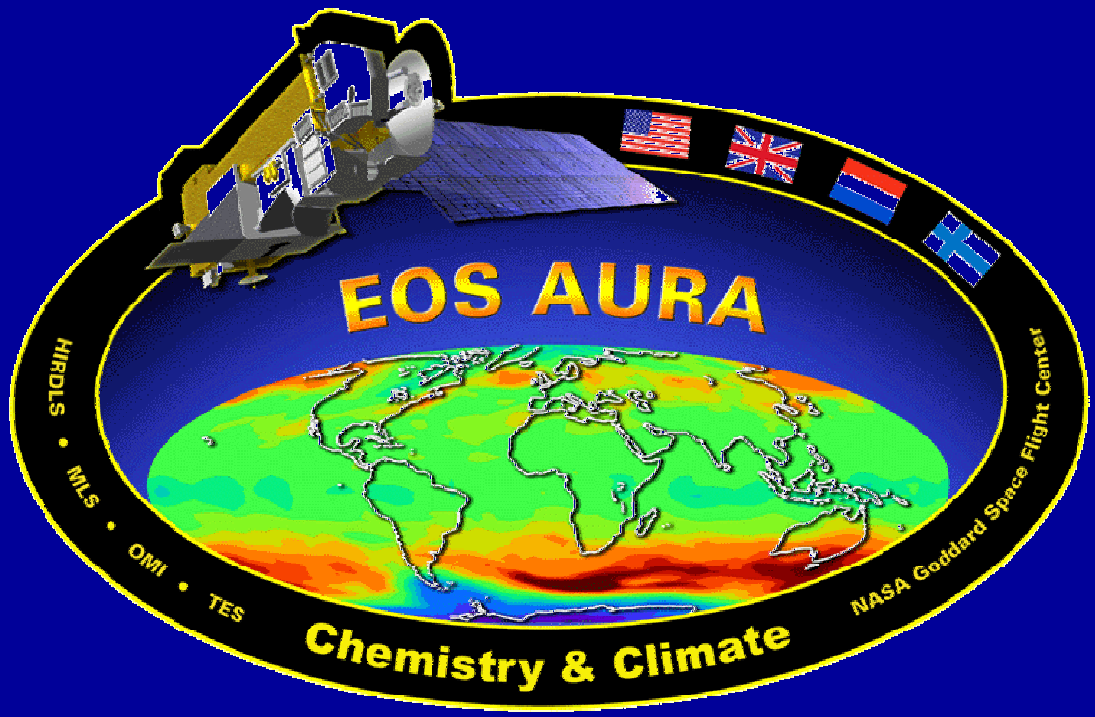
# Intex B & Aura Validation




Mark Schoeberl
Aura Project Scientist

# Validation of Aura Measurements

- Goals
  - Daylight underflights for OMI - descent into polluted regions
    - OMI: $NO_2$, HCOOH, $O_3$, UV Flux, Aerosols, Cloud heights
    - Profiles for trace gases, lidar curtains for ozone
  - Underflights for TES, MLS & HIRDLS
    - TES - $O_3$, CO, $H_2O$, upper trop $HNO_3$
    - MLS - $O_3$, CO, Cirrus ice
    - HIRDLS - $O_3$, $H_2O$, $CH_4$, $NO_2$, upper trop $HNO_3$
    - Profiles for trace gases, lidar curtains for ozone
  - TES nadir and OMI validation in cloud free regions
- Flights should be timed for Aura overpass

# Aura Tropospheric Requirements

| Parameter | Priority | HIRDLS | MLS | TES | OMI |
|---|---|---|---|---|---|
| **Temperature** | [1] | •[2] | •[2] | • | |
| **$O_3$** | 1 | •[2] | •[2] | • | $C_{trop}$[1] |
| **$H_2O$** | 1 | •[2] | •[2] | • | |
| **CO** | 1 | | •[2*] | • | |
| **$HNO_3$** | 1 | | | • | |
| **NO** | 1 | | | •[2] | |
| **$NO_2$** | 1 | | | •[2] | $C_{trop}$[1] |
| **Cloud properties** | 1 | •[1] | •[1] | •[1] | • |
| **Cloud detection** | [1] | • | • | •[1] | • |
| **Aerosols** | 1 | •[2] | | •[1] | • |
| **$CH_4$** | 2 | •[2] | | • | • |
| **HCN** | 2 | | •[2] | | |
| **$N_2O$** | [2] | •[2] | | | |
| **CFC-11, CFC-12** | [2] | •[2] | | | |
| **Geopotential Hgt.** | [3] | •[2] | •[2] | | |

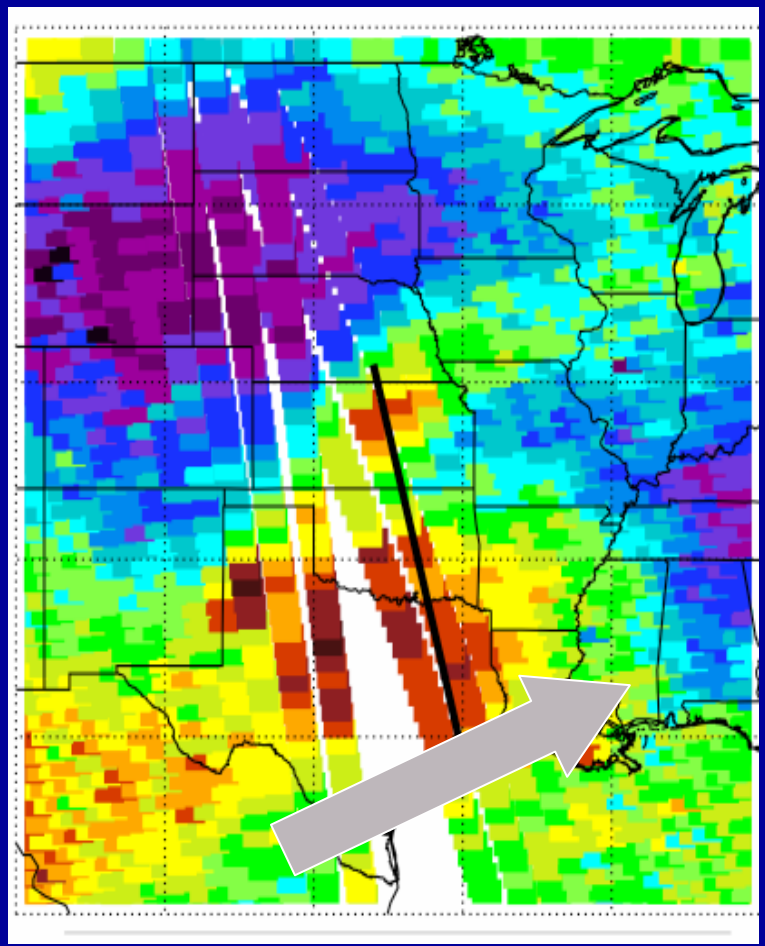
HCOOH should be added

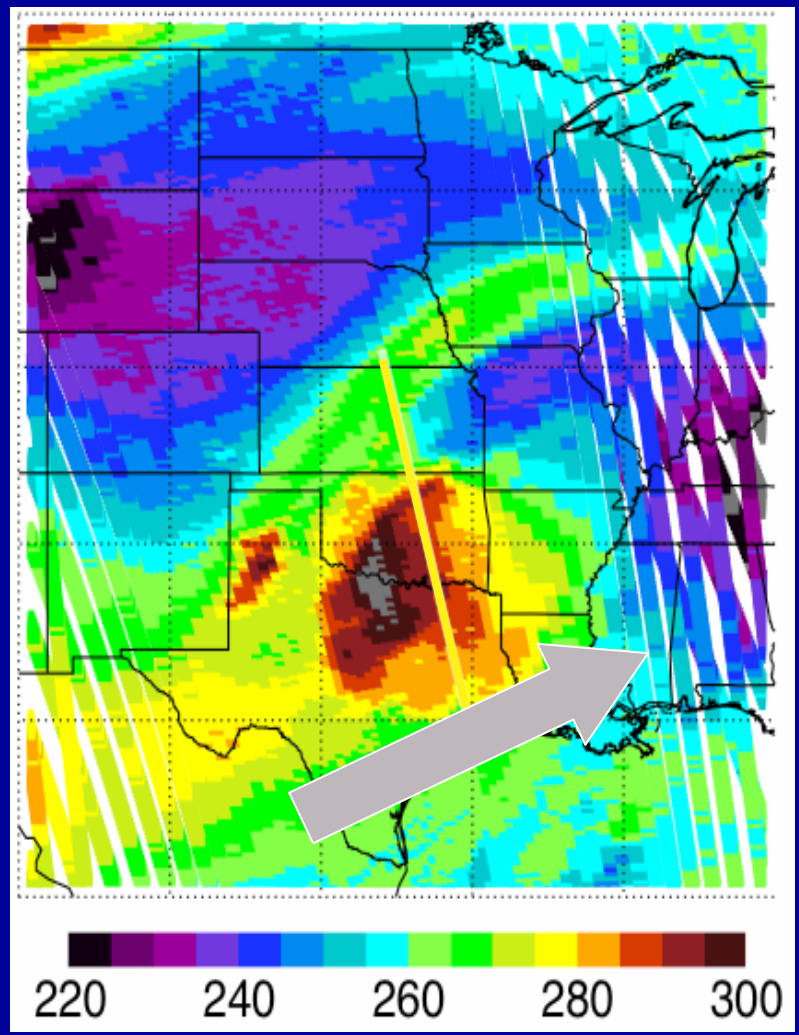
# Validation/Science Examples from AVE and PAVE

# Tropopause Fold from AVE

EP TOMS

OMI






11/3/2004

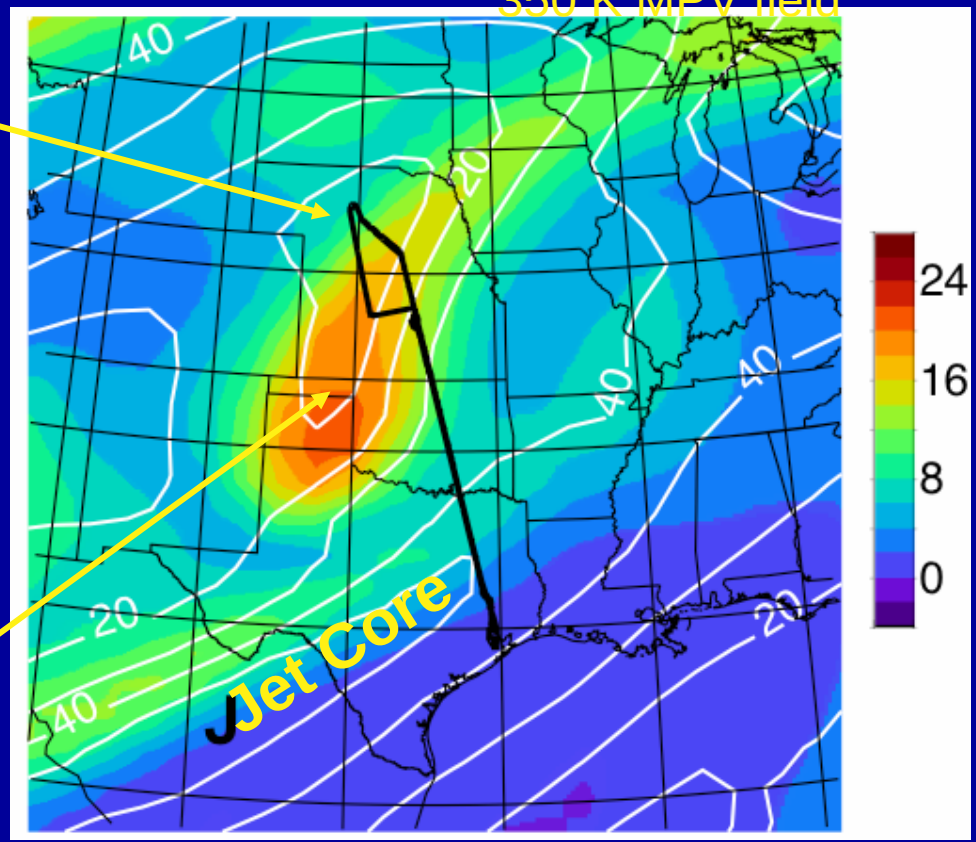
DU

# 11/3/2004 Flight Track

## Tropopause Fold

WB-57F flight track

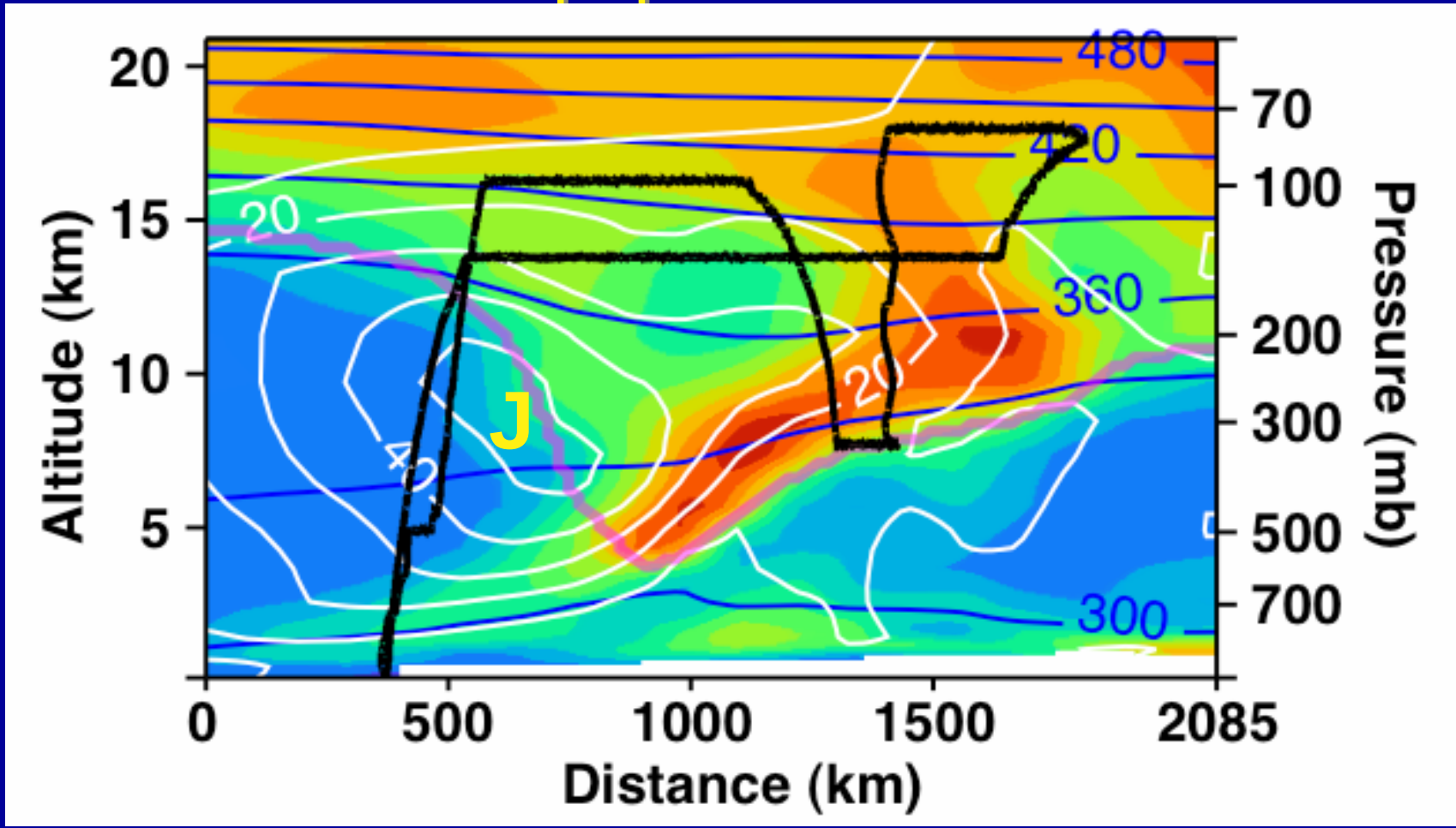
High PV - advected downward by secondary circulation around jet



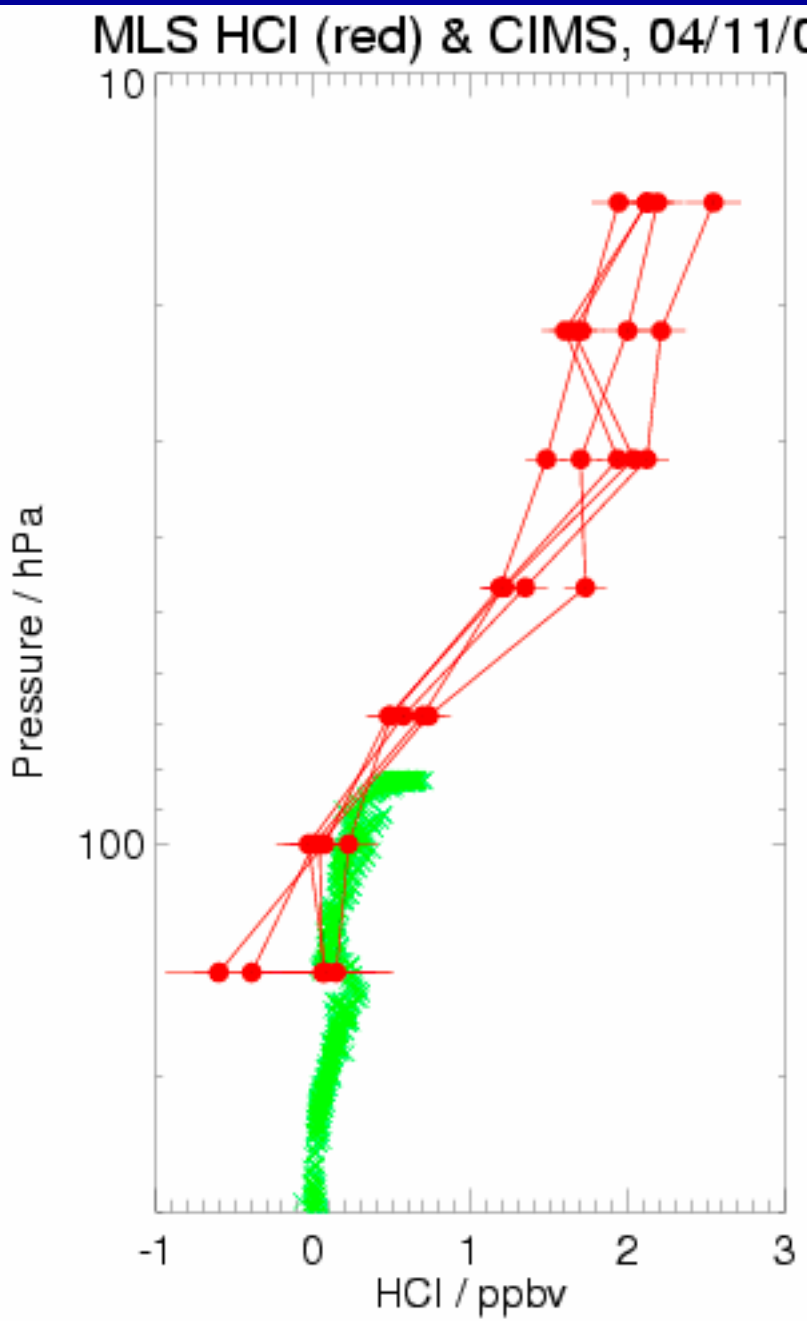

Aura nadir track

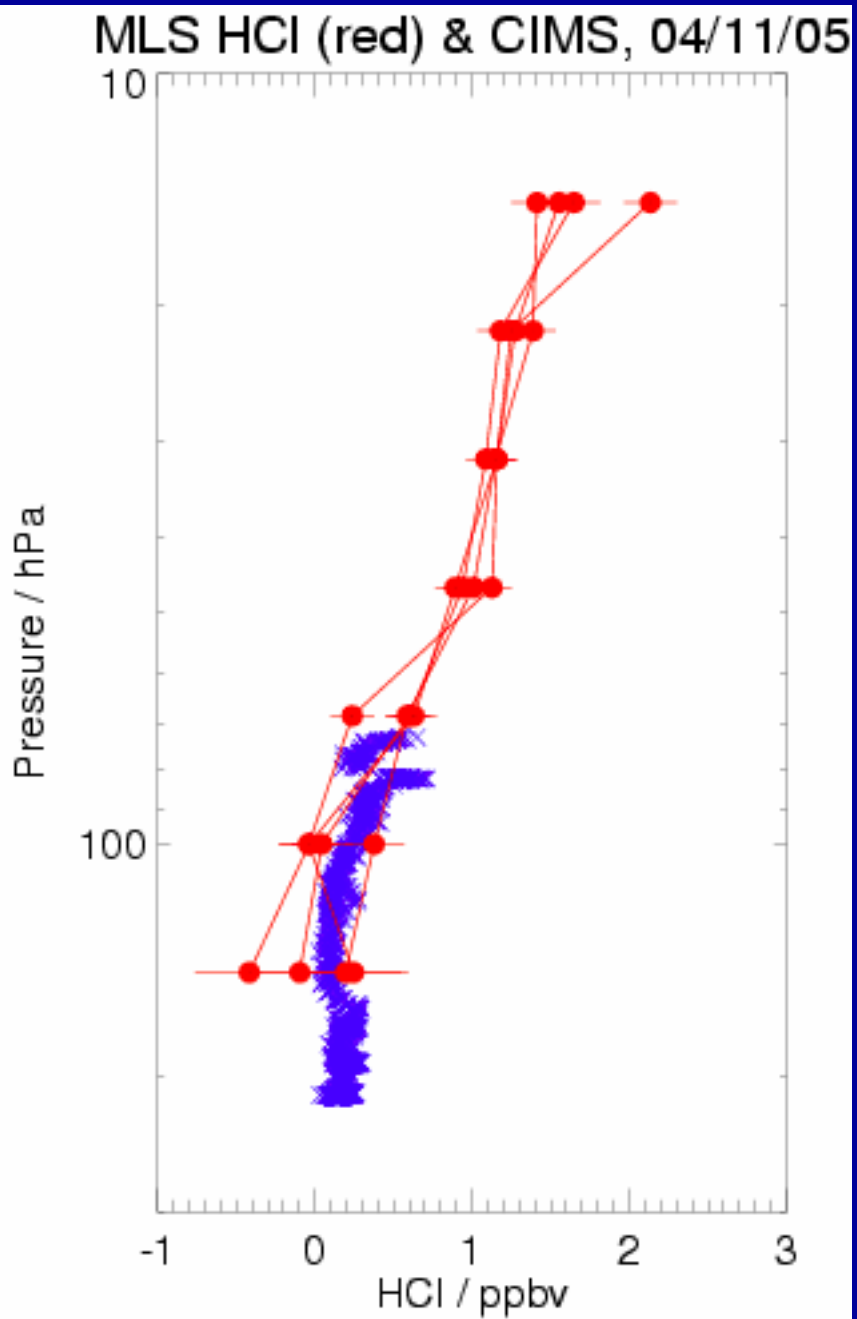
# 11/3/2004 Flight Track

## Tropopause Fold



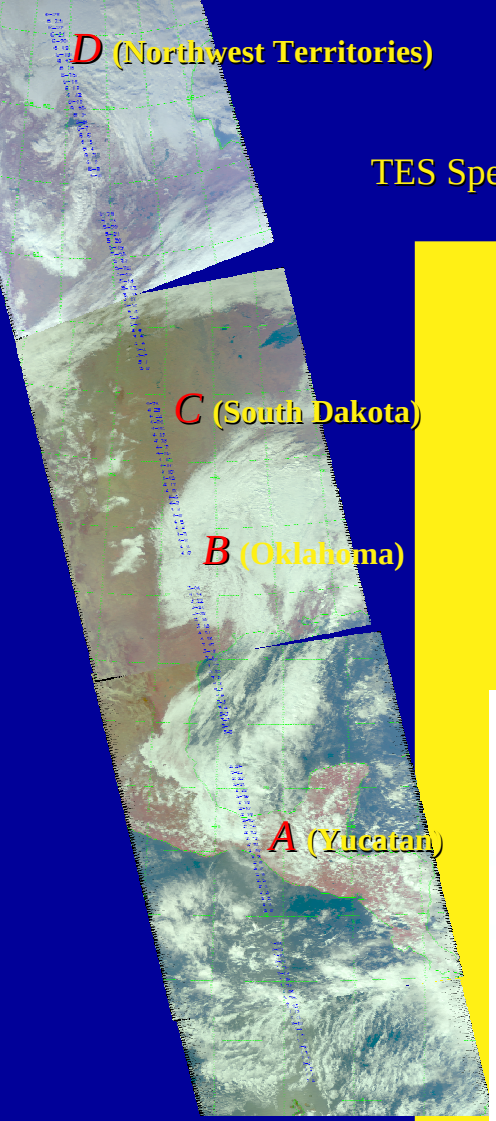

Secondary circulation around jet core pulls stratospheric air downward, folding high pv air below the jet

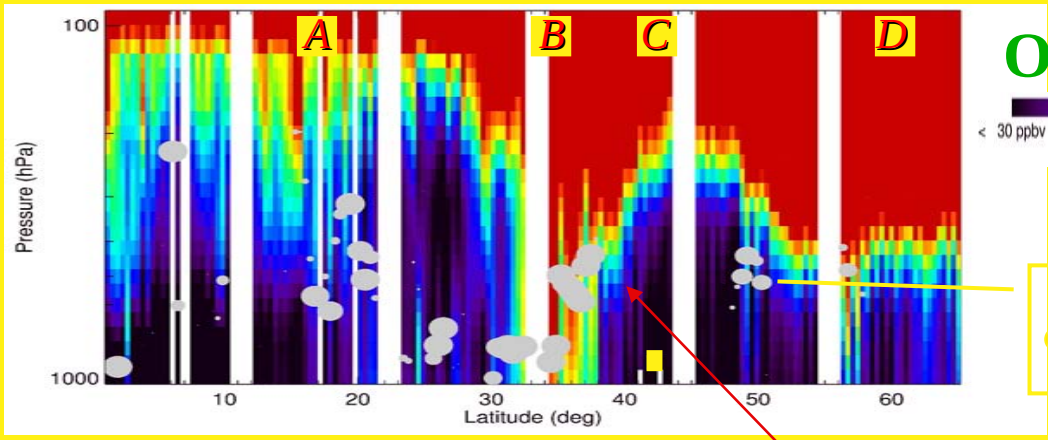

MLS HCl (red) & CIMS, 04/11/05
10
100
Pressure / hPa
-1
0
1
2
3
HCl / ppbv


MLS HCl (red) & CIMS, 04/11/05
10
100
Pressure / hPa
-1
0
1
2
3
HCl / ppbv

# TES Retrieval through Clouds

TES Special Observation: Nadir Step & Stare for Nov 3, 2004 (150 observations from 1N to 65N)



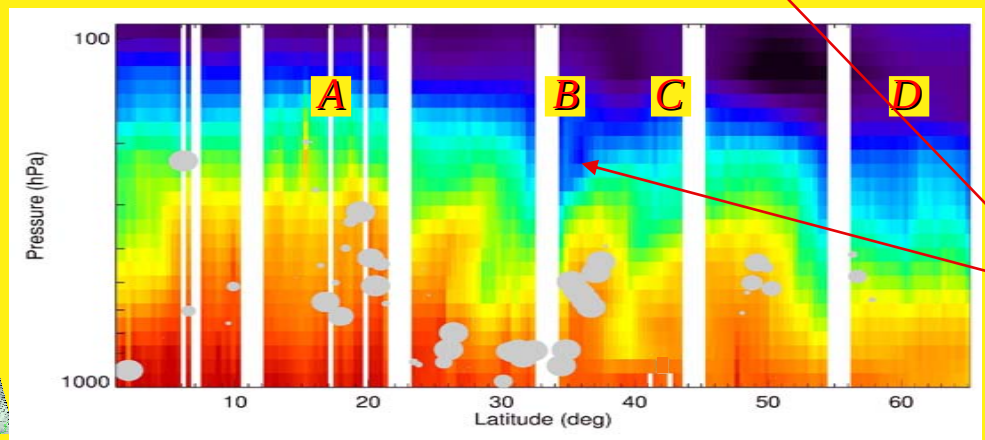




## Ozone

< 30 ppbv > 100 ppbv

Ozone Volume Mixing Ratio

Cloud effective OD = 3.0
Cloud effective OD = 0.3




## Water

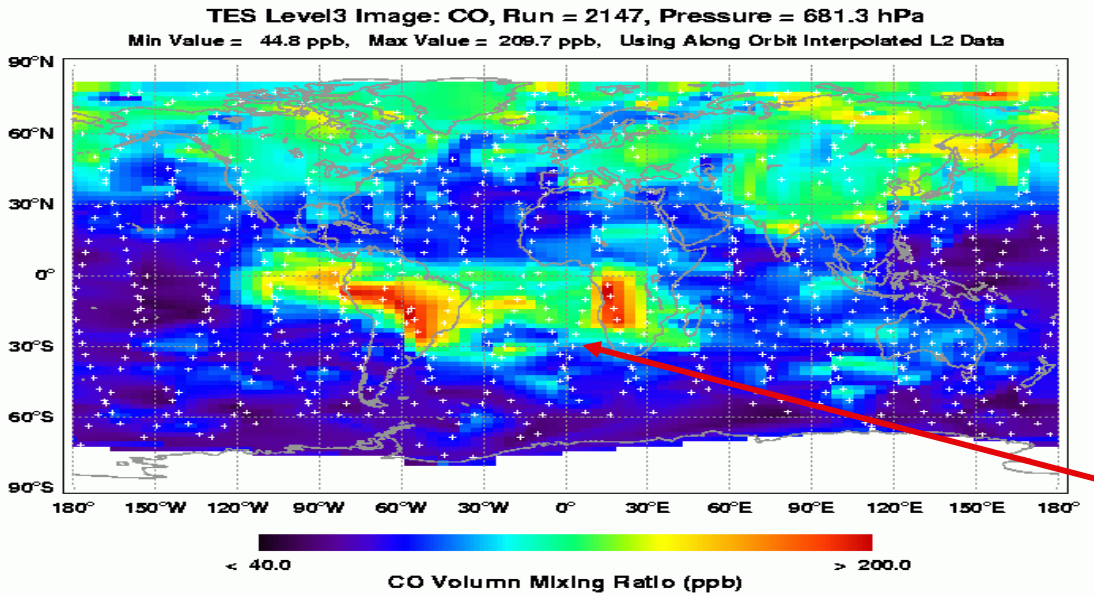
< -6.67 > -1.50

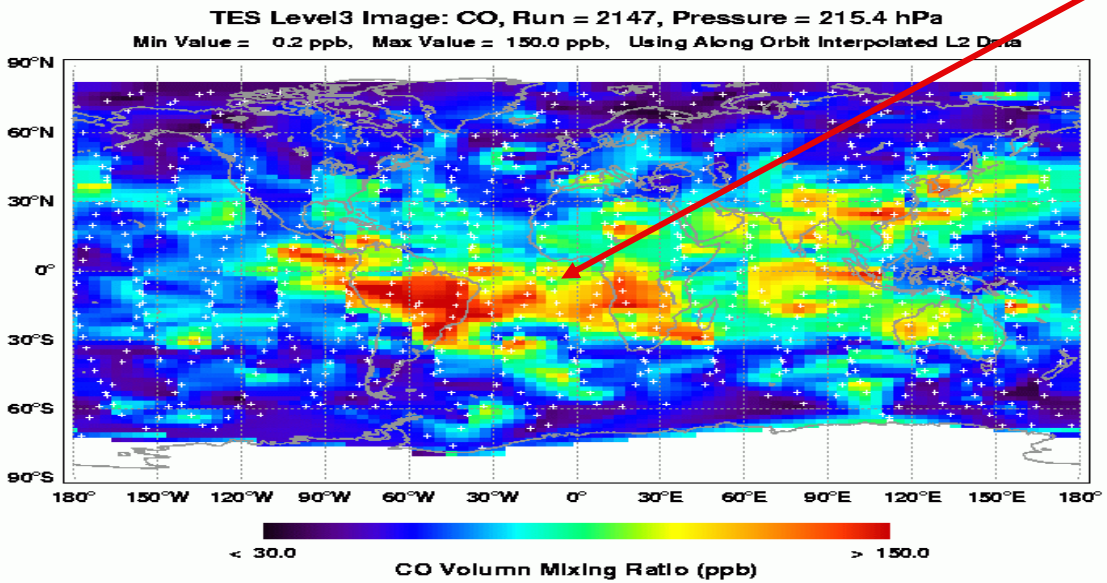
$H_2O$ log(VMR)

**Intrusion**

The TES retrievals for ozone and water with the TES retrieved cloud effective optical depth and height shown with gray circles. The ozone and water retrievals both indicate a stratospheric intrusion around 35ºN (near B), and show TES's capability to retrieve through thin clouds and above thick clouds.

# TES Carbon Monoxide




Sept. 20, 2004

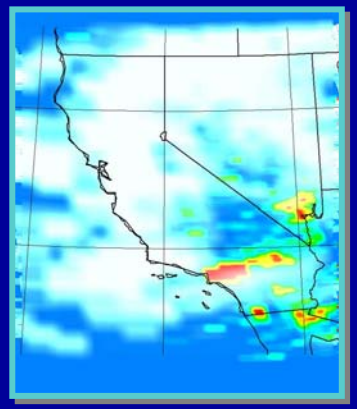
Lower troposphere

High values of CO near biomass burning regions and NH cities. CO in the upper trop is lofted by convection and fires.

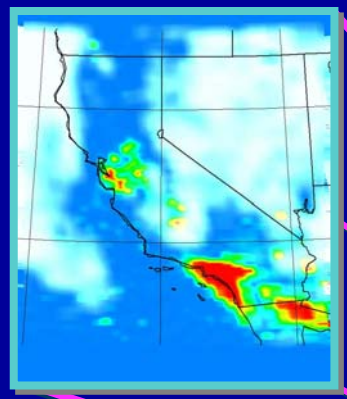
Upper troposphere

# OMI $NO_2$

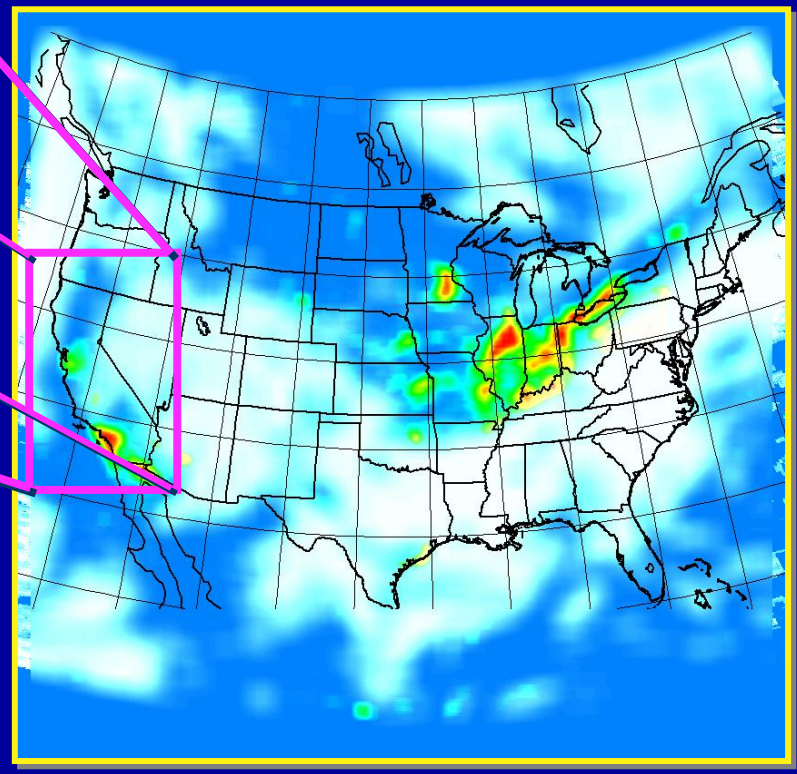
November 11



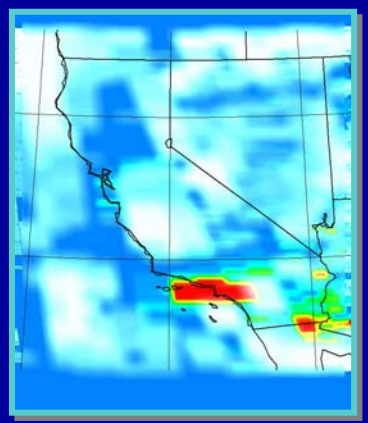
November 12



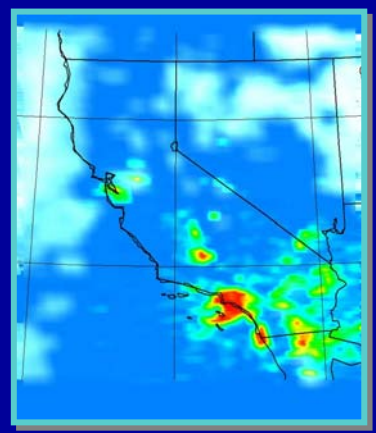
November 12, 2004



November 13

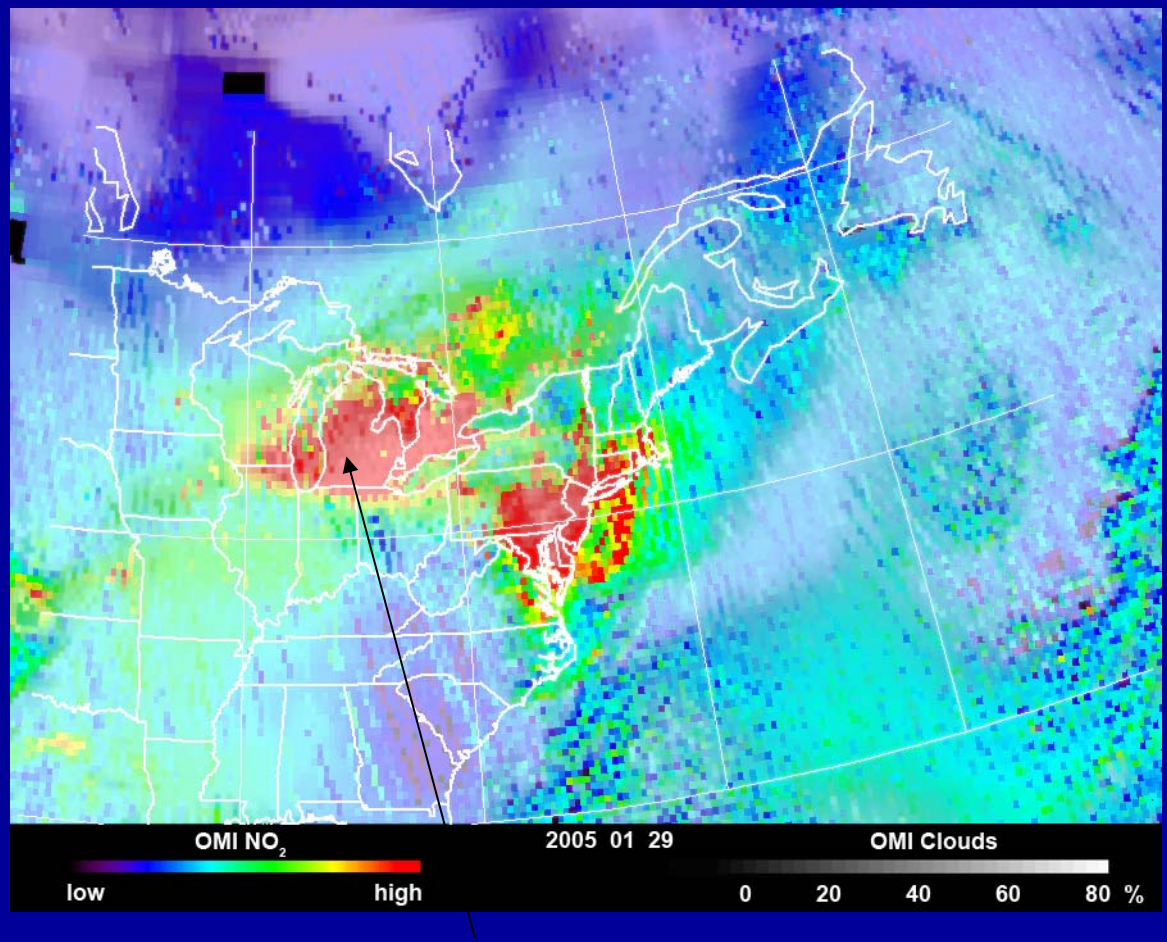


November 14



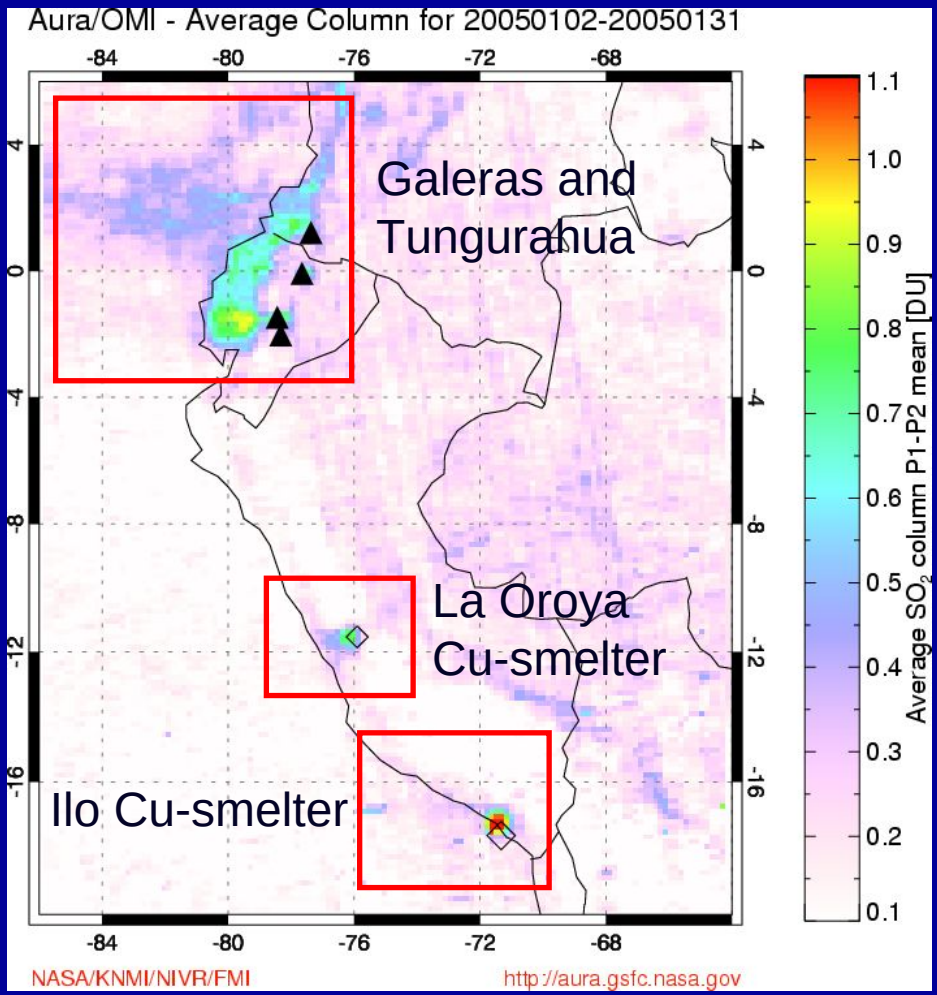
OMI high resolution allows near real time mapping of $NO_2$

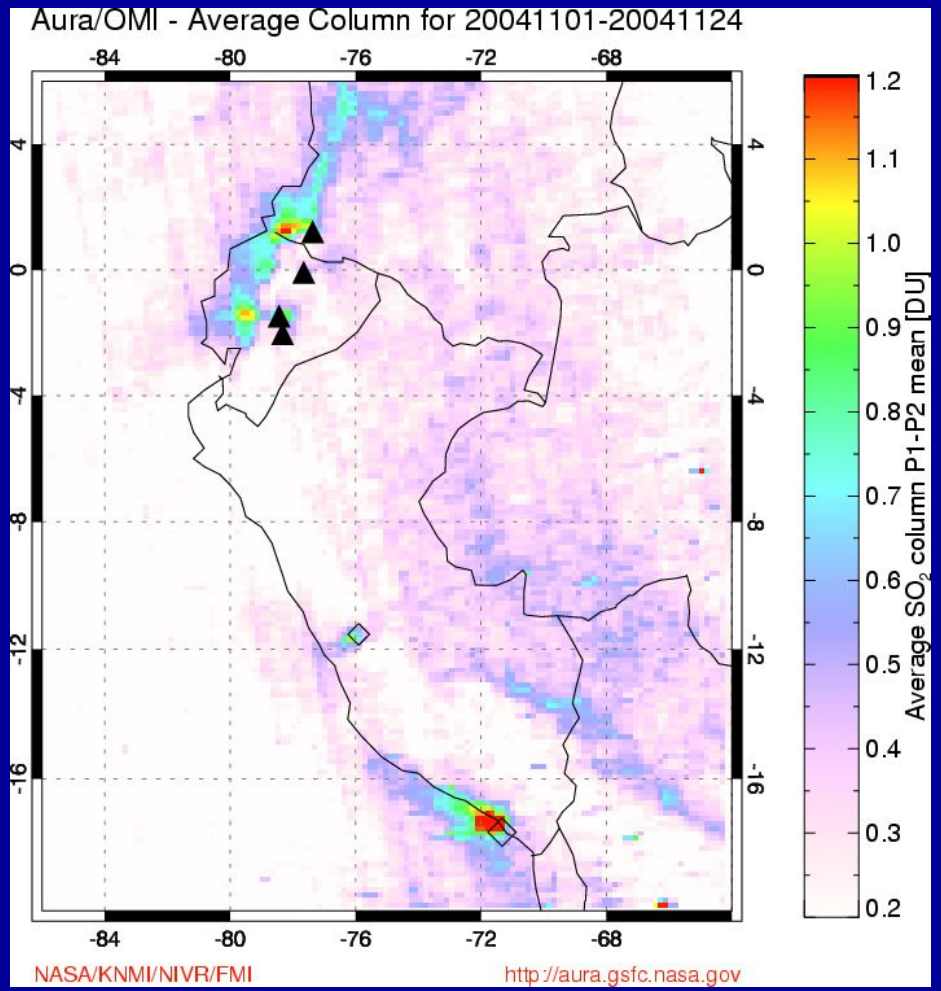
# OMI $NO_2$




PAVE flight went in to this region

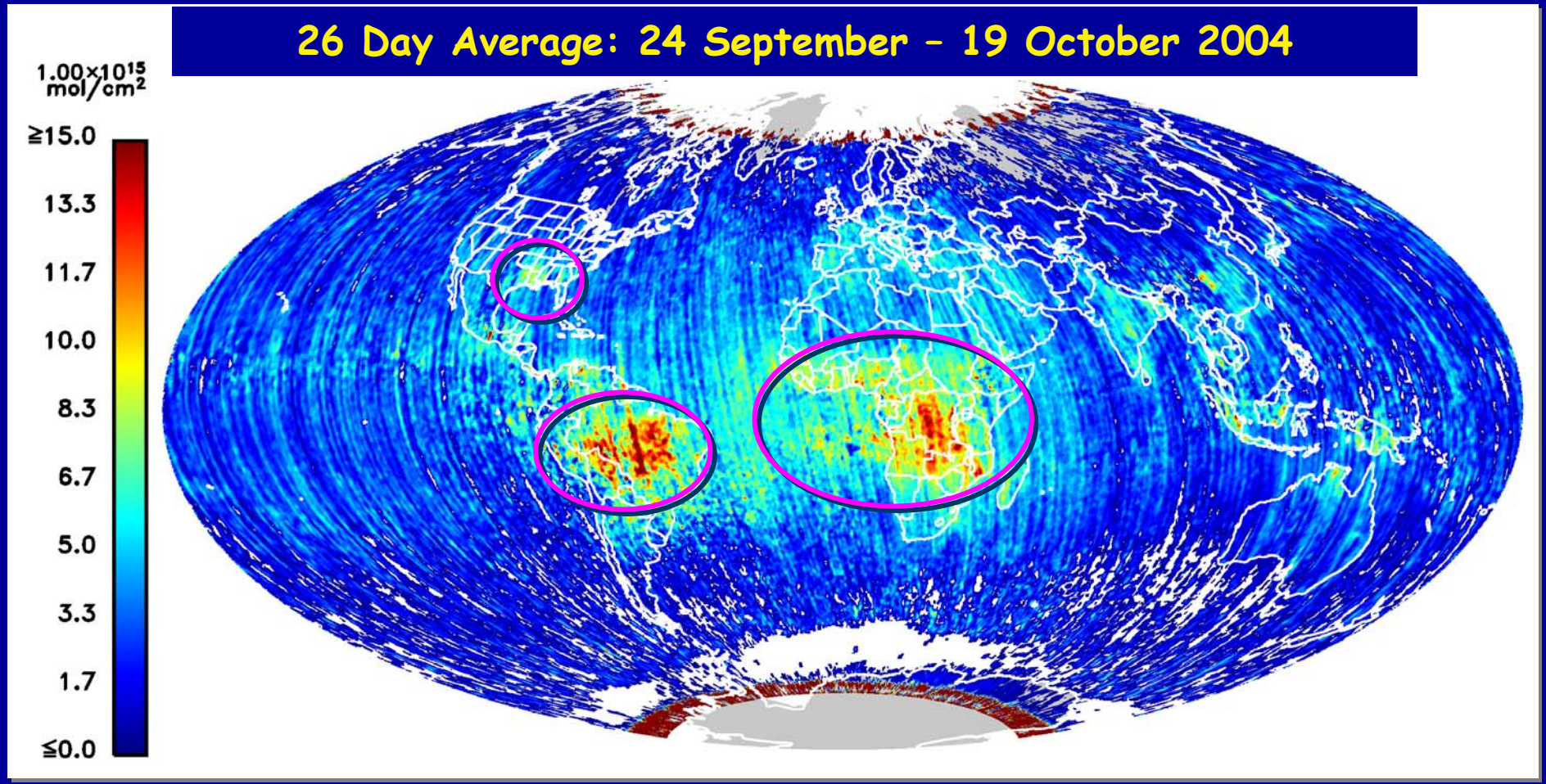
# OMI $SO_2$ measurements




| Sep 2004 | Oct 2004 | Nov 2004 | Dec 2004 | Jan 2005 |
|---|---|---|---|---|
| G&T: 1150 $td^{-1}$ | G&T: 2200 $td^{-1}$ | G&T: 4550 $td^{-1}$ | G&T: 10850 $td^{-1}$ | G&T: 5300 $td^{-1}$ |
| Or: 2150 $td^{-1}$ | Or: 2600 $td^{-1}$ | Or: 750 $td^{-1}$ | Or: 750 $td^{-1}$ | Or: 500 $td^{-1}$ |
| Ilo: 4100 $td^{-1}$ | Ilo: 3500 $td^{-1}$ | Ilo: 3600 $td^{-1}$ | Ilo: 3500 $td^{-1}$ | Ilo: 1250 $td^{-1}$ |

# OMI HCHO: Biomass Burning, Anthropogenic Emission



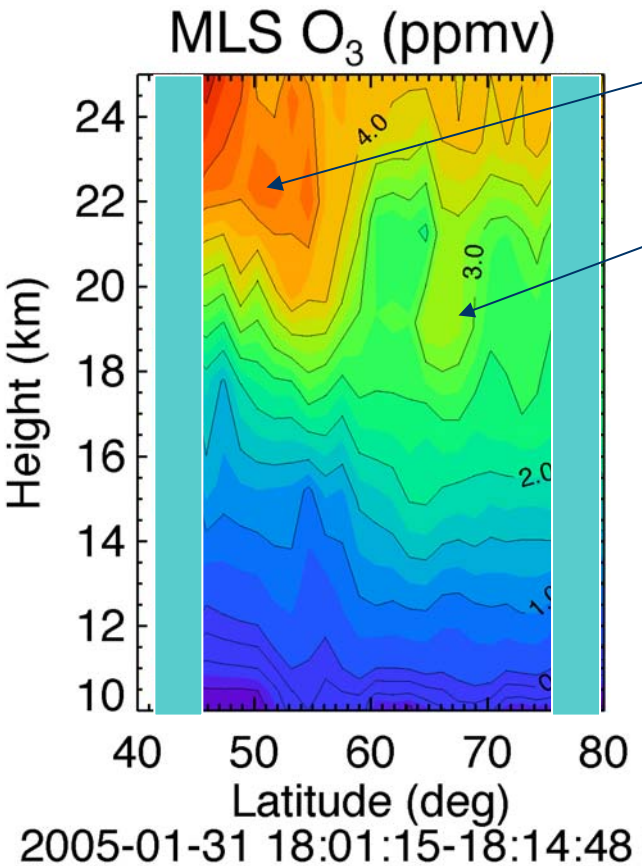

**HCHO: Principal intermediate in the oxidation of hydrocarbons**

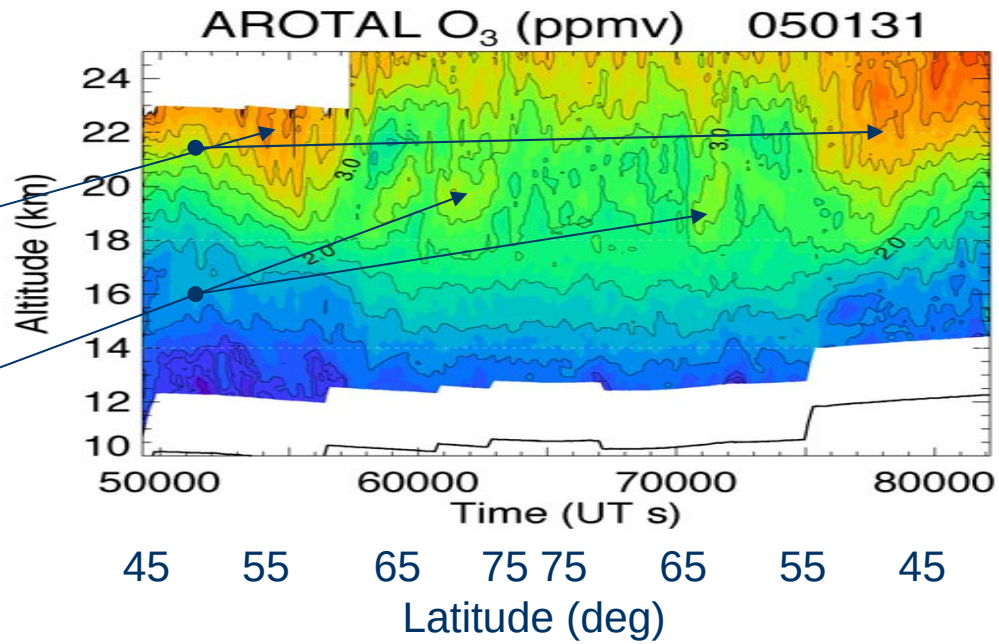
From Tom Kurosu

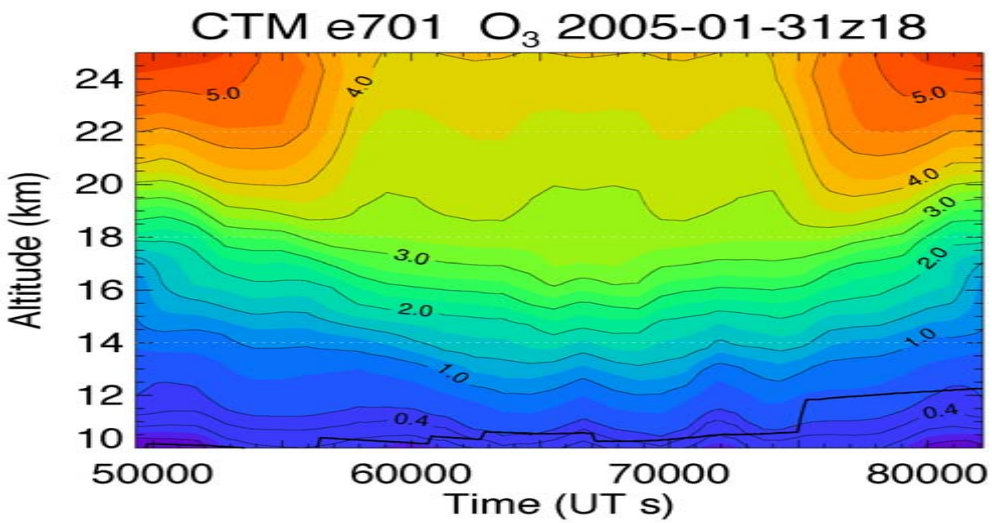
# PAVE Payload Instruments

| Instrument | Experimenter | Product |
|---|---|---|
| AROTAL | McGee | Ozone & temperature profile (above) |
| DIAL | Browell | Ozone and aerosol profile (above and below) |
| FastOz | Avery | In situ ozone |
| FTIR | Coffey | $NO_2$, $HNO_3$, $CH_4$, etc. (slant column) |
| CAFS | Shetter | $O_3$ column |
| ASUR | Nothalt | ClO, HCl, $N_2O$, $HNO_3$, CO |
| DACOM | Diskin | $CH_4$, H2O, ClO, HCl, $N_2O$, $HNO_3$, CO |
| HNO3 | Dibb | HNO3 |
| TD-LIF | Cohen | $NO_2$ |
| ICATS | facility | In situ temperature |
| MTP | Mahoney | Temperature profile |

# 1/31/05 Ozone Comparisons



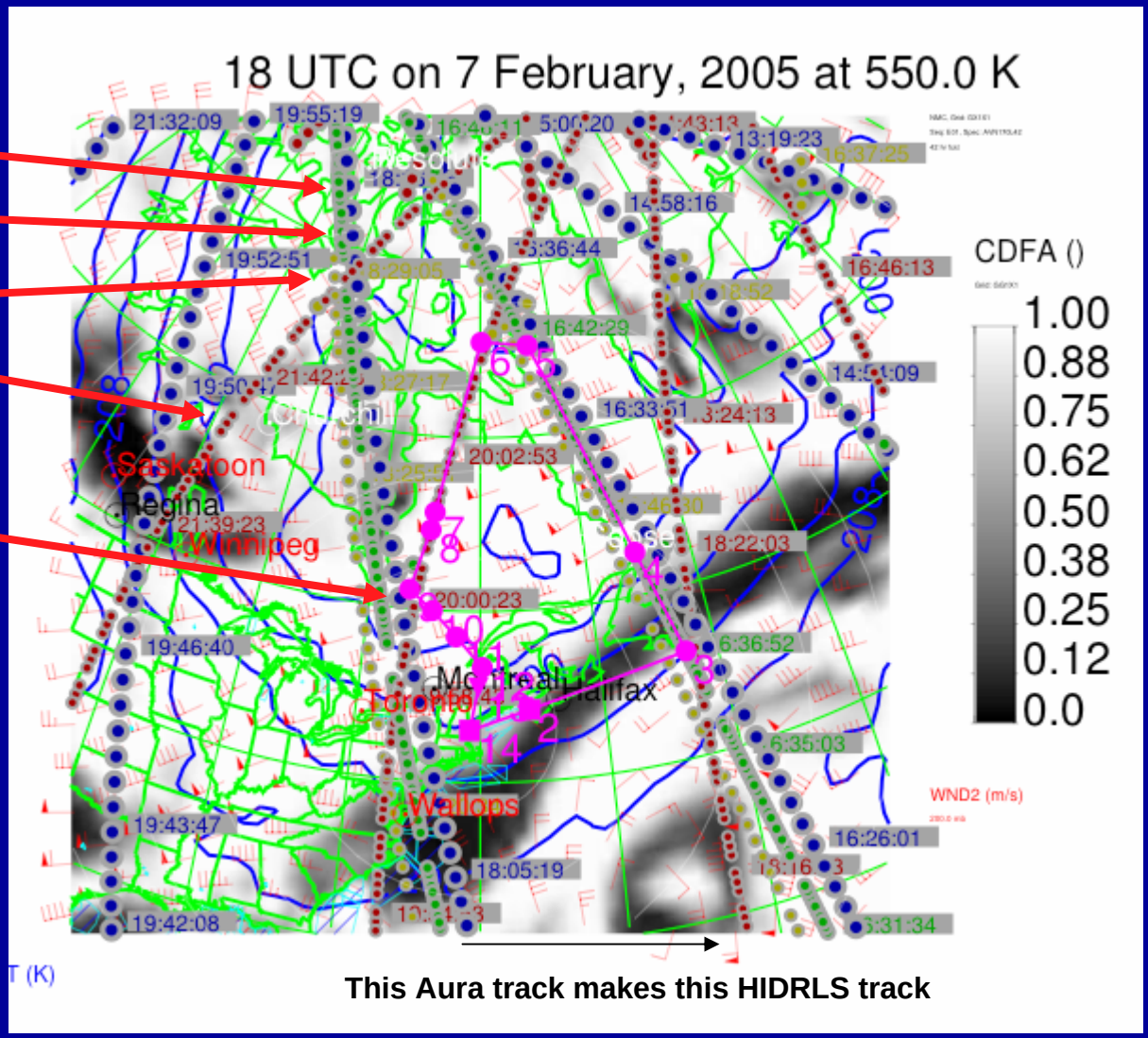




Randy Kawa

# Flight Plan 2/7/05

MLS
TES Nadir
TES Limb
HIRDLS

Sun Run



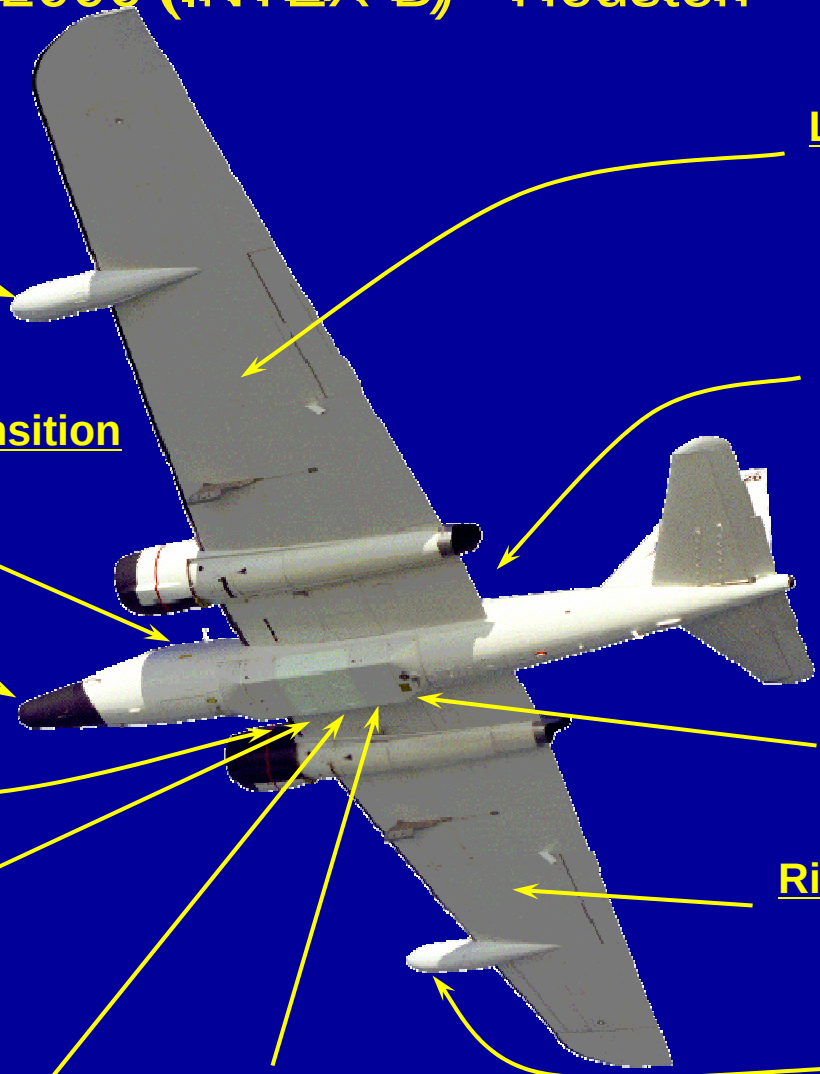

Up the Aura Track - down the HIRDLS track + sun run

# Schedule

- March deployment with AVE?
- April deployment with DC-8 only?

# AVE WB-57 payload

## March 2006 (INTEX-B) - Houston



**Left Wing Pod**
$H_2O$-Vap, MTP, CAPS

**Left Wing Hatches**
JLH

**Upper Equip Bay**
CAFS

**Nose**
P/T

**Fwd UEB/Transition**

**Pallet 1**
CIMS/O3

**Aft Transition**
PANTHER, CAFS

**Pallet 2**
Argus, FCAS, NMASS

**Right Wing Hatches**

**Right Wing Pod**
SHIS

**Pallet 3**
CPL

**Pallet 4**
Isotope Instrument

2 weeks of science flights + 1 week integration

# Summary

- Aura validations have been very successful so far
- For Aura it is critical that flights are coordinated with Aura - time and place.
  - Can't neglect HIRDLS
- Schedule:
  - Sonde campaign in Costa Rica July-August (Ticosonde II)
  - AVE Houston summer '05
  - Isotope shoot out - summer '05
  - AVE Costa Rica January 06
  - Intex B (Houston) 57+DC8
  - Intex B (Elsewhere) DC8