

# Satellite Based Characterization of influences of agricultural and wildfires on Continental US O<sub>3</sub> and CO transport during TexAQS II

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# Overview

Trajectory mapping techniques are used to link transport of biomass burning emissions to satellite based CO (MOPITT) and O<sub>3</sub> (OMI) observations onboard the NASA Terra and Aura satellites.

Composite maps of biomass burning emission influences illustrate the contributions from agricultural and wildfire emissions to the distribution of column CO and tropospheric column O<sub>3</sub>

The impacts of continental scale biomass burning emissions on local air quality in the Houston Metropolitan area is evaluated via comparisons with surface CO measurements from the TCEQ Deer Park Site.

This study address Questions G and H of the TEXAQSII rapid science synthesis: **How do emissions from local and distant sources interact to determine the air quality in Texas, and which areas outside of Texas adversely affect the air quality of non-attainment areas within Texas?**

# Fire Statistics

National Interagency Fire Center (<http://www.nifc.gov/fireinfo/nfn.html>)

## January-September Statistics:

2006 (1/1/06 - 9/29/06) Fires: 83,752 Acres: 9,074,358

2005 (1/1/05 - 9/29/05) Fires: 53,175 Acres: 8,160,688

2004 (1/1/04 - 9/29/04) Fires: 60,934 Acres: 7,737,472

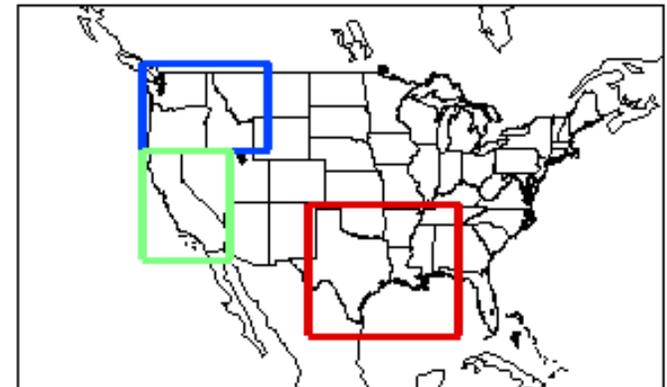
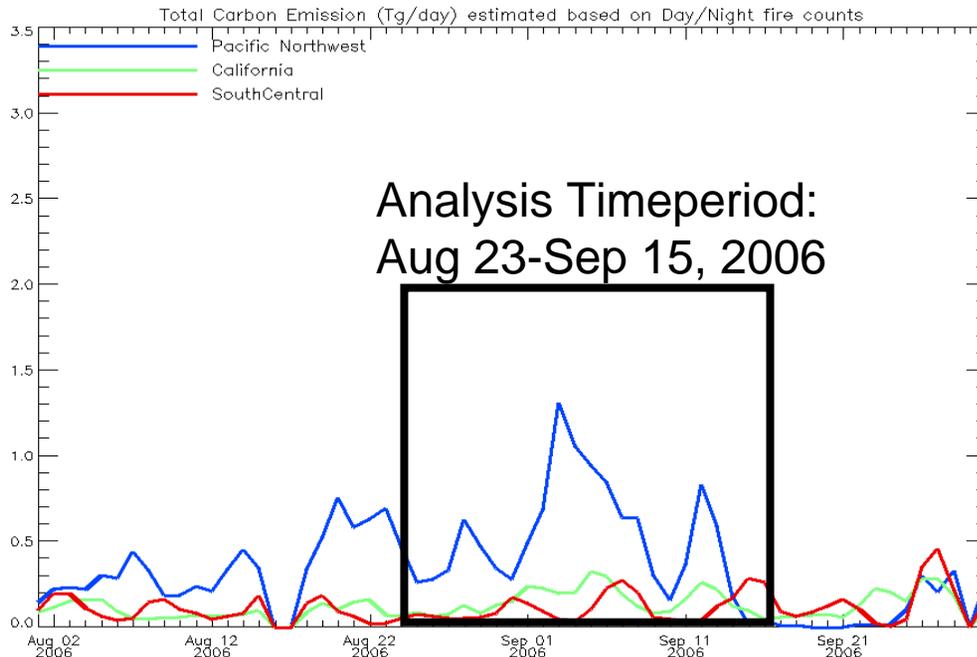
2003 (1/1/03 - 9/29/03) Fires: 49,180 Acres: 3,167,289

2002 (1/1/02 - 9/29/02) Fires: 67,265 Acres: 6,578,985

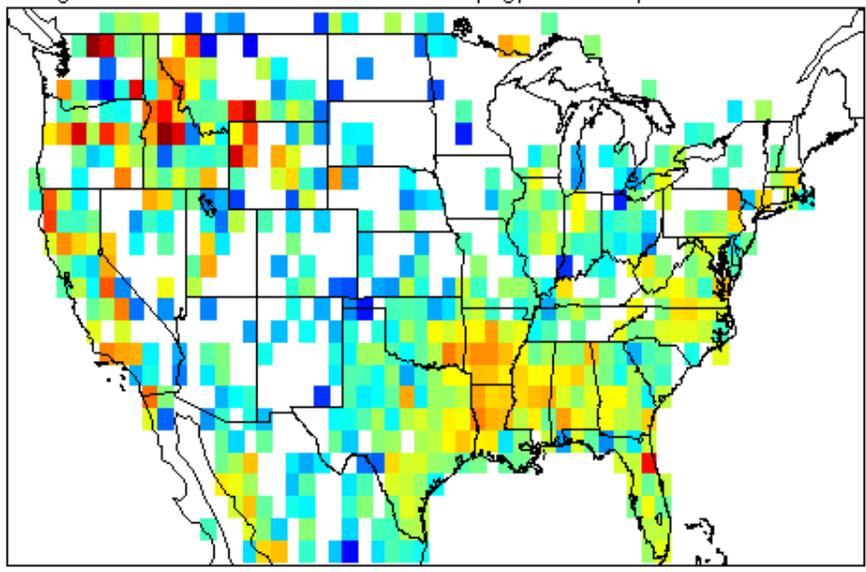
2001 (1/1/01 - 9/29/01) Fires: 63,067 Acres: 3,221,391

2000 (1/1/00 - 9/29/00) Fires: 80,158 Acres: 6,862,561

Wild fire influences during 2006 were higher than the previous 6 years by 110 -280%

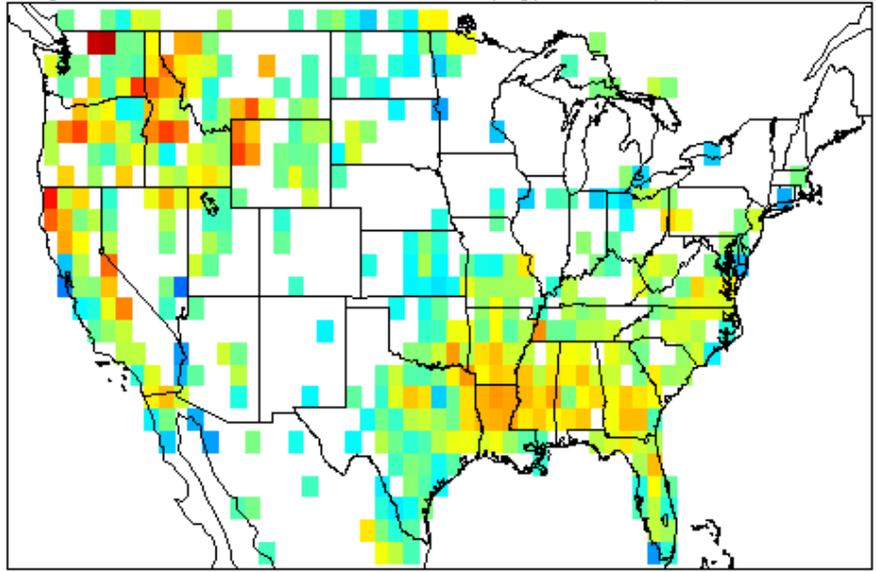


Aug 2006 GOES CO Emitted (kg/month) 4.438e+09



3 4 5 6 7 8  
log10(kg)

Aug 2006 RAQMS CO Emitted (kg/month) 2.115e+09



3 4 5 6 7 8  
log10(kg)

# Biomass Burning Emissions

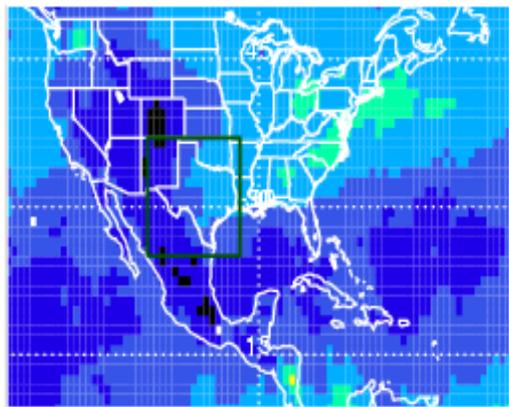
	NASA Global (RAQMS)	NOAA GOES
Domain	Global	CONUS
Satellite Fire Detection	MODIS Rapid Response	GOES processed half-hourly
Area Burned Estimate	1km <sup>2</sup> for each unique Terra+Aqua detect in running 48-hr window	Simulated from WF_ABBA subpixel algorithm
Emissions Estimate	Calculated from fire severity-based carbon consumption databases (severity estimated with Haines Index) and published emission ratios	Calculated from fuel loading databases, combustion efficiency parameters, and emission factors from FOFEM model
2006 Dates of Coverage	Feb 1 § Oct 15	Mar 1 § Sep 30
Horizontal Resolution	1 deg x 1 deg	4 km (GOES nadir pixel size)
Temporal Resolution	Daily	Daily
Species available in this intercomparison	CO, NO, C, area-burned	CO, area-burned
Other species typically produced	Other species calculated from C	PM2.5, CH4

**RAQMS MODIS based biomass burning emissions underestimate total biomass CO emissions by 2x during August 2006 relative to GOES**

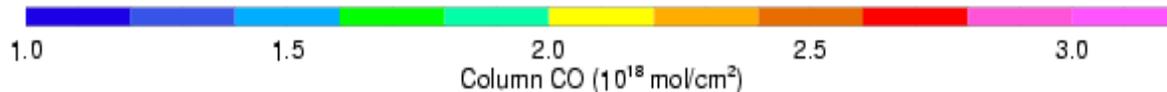
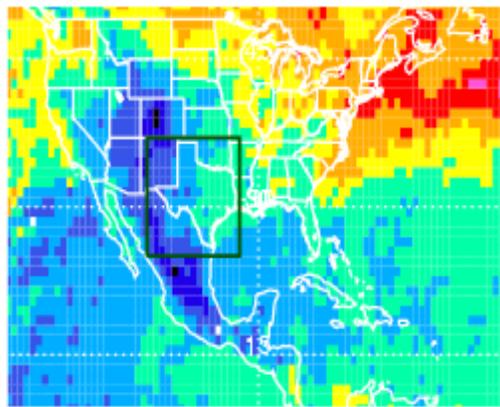
# RAQMS Column CO vs MOPITT

# RAQMS CO vs NOAA P3B

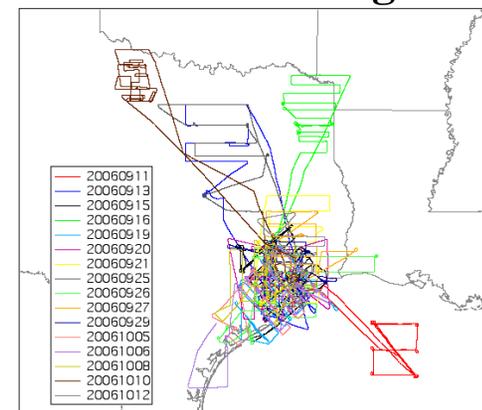
RAQMS<sub>200701c</sub> Column CO  
(MOPITT Averaging Kernel and Apriori)  
August, 2006



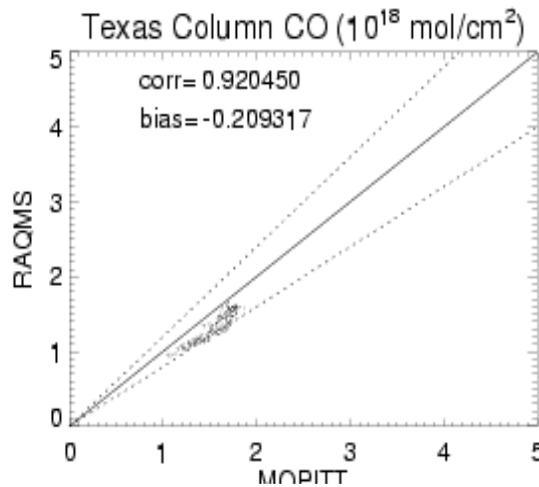
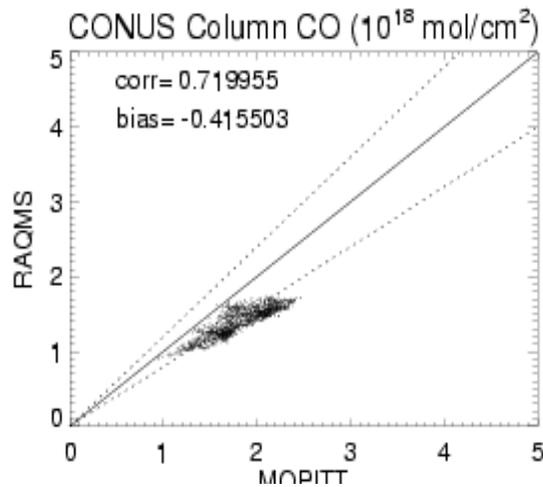
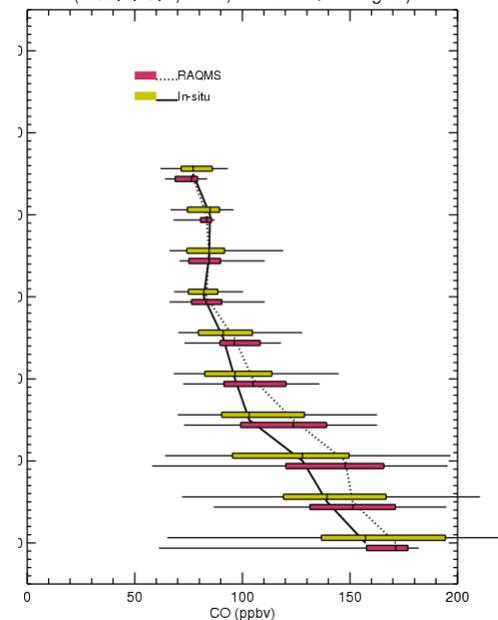
MOPITT Column CO  
August, 2006



## NOAA P3B Flights



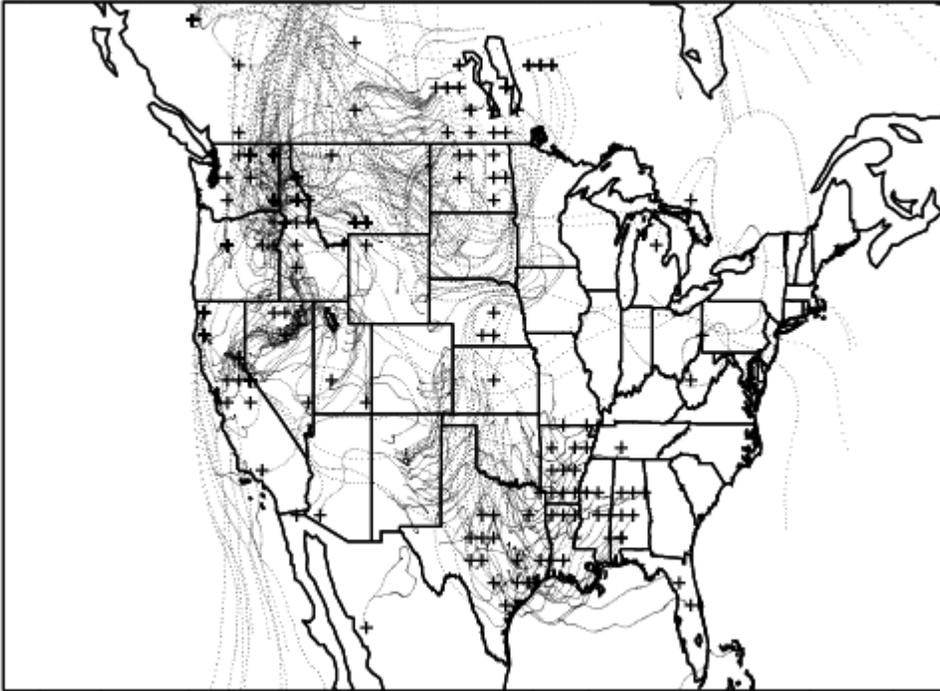
RAQMS<sub>200701c</sub>/NOAA P3 Insitu CO (Holloway)  
(08/31-10/13, 2006, All TEXAQS II Flights)



**RAQMS mean CO column is low by 10-20% relative to MOPITT over Texas**  
**RAQMS median CO mixing ratio is high by 10-20% relative to Houston P3B data**

# Analysis Procedure

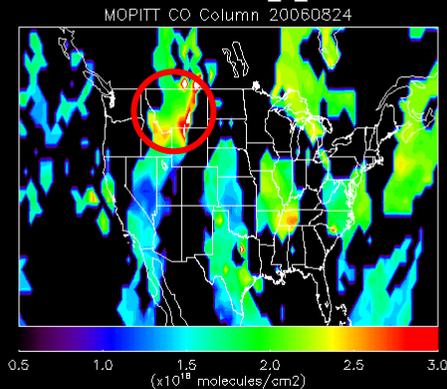
## RAQMS Biomass Burning Trajectories Sep 07, 2006



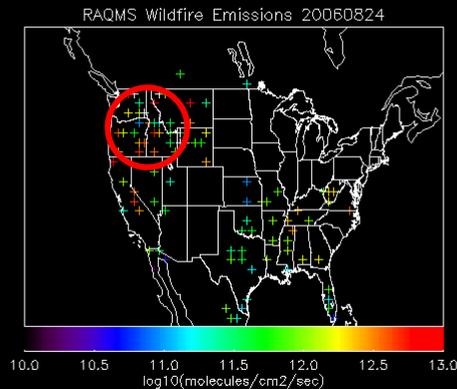
1. **Daily (12Z) initialization of forward Wildfire trajectories**
  - Track wildfire emissions
  - Sample 6hr RAQMS chemical analyses
2. **Daily binning of Wildfire trajectories (all ages)**
  - Wildfire emission exposure
  - Ozone P-L

**Comparison of wildfire emission exposure with MOPITT CO column and OMI Tropospheric O<sub>3</sub> column (OMI-RAQMS<sub>strat</sub>)**

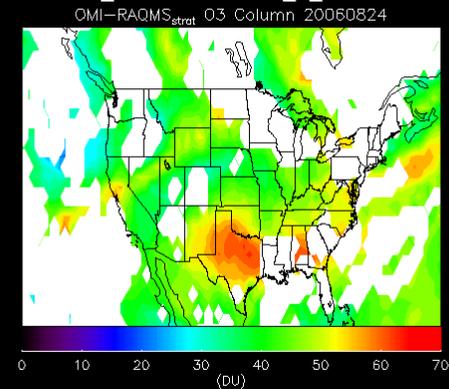
# MOPITT CO/Mapped Emissions



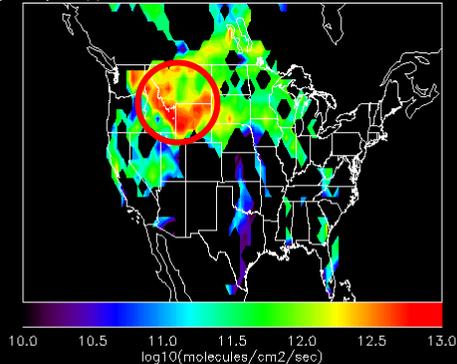
# CO Emissions/Count



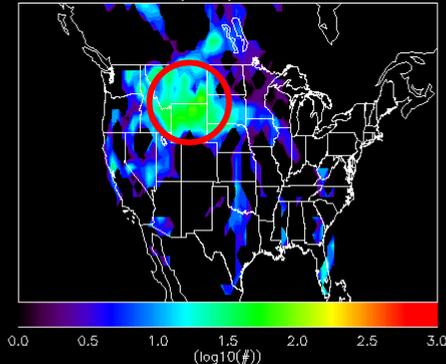
# OMI Trop O3/Mapped O3 P-L



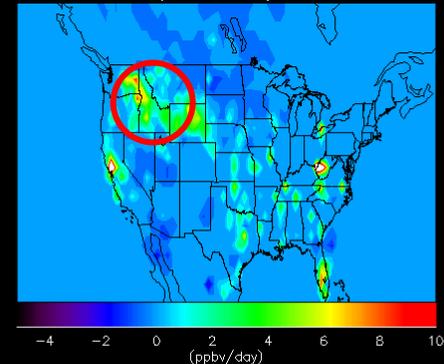
Trajectory Mapped Total Column Wildfire Emissions 20060824



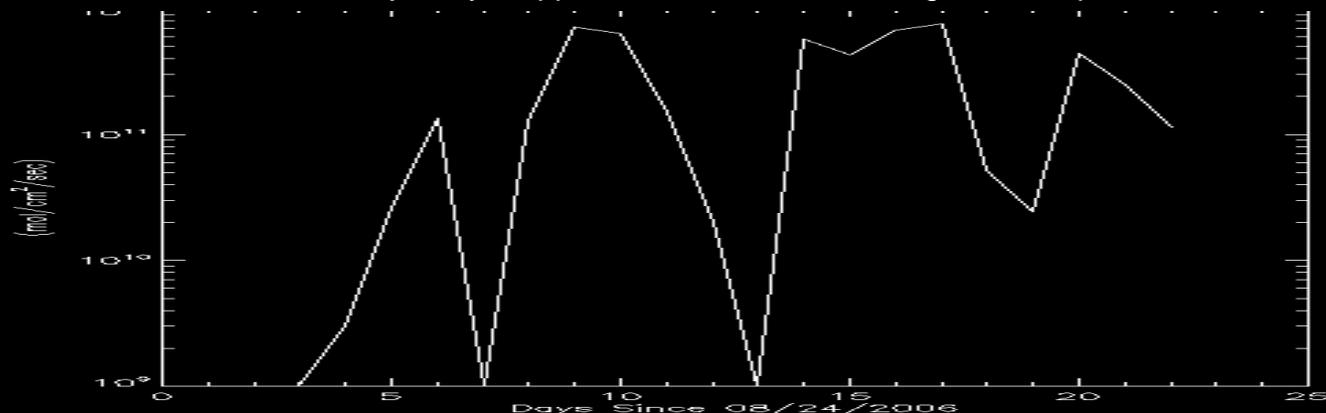
Wild Fire Trajectory Count 20060824



Ozone P-L along Wildfire Trajectories 20060824



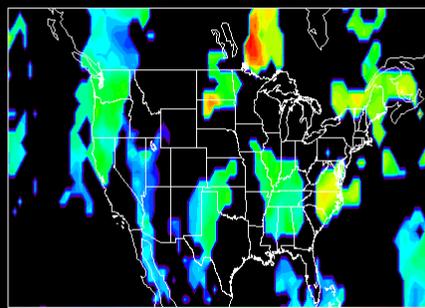
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Aug 24, 2006

# MOPITT CO/Mapped Emissions

MOPITT CO Column 20060825

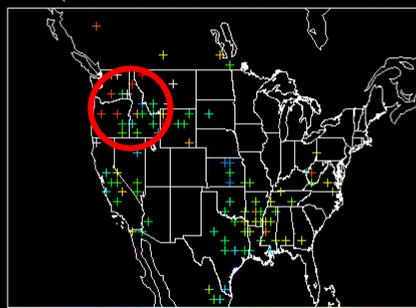


0.5 1.0 1.5 2.0 2.5 3.0

( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

RAQMS Wildfire Emissions 20060825

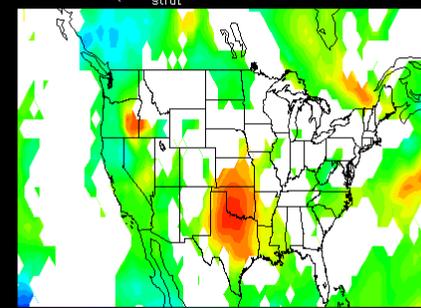


10.0 10.5 11.0 11.5 12.0 12.5 13.0

$\log_{10}(\text{molecules/cm}^2/\text{sec})$

# OMI Trop O3/Mapped O3 P-L

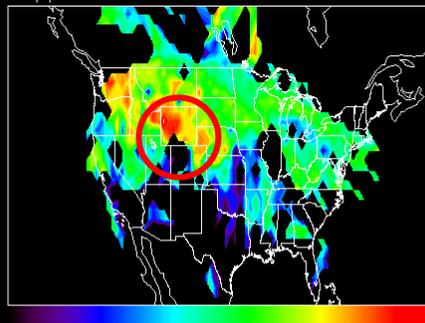
OMI-RAQMS<sub>strat</sub> O3 Column 20060825



0 10 20 30 40 50 60 70

(DU)

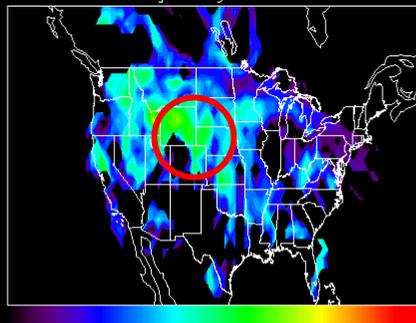
Trajectory Mapped Total Column Wildfire Emissions 20060825



10.0 10.5 11.0 11.5 12.0 12.5 13.0

$\log_{10}(\text{molecules/cm}^2/\text{sec})$

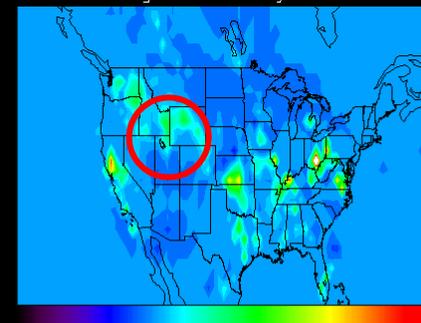
Wild Fire Trajectory Count 20060825



0.0 0.5 1.0 1.5 2.0 2.5 3.0

$\log_{10}(\#)$

Ozone P-L along Wildfire Trajectories 20060825

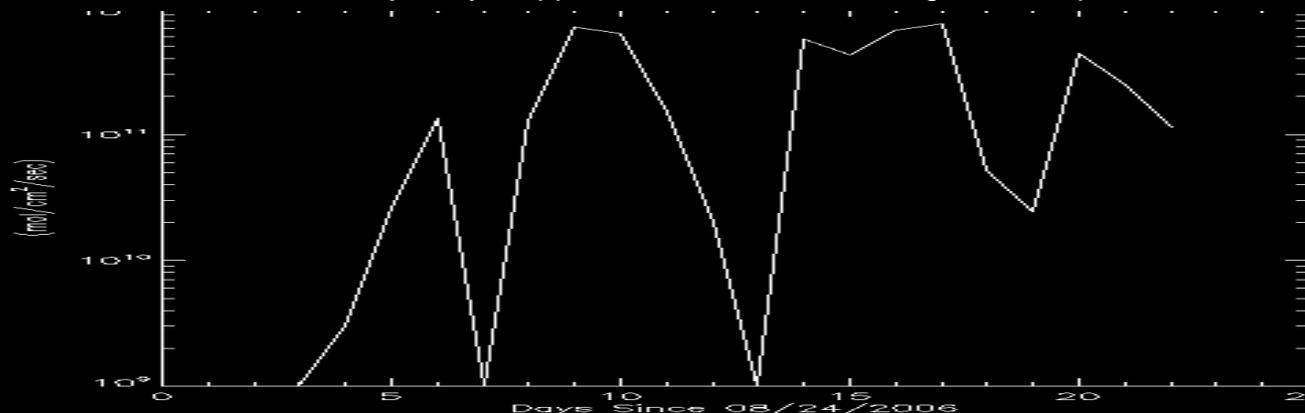


-4 -2 0 2 4 6 8 10

(ppbv/day)



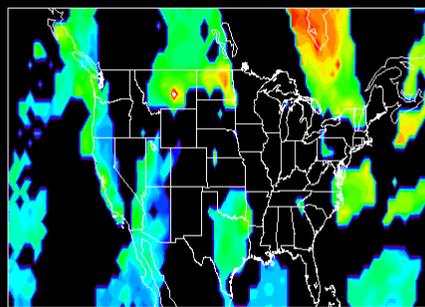
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Aug 25, 2006

# MOPITT CO/Mapped Emissions

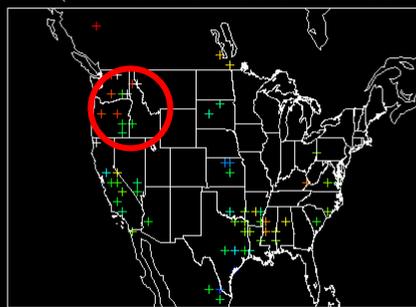
MOPITT CO Column 20060826



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

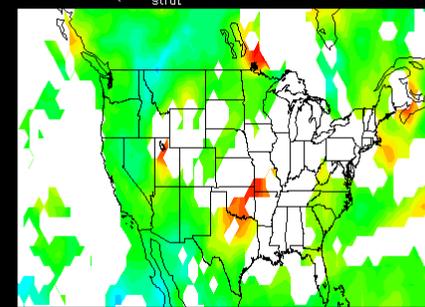
RAQMS Wildfire Emissions 20060826



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

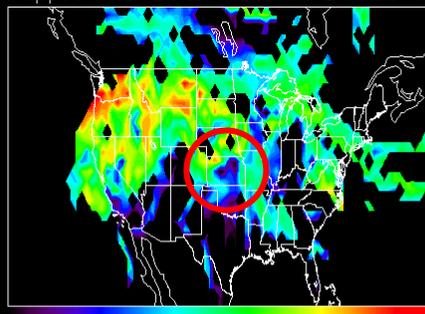
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strot</sub> O3 Column 20060826



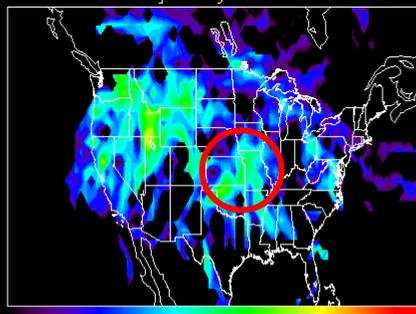
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060826



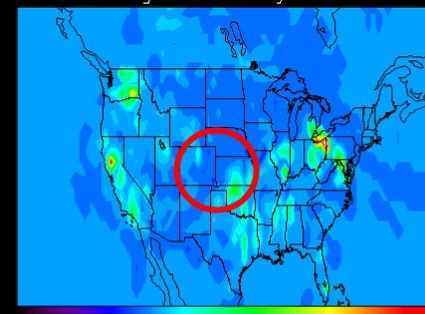
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

Wild Fire Trajectory Count 20060826



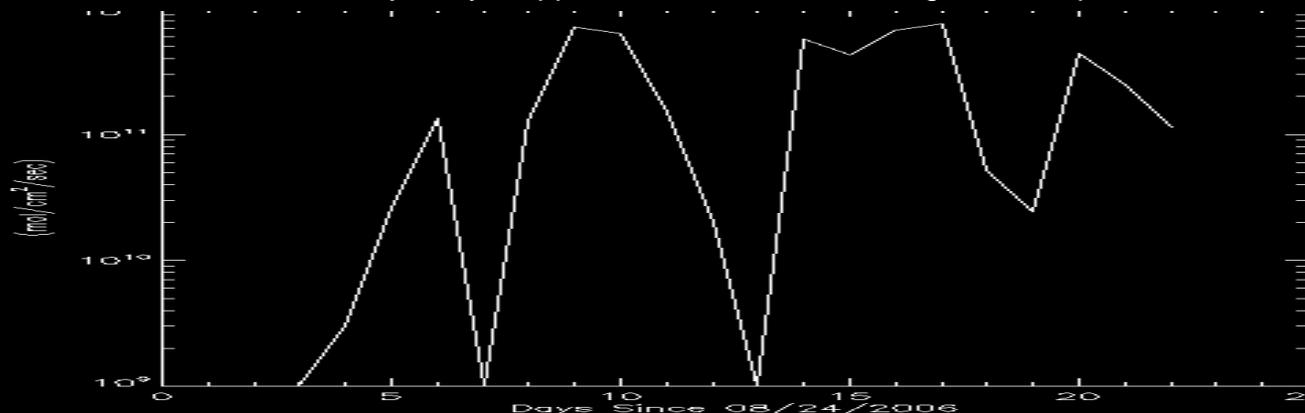
0.0 0.5 1.0 1.5 2.0 2.5 3.0  
 $\log_{10}(\#)$

Ozone P-L along Wildfire Trajectories 20060826



-4 -2 0 2 4 6 8 10  
(ppbv/day)

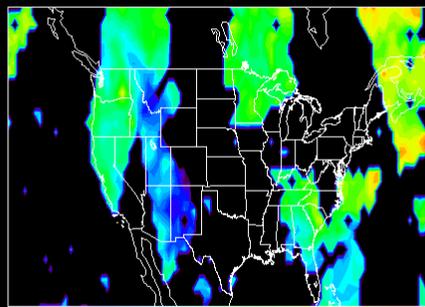
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Aug 26, 2006

# MOPITT CO/Mapped Emissions

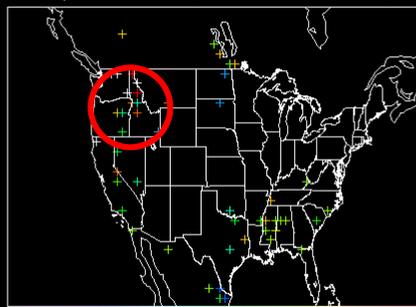
MOPITT CO Column 20060827



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

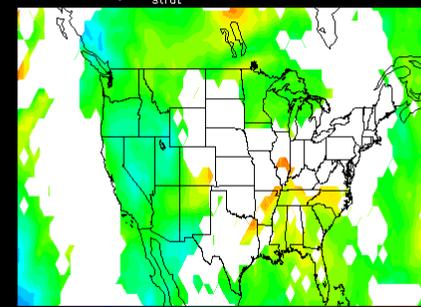
RAQMS Wildfire Emissions 20060827



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
log10(molecules/cm<sup>2</sup>/sec)

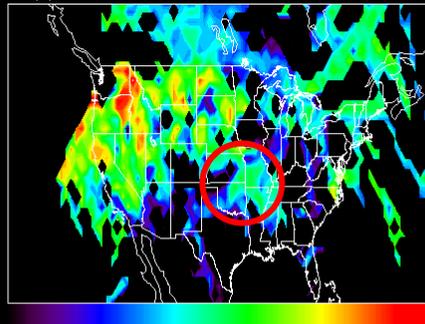
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060827



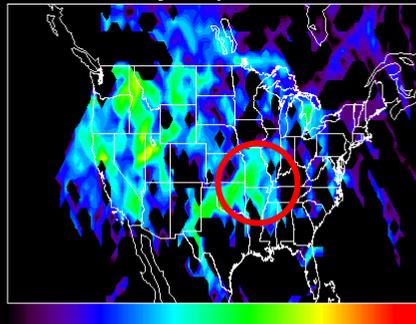
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060827



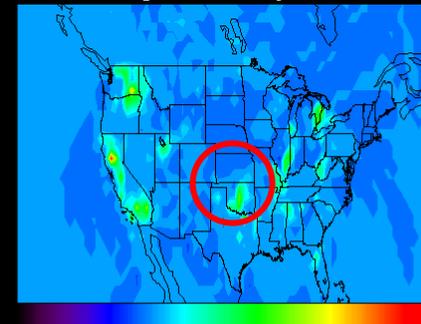
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
log10(molecules/cm<sup>2</sup>/sec)

Wild Fire Trajectory Count 20060827



0.0 0.5 1.0 1.5 2.0 2.5 3.0  
(log10(#))

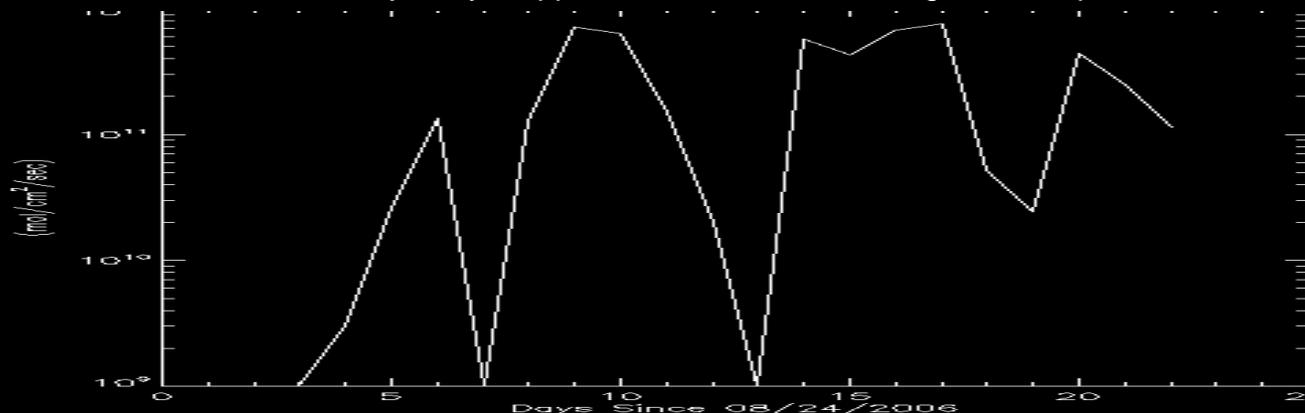
Ozone P-L along Wildfire Trajectories 20060827



-4 -2 0 2 4 6 8 10  
(ppbv/day)



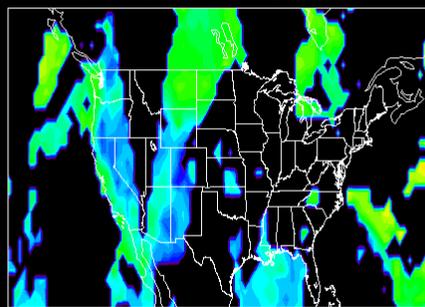
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Aug 27, 2006

# MOPITT CO/Mapped Emissions

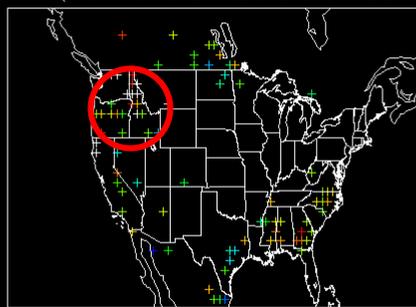
MOPITT CO Column 20060828



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

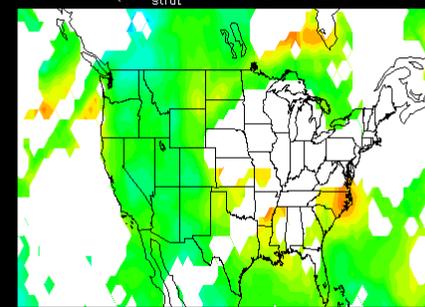
RAQMS Wildfire Emissions 20060828



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

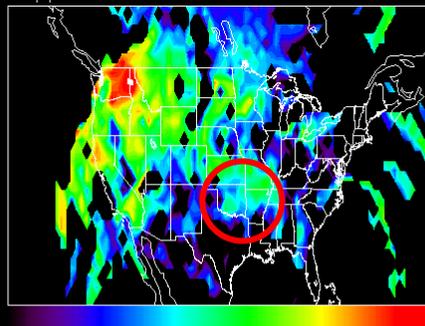
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060828



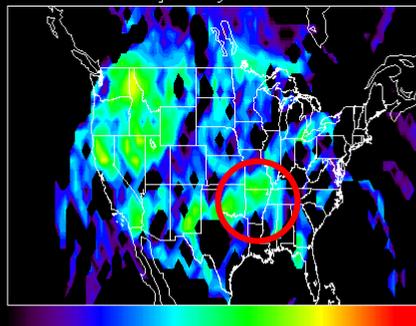
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060828



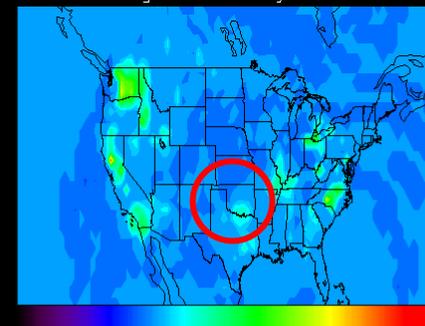
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

Wild Fire Trajectory Count 20060828



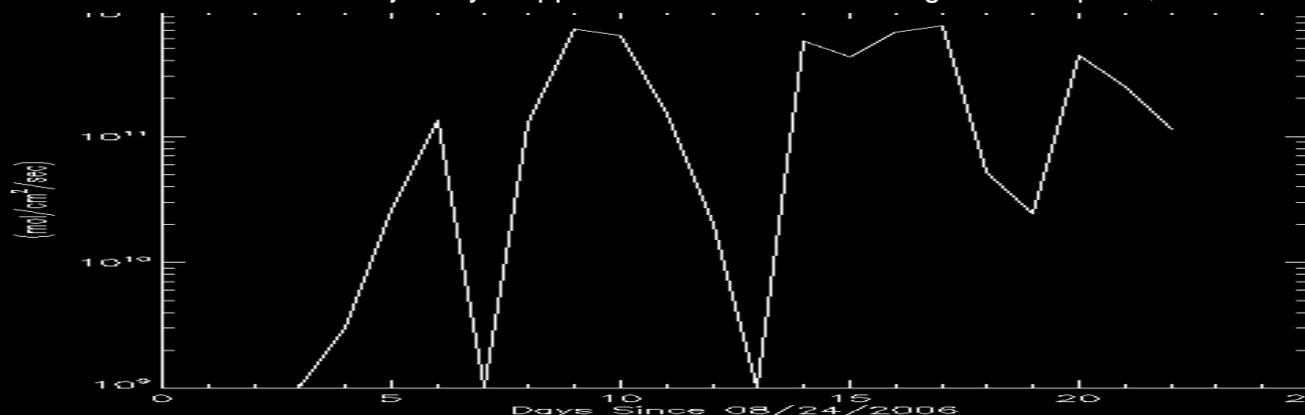
0.0 0.5 1.0 1.5 2.0 2.5 3.0  
 $\log_{10}(\#)$

Ozone P-L along Wildfire Trajectories 20060828



-4 -2 0 2 4 6 8 10  
(ppbv/day)

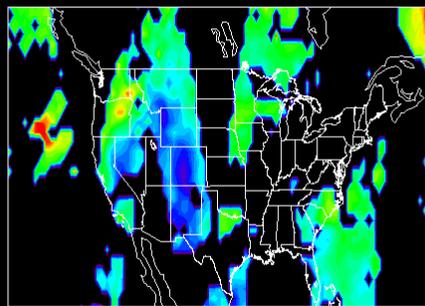
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Aug 28, 2006

# MOPITT CO/Mapped Emissions

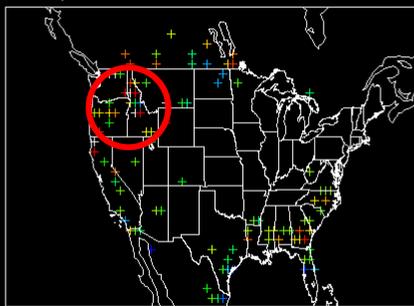
MOPITT CO Column 20060829



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

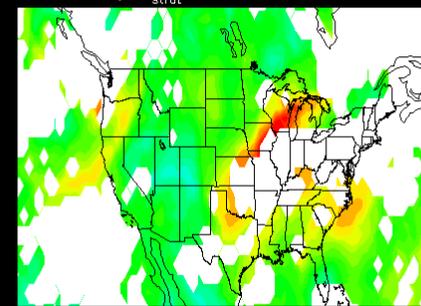
RAQMS Wildfire Emissions 20060829



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

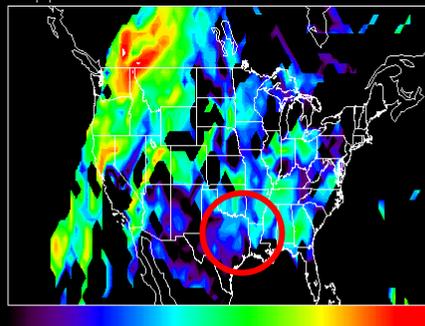
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060829



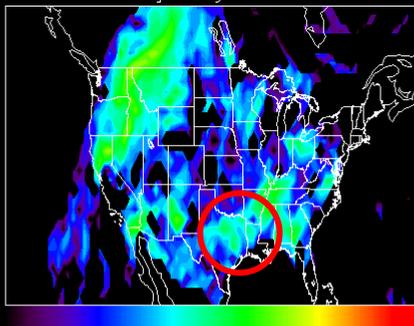
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060829



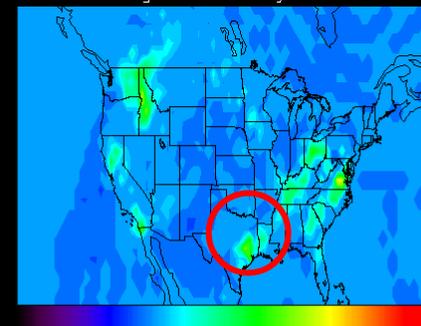
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

Wild Fire Trajectory Count 20060829



0.0 0.5 1.0 1.5 2.0 2.5 3.0  
 $\log_{10}(\#)$

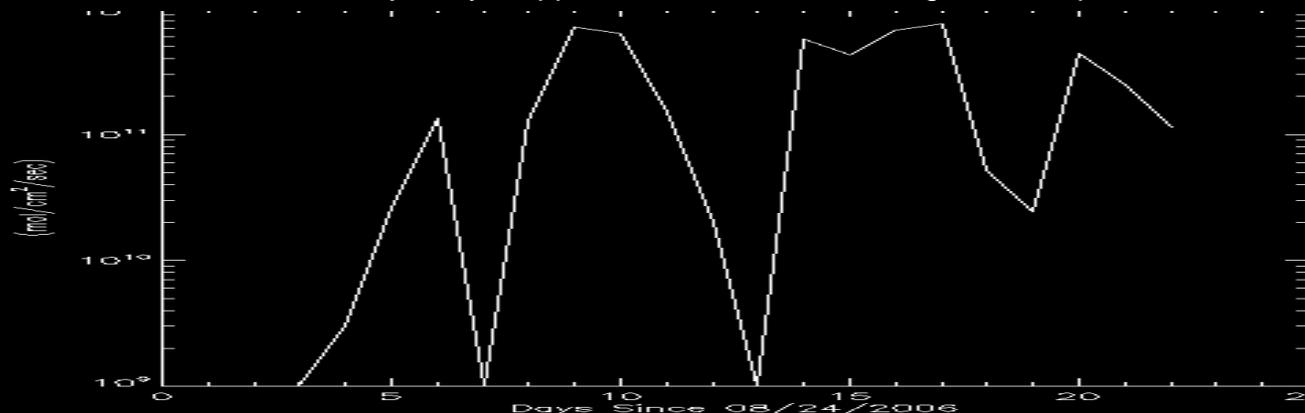
Ozone P-L along Wildfire Trajectories 20060829



-4 -2 0 2 4 6 8 10  
(ppbv/day)



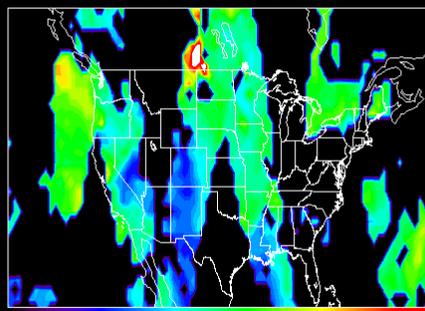
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Aug 29, 2006

# MOPITT CO/Mapped Emissions

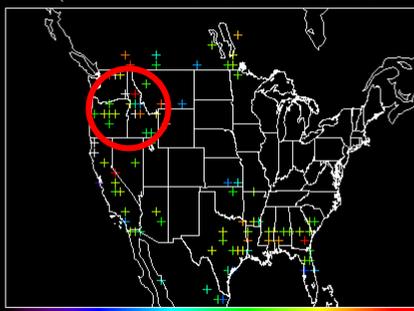
MOPITT CO Column 20060830



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

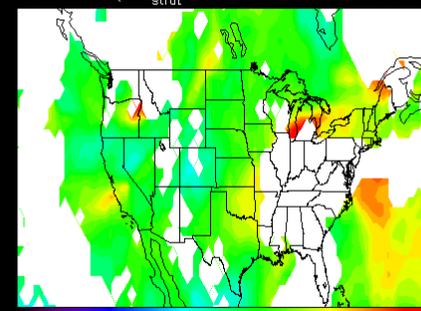
RAQMS Wildfire Emissions 20060830



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
log10(molecules/cm<sup>2</sup>/sec)

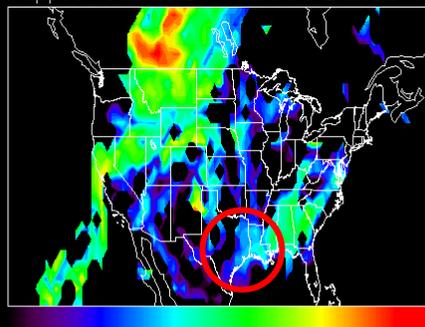
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060830



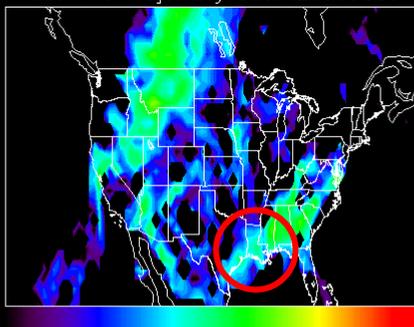
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060830



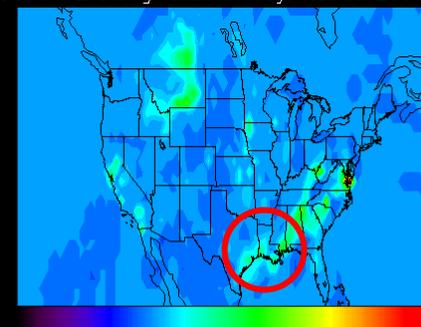
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
log10(molecules/cm<sup>2</sup>/sec)

Wild Fire Trajectory Count 20060830



0.0 0.5 1.0 1.5 2.0 2.5 3.0  
(log10(#))

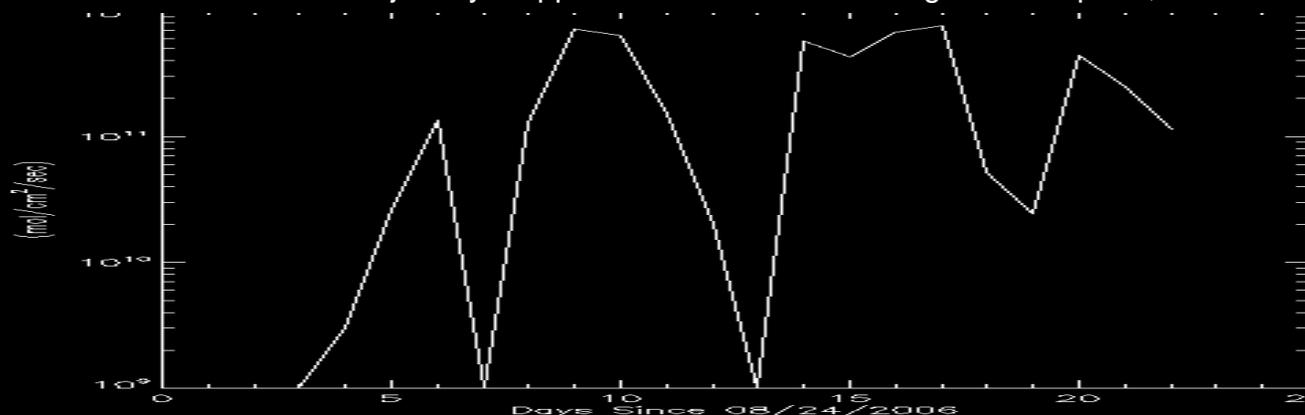
Ozone P-L along Wildfire Trajectories 20060830



-4 -2 0 2 4 6 8 10  
(ppbv/day)



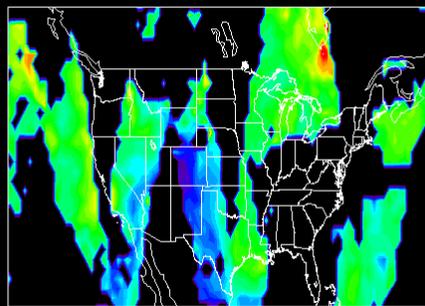
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Aug 30, 2006

# MOPITT CO/Mapped Emissions

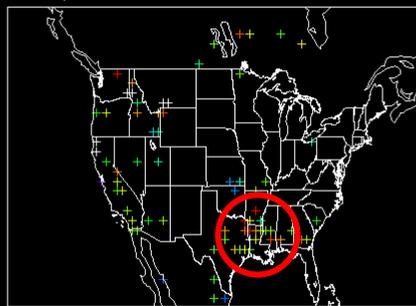
MOPITT CO Column 20060831



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

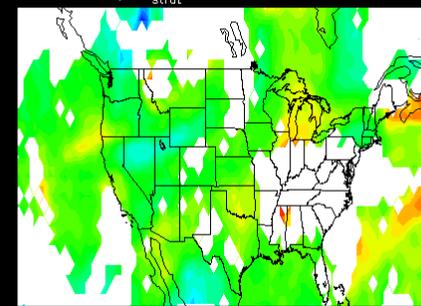
RAQMS Wildfire Emissions 20060831



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

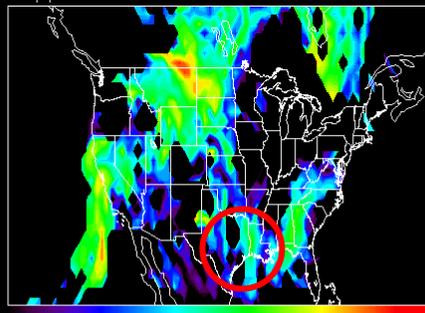
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060831



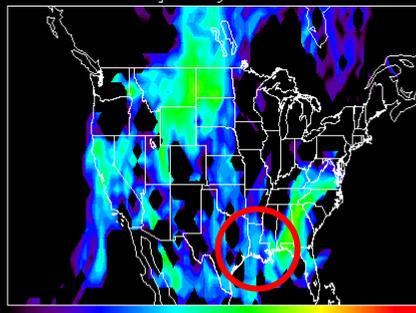
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060831



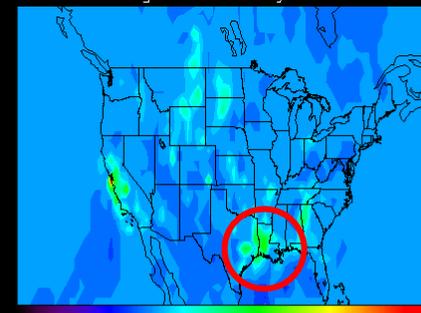
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

Wild Fire Trajectory Count 20060831



0.0 0.5 1.0 1.5 2.0 2.5 3.0  
 $\log_{10}(\#)$

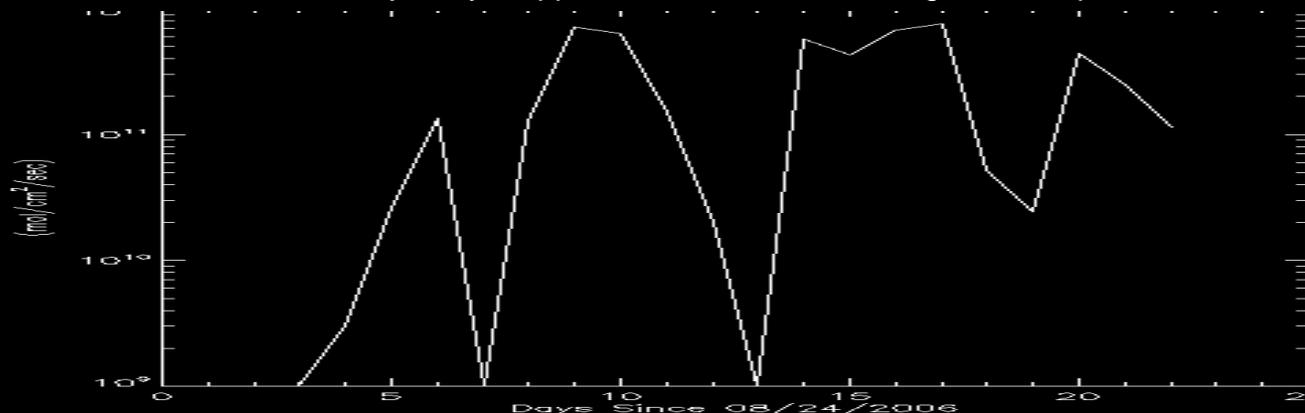
Ozone P-L along Wildfire Trajectories 20060831



-4 -2 0 2 4 6 8 10  
(ppbv/day)



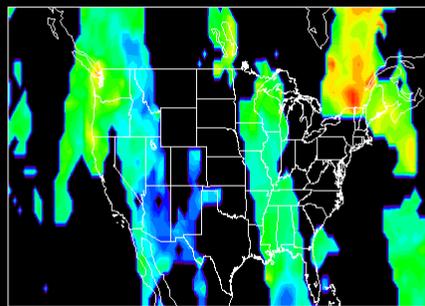
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Aug 31, 2006

# MOPITT CO/Mapped Emissions

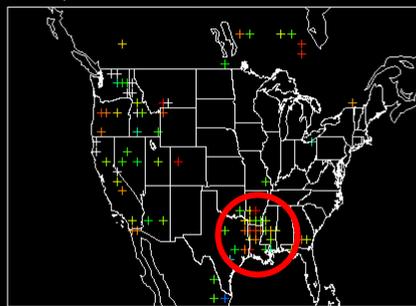
MOPITT CO Column 20060901



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

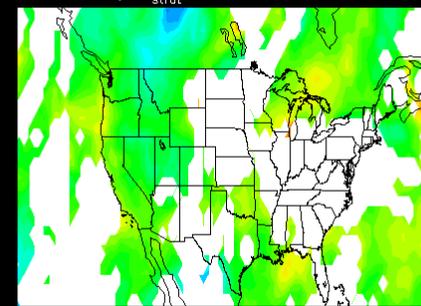
RAQMS Wildfire Emissions 20060901



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

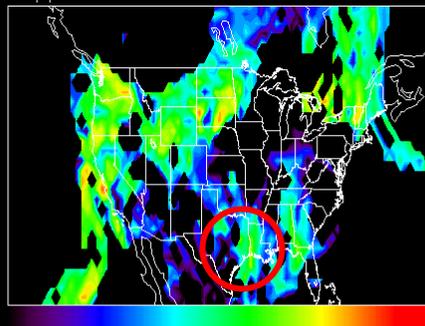
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060901



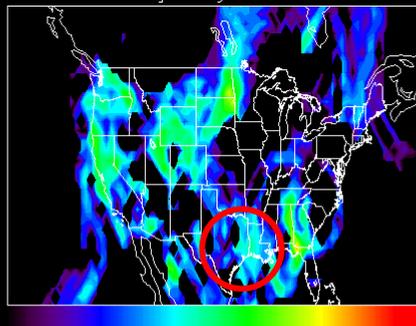
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060901



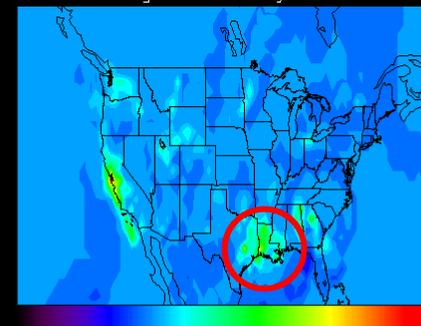
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

Wild Fire Trajectory Count 20060901



0.0 0.5 1.0 1.5 2.0 2.5 3.0  
 $\log_{10}(\#)$

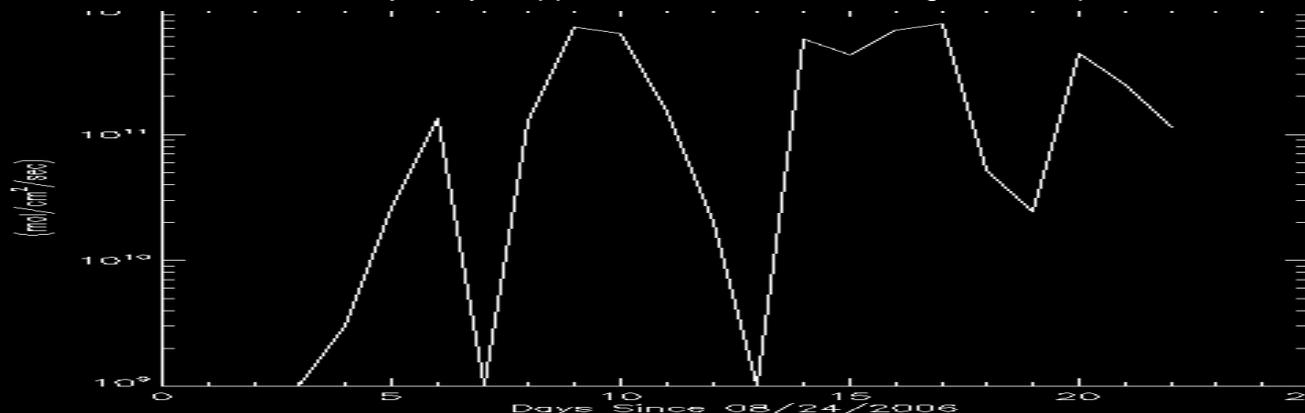
Ozone P-L along Wildfire Trajectories 20060901



-4 -2 0 2 4 6 8 10  
(ppbv/day)



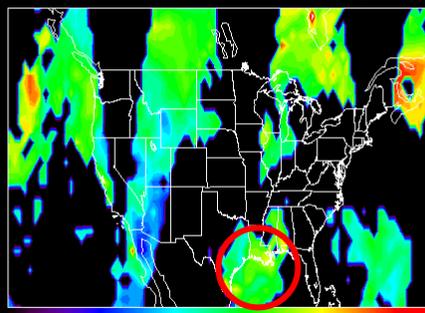
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 01, 2006

# MOPITT CO/Mapped Emissions

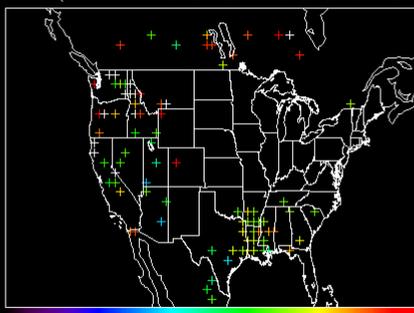
MOPITT CO Column 20060902



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

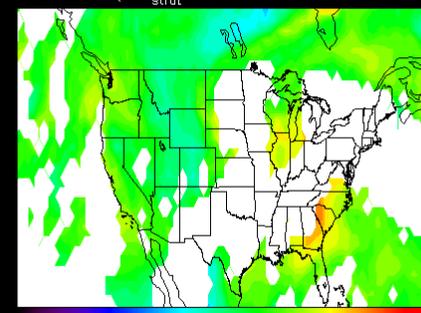
RAQMS Wildfire Emissions 20060902



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

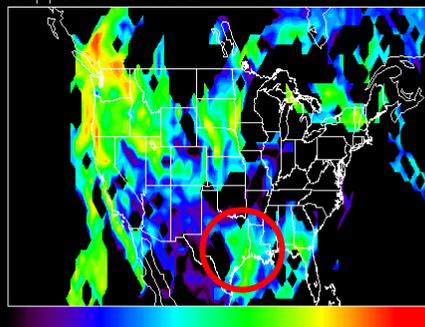
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060902



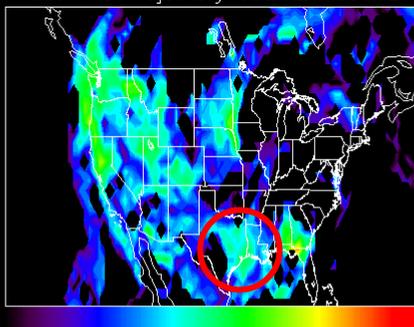
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060902



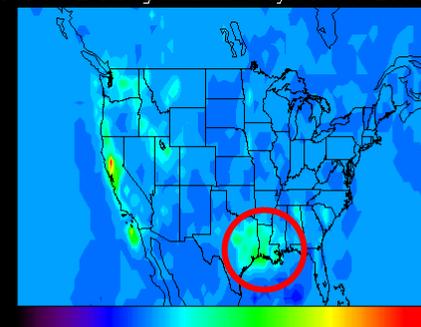
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

Wild Fire Trajectory Count 20060902



0.0 0.5 1.0 1.5 2.0 2.5 3.0  
 $\log_{10}(\#)$

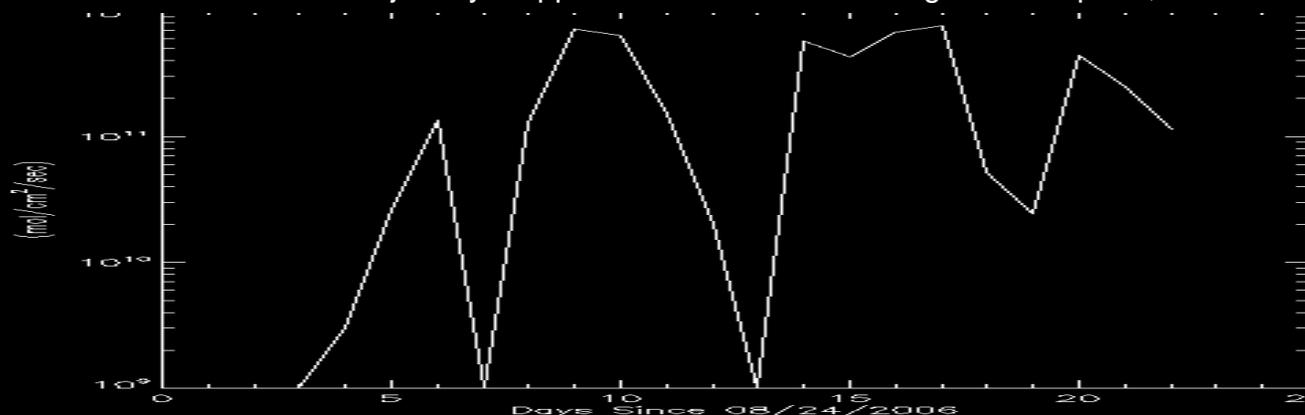
Ozone P-L along Wildfire Trajectories 20060902



-4 -2 0 2 4 6 8 10  
(ppbv/day)



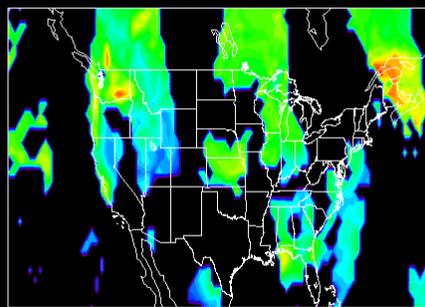
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 02, 2006

# MOPITT CO/Mapped Emissions

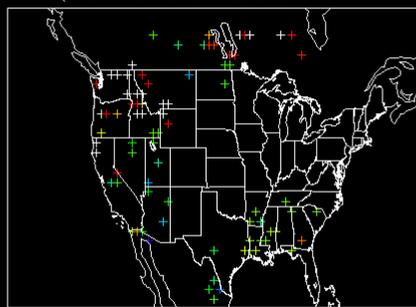
MOPITT CO Column 20060903



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

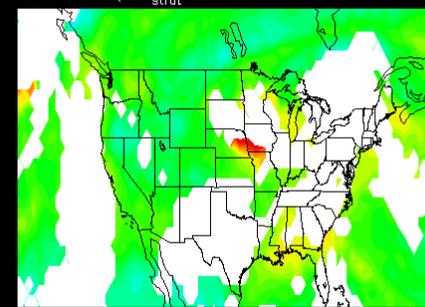
RAQMS Wildfire Emissions 20060903



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

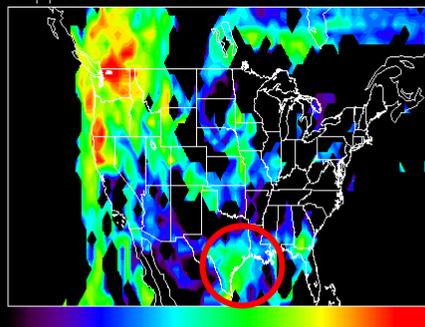
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strot</sub> O3 Column 20060903



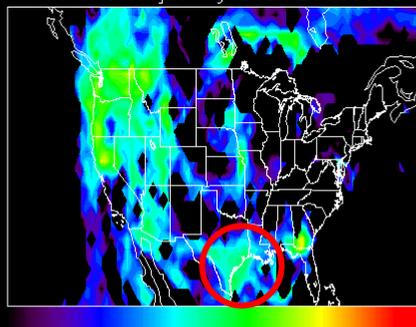
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060903



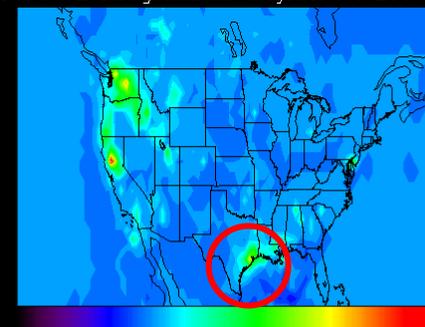
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

Wild Fire Trajectory Count 20060903



0.0 0.5 1.0 1.5 2.0 2.5 3.0  
 $\log_{10}(\#)$

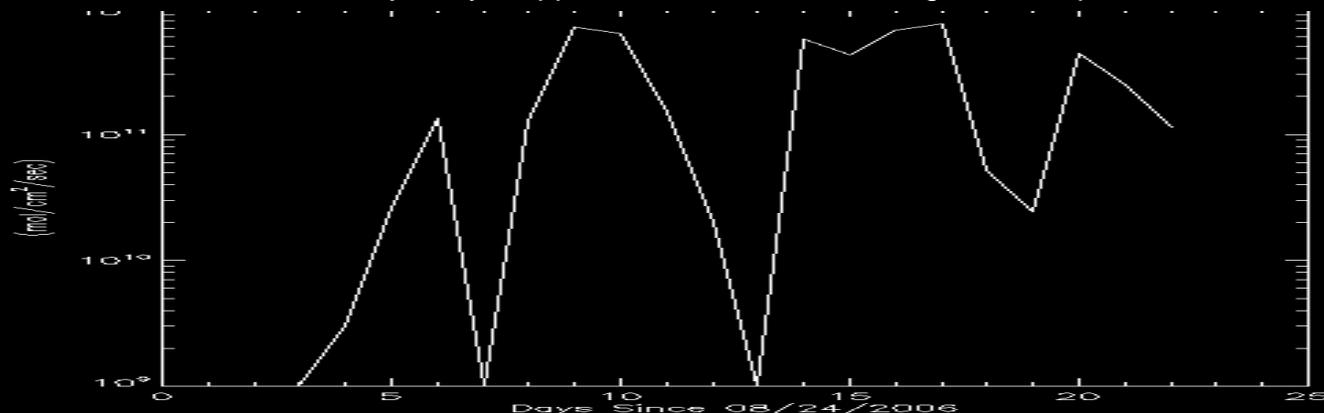
Ozone P-L along Wildfire Trajectories 20060903



-4 -2 0 2 4 6 8 10  
(ppbv/day)



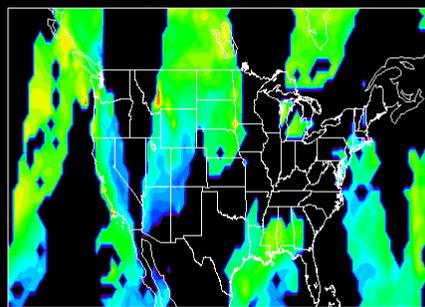
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 03, 2006

# MOPITT CO/Mapped Emissions

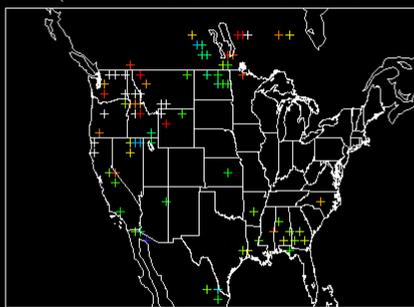
MOPITT CO Column 20060904



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

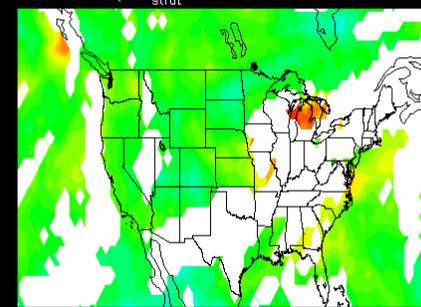
RAQMS Wildfire Emissions 20060904



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
log<sub>10</sub>(molecules/cm<sup>2</sup>/sec)

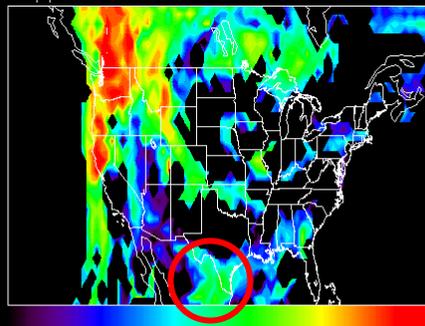
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060904



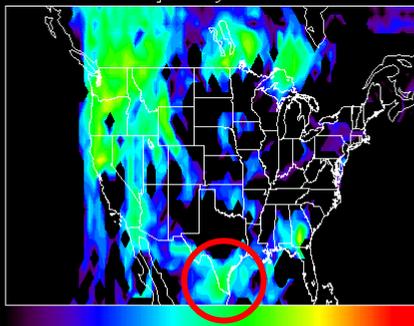
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060904



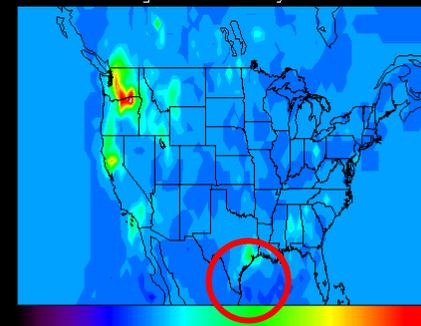
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
log<sub>10</sub>(molecules/cm<sup>2</sup>/sec)

Wild Fire Trajectory Count 20060904



0.0 0.5 1.0 1.5 2.0 2.5 3.0  
(log<sub>10</sub>(#))

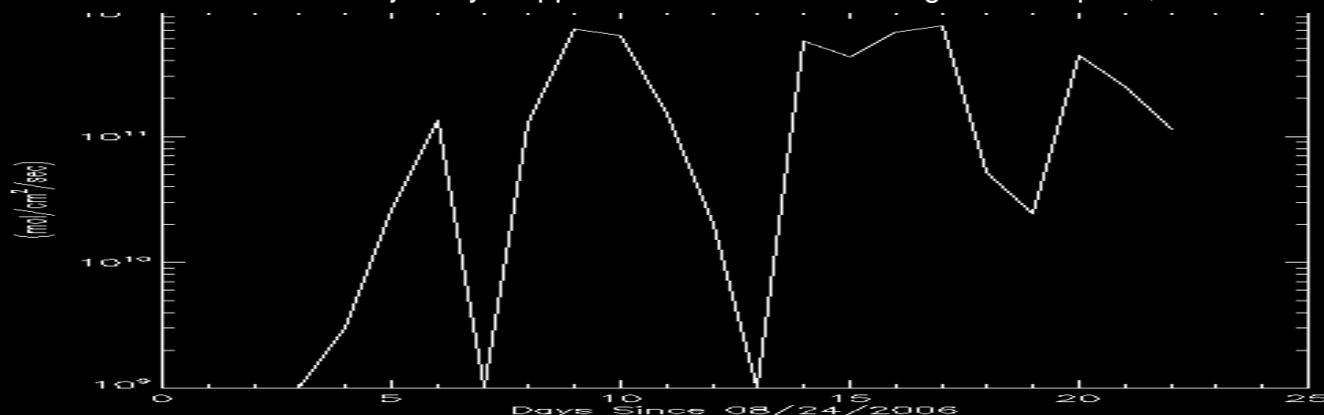
Ozone P-L along Wildfire Trajectories 20060904



-4 -2 0 2 4 6 8 10  
(ppbv/day)



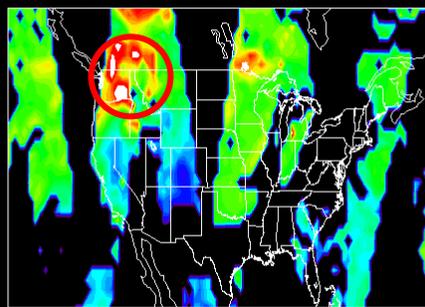
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 04, 2006

# MOPITT CO/Mapped Emissions

MOPITT CO Column 20060905

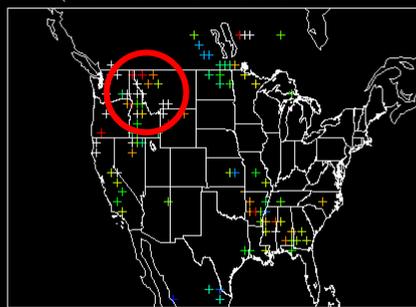


0.5 1.0 1.5 2.0 2.5 3.0

( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

RAQMS Wildfire Emissions 20060905

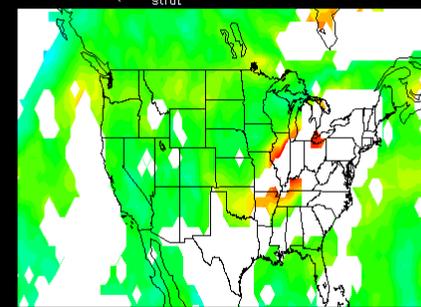


10.0 10.5 11.0 11.5 12.0 12.5 13.0

$\log_{10}(\text{molecules/cm}^2/\text{sec})$

# OMI Trop O3/Mapped O3 P-L

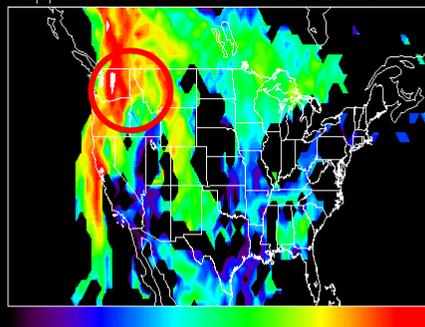
OMI-RAQMS<sub>strot</sub> O3 Column 20060905



0 10 20 30 40 50 60 70

(DU)

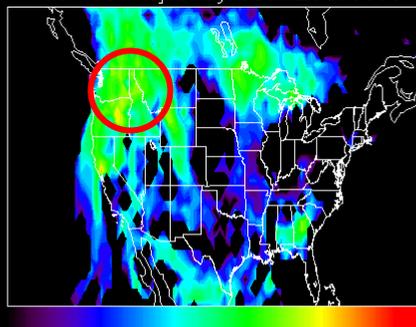
Trajectory Mapped Total Column Wildfire Emissions 20060905



10.0 10.5 11.0 11.5 12.0 12.5 13.0

$\log_{10}(\text{molecules/cm}^2/\text{sec})$

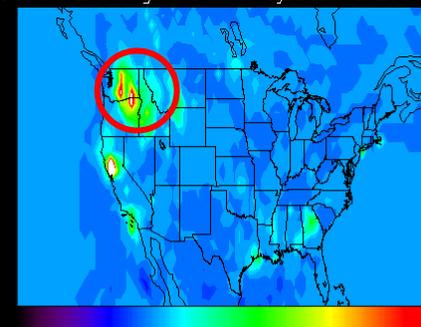
Wild Fire Trajectory Count 20060905



0.0 0.5 1.0 1.5 2.0 2.5 3.0

$\log_{10}(\#)$

Ozone P-L along Wildfire Trajectories 20060905

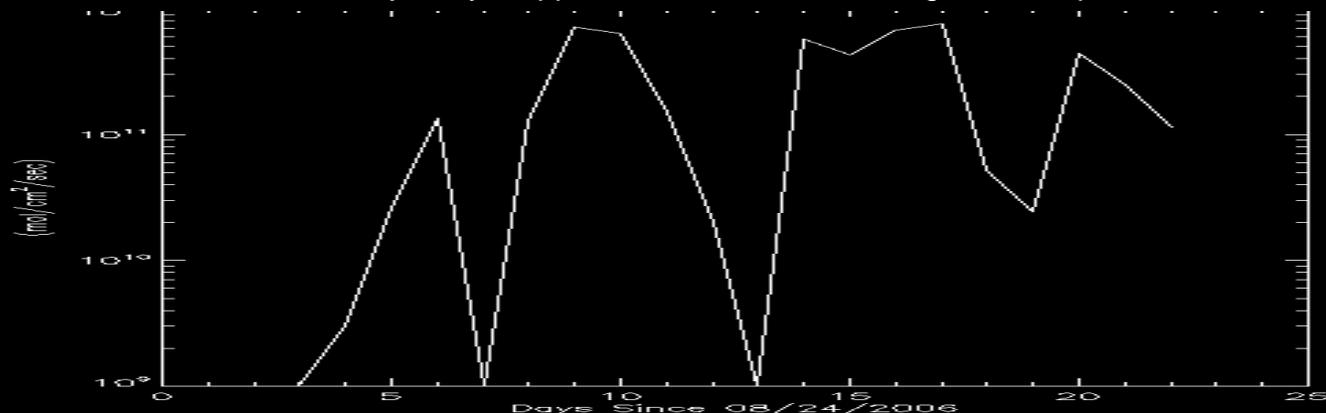


-4 -2 0 2 4 6 8 10

(ppbv/day)



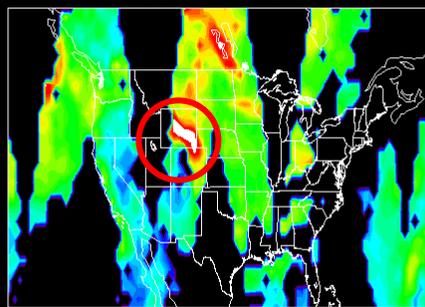
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 05, 2006

# MOPITT CO/Mapped Emissions

MOPITT CO Column 20060906

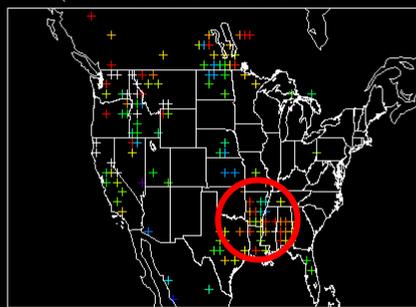


0.5 1.0 1.5 2.0 2.5 3.0

( $\times 10^{18}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

RAQMS Wildfire Emissions 20060906

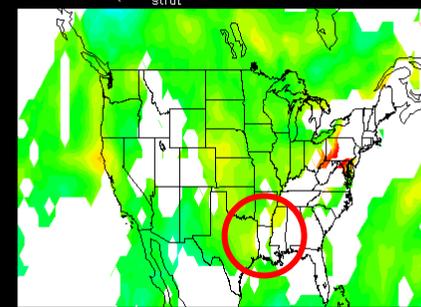


10.0 10.5 11.0 11.5 12.0 12.5 13.0

$\log_{10}$ (molecules/cm<sup>2</sup>/sec)

# OMI Trop O3/Mapped O3 P-L

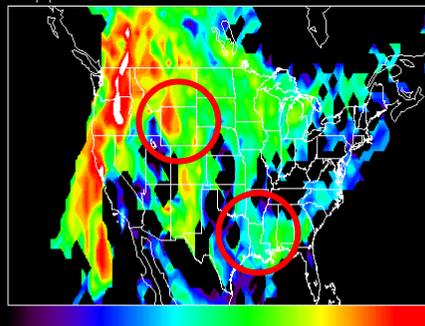
OMI-RAQMS<sub>strat</sub> O3 Column 20060906



0 10 20 30 40 50 60 70

(DU)

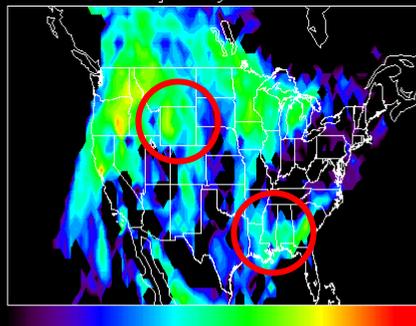
Trajectory Mapped Total Column Wildfire Emissions 20060906



10.0 10.5 11.0 11.5 12.0 12.5 13.0

$\log_{10}$ (molecules/cm<sup>2</sup>/sec)

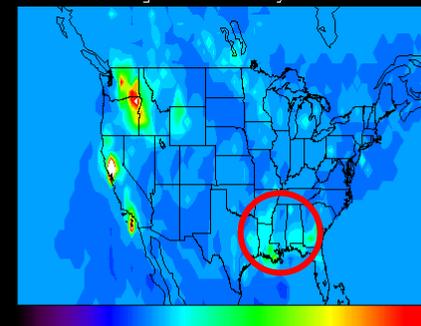
Wild Fire Trajectory Count 20060906



0.0 0.5 1.0 1.5 2.0 2.5 3.0

$\log_{10}$ (#)

Ozone P-L along Wildfire Trajectories 20060906

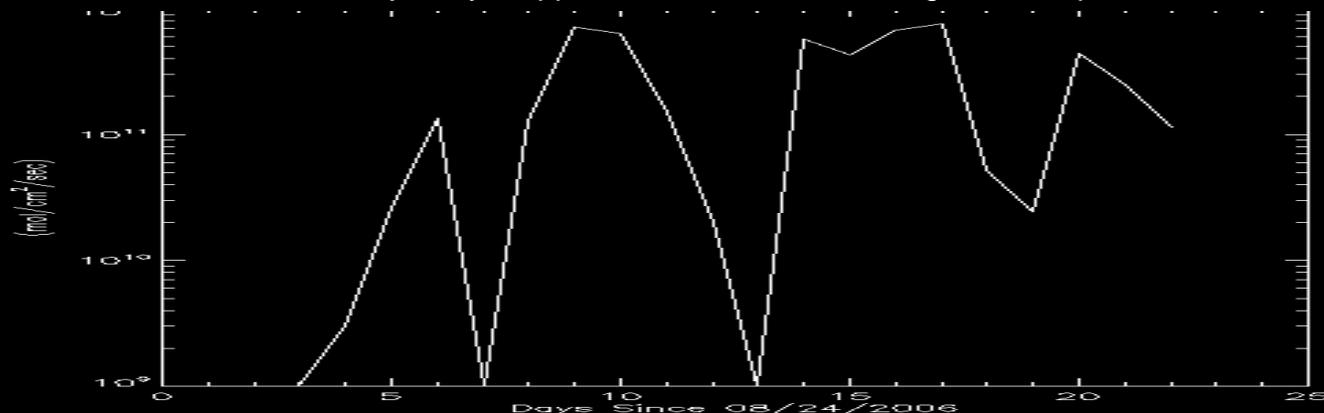


-4 -2 0 2 4 6 8 10

(ppbv/day)



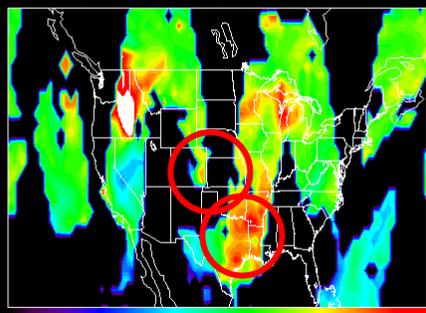
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 06, 2006

# MOPITT CO/Mapped Emissions

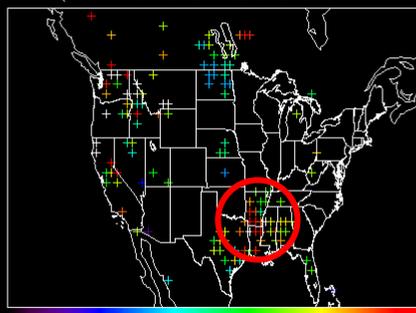
MOPITT CO Column 20060907



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

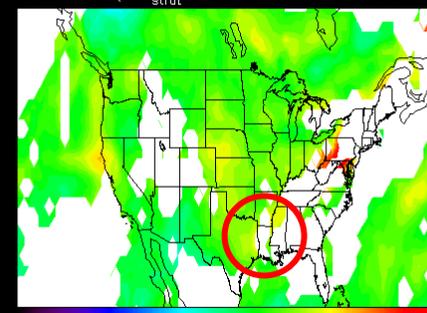
# CO Emissions/Count

RAQMS Wildfire Emissions 20060907



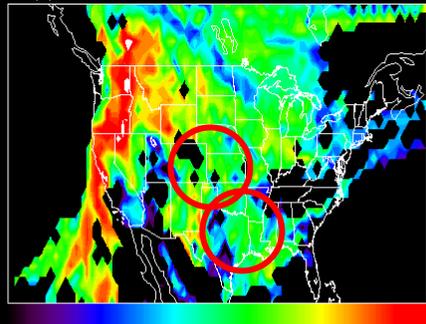
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

OMI-RAQMS<sub>strat</sub> O3 Column 20060906



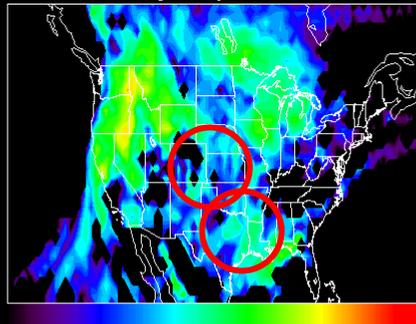
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060907



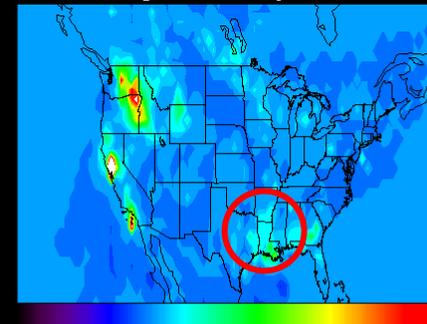
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

Wild Fire Trajectory Count 20060907



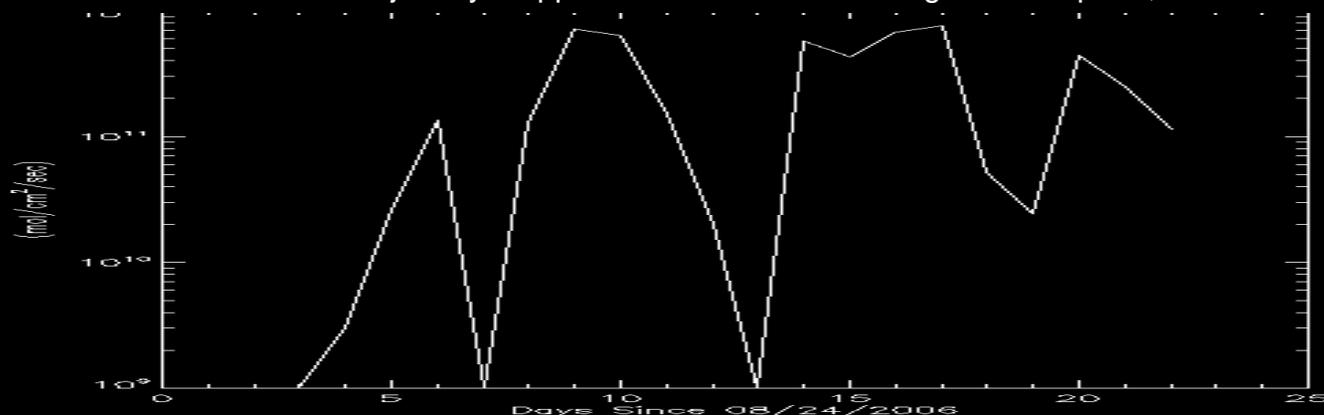
0.0 0.5 1.0 1.5 2.0 2.5 3.0  
 $\log_{10}(\#)$

Ozone P-L along Wildfire Trajectories 20060906



-4 -2 0 2 4 6 8 10  
(ppbv/day)

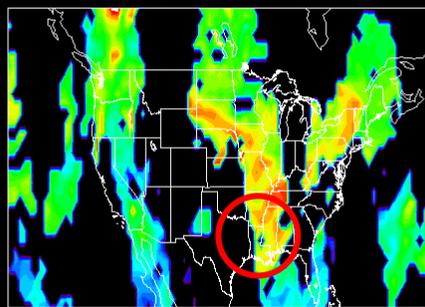
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 07, 2006

# MOPITT CO/Mapped Emissions

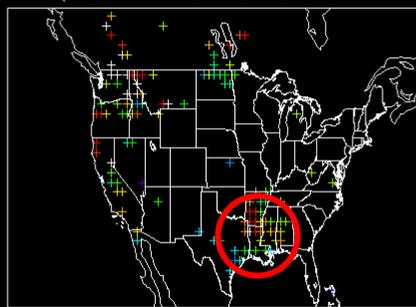
MOPITT CO Column 20060908



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

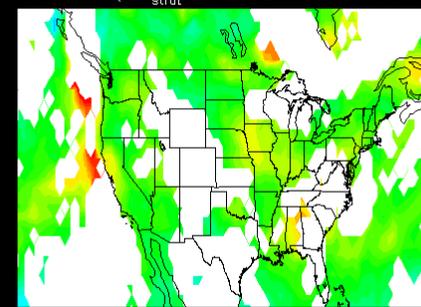
RAQMS Wildfire Emissions 20060908



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

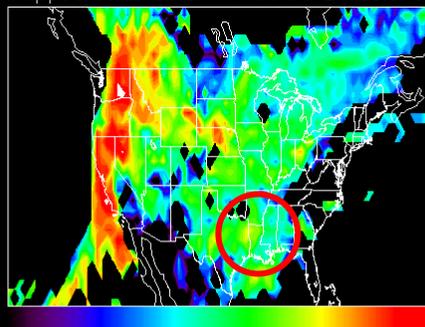
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060908



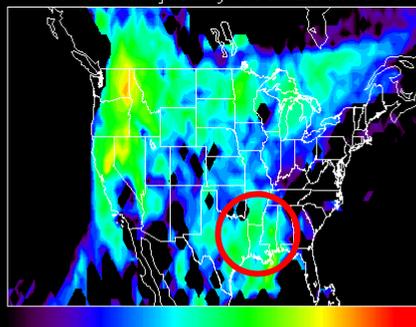
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060908



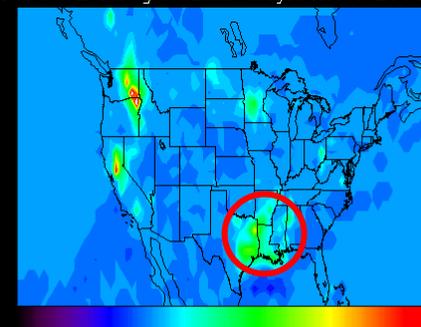
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

Wild Fire Trajectory Count 20060908



0.0 0.5 1.0 1.5 2.0 2.5 3.0  
 $\log_{10}(\#)$

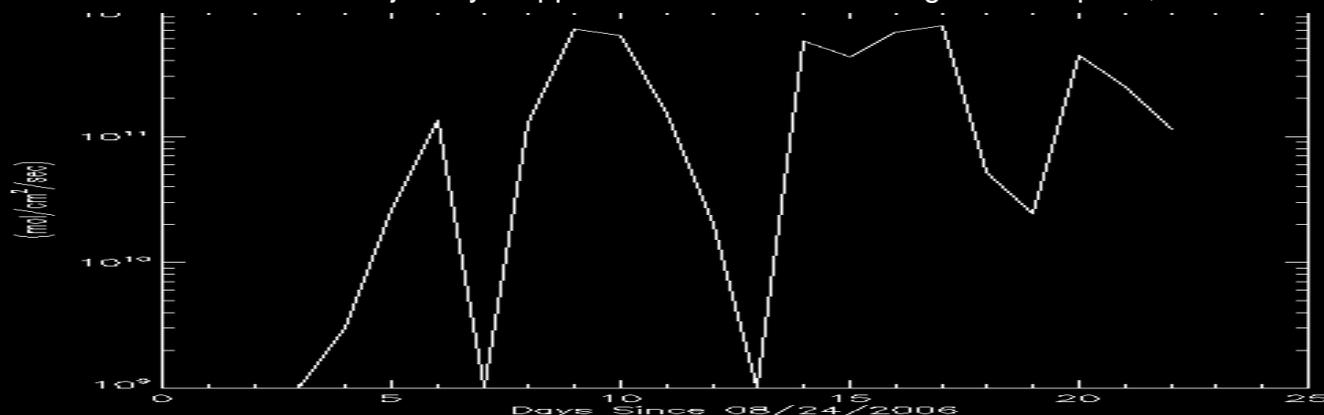
Ozone P-L along Wildfire Trajectories 20060908



-4 -2 0 2 4 6 8 10  
(ppbv/day)

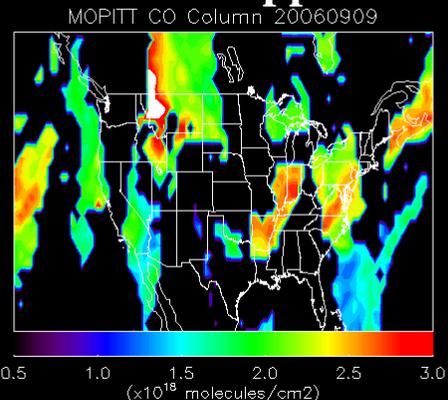


Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006

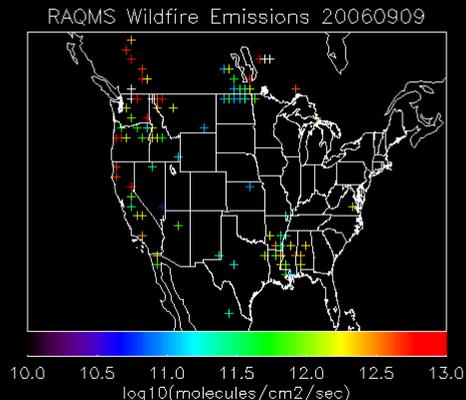


Sep 08, 2006

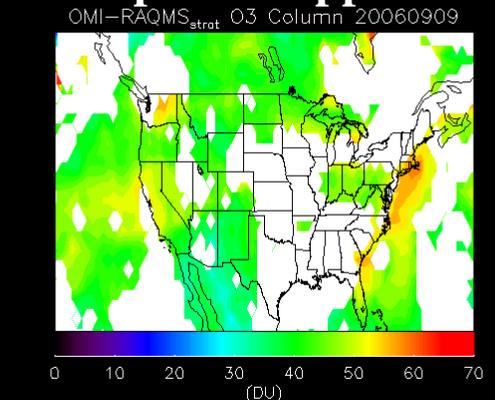
# MOPITT CO/Mapped Emissions



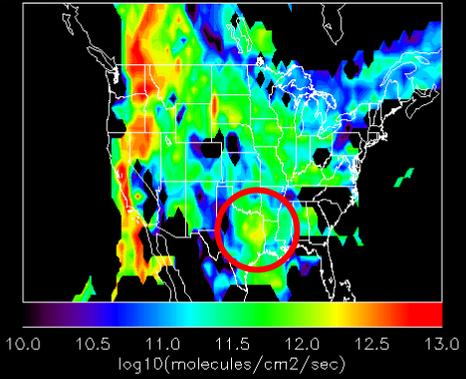
# CO Emissions/Count



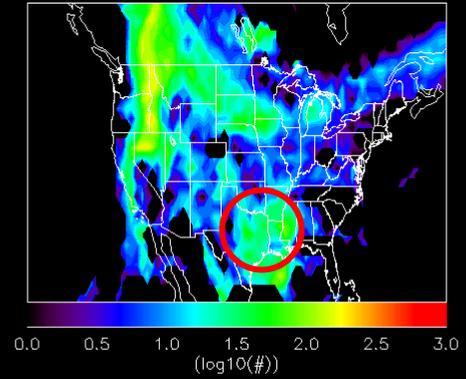
# OMI Trop O3/Mapped O3 P-L



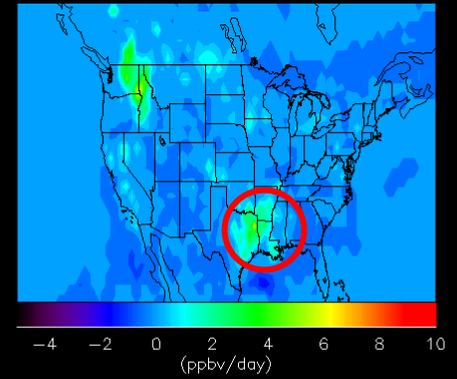
Trajectory Mapped Total Column Wildfire Emissions 20060909



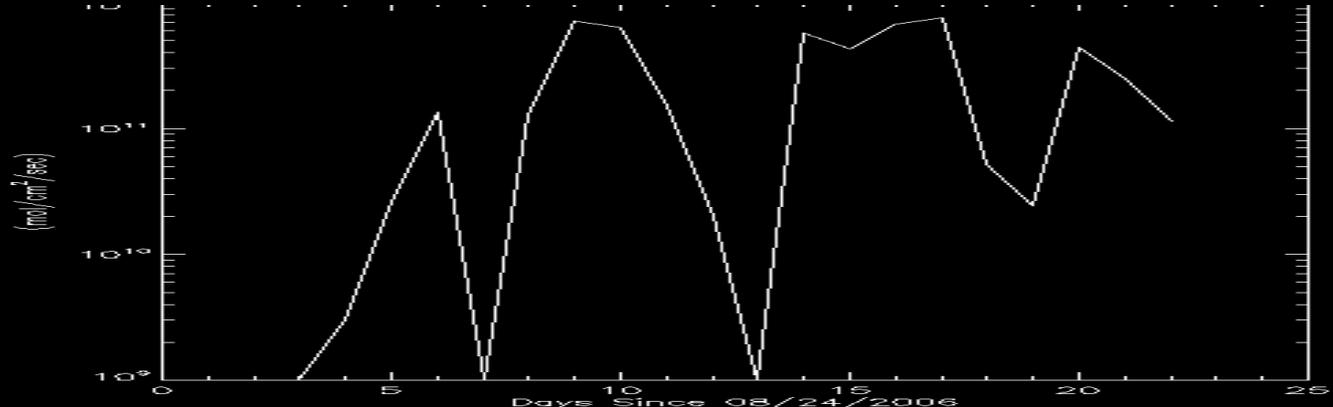
Wild Fire Trajectory Count 20060909



Ozone P-L along Wildfire Trajectories 20060909



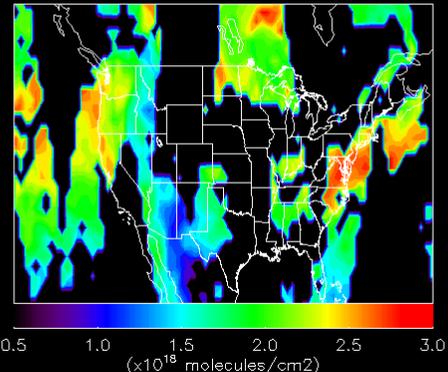
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 09, 2006

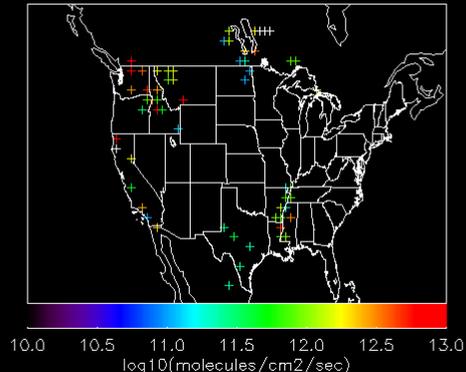
# MOPITT CO/Mapped Emissions

MOPITT CO Column 20060910



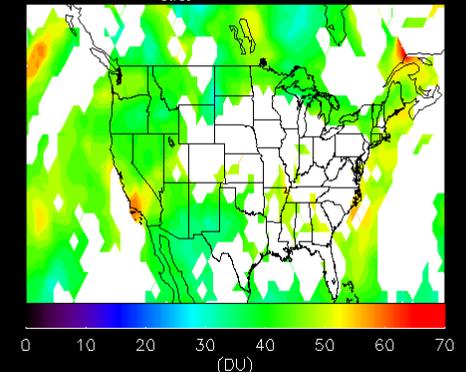
# CO Emissions/Count

RAQMS Wildfire Emissions 20060910

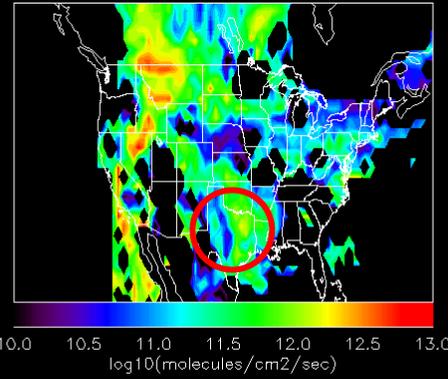


# OMI Trop O3/Mapped O3 P-L

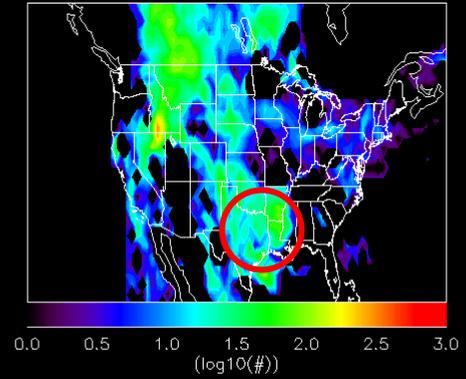
OMI-RAQMS<sub>strat</sub> O3 Column 20060910



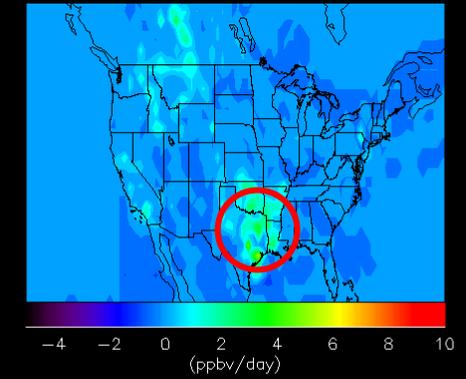
Trajectory Mapped Total Column Wildfire Emissions 20060910



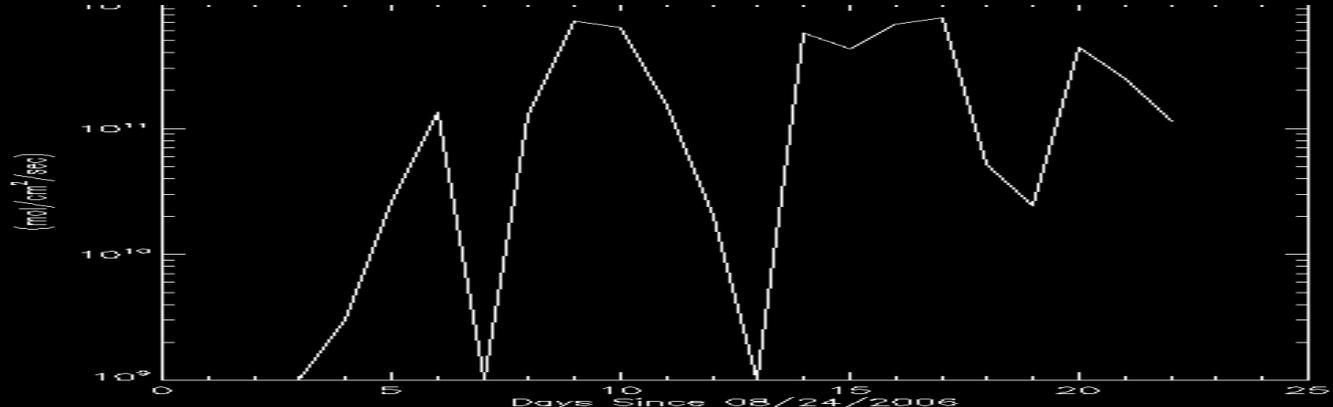
Wild Fire Trajectory Count 20060910



Ozone P-L along Wildfire Trajectories 20060910



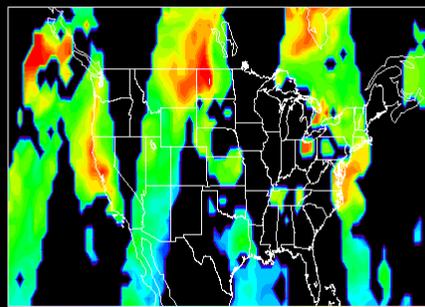
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 10, 2006

# MOPITT CO/Mapped Emissions

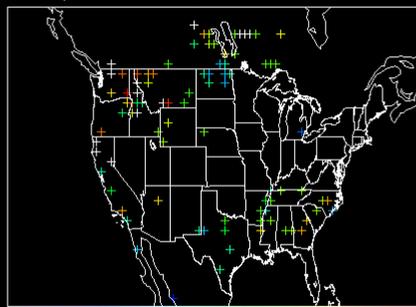
MOPITT CO Column 20060911



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

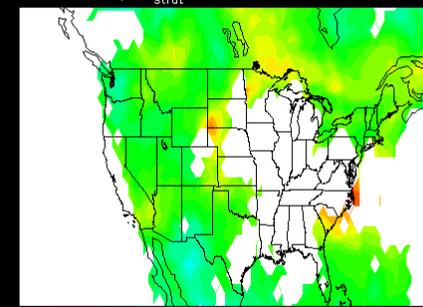
RAQMS Wildfire Emissions 20060911



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

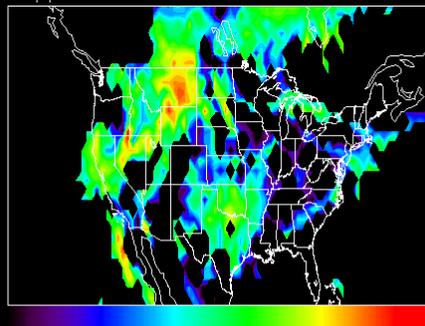
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060911



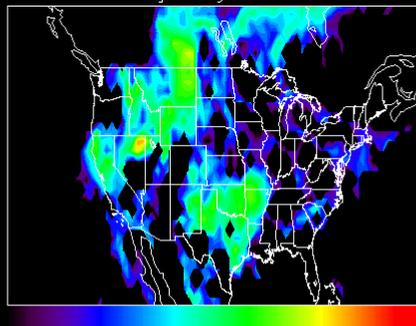
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060911



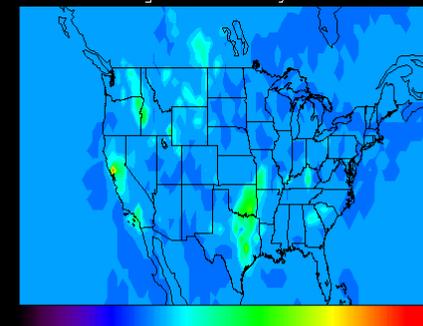
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

Wild Fire Trajectory Count 20060911



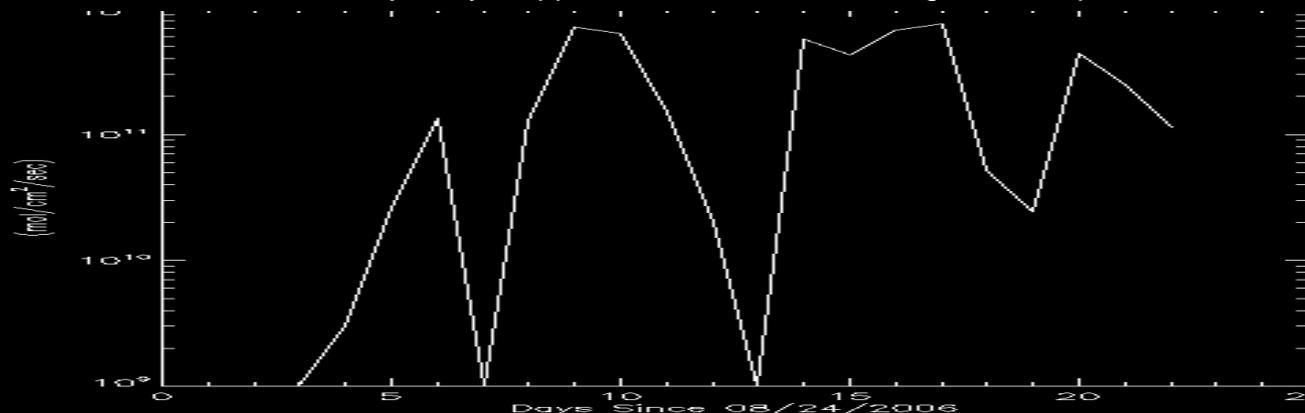
0.0 0.5 1.0 1.5 2.0 2.5 3.0  
 $\log_{10}(\#)$

Ozone P-L along Wildfire Trajectories 20060911



-4 -2 0 2 4 6 8 10  
(ppbv/day)

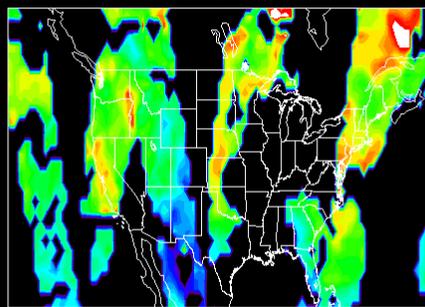
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 11, 2006

# MOPITT CO/Mapped Emissions

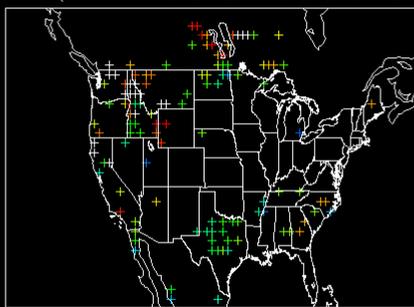
MOPITT CO Column 20060912



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

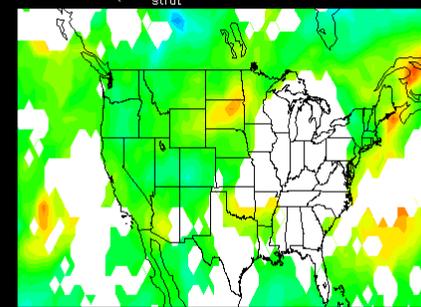
RAQMS Wildfire Emissions 20060912



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

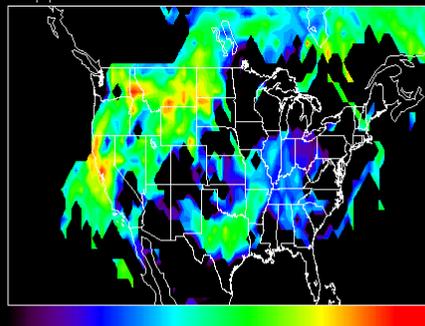
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060912



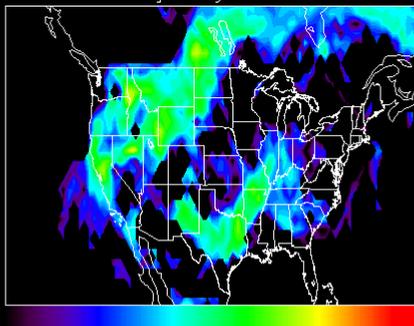
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060912



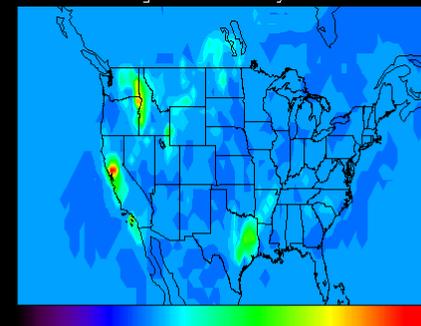
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

Wild Fire Trajectory Count 20060912



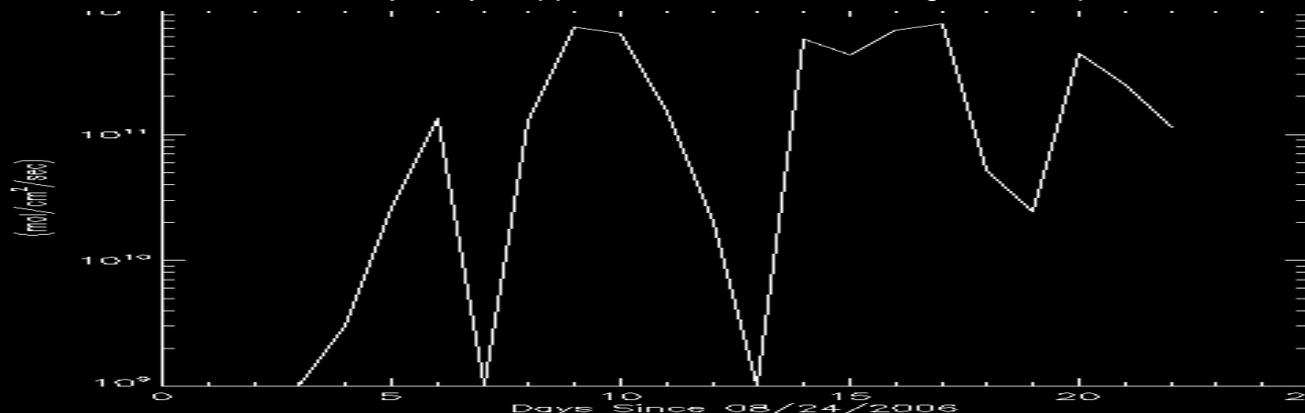
0.0 0.5 1.0 1.5 2.0 2.5 3.0  
 $\log_{10}(\#)$

Ozone P-L along Wildfire Trajectories 20060912



-4 -2 0 2 4 6 8 10  
(ppbv/day)

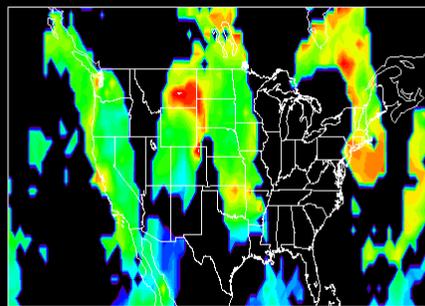
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 12, 2006

# MOPITT CO/Mapped Emissions

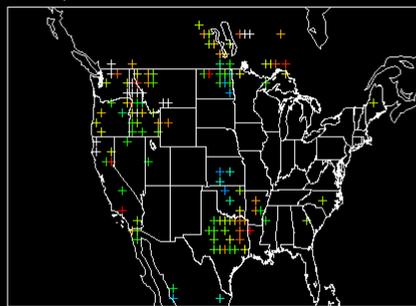
MOPITT CO Column 20060913



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

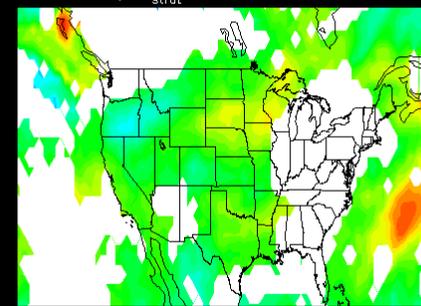
RAQMS Wildfire Emissions 20060913



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

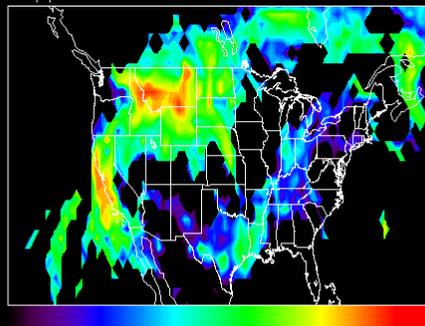
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strot</sub> O3 Column 20060913



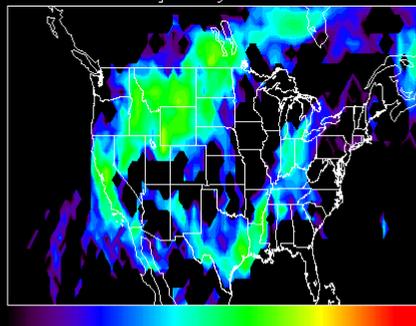
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060913



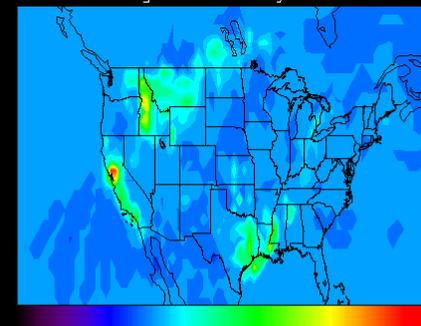
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
 $\log_{10}(\text{molecules/cm}^2/\text{sec})$

Wild Fire Trajectory Count 20060913



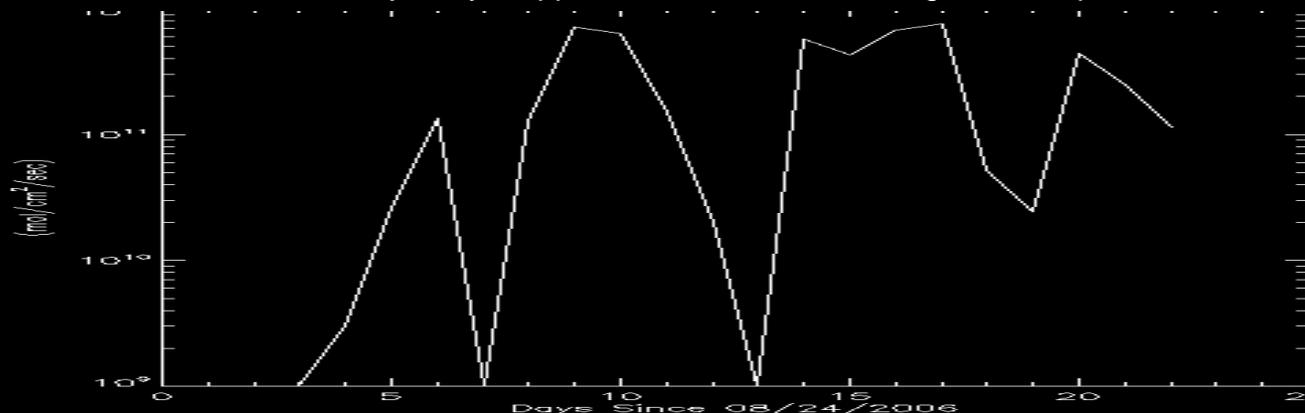
0.0 0.5 1.0 1.5 2.0 2.5 3.0  
 $\log_{10}(\#)$

Ozone P-L along Wildfire Trajectories 20060913



-4 -2 0 2 4 6 8 10  
(ppbv/day)

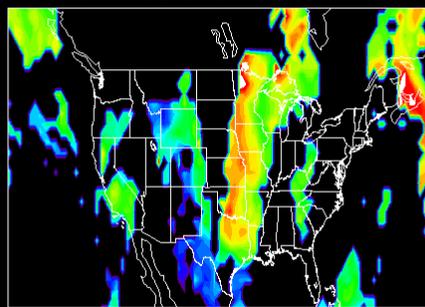
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 13, 2006

# MOPITT CO/Mapped Emissions

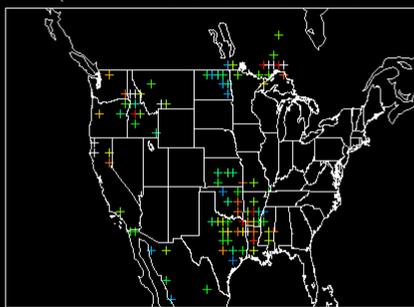
MOPITT CO Column 20060914



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

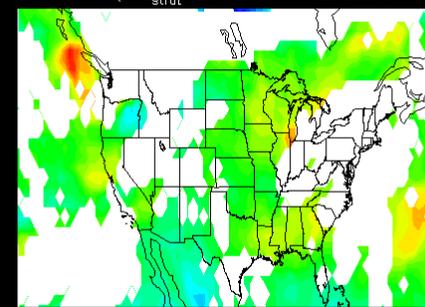
RAQMS Wildfire Emissions 20060914



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
log<sub>10</sub>(molecules/cm<sup>2</sup>/sec)

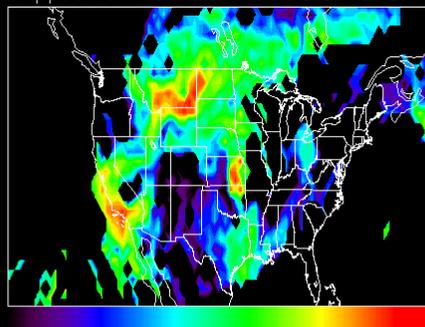
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060914



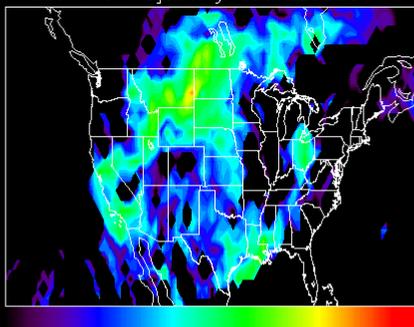
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060914



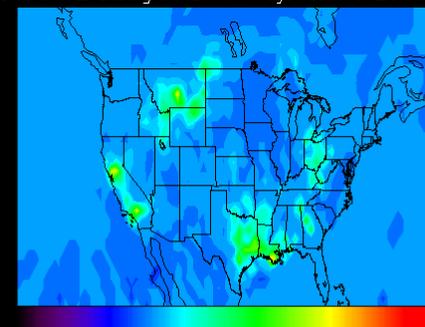
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
log<sub>10</sub>(molecules/cm<sup>2</sup>/sec)

Wild Fire Trajectory Count 20060914



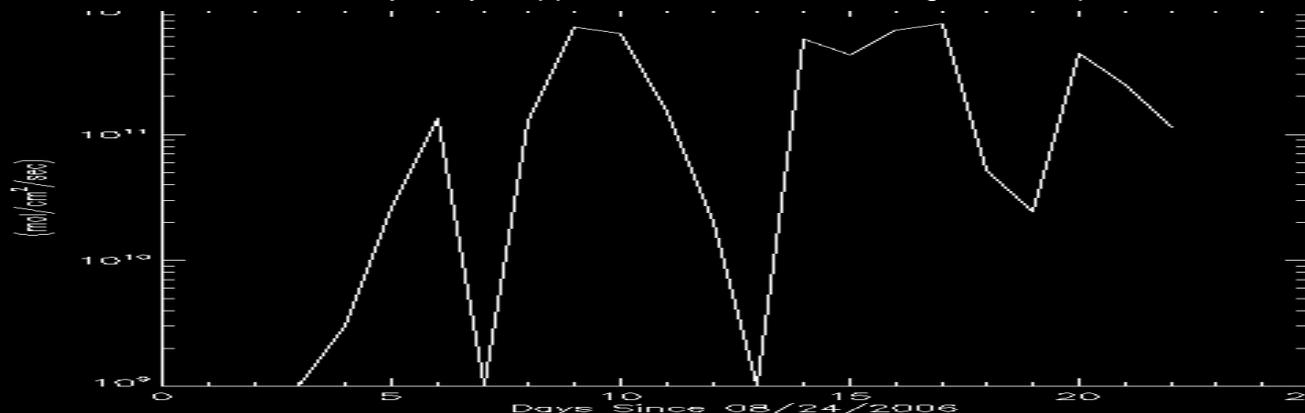
0.0 0.5 1.0 1.5 2.0 2.5 3.0  
(log<sub>10</sub>(#))

Ozone P-L along Wildfire Trajectories 20060914



-4 -2 0 2 4 6 8 10  
(ppbv/day)

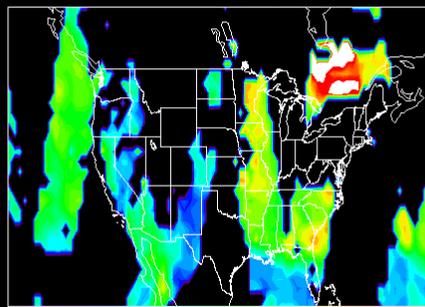
Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 14, 2006

# MOPITT CO/Mapped Emissions

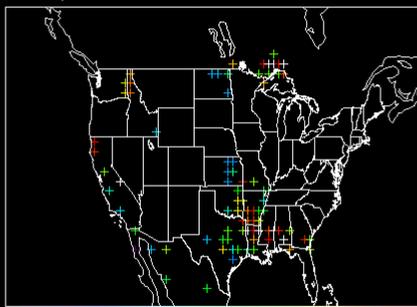
MOPITT CO Column 20060915



0.5 1.0 1.5 2.0 2.5 3.0  
( $\times 10^{16}$  molecules/cm<sup>2</sup>)

# CO Emissions/Count

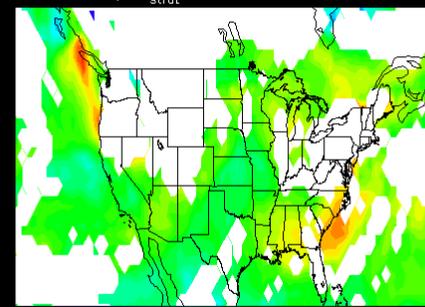
RAQMS Wildfire Emissions 20060915



10.0 10.5 11.0 11.5 12.0 12.5 13.0  
log10(molecules/cm<sup>2</sup>/sec)

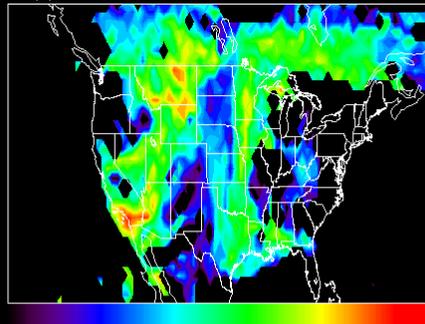
# OMI Trop O3/Mapped O3 P-L

OMI-RAQMS<sub>strat</sub> O3 Column 20060915



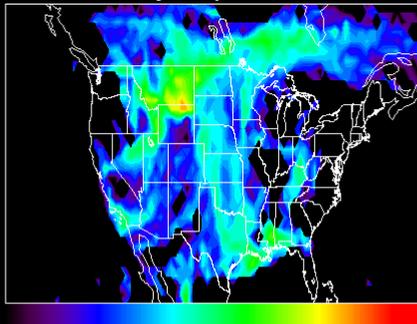
0 10 20 30 40 50 60 70  
(DU)

Trajectory Mapped Total Column Wildfire Emissions 20060915



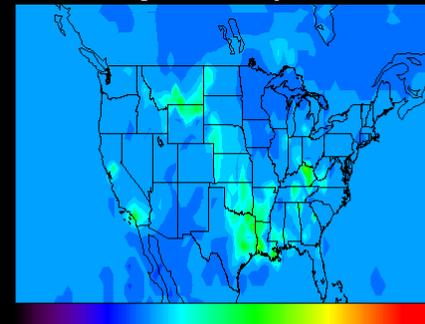
10.0 10.5 11.0 11.5 12.0 12.5 13.0  
log10(molecules/cm<sup>2</sup>/sec)

Wild Fire Trajectory Count 20060915



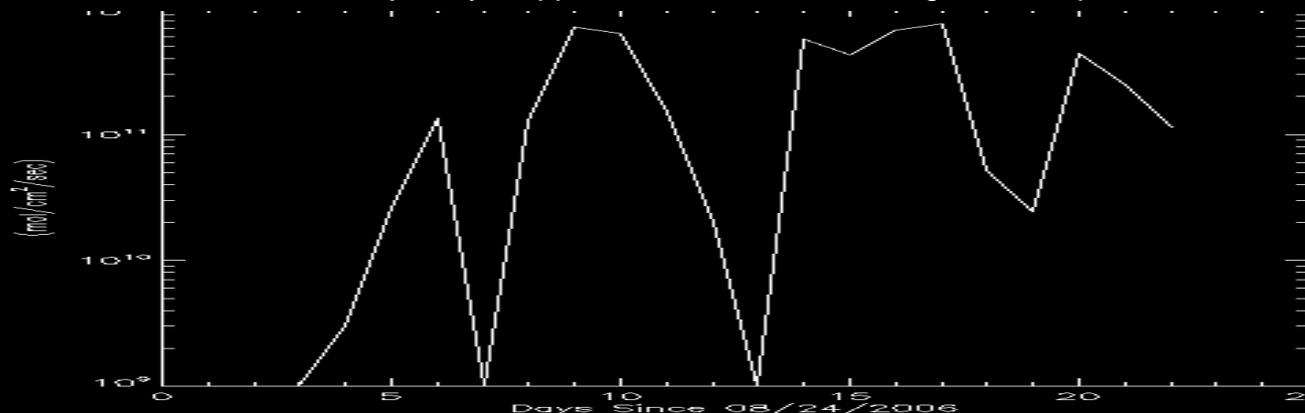
0.0 0.5 1.0 1.5 2.0 2.5 3.0  
(log10(#))

Ozone P-L along Wildfire Trajectories 20060915



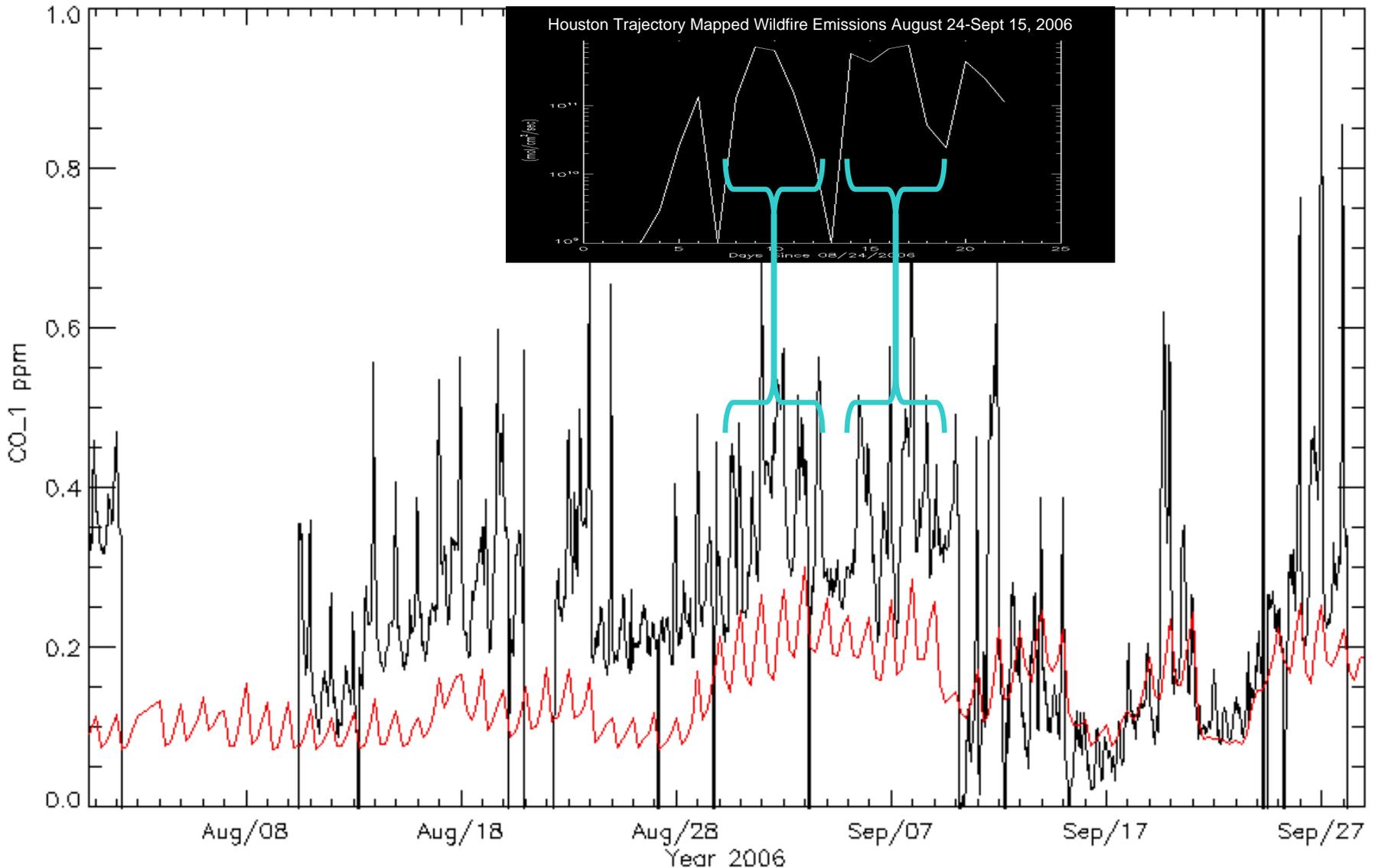
-4 -2 0 2 4 6 8 10  
(ppbv/day)

Houston Trajectory Mapped Wildfire Emissions August 24-Sept 15, 2006



Sep 15, 2006

CAMS 35, Region 12 Houston, EPA Site: 48-201-1039  
Site: Hous.Deer Park 2 C35/1001/AFH139F239 [H]



**Periods of enhanced biomass burning influences over Houston correspond to period of elevated surface CO at the TCEQ Deer Park site**

# Summary

**Trajectory analysis of continental scale transport of biomass burning emissions, combined with satellite observations of column CO and tropospheric O<sub>3</sub> suggest that:**

**Southwestward transport of emissions from biomass burning in the lower Mississippi Valley (LA, MS) and Southeastward transport of emissions from Pacific Northwest wildfires contributed to enhanced CO mixing ratios at the Houston Deer Park TCEQ site on Aug 30-Sep 04, 2006.**