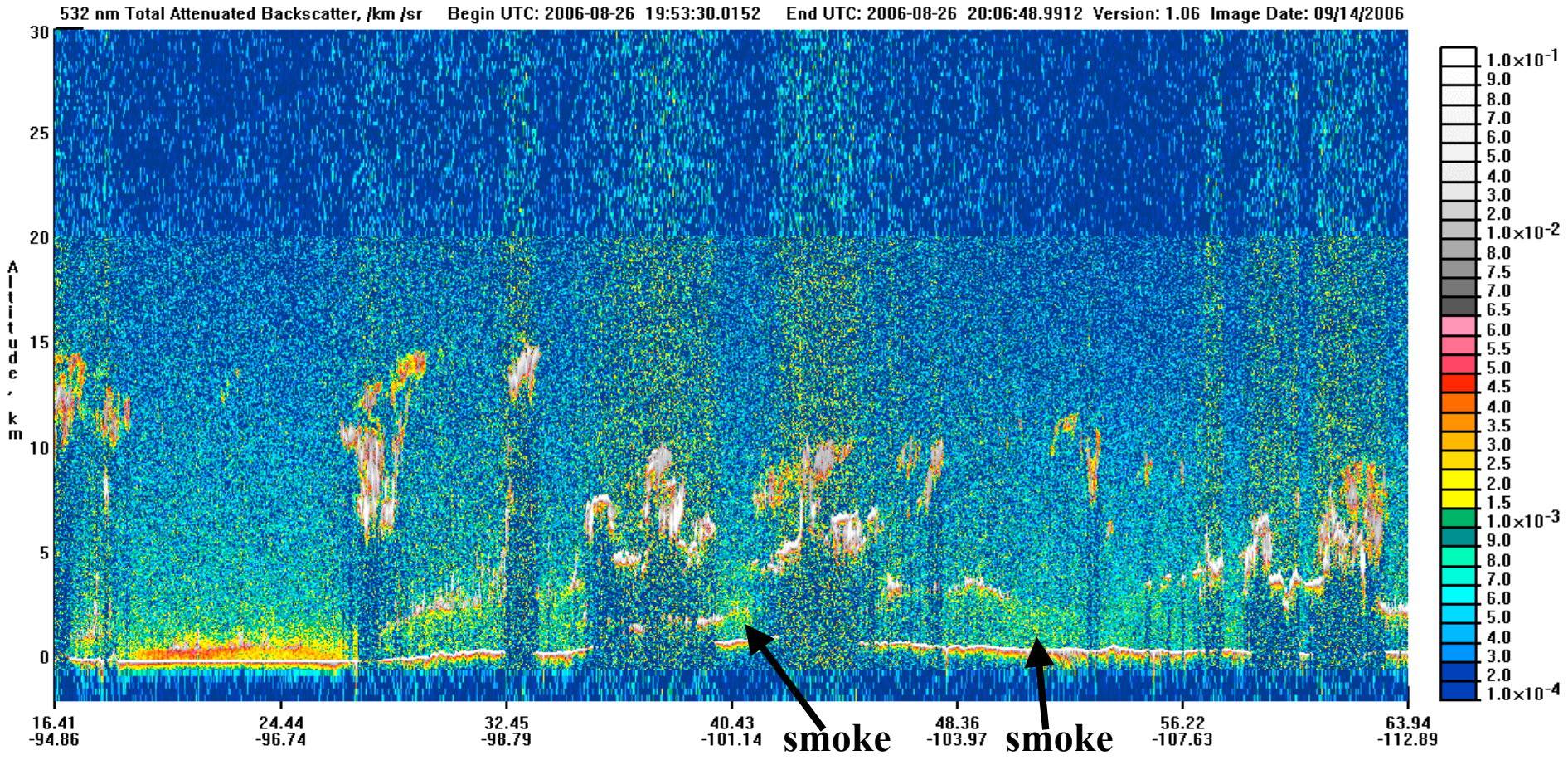
CALIPSO 532 nm backscatter - day



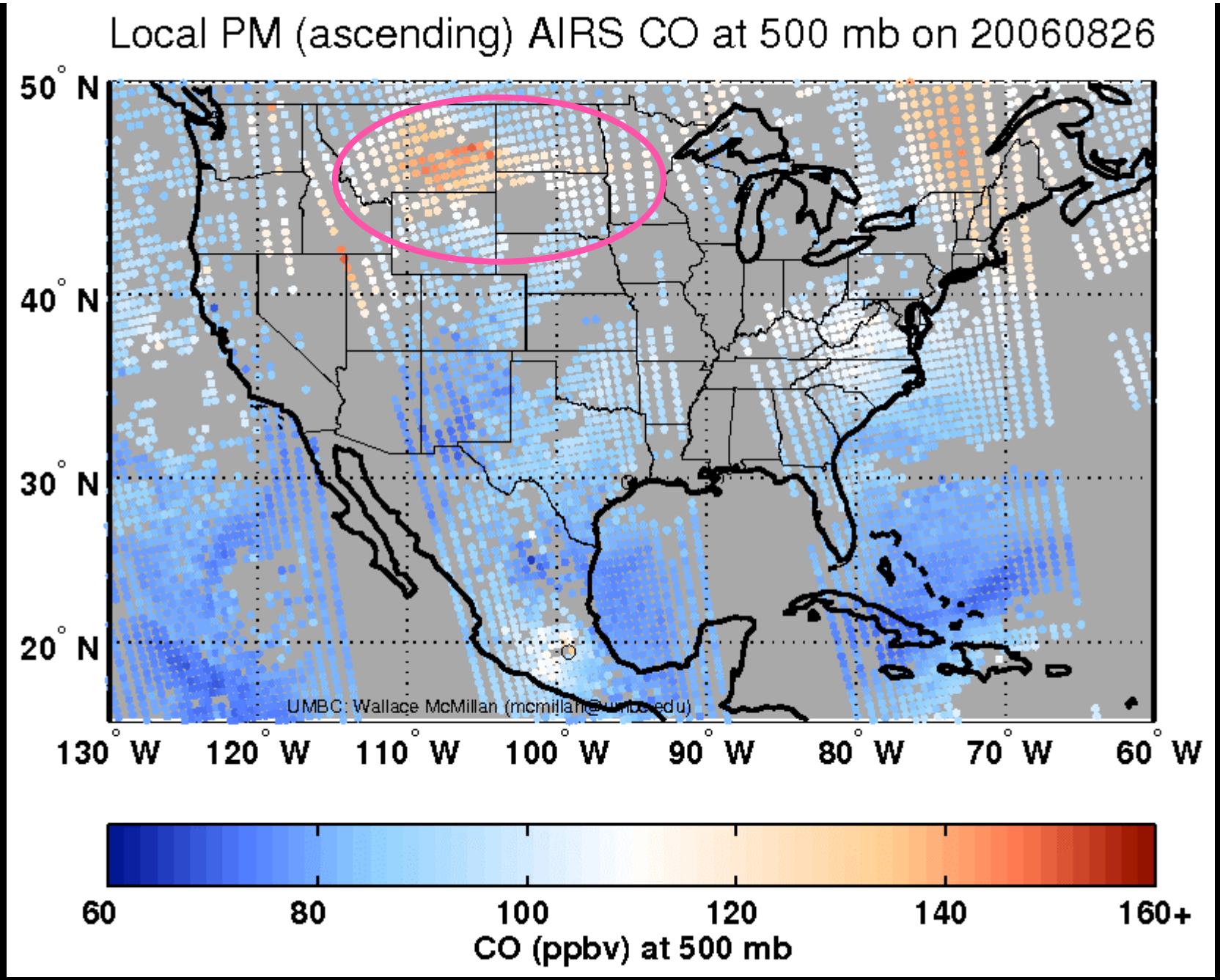
CALIPSO 532 nm backscatter - day

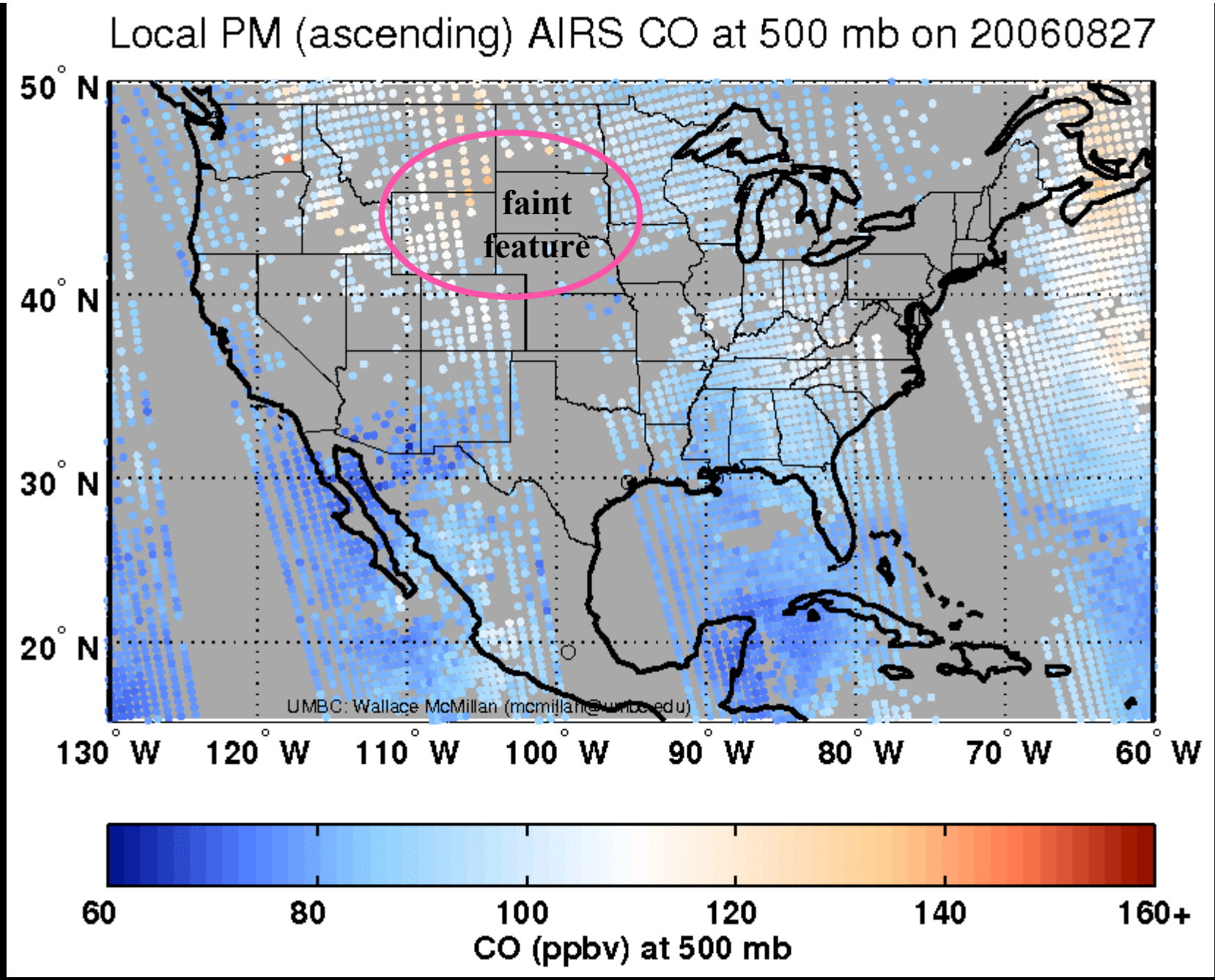


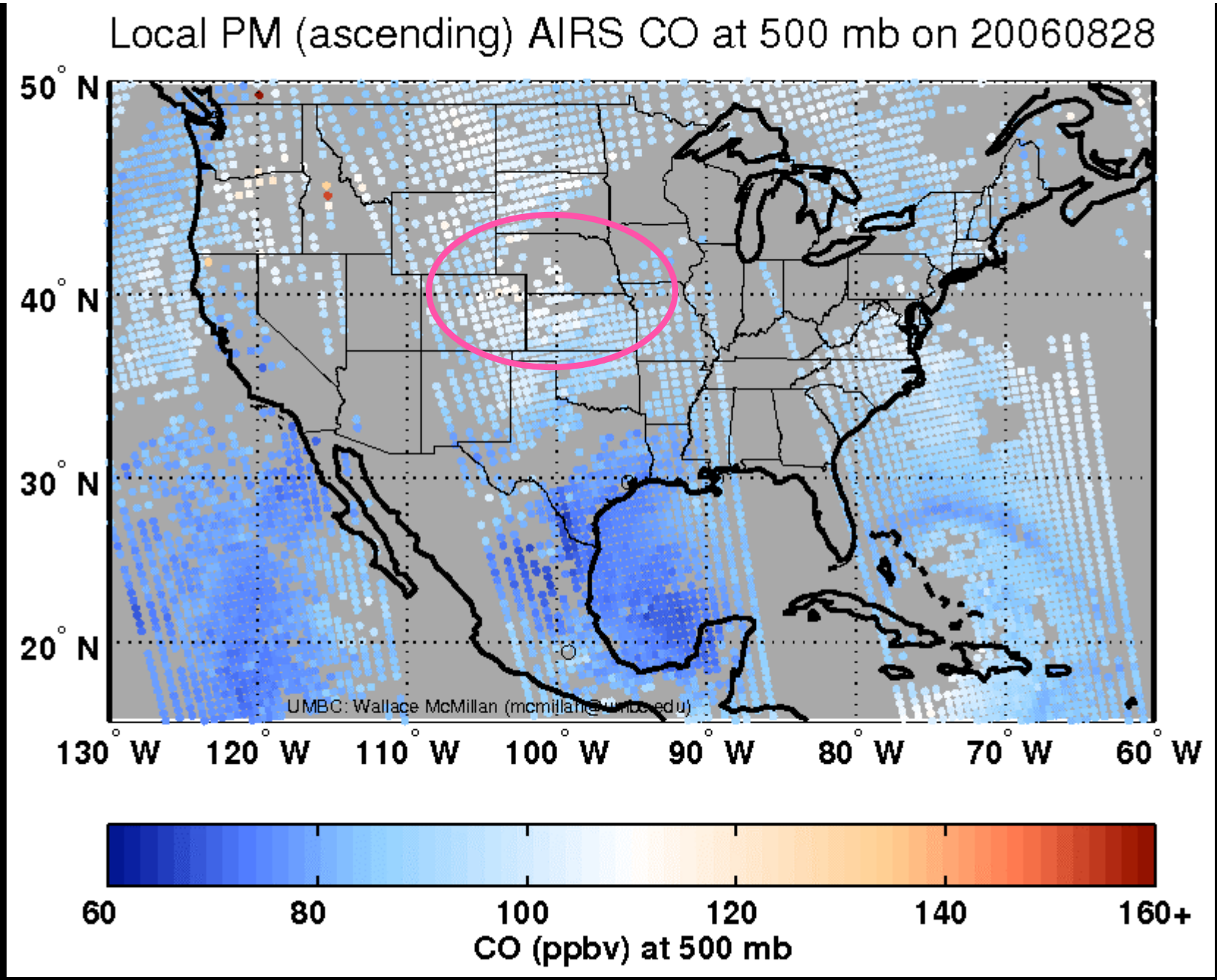
CALIPSO 532 nm backscatter - day

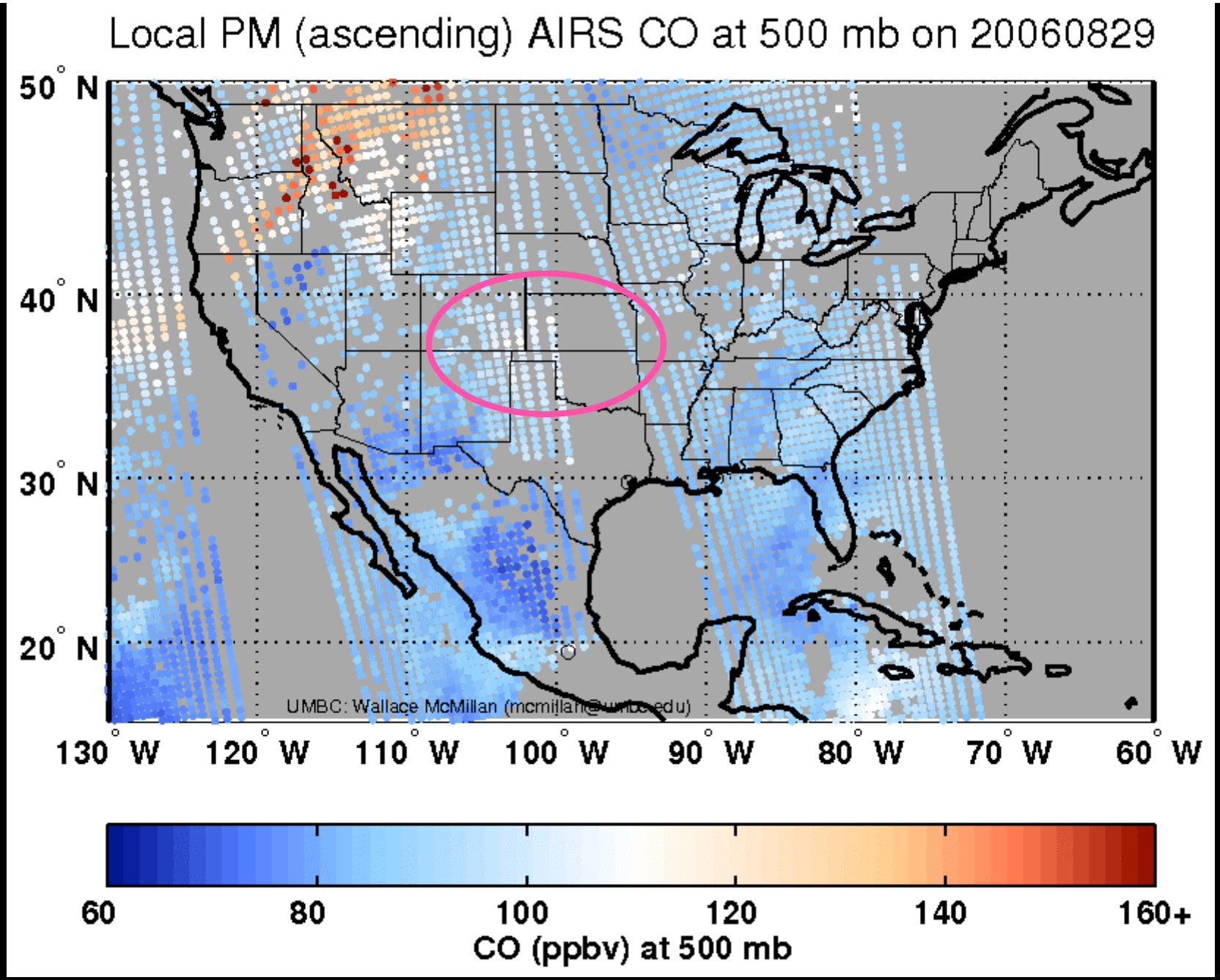


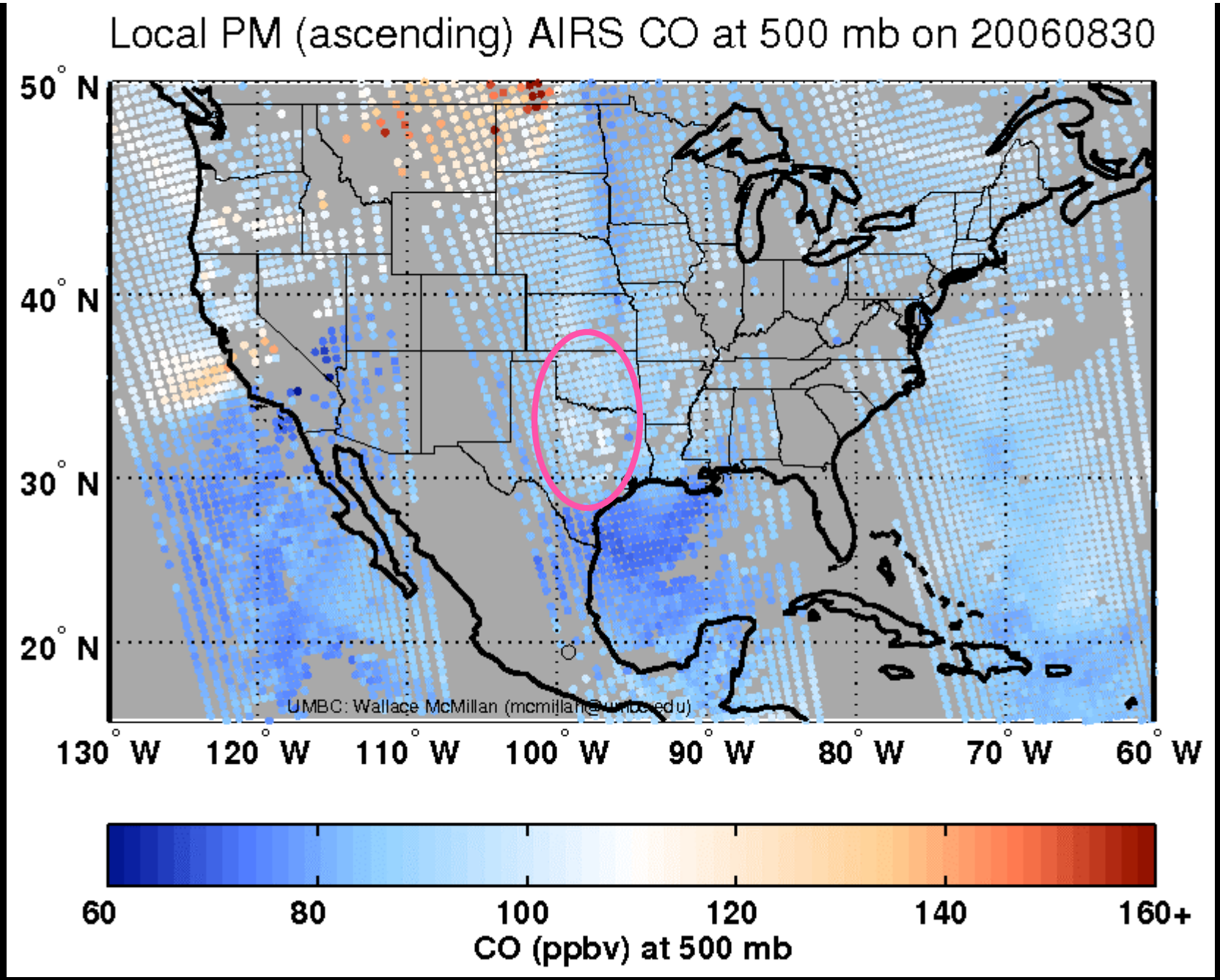
Surface CO at DOE ARM SGP observed smoke plumes, OMI aerosols do not.

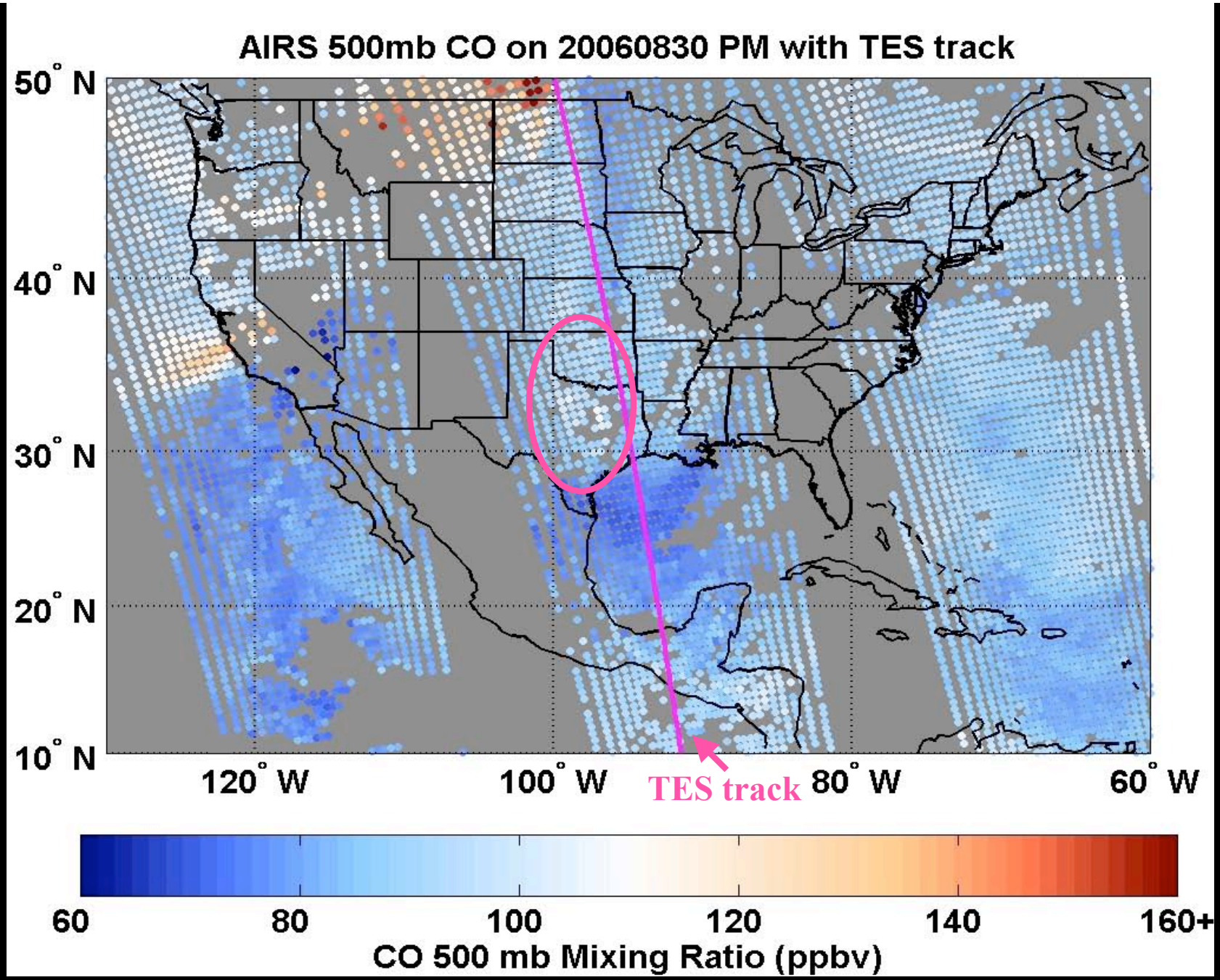

Local PM (ascending) AIRS CO at 500 mb on 20060826
50° N
40° N
30° N
20° N
UMBC: Wallace McMillan (mcmillan@umbc.edu)
130° W
120° W
110° W
100° W
90° W
80° W
70° W
60° W
60
80
100
120
140
160+
CO (ppbv) at 500 mb


Local PM (ascending) AIRS CO at 500 mb on 20060827
faint feature
50° N
40° N
30° N
20° N
130° W
120° W
110° W
100° W
90° W
80° W
70° W
60° W
UMBC: Wallace McMillan (mcmillan@umbc.edu)
60
80
100
120
140
160+
CO (ppbv) at 500 mb


Local PM (ascending) AIRS CO at 500 mb on 20060828
50° N
40° N
30° N
20° N
UMBC: Wallace McMillan (mcmillan@umbc.edu)
130° W
120° W
110° W
100° W
90° W
80° W
70° W
60° W
60
80
100
120
140
160+
CO (ppbv) at 500 mb

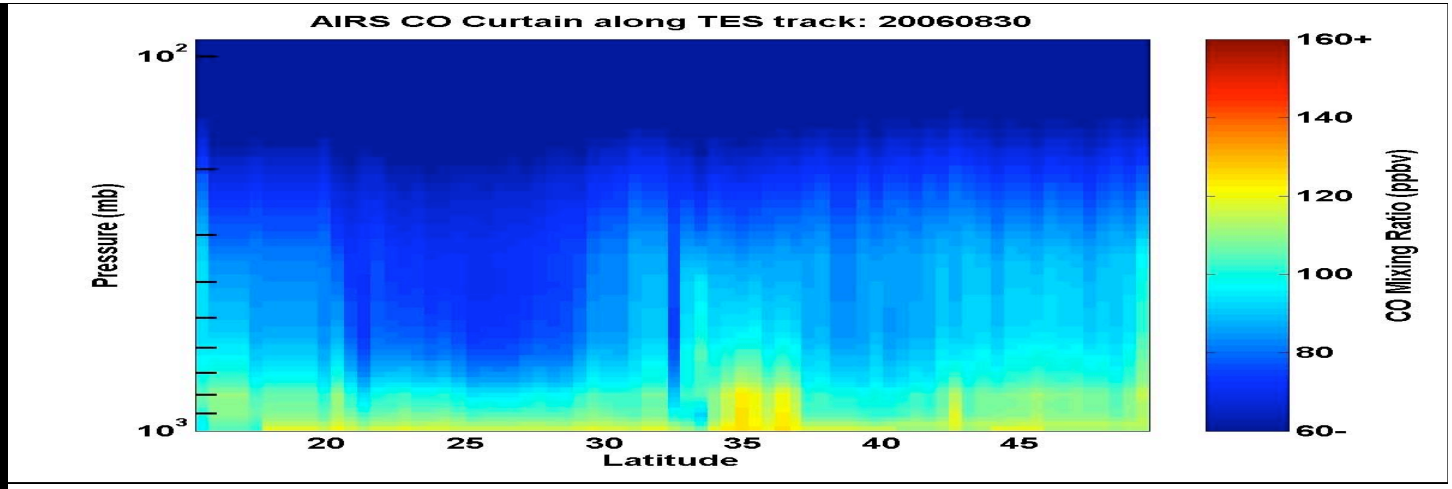

Local PM (ascending) AIRS CO at 500 mb on 20060829
50° N
40° N
30° N
20° N
UMBC: Wallace McMillan (mcmillan@umbc.edu)
130° W
120° W
110° W
100° W
90° W
80° W
70° W
60° W
60
80
100
120
140
160+
CO (ppbv) at 500 mb

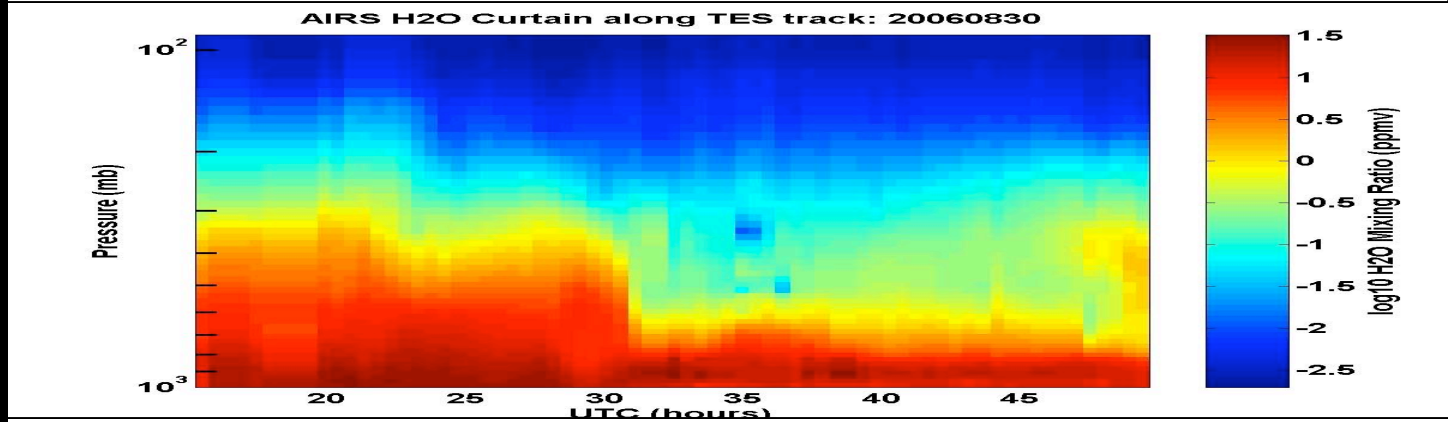

Local PM (ascending) AIRS CO at 500 mb on 20060830
50° N
40° N
30° N
20° N
UMBC: Wallace McMillan (mcmillan@umbc.edu)
130° W
120° W
110° W
100° W
90° W
80° W
70° W
60° W
60
80
100
120
140
160+
CO (ppbv) at 500 mb

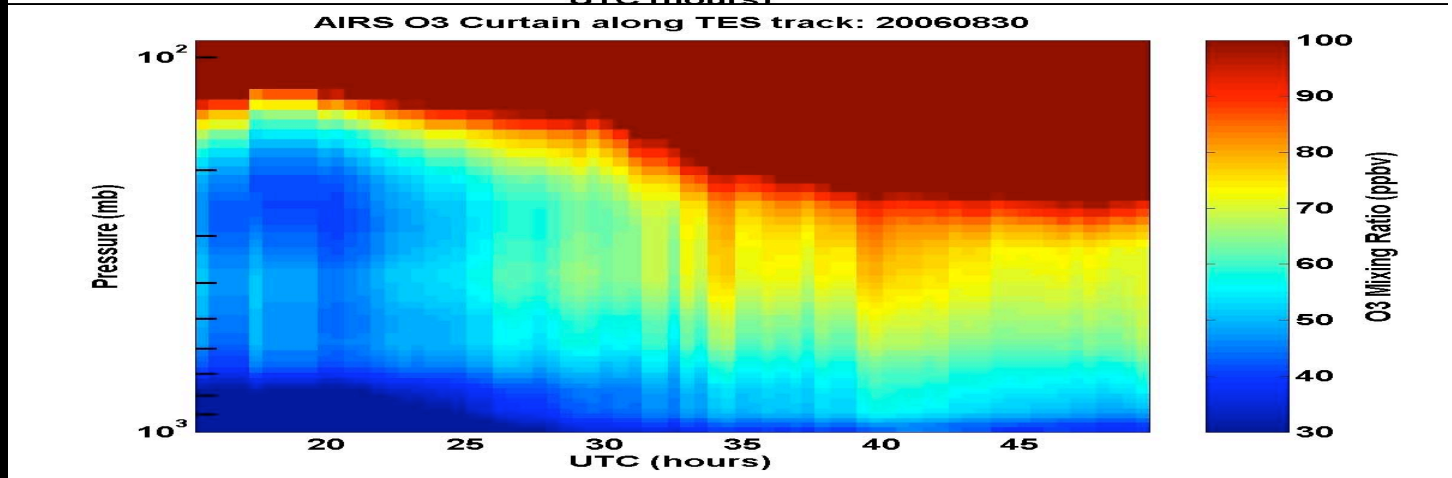

AIRS 500mb CO on 20060830 PM with TES track
50° N
40° N
30° N
20° N
10° N
120° W
100° W
80° W
60° W
TES track
60
80
100
120
140
160+
CO 500 mb Mixing Ratio (ppbv)

August 30, 2006

AIRS along TES track

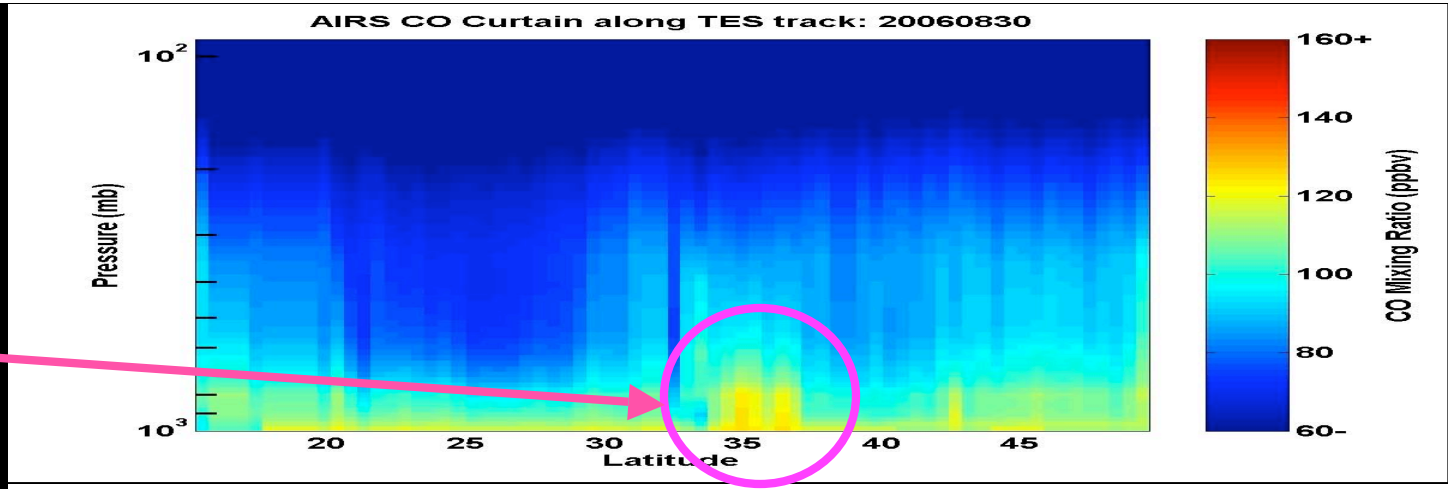


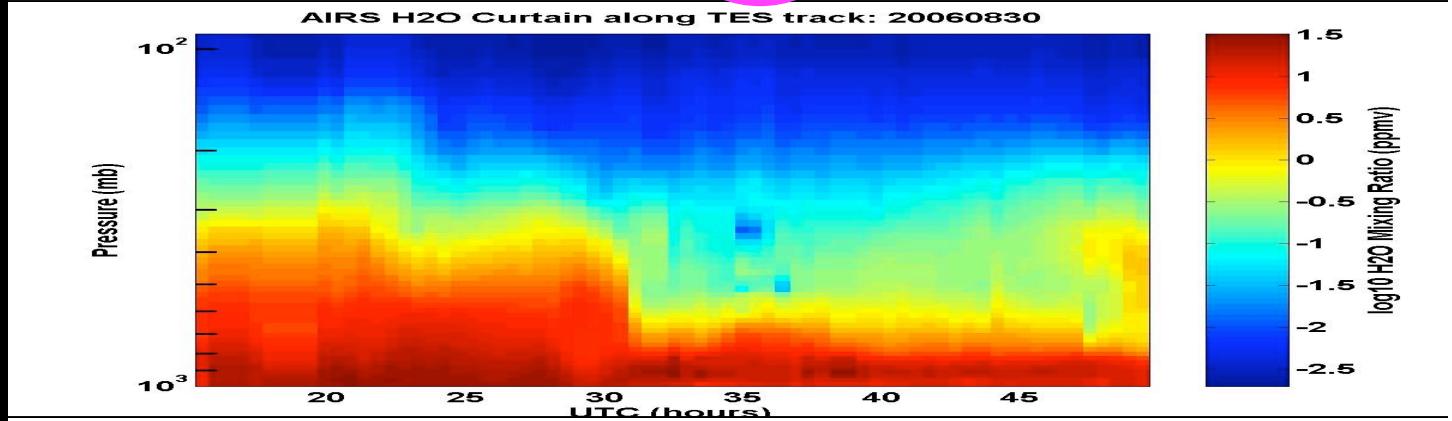


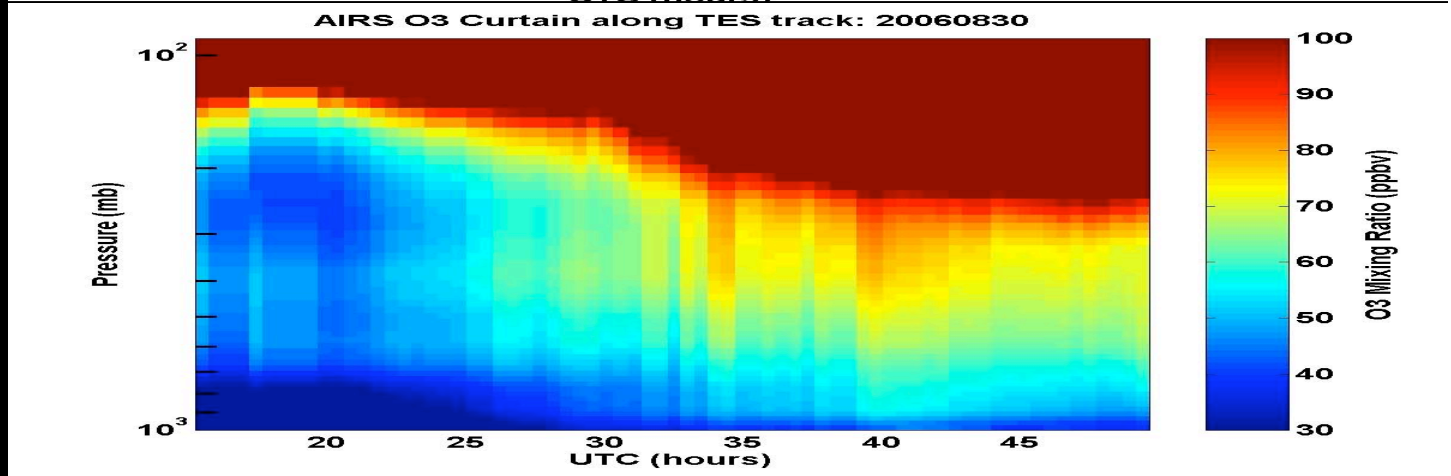


August 30, 2006

CO enhancement in lower troposphere

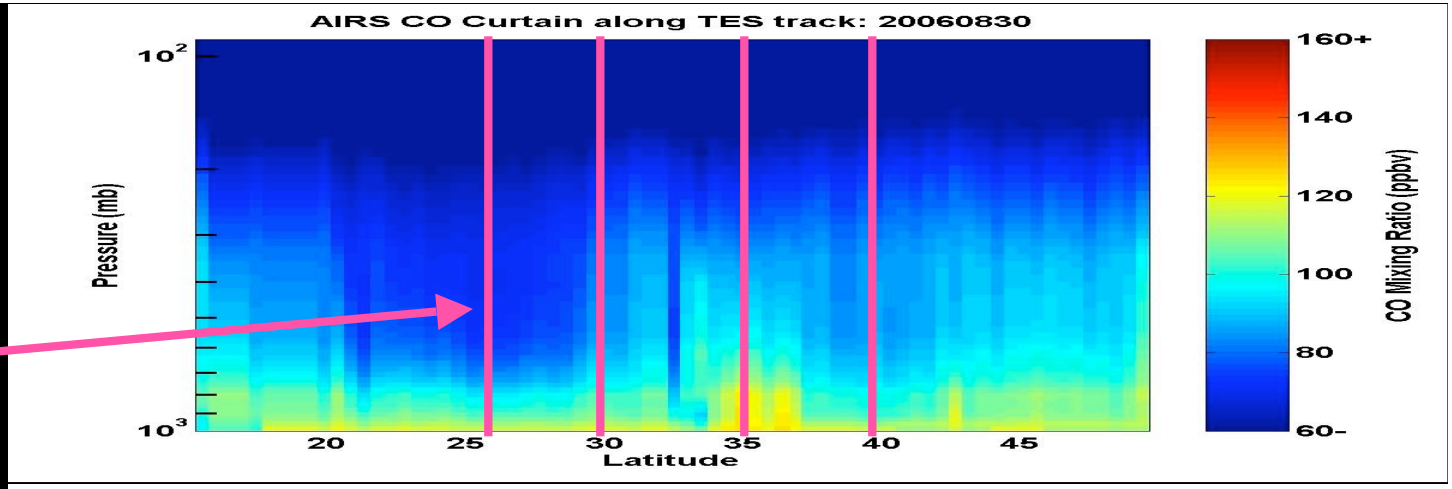


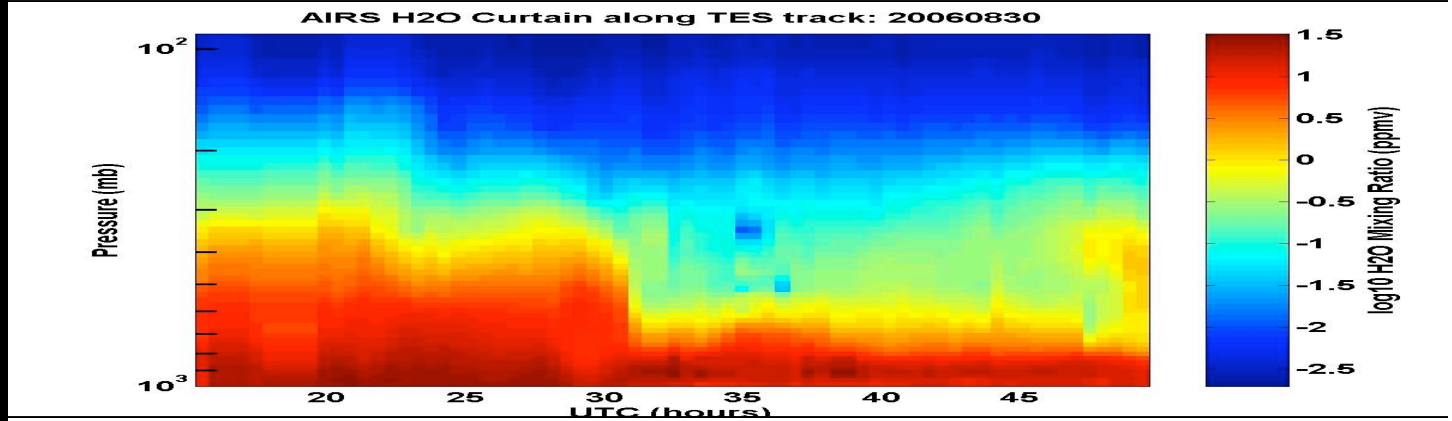


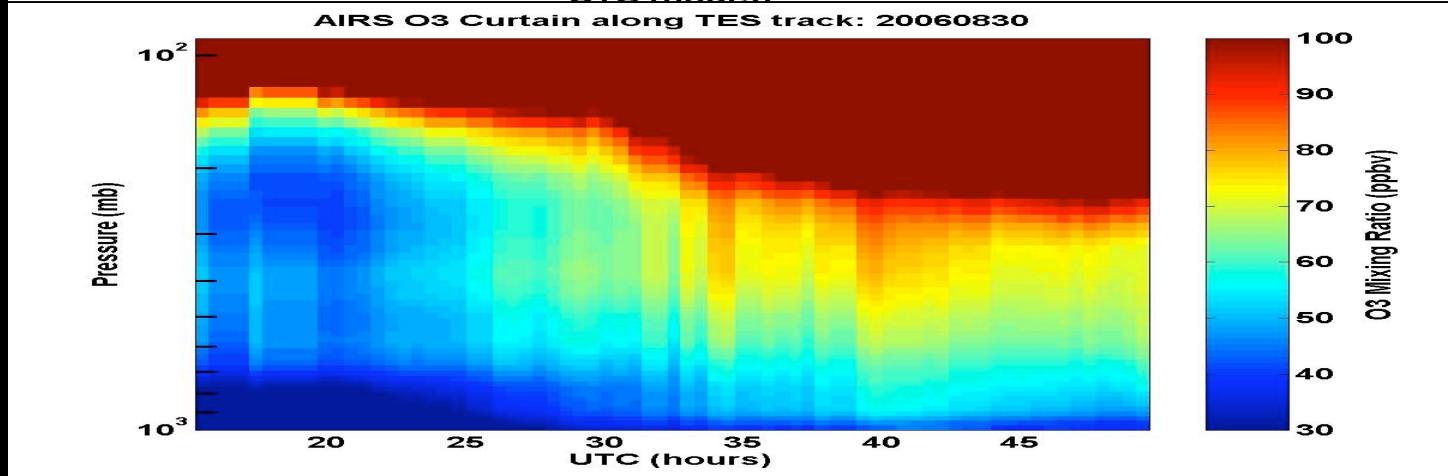


August 30, 2006

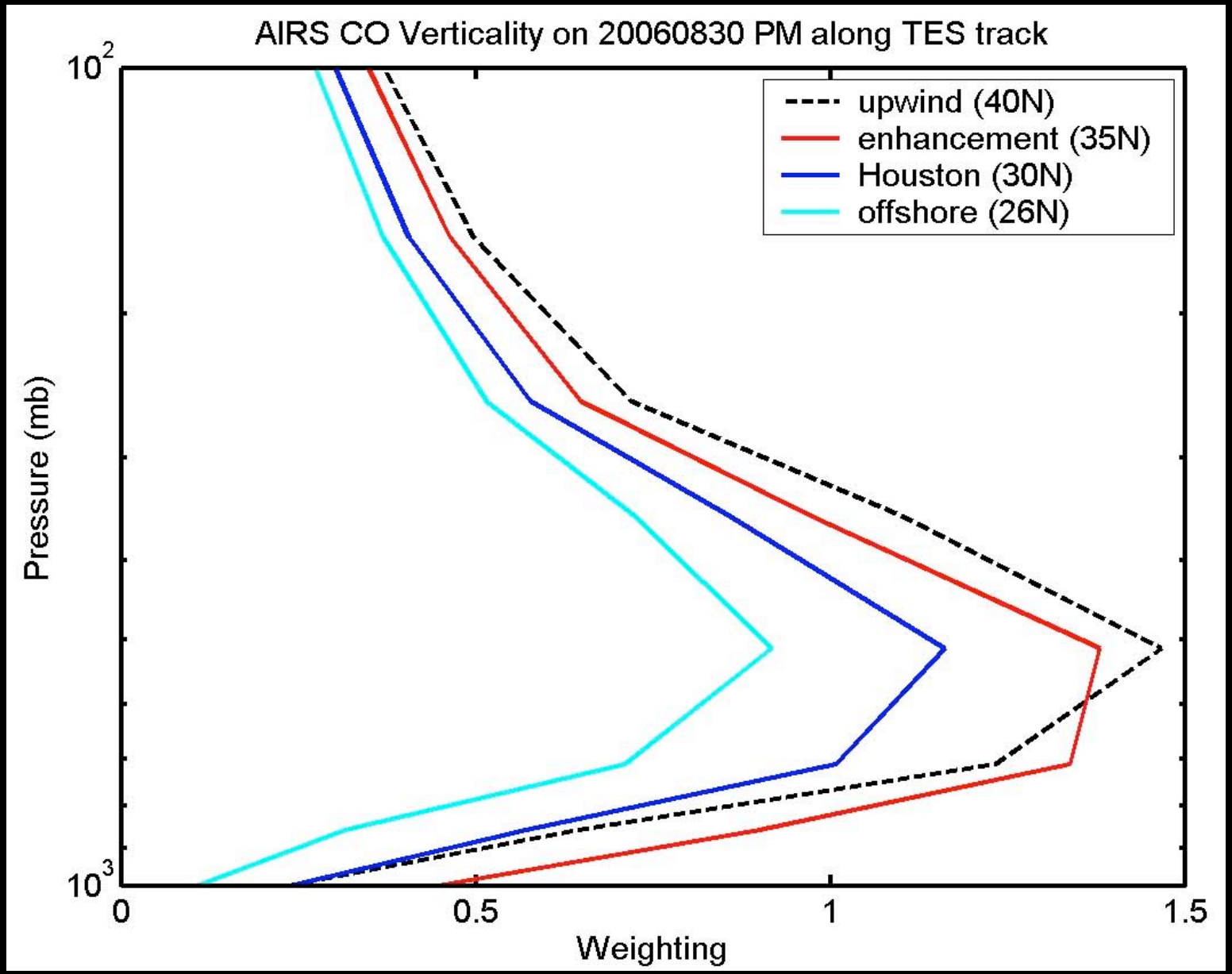
CO vertical sensitivity profiles



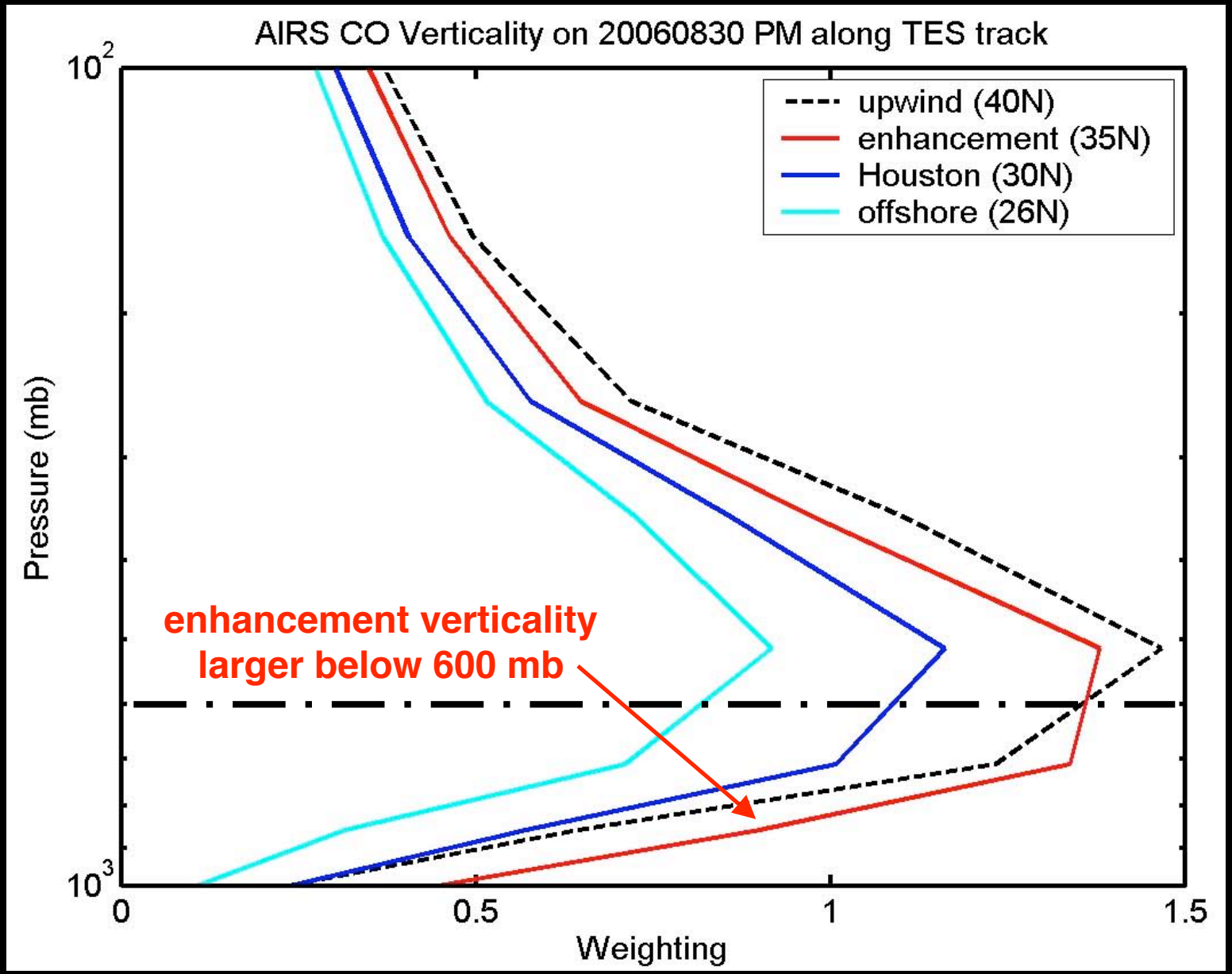




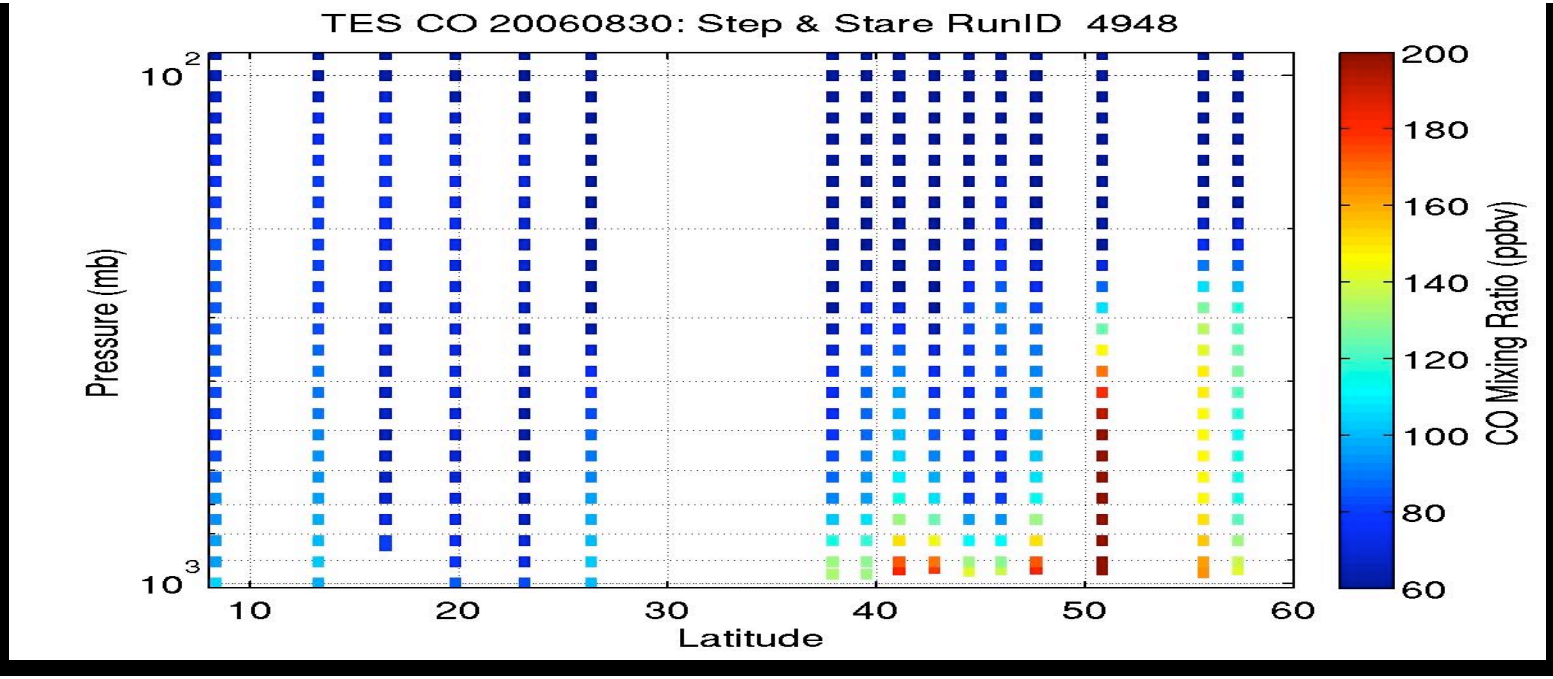
AIRS CO Column Averaging Kernels

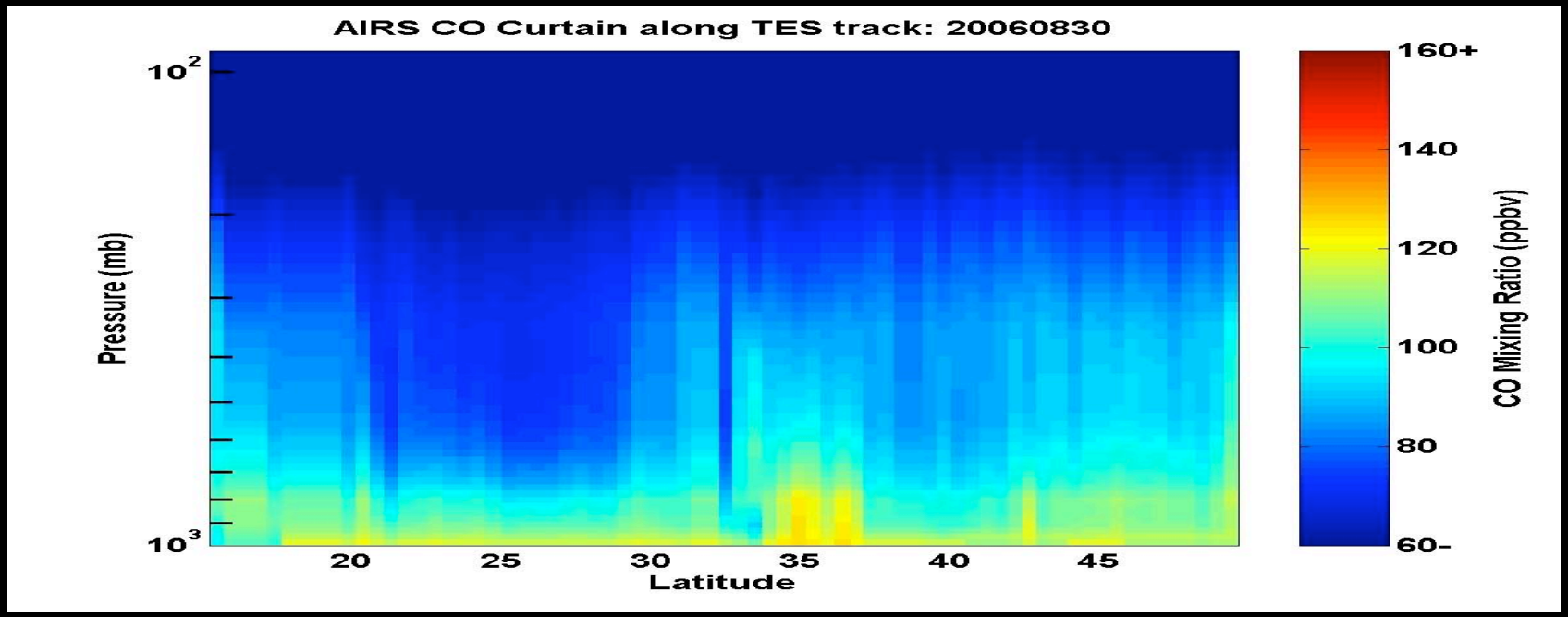


AIRS CO Column Averaging Kernels

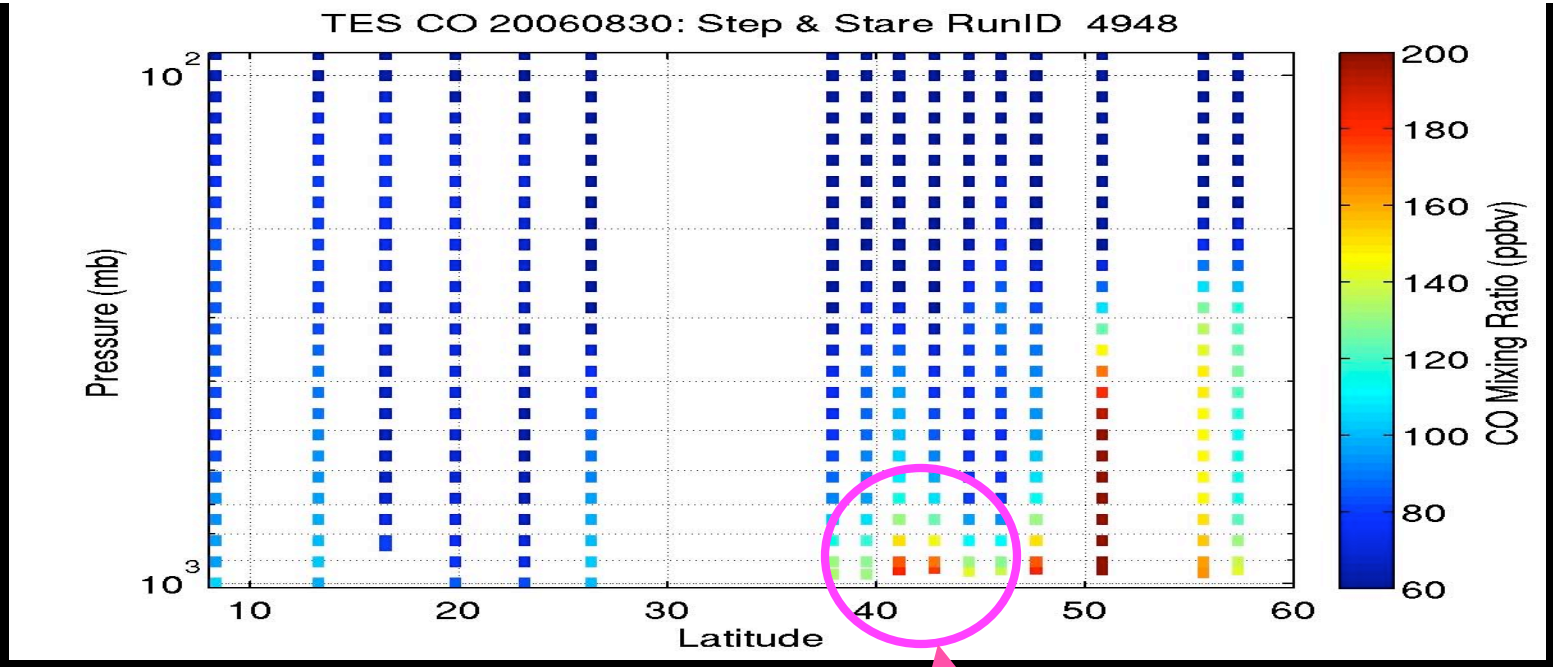


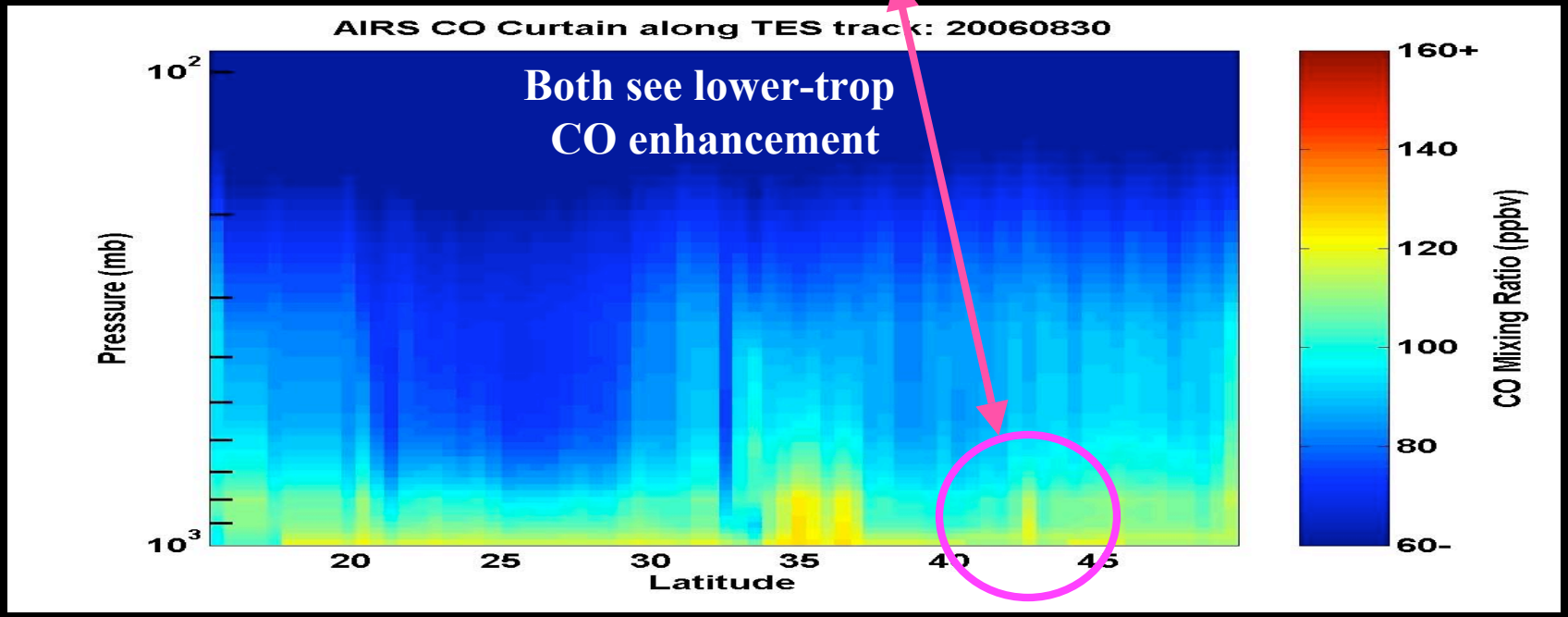
CO


TES CO 20060830: Step & Stare RunID 4948
Pressure (mb)
Latitude
CO Mixing Ratio (ppbv)

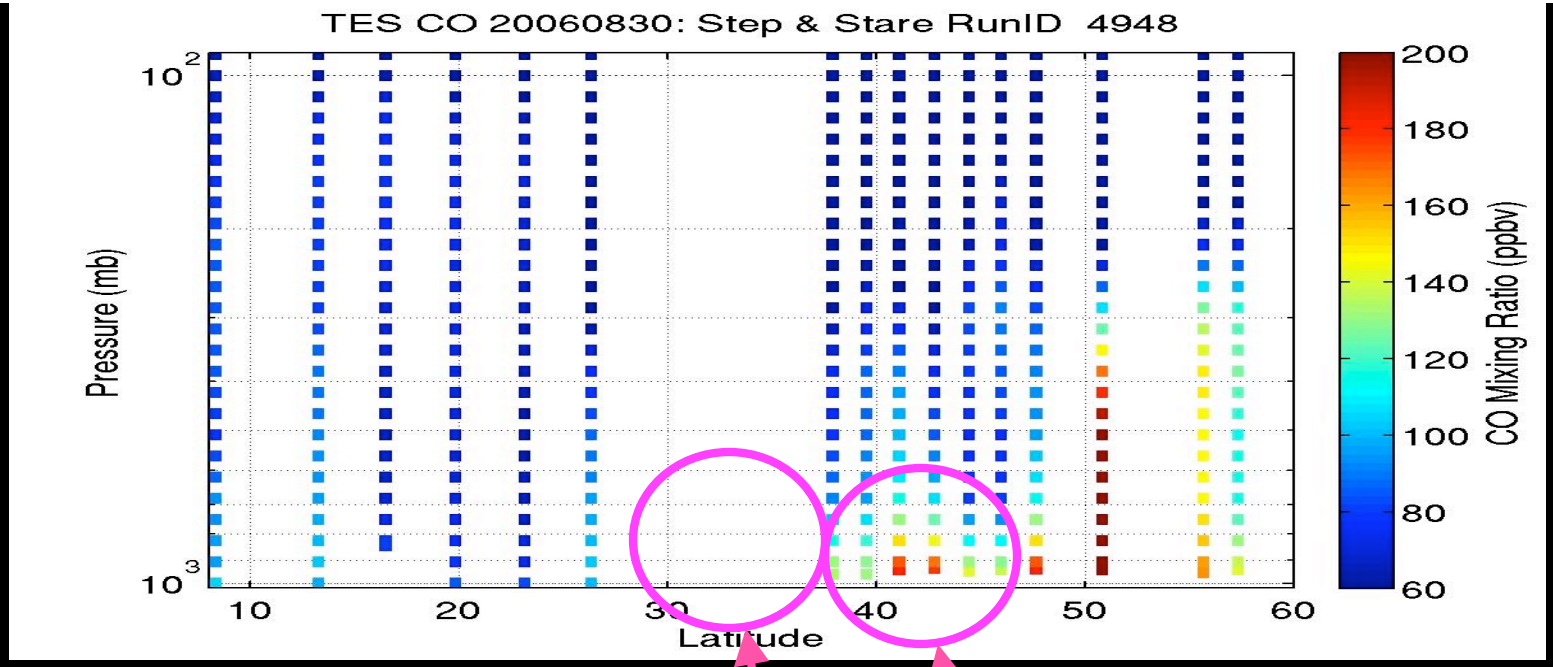

AIRS CO Curtain along TES track: 20060830
Pressure (mb)
Latitude
CO Mixing Ratio (ppbv)

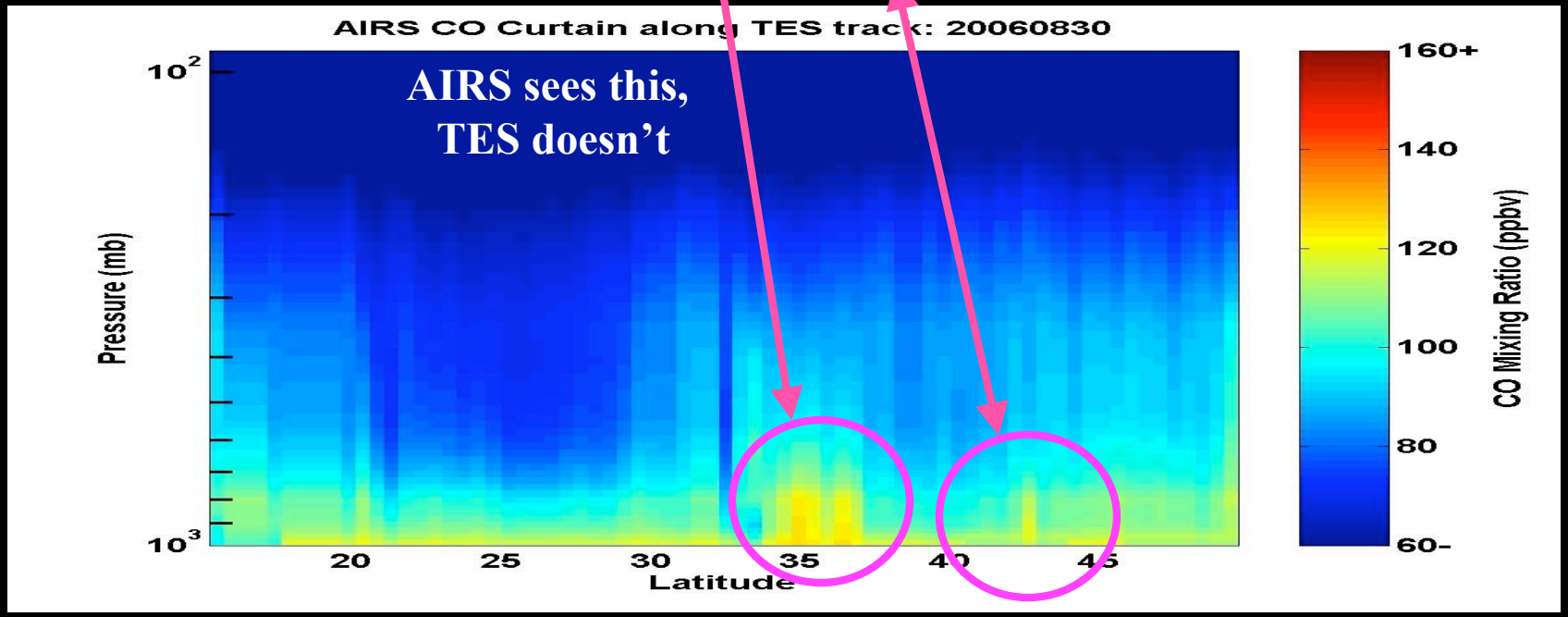
CO


TES CO 20060830: Step & Stare RunID 4948
Pressure (mb)
Latitude
CO Mixing Ratio (ppbv)

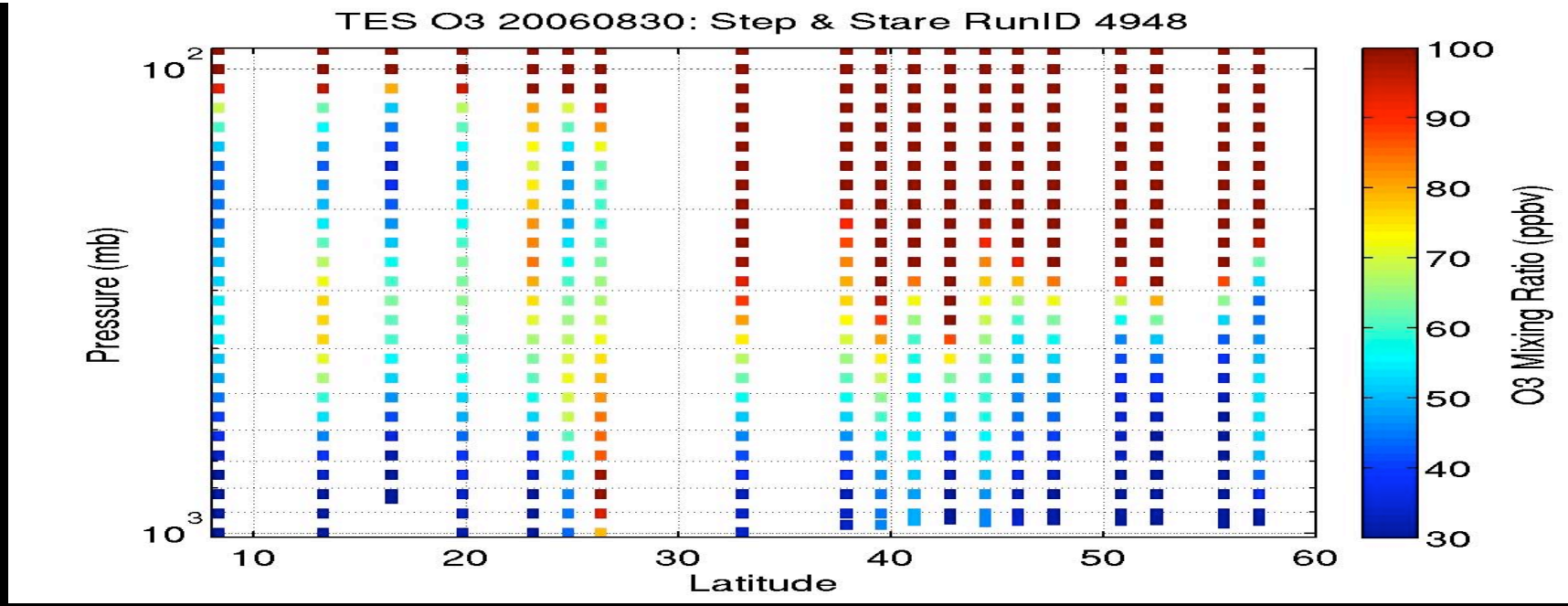

AIRS CO Curtain along TES track: 20060830
Both see lower-trop
CO enhancement
Pressure (mb)
Latitude
CO Mixing Ratio (ppbv)

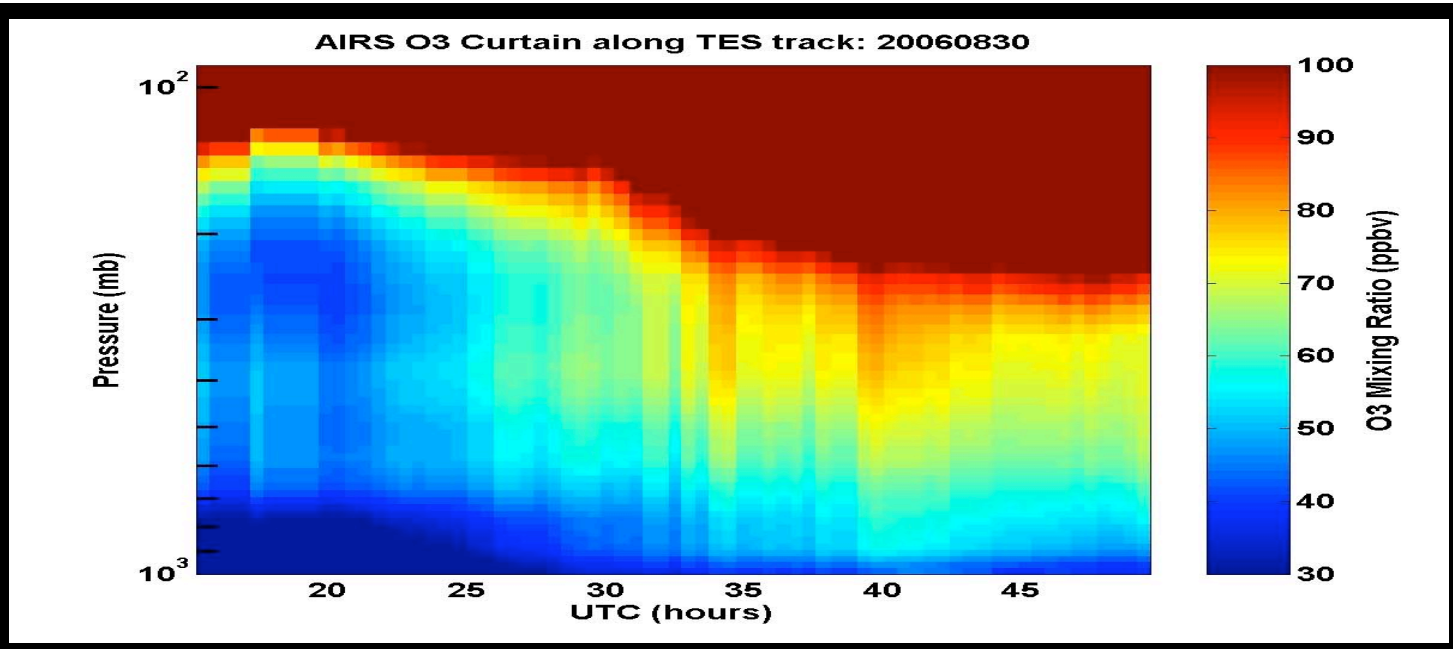
CO


TES CO 20060830: Step & Stare RunID 4948
Pressure (mb)
Latitude
CO Mixing Ratio (ppbv)

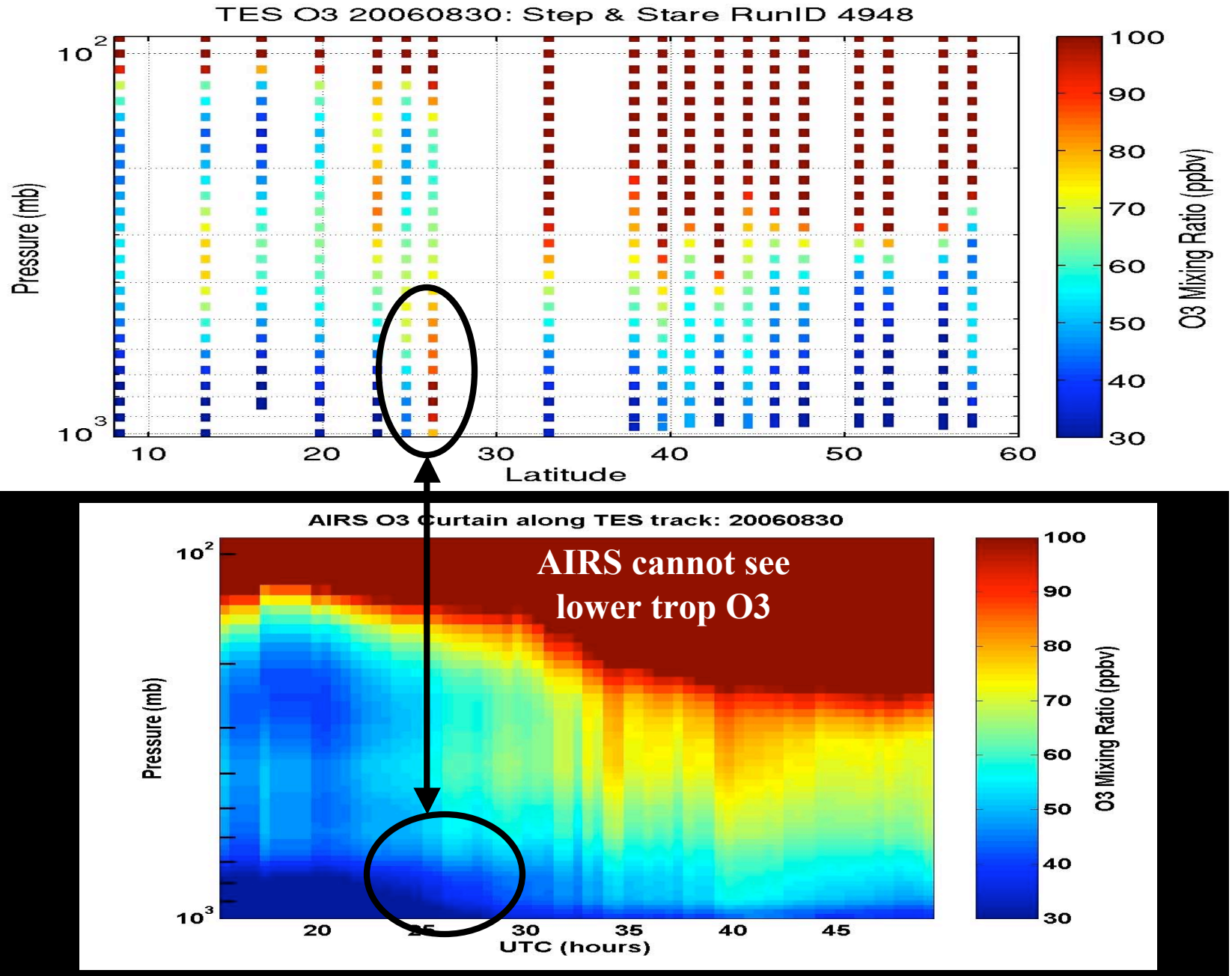

AIRS CO Curtain along TES track: 20060830
AIRS sees this,
TES doesn't
Pressure (mb)
Latitude
CO Mixing Ratio (ppbv)

O_3

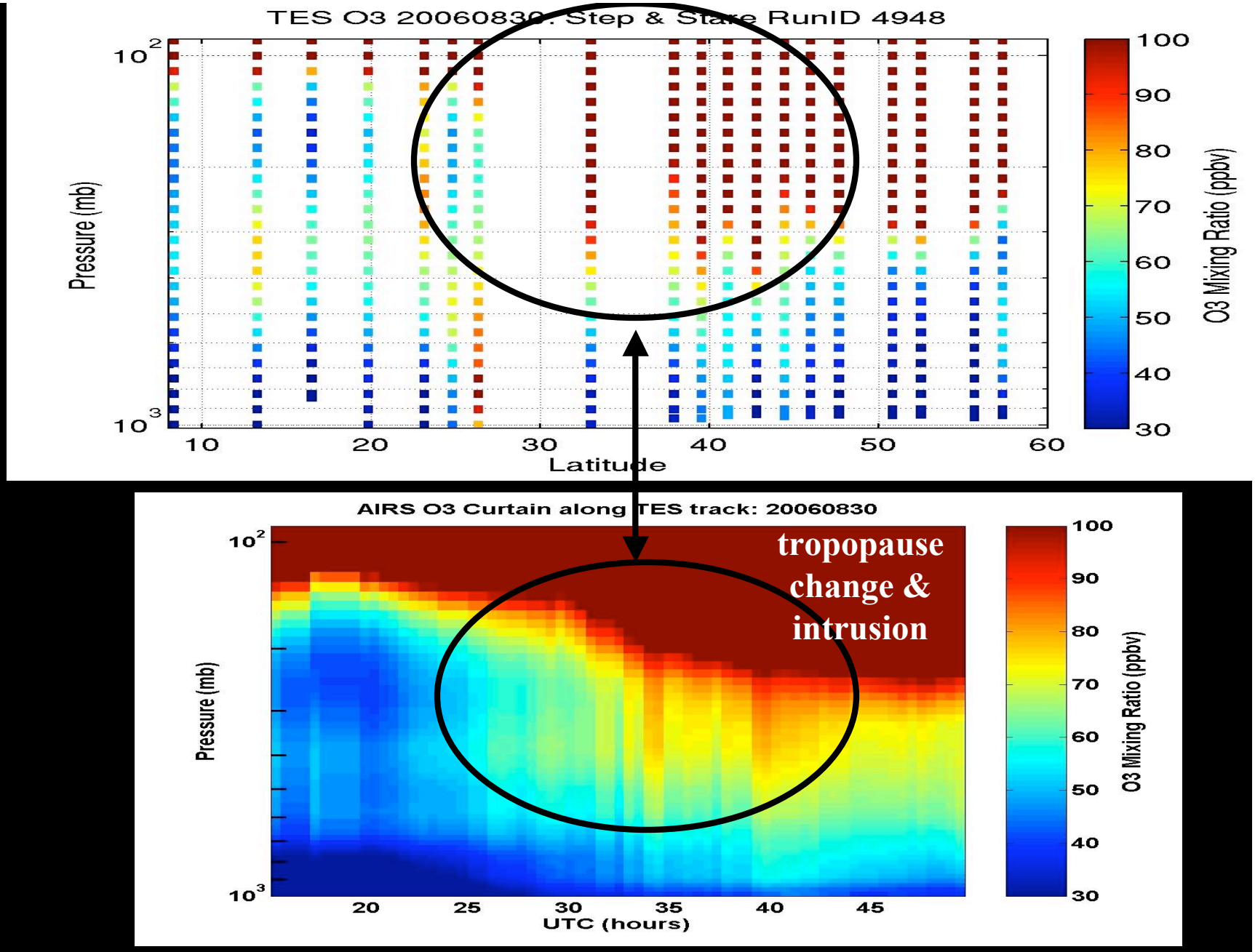

TES O3 20060830: Step & Stare RunID 4948
Pressure (mb)
Latitude
O3 Mixing Ratio (ppbv)


AIRS O3 Curtain along TES track: 20060830
Pressure (mb)
UTC (hours)
O3 Mixing Ratio (ppbv)

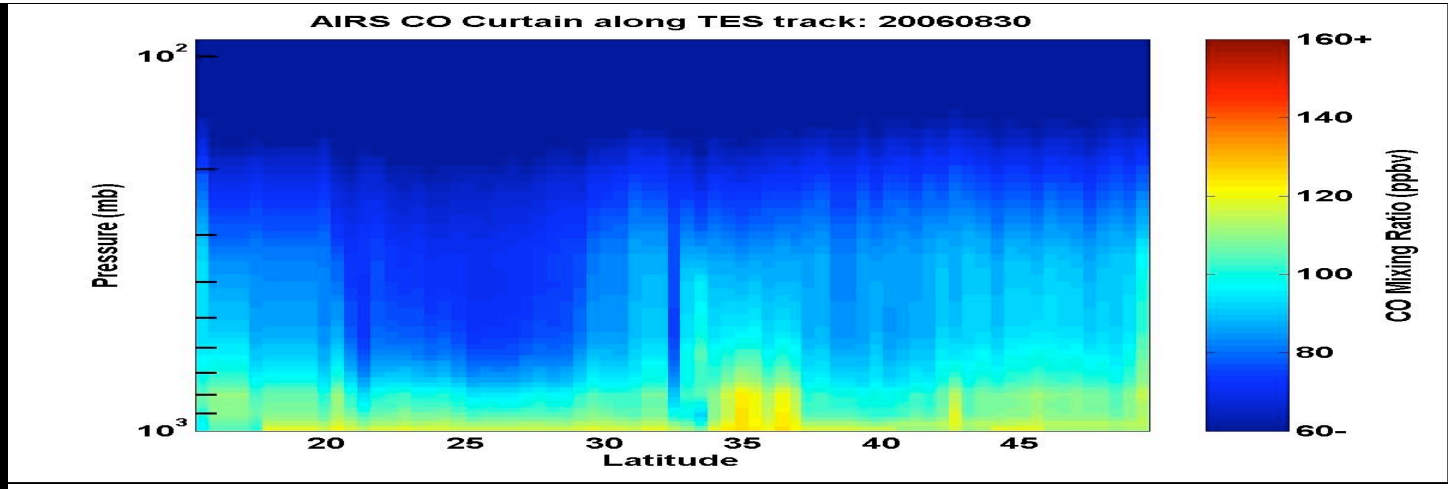
O_3

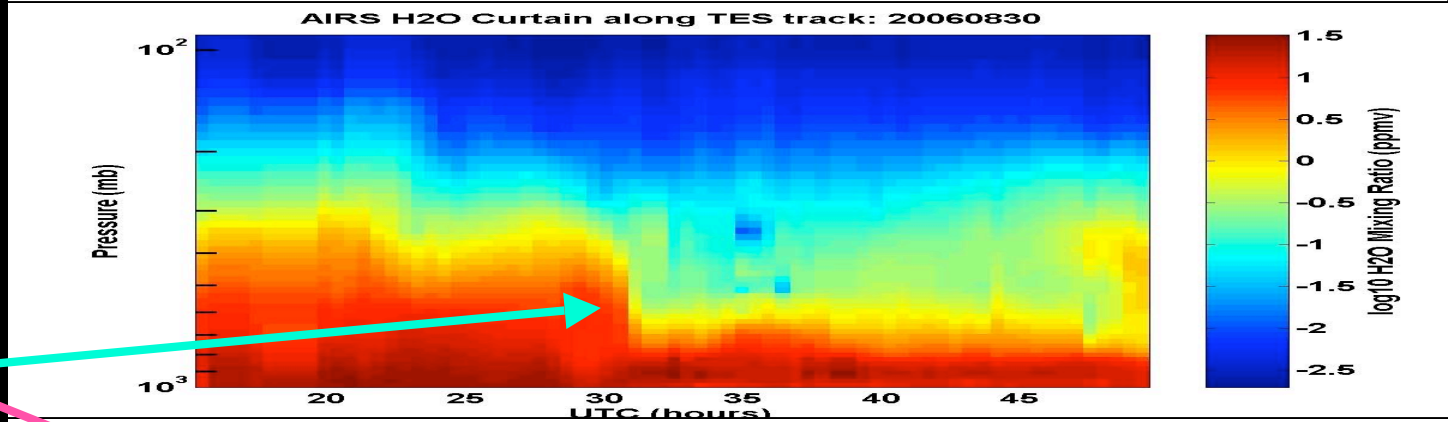

TES O3 20060830: Step & Stare RunID 4948
Pressure (mb)
Latitude
O3 Mixing Ratio (ppbv)
AIRS O3 Curtain along TES track: 20060830
AIRS cannot see
lower trop O3
Pressure (mb)
UTC (hours)
O3 Mixing Ratio (ppbv)

O_3


TES O3 20060830: Step & Stare RunID 4948
Pressure (mb)
Latitude
O3 Mixing Ratio (ppbv)
AIRS O3 Curtain along TES track: 20060830
tropopause
change &
intrusion
Pressure (mb)
UTC (hours)
O3 Mixing Ratio (ppbv)

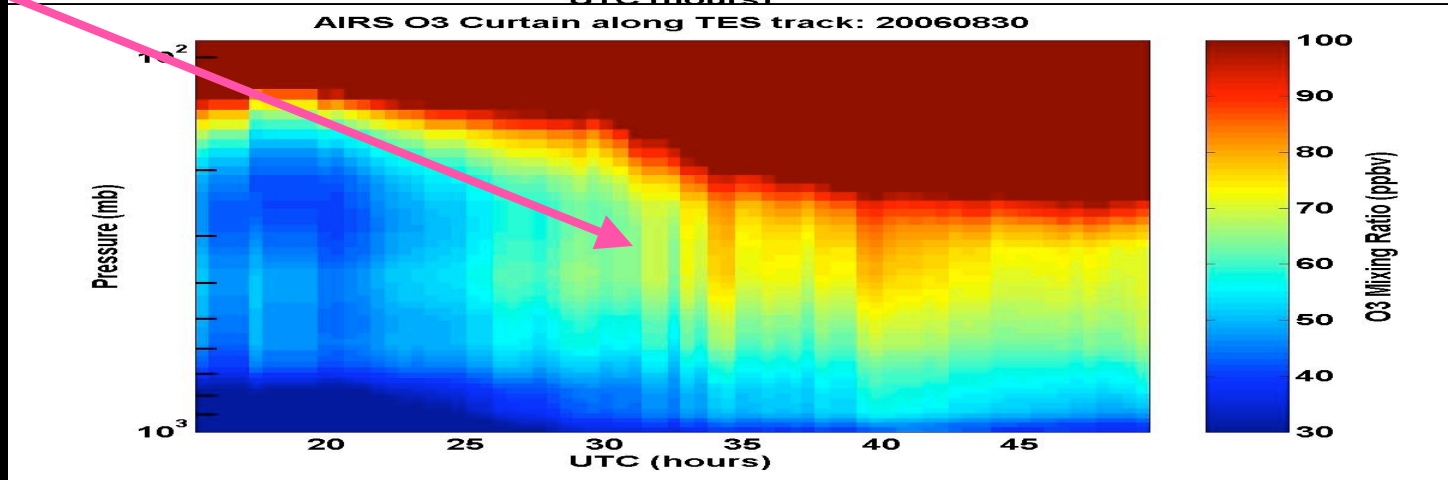
August 30, 2006





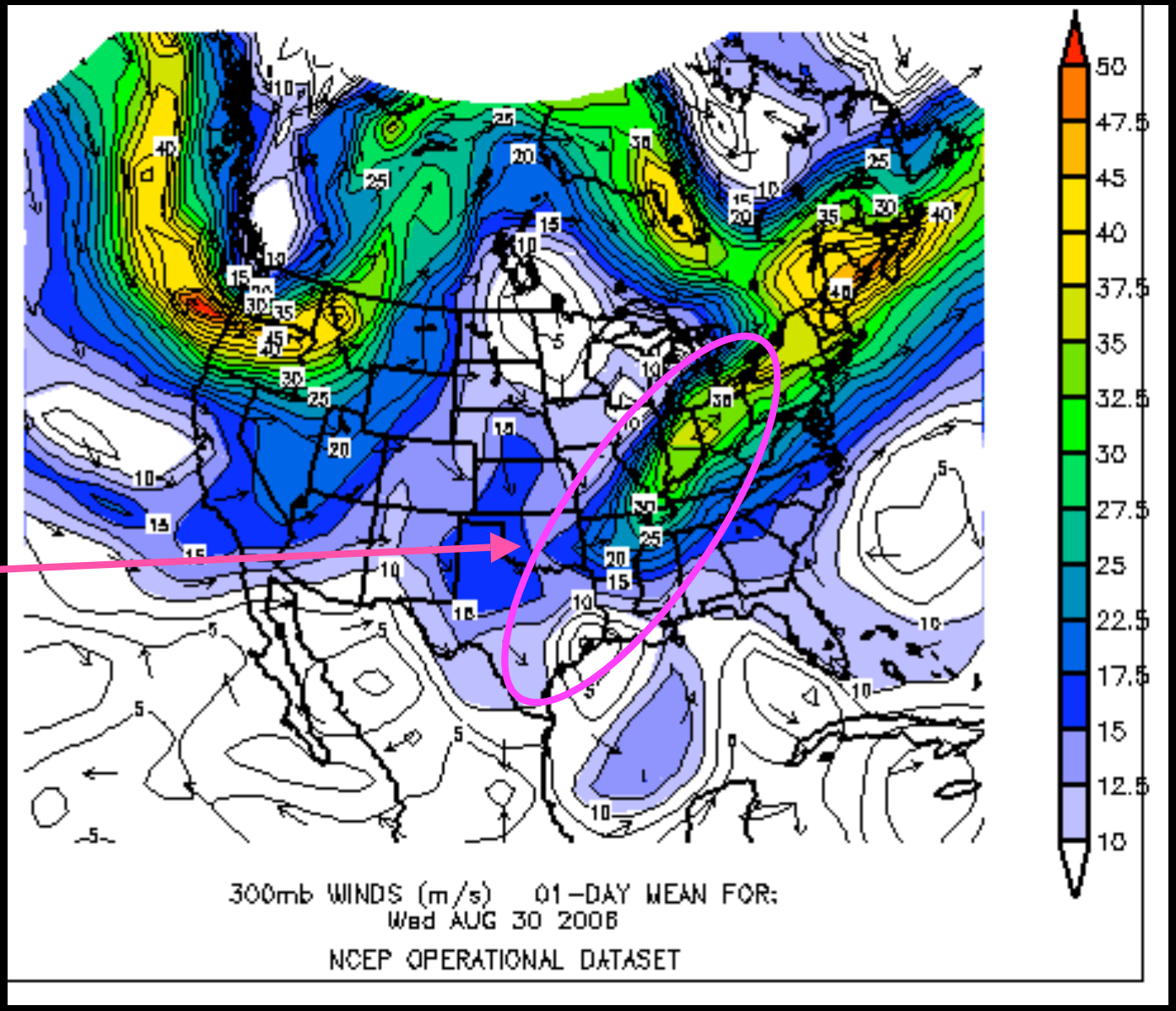
upper level front

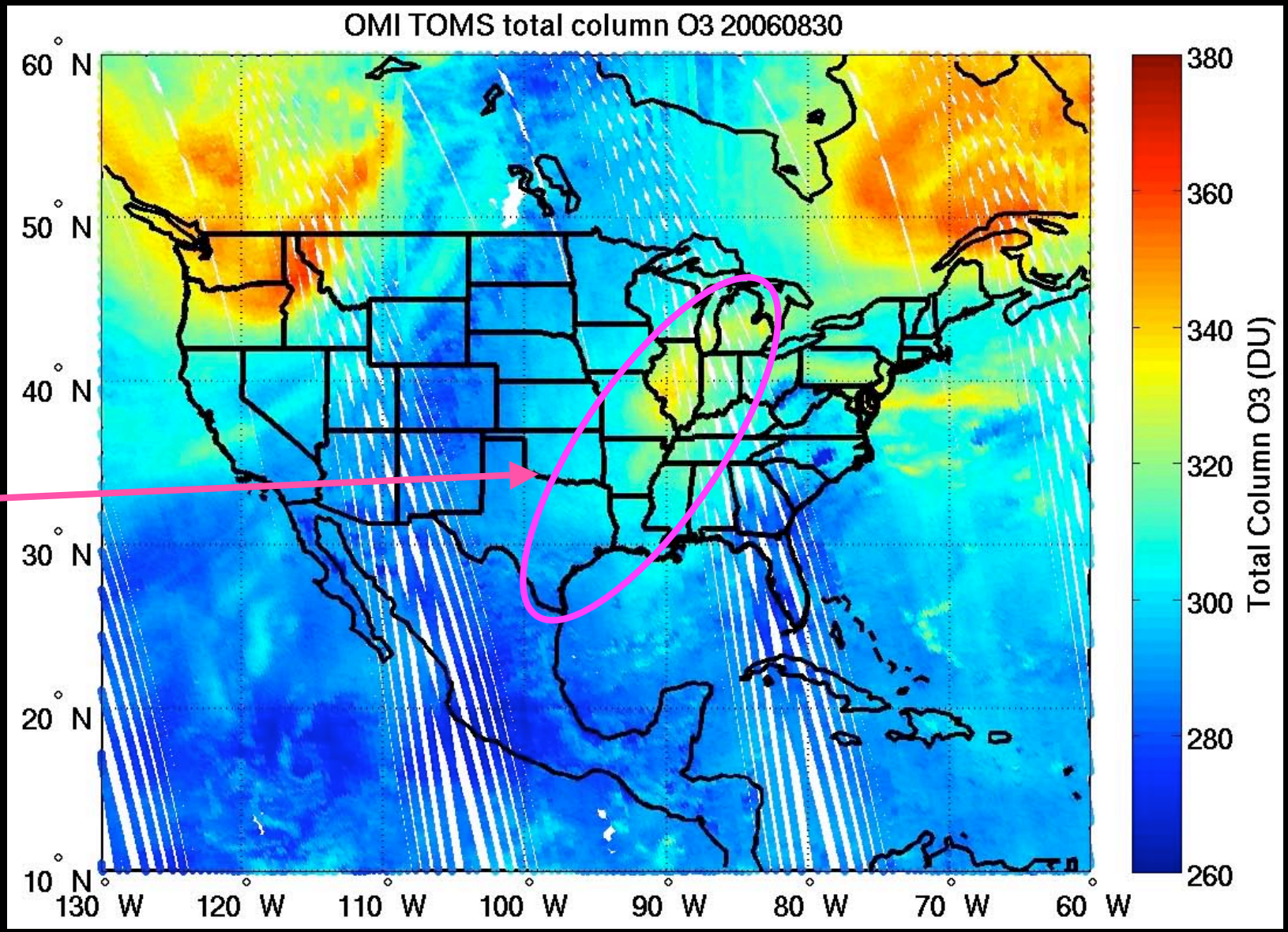
MLS sees similar features to 215-316 mb



Upper level front (& surface front)

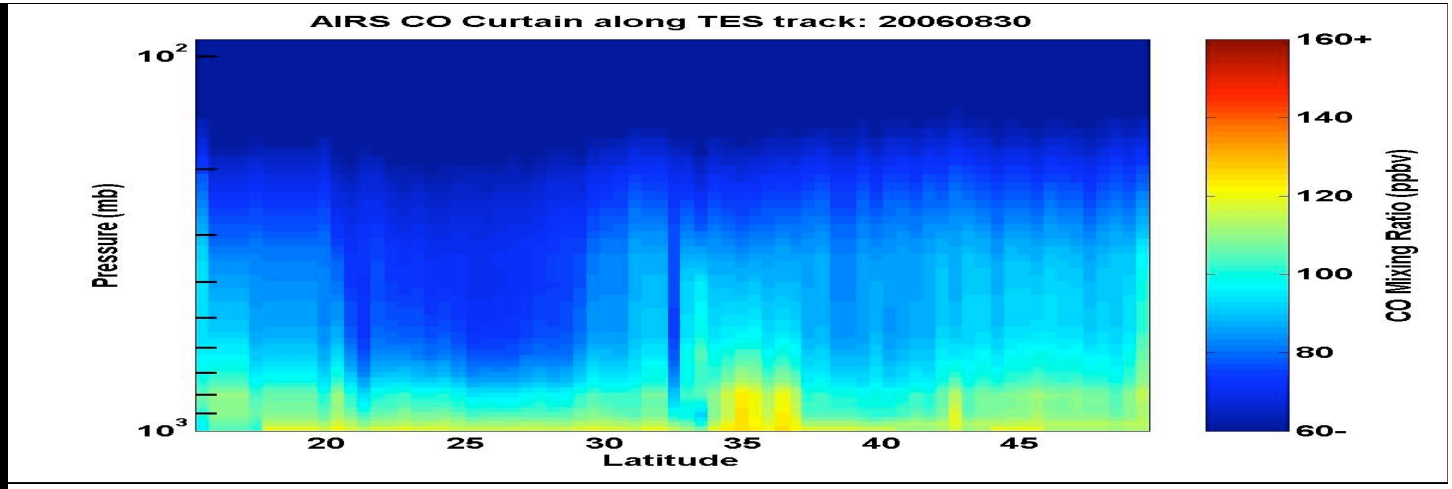
upper level front

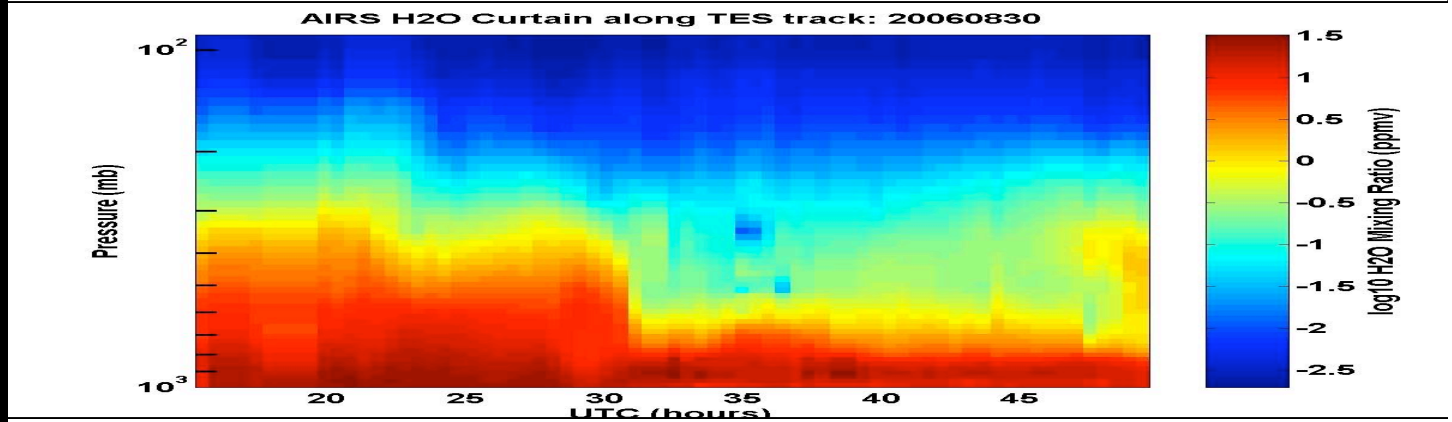


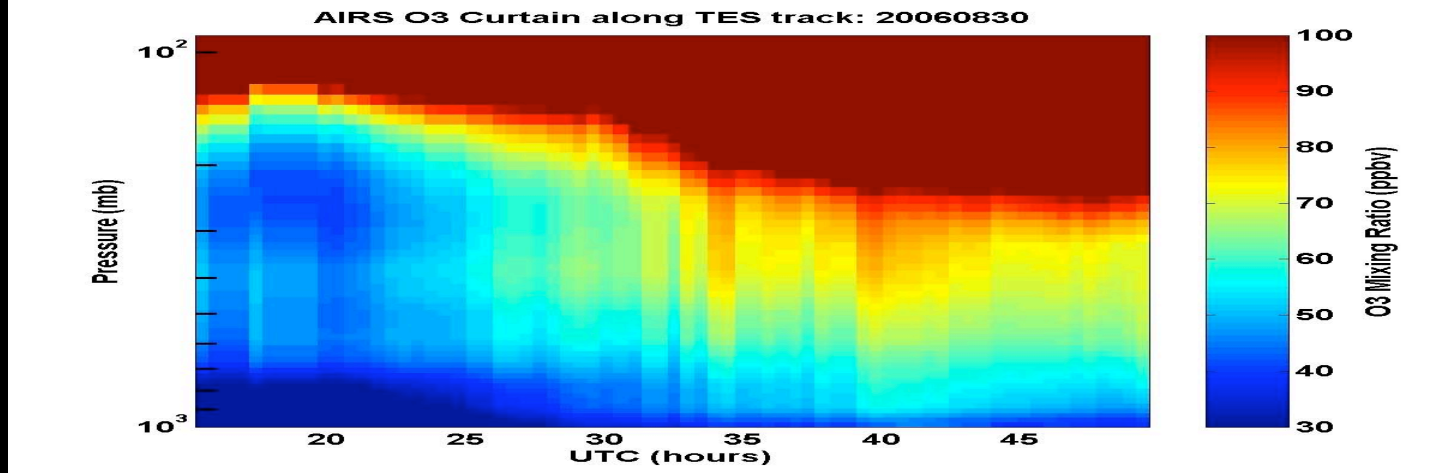


upper level front

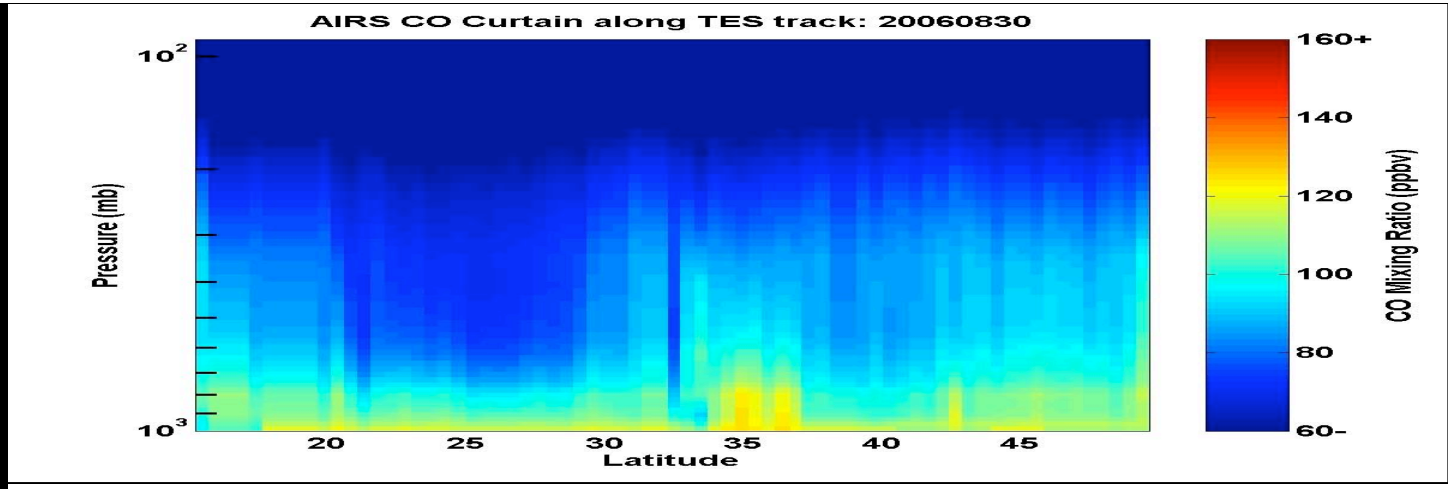
August 30, 2006

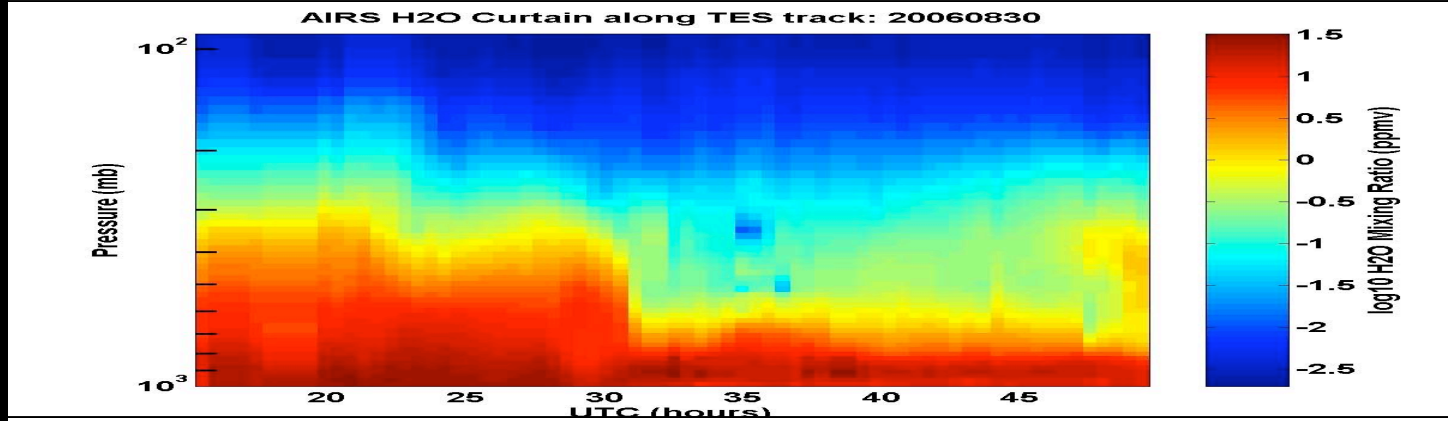


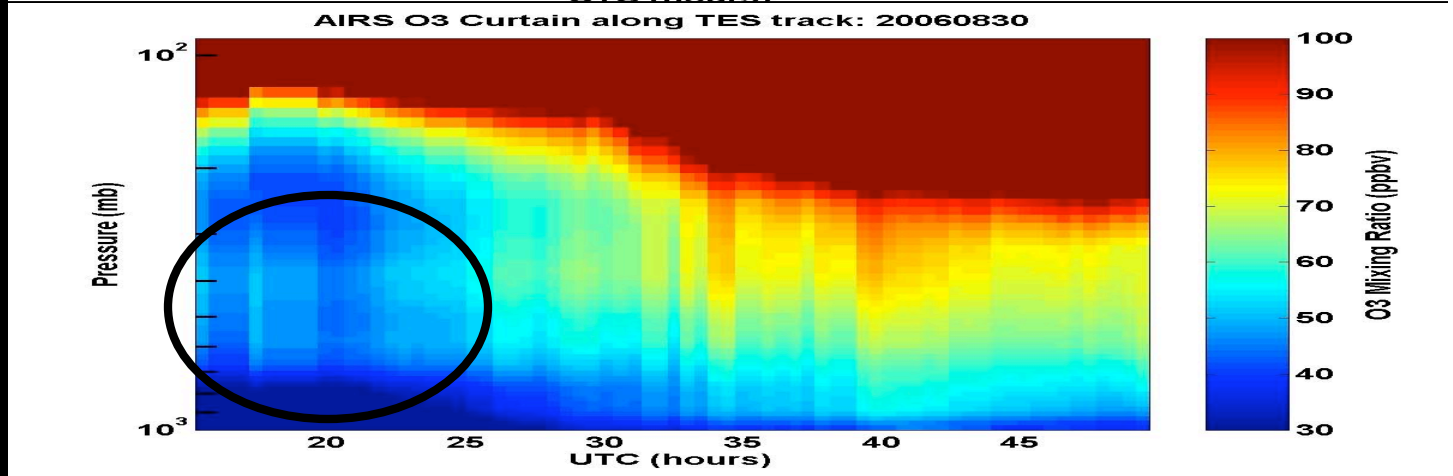




August 30, 2006





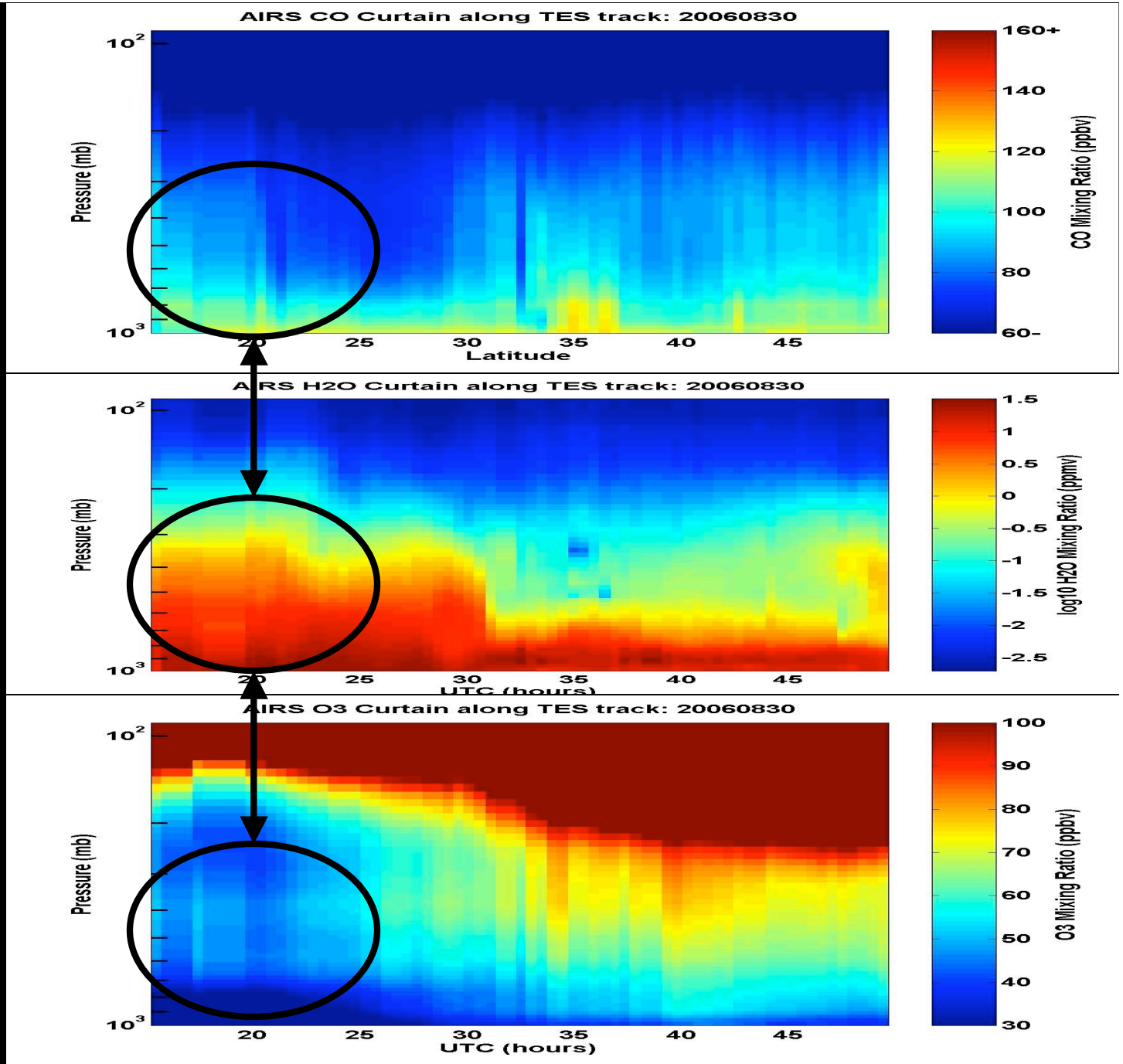


AIRS sees mid-trop O3 enhancement,

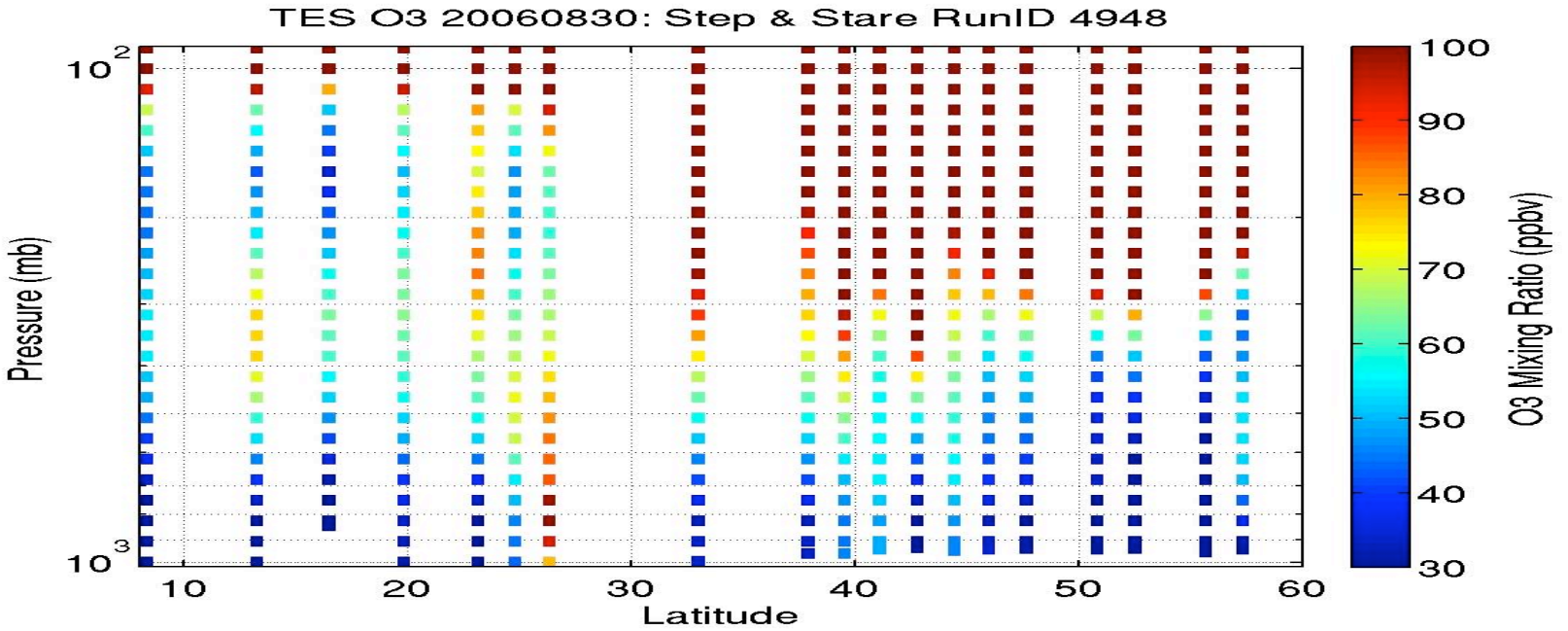
August 30, 2006

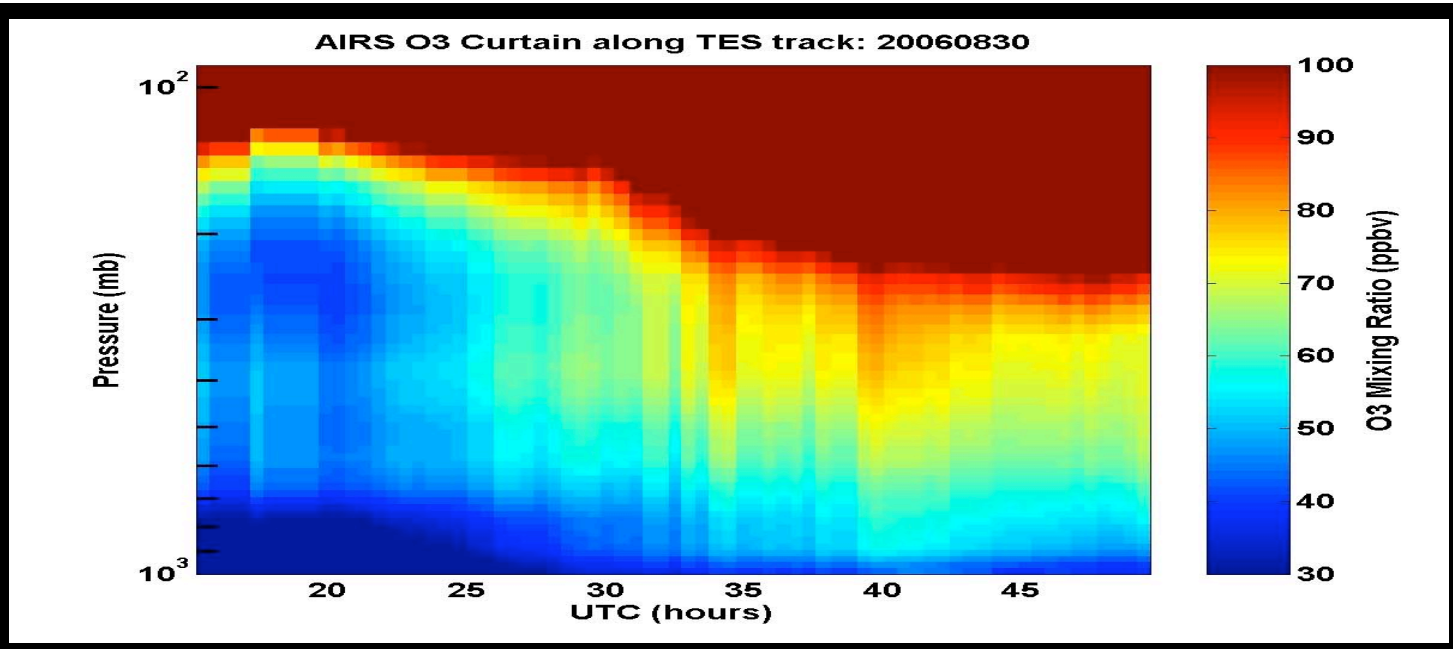
No feature in CO or H2O

AIRS sees mid-trop O3 enhancement,

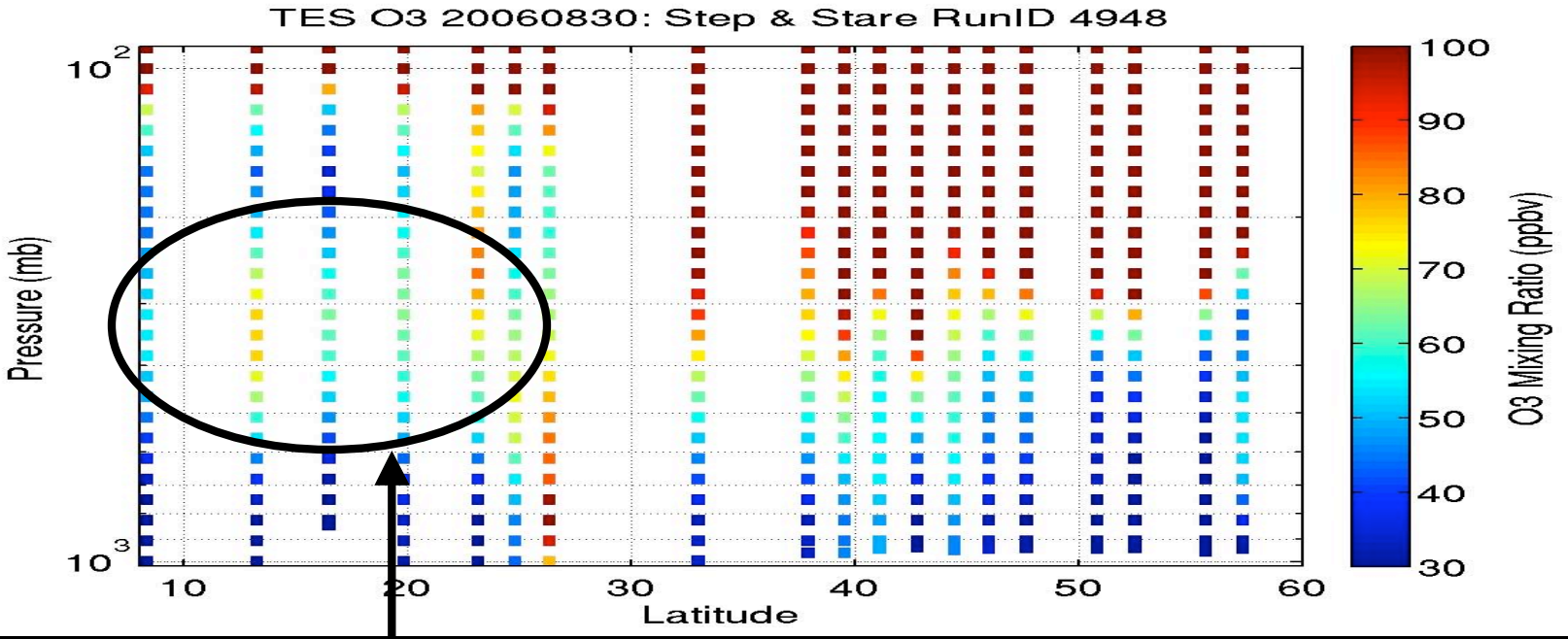


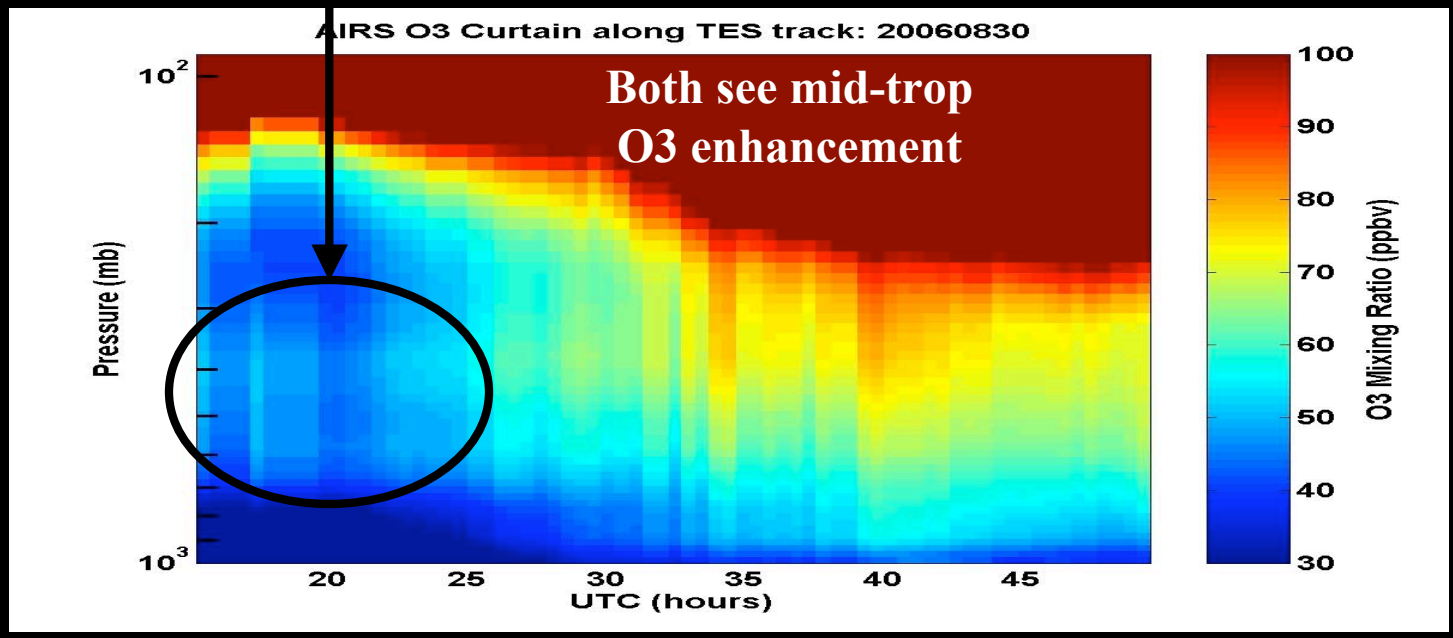
O_3


TES O3 20060830: Step & Stare RunID 4948
Pressure (mb)
Latitude
O3 Mixing Ratio (ppbv)

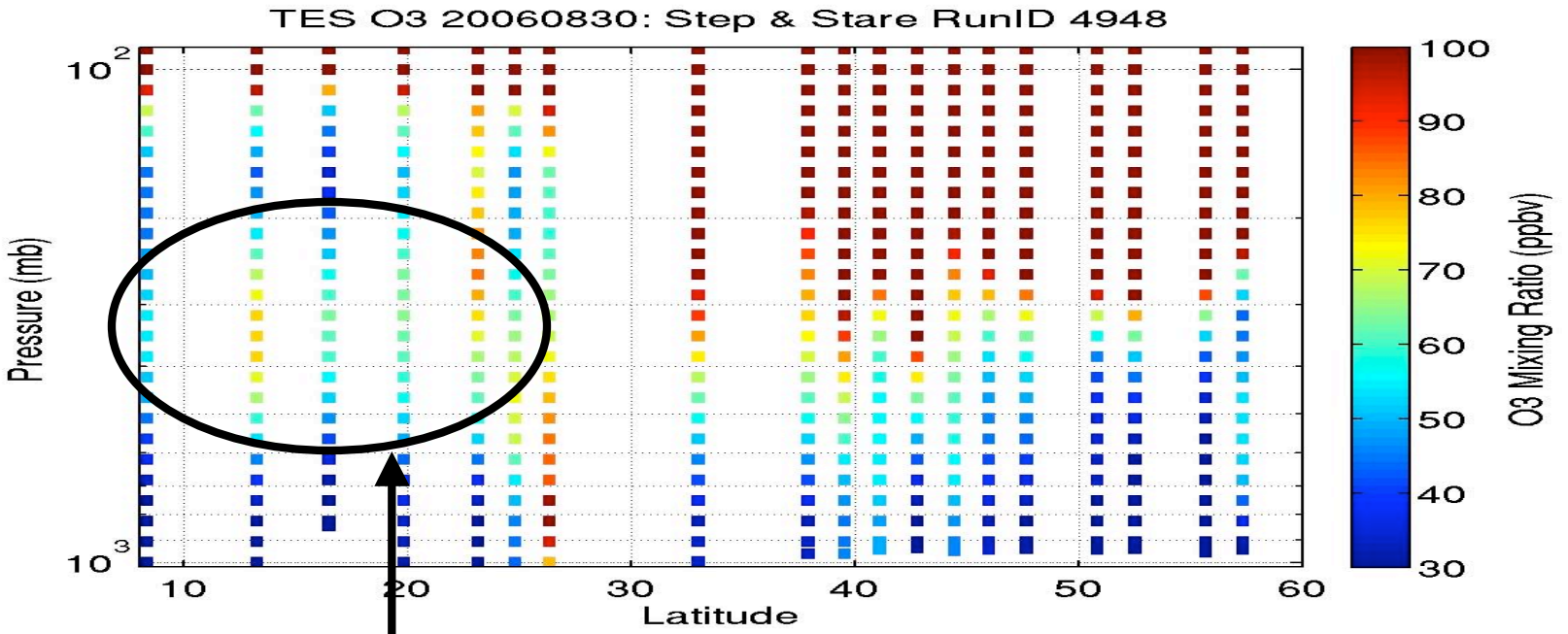

AIRS O3 Curtain along TES track: 20060830
Pressure (mb)
UTC (hours)
O3 Mixing Ratio (ppbv)

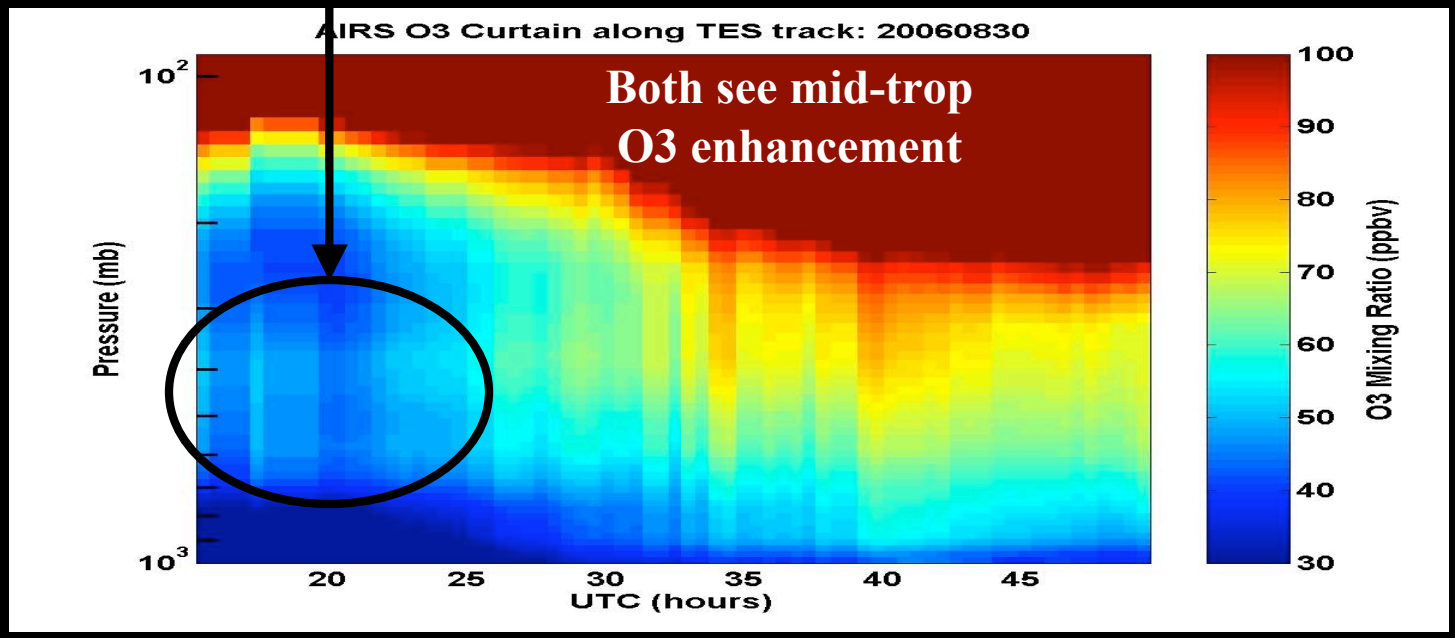
O_3


TES O3 20060830: Step & Stare RunID 4948
Pressure (mb)
Latitude
O3 Mixing Ratio (ppbv)


AIRS O3 Curtain along TES track: 20060830
Both see mid-trop
O3 enhancement
Pressure (mb)
UTC (hours)
O3 Mixing Ratio (ppbv)

O_3

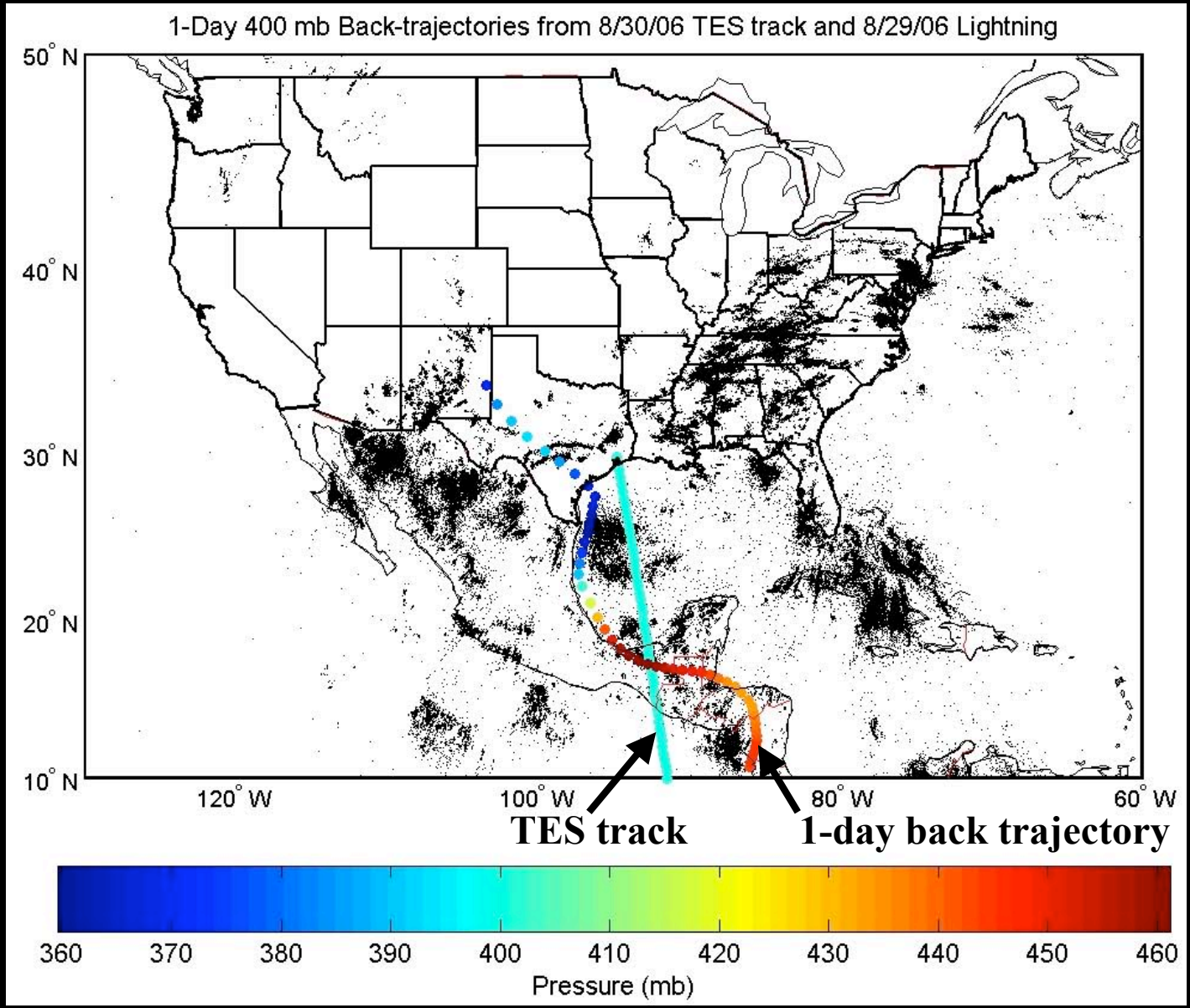




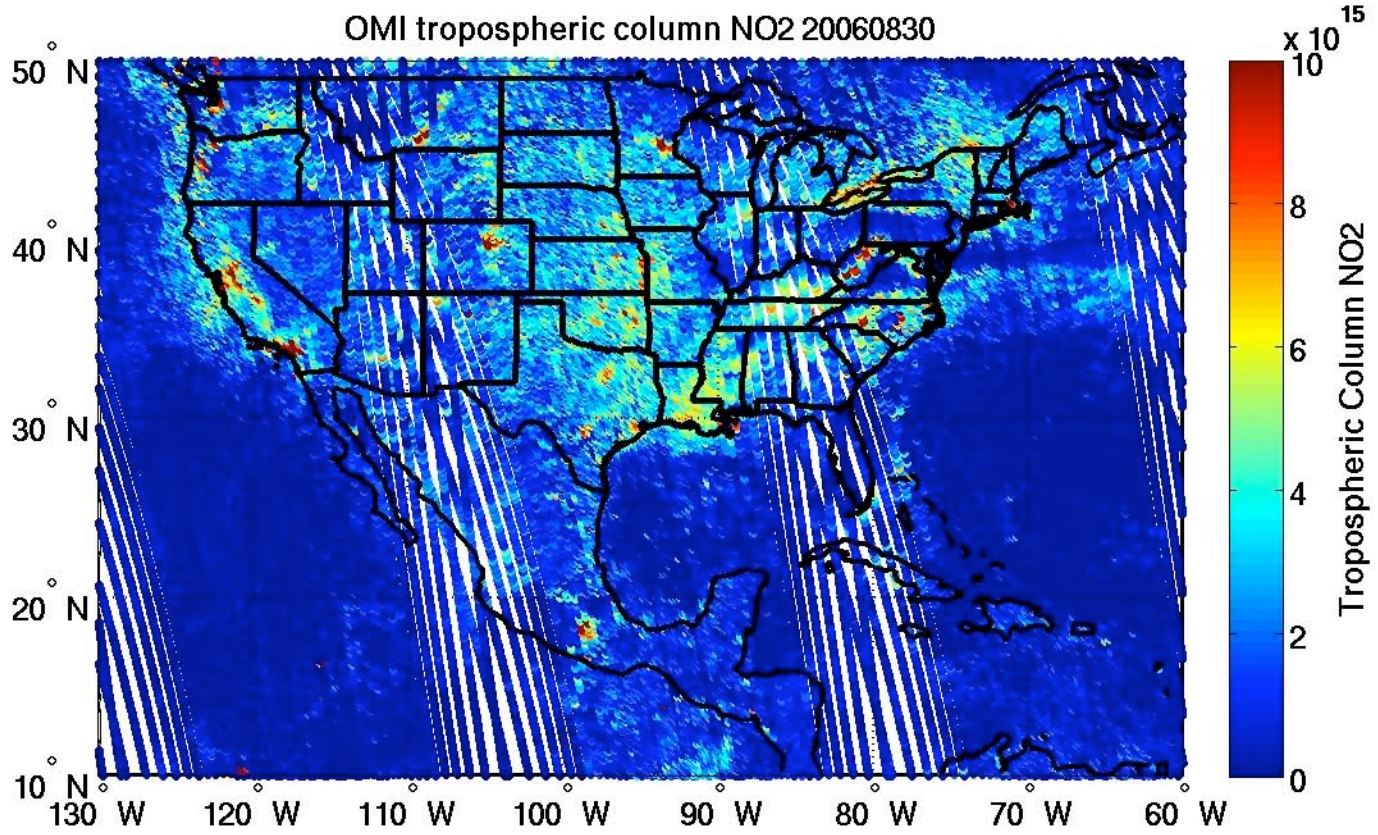
I would not believe AIRS alone, but with TES…?

What could cause such a feature?

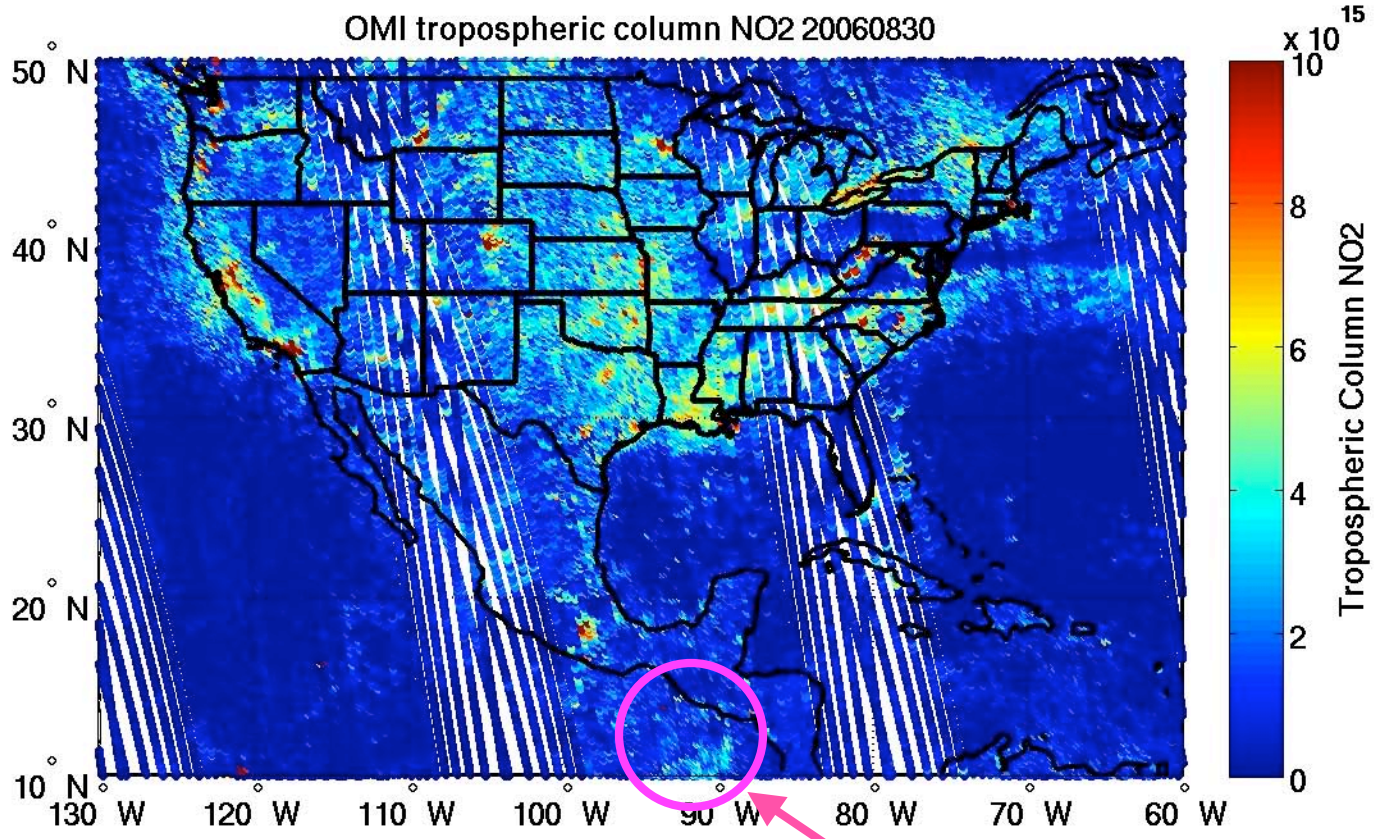
Lightning source?



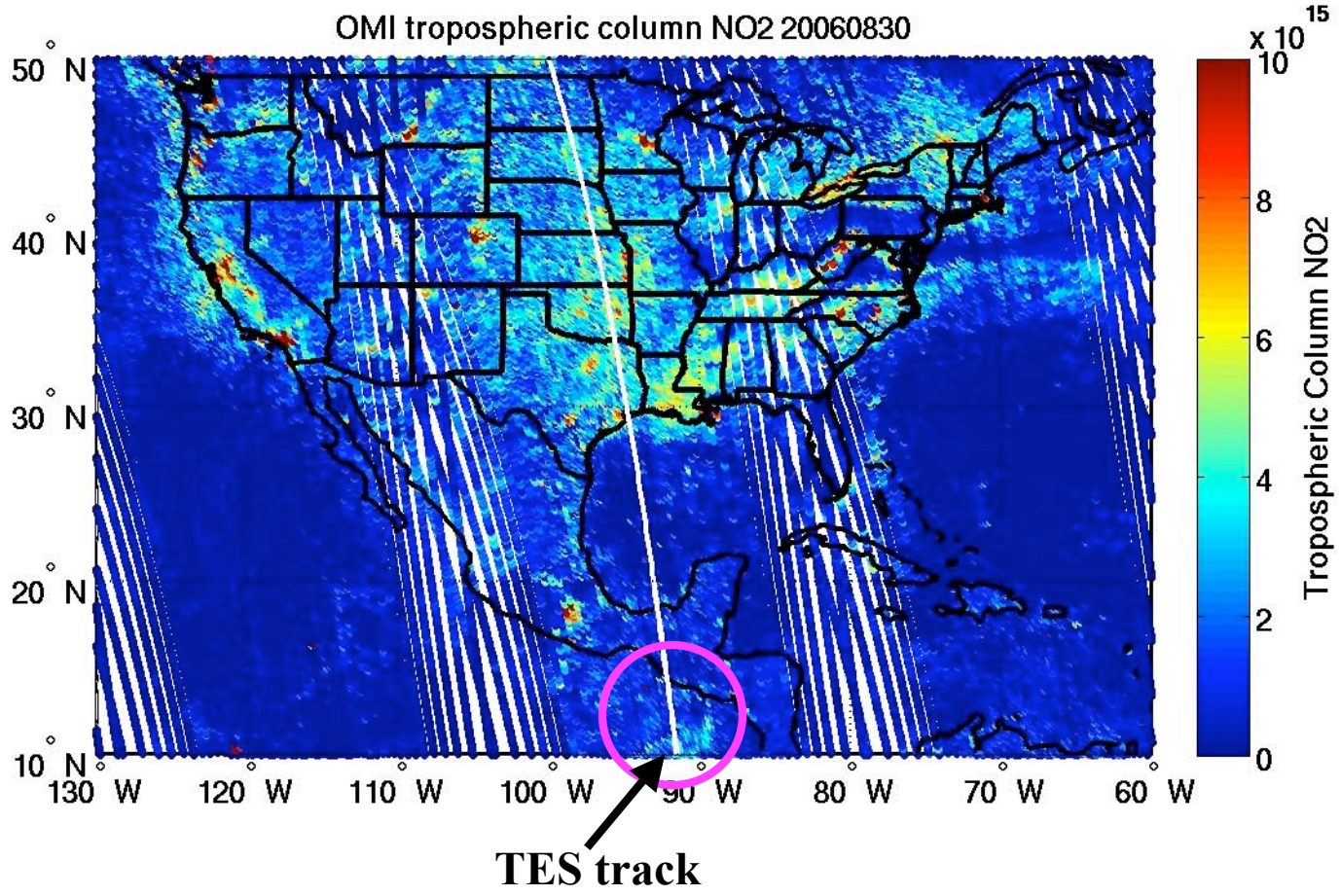
OMI NO_2


OMI tropospheric column NO2 20060830
50° N
40° N
30° N
20° N
10° N
130° W
120° W
110° W
100° W
90° W
80° W
70° W
60° W
x 10^15
10
8
6
4
2
0
Tropospheric Column NO2

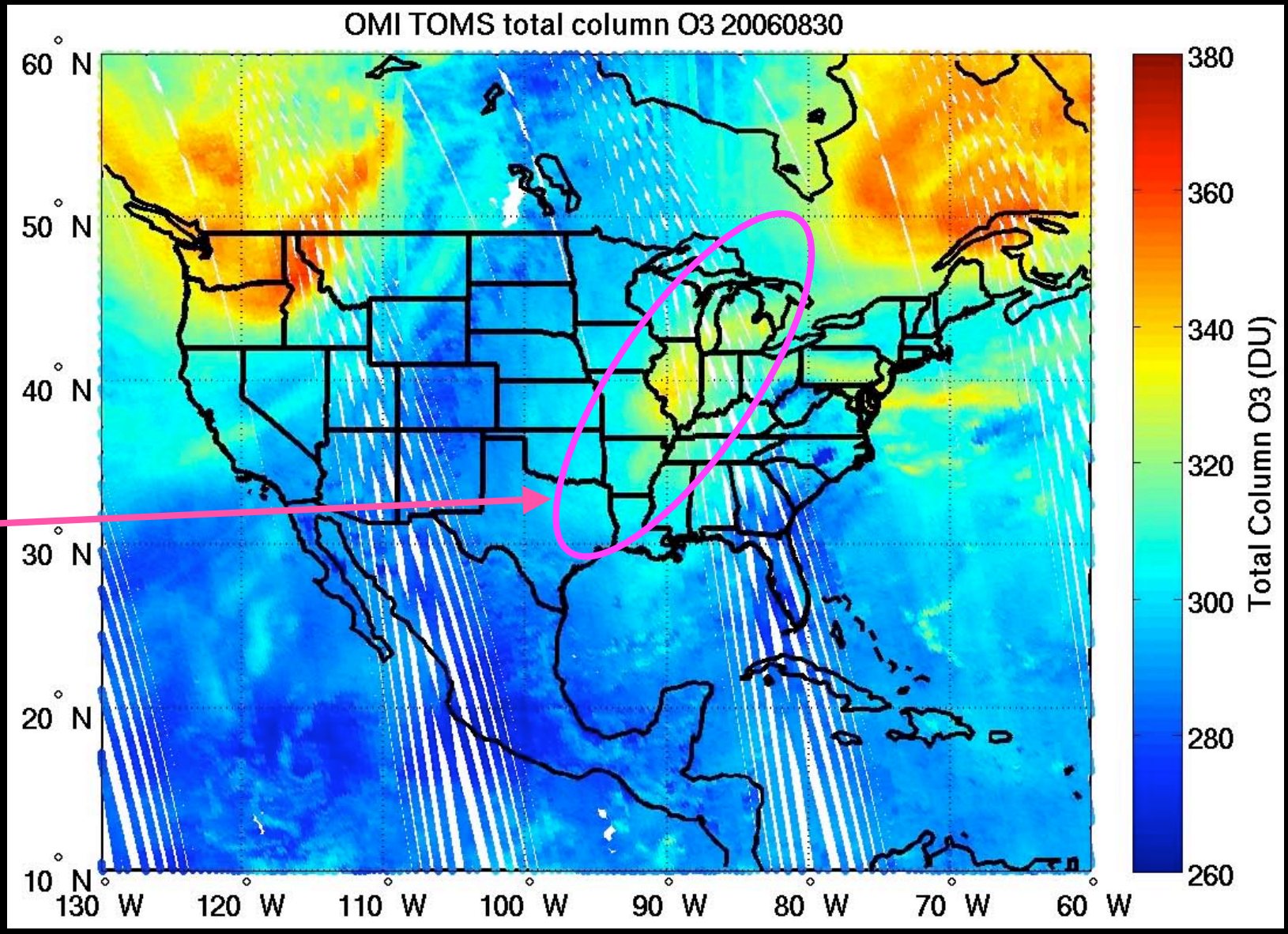
OMI NO_2


OMI tropospheric column NO2 20060830
50° N
40° N
30° N
20° N
10° N
130° W
120° W
110° W
100° W
90° W
80° W
70° W
60° W
x 10^15
10
8
6
4
2
0
Tropospheric Column NO2
NO2 from lightning?

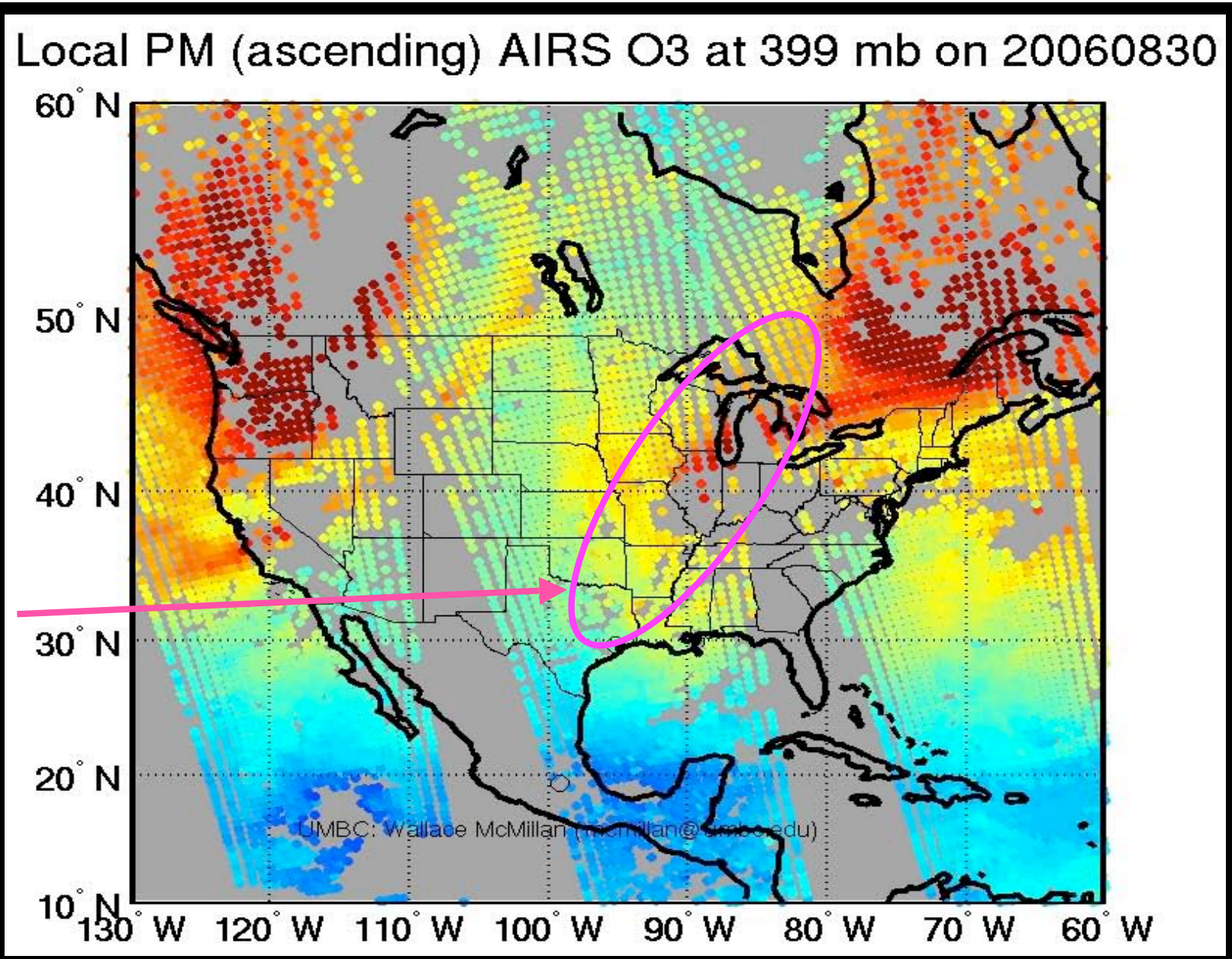
OMI NO_2


OMI tropospheric column NO2 20060830
50° N
40° N
30° N
20° N
10° N
130° W
120° W
110° W
100° W
90° W
80° W
70° W
60° W
x 10^15
10
8
6
4
2
0
Tropospheric Column NO2
TES track

OMI O_3



upper level front



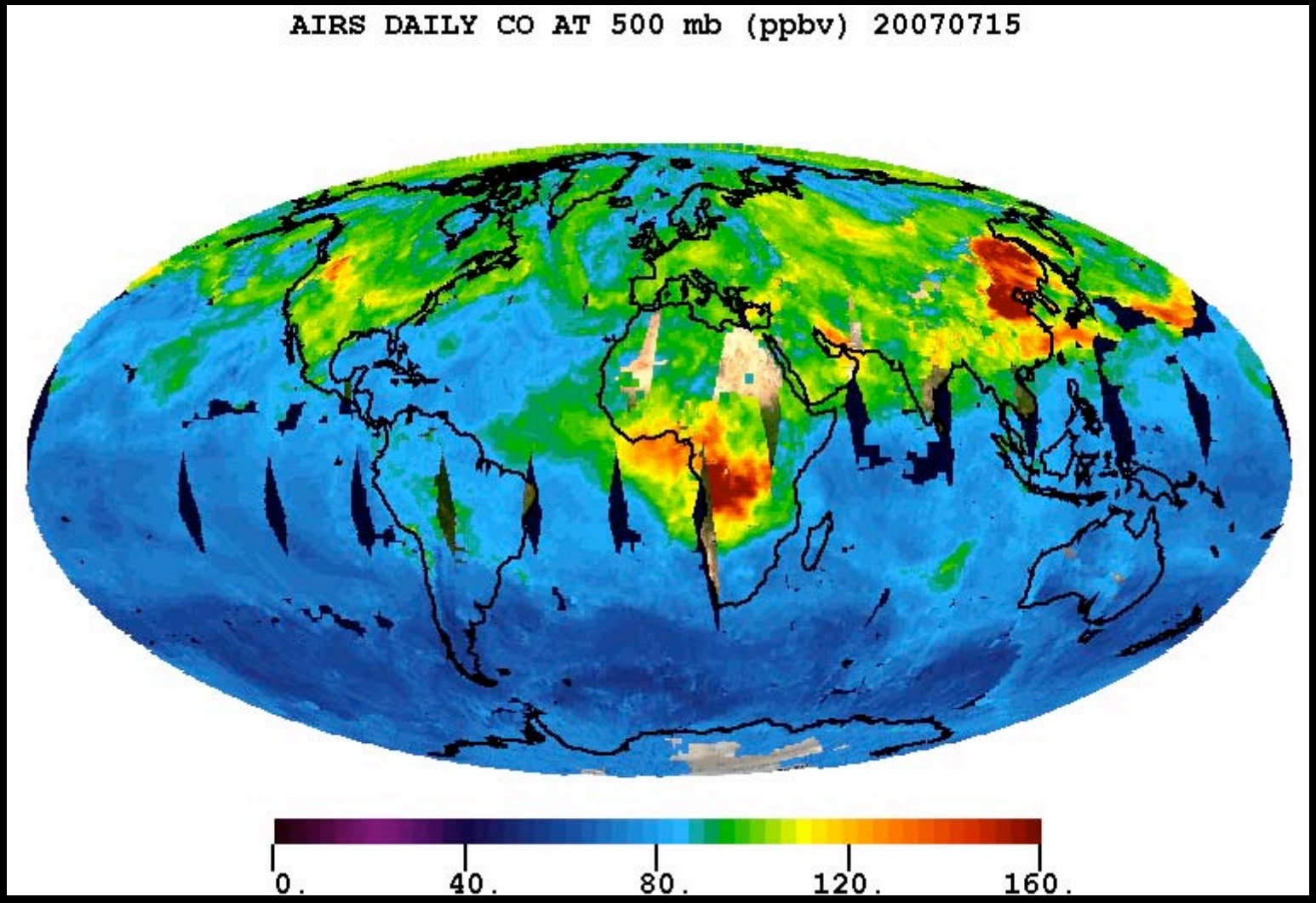
upper level front

UMBC

SUMMARY

- AIRS, TES, MLS, and OMI provide consistent view of UTLS (CO, O_3, H_2O) on 30 August 2006 in TexAQS area
  - Track lower trop CO from fires to Houston
  - Stratospheric intrusion mapped
  - Possible lightning O_3 (too low in altitude?)
- AIRS v5.0.14.0 reprocessing at GES DISC:
  - CO, CH_4, O_3 with averaging kernels
  - Trace gas subset files being defined
  - Please use the data and provide feedback!

AIRS: Daily Global view



V5.0.14.0 CO standard product (movie from Ed Olsen, JPL)