

# Process analysis of CAMx modeling for DFW Aug 1999 episode

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# Analysis of processes that create ozone

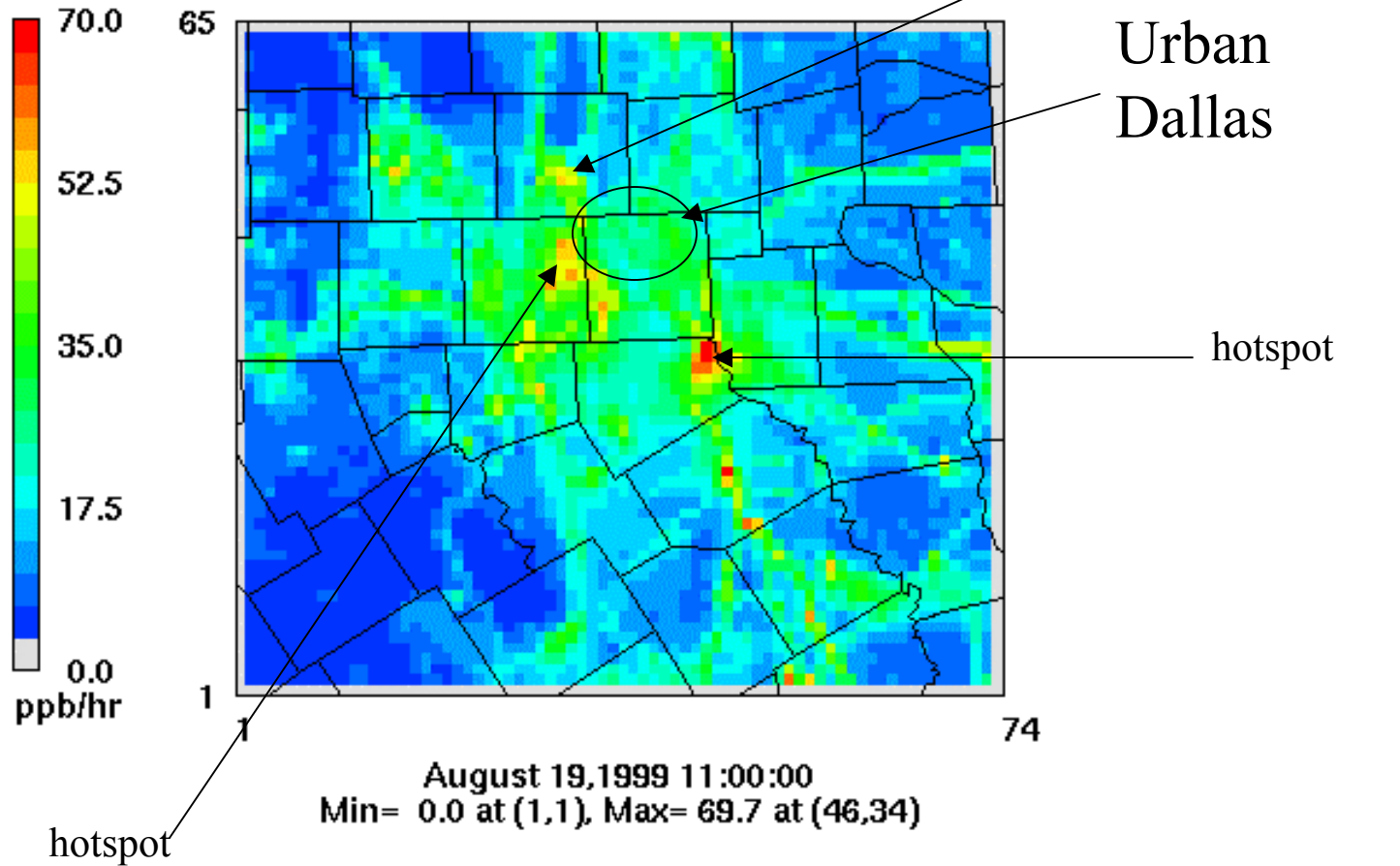
- Ox production: production of “odd oxygen” species, which include O<sub>3</sub> and other species that play important roles in O<sub>3</sub> formation, e.g., NO<sub>2</sub>
- Radical propagation:  
 $\text{OH} + \text{VOC} \rightarrow \text{HCHO}, \text{HO}_2, \text{etc.} \rightarrow \text{O}_3$
- Radical termination:  
 $\text{OH} + \text{NO}_2 \rightarrow \text{HNO}_3$

# 19 Aug 1999

- Excellent performance
- Ozone formation occurs primarily in NO<sub>x</sub> limited regime.
- Strongly VOC limited regime retards ozone formation in central Dallas.
- Anthropogenic and biogenic VOCs play a role in ozone formation.

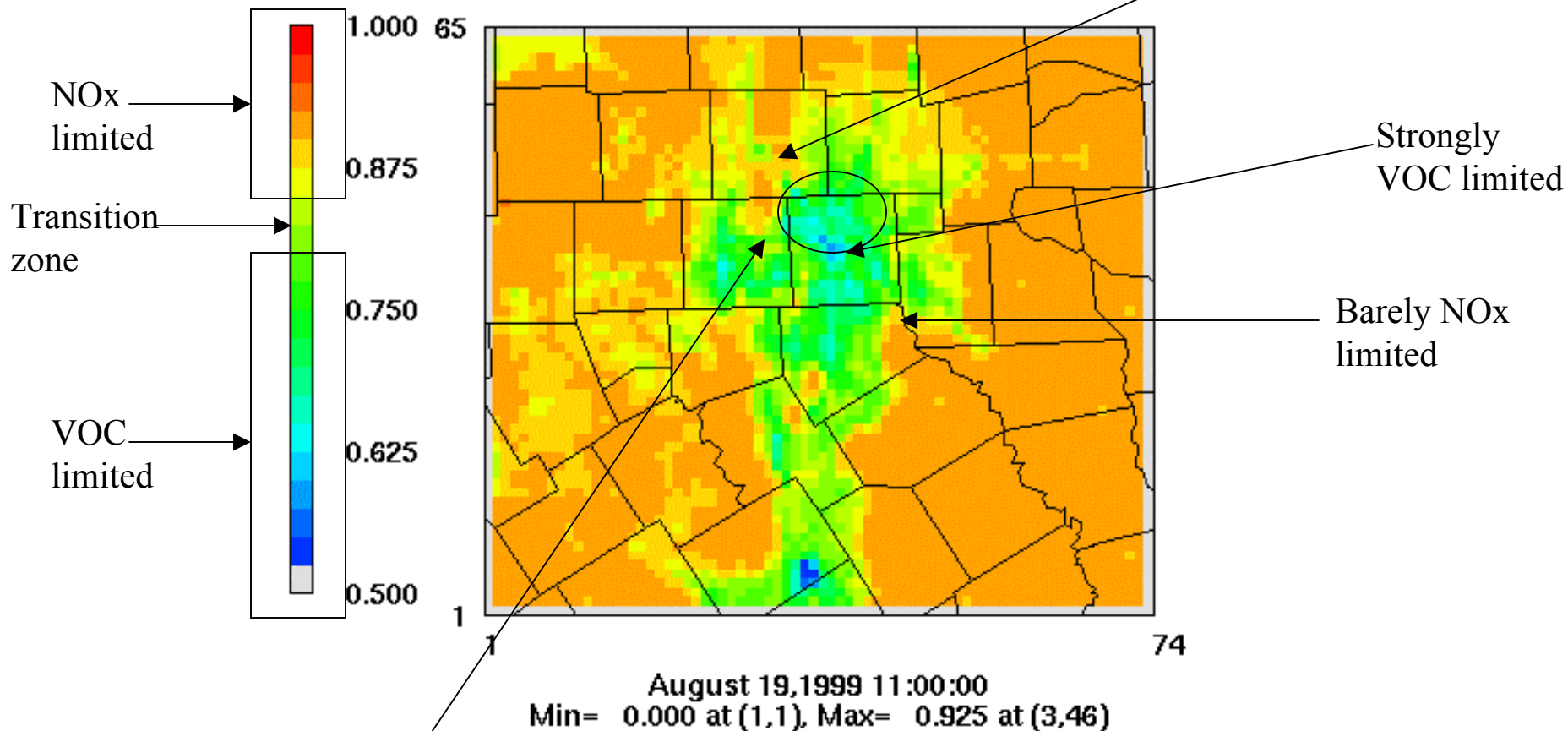
# Ox Production

19 Aug 1999, CAMx v4.03 run17b0\_pa1  
h=camx403\_cpa.19990819.1999.run17b0\_pa1.dfw\_04km



# Fraction OH reacting with VOCs

Radical propagation  
Rule of thumb:  $>0.85$  NO<sub>x</sub> limited;  $<0.80$  VOC limited



Barely NO<sub>x</sub> limited

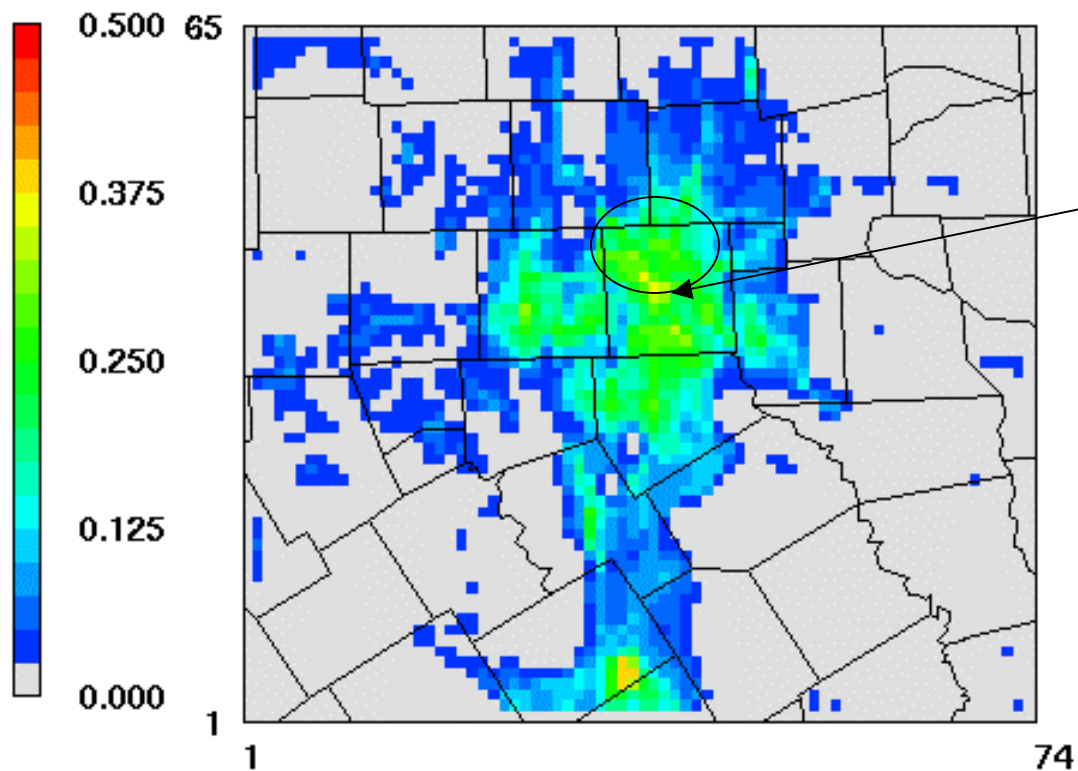
Strongly VOC limited

Barely NO<sub>x</sub> limited

Transition = enough of everything

# Fraction OH forming HNO<sub>3</sub>

Radical termination  
camx403\_cpa.19990819.1999.run17b0\_pa1.dfw\_04km

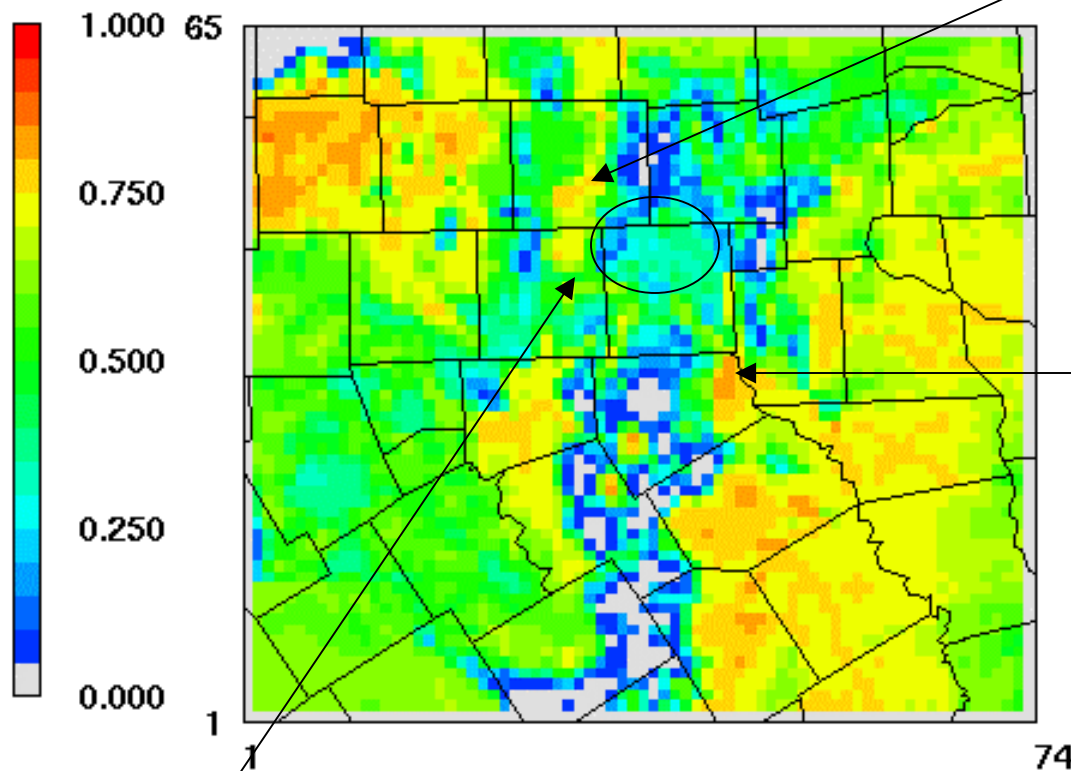


Strongly  
VOC limited

August 19, 1999 11:00:00  
Min= 0.000 at (1,1), Max= 0.393 at (36,5)

# Fraction HCHO from isoprene (biogenic)

CAMx v4.03 run17b0\_pa1 Aug 13-22 1999  
h=camx403\_cpa.19990819.1999.run17b0\_pa1.dfw\_04km



biogenic

biogenic

August 19, 1999 11:00:00  
Min= 0.000 at (1,1), Max= 0.867 at (3,55)

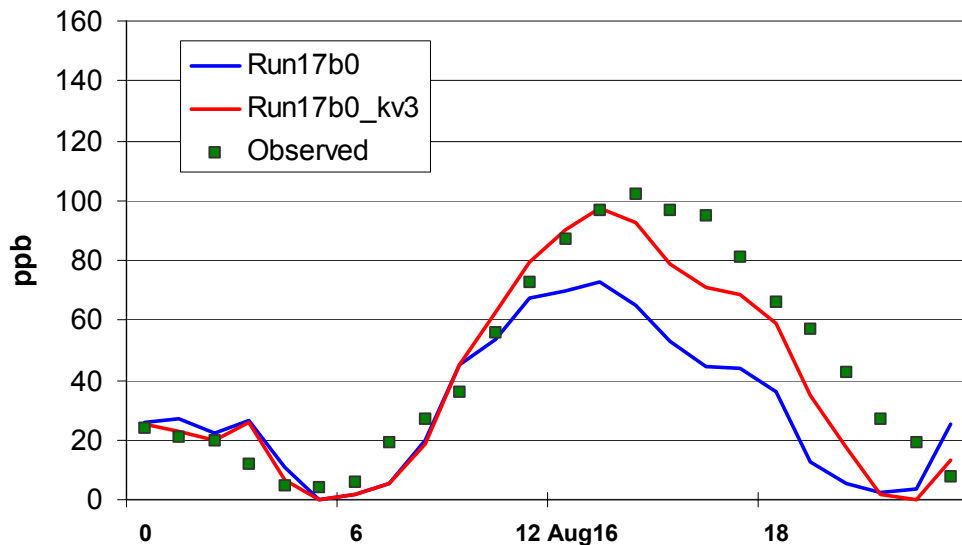
Mixed anthro and bio

# 16 Aug 1999

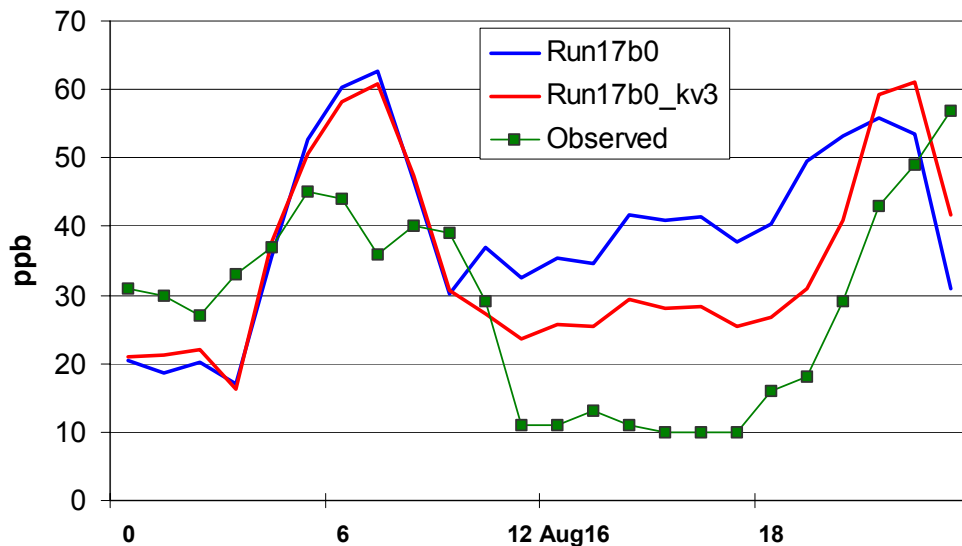
- Ozone performance improves greatly after mixing adjustments.
- New kv3 scenario mixes low-level urban NO<sub>x</sub> upward, thus creating a more favorable environment for ozone formation in central Dallas.
- O<sub>3</sub> concentrations increase, NO<sub>2</sub> concentrations decrease.



### Hinton Ozone Concentrations, 16 Aug 1999

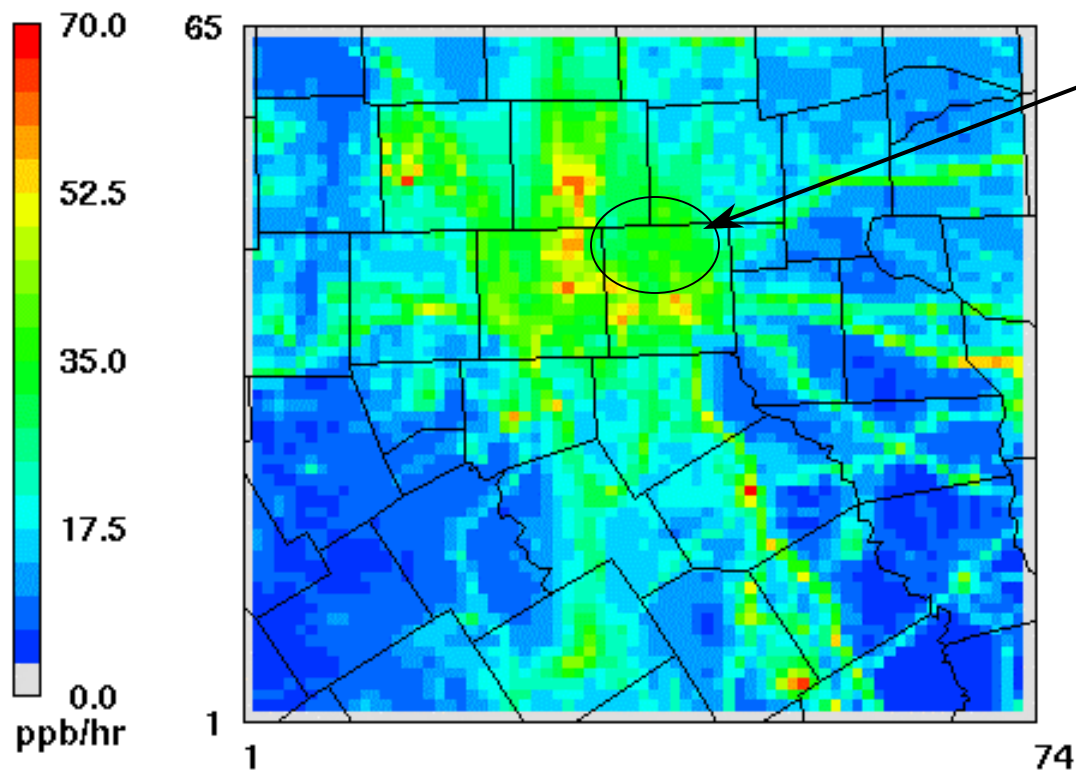


### Hinton NO2 Concentrations, 16 Aug 1999



# Ox Production

16 Aug 1999, CAMx v4.03 run17b0\_pa1  
b=camx403\_cpa.19990816.1999.run17b0\_pa1.dfw\_04km

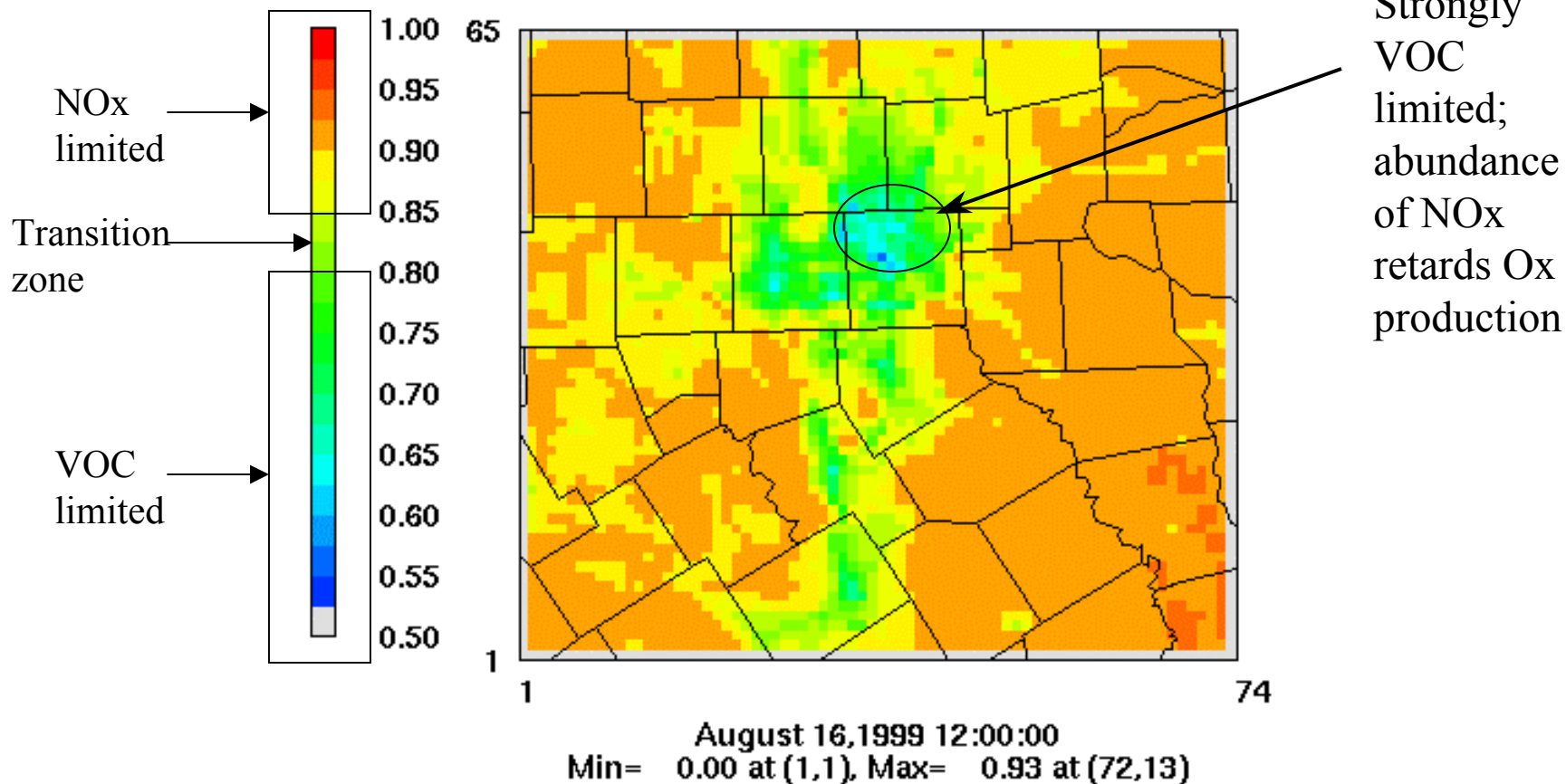


Relatively low  
Ox production

August 16, 1999 12:00:00  
Min= 0.0 at (1,1), Max= 72.7 at (48,22)

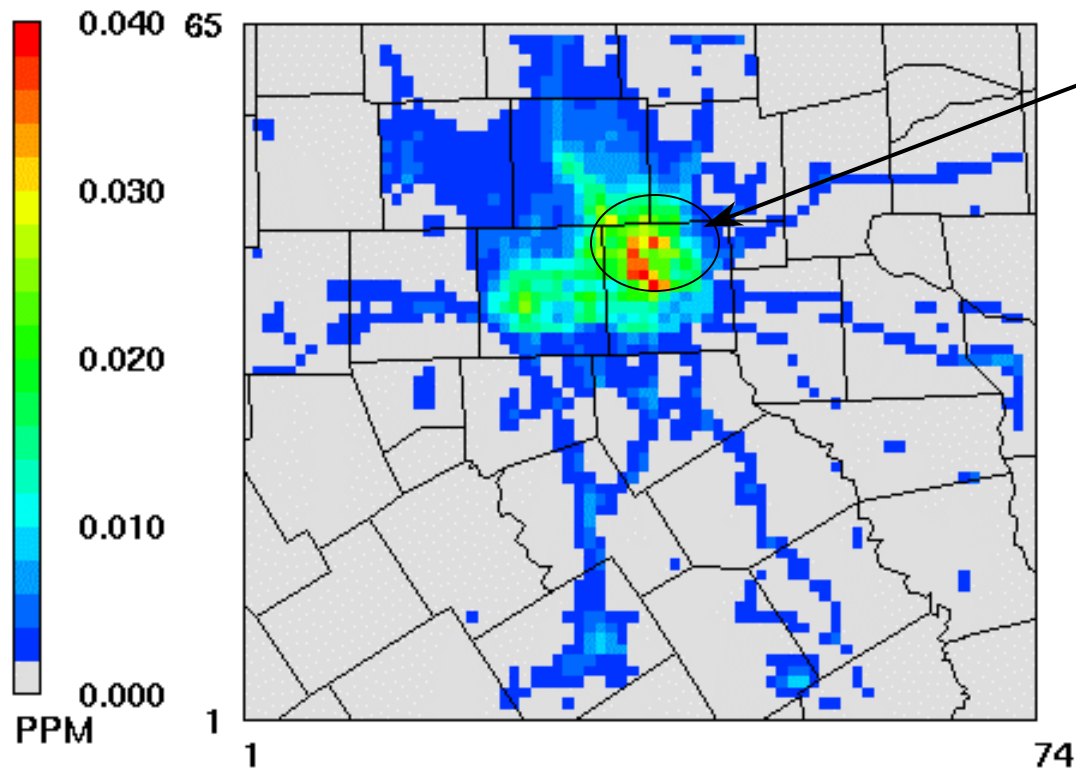
# Fraction OH reacting with VOCs

Radical propagation  
Rule of thumb: >0.85 NO<sub>x</sub> limited; >0.80 VOC limited



# NOx concentration

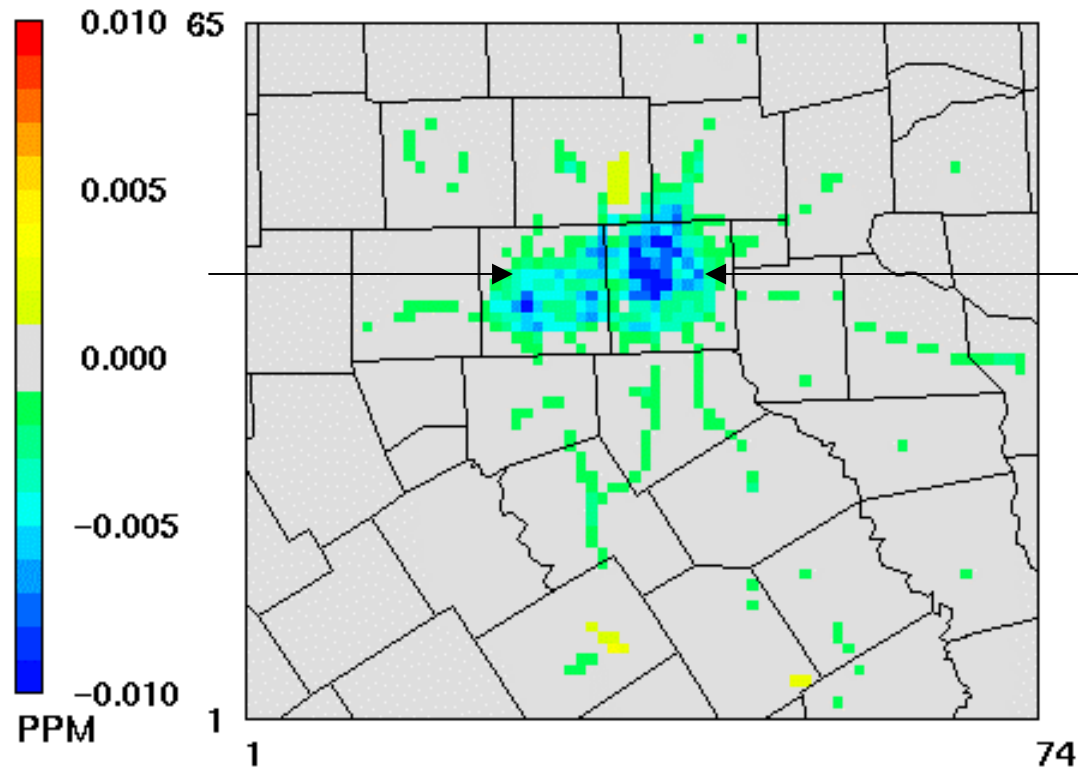
16 Aug 1999, CAMx v4.03 run17b0  
a=camx403\_avrg.19990816.1999.run17b0.dfw\_04km



Relatively large NOx concentrations

August 16, 1999 12:00:00  
Min= 0.000 at (1,1), Max= 0.054 at (38,42)

Layer 1 NO<sub>x</sub> decreases with increased mixing in lowest layers, especially in central Dallas



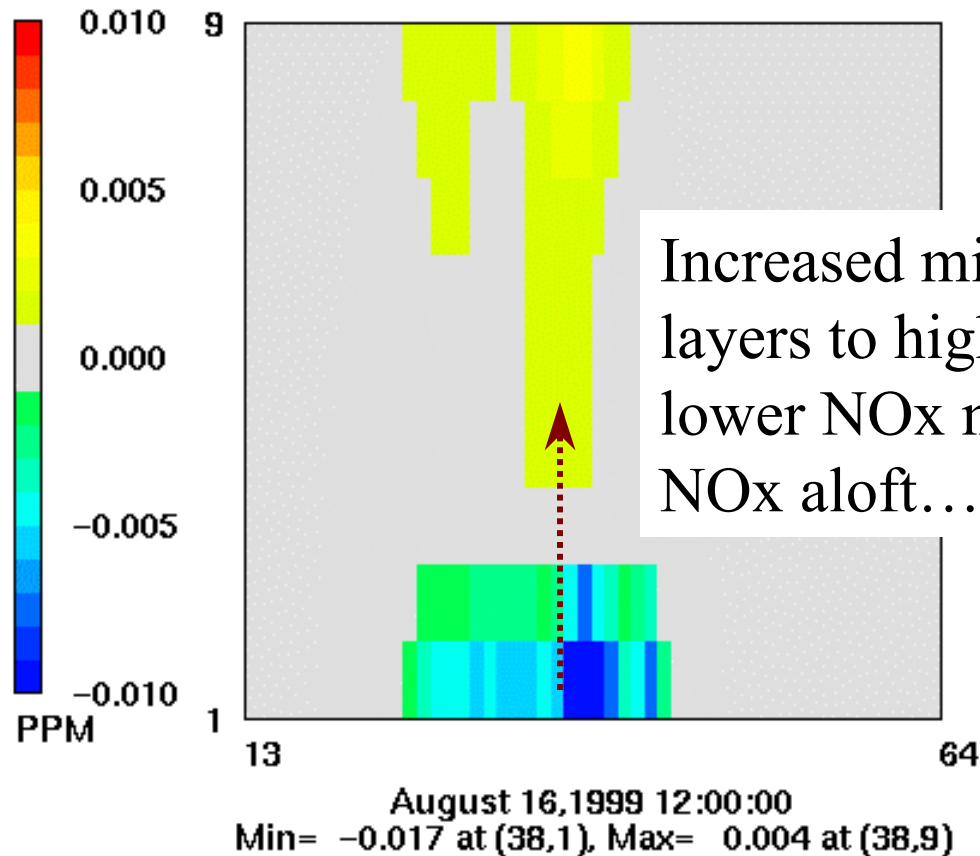
Vertical cross-section  
of this transect in  
next slide

August 16, 1999 12:00:00  
Min= -0.017 at (38,42), Max= 0.003 at (35,7)

# Vertical cross-section through central Dallas

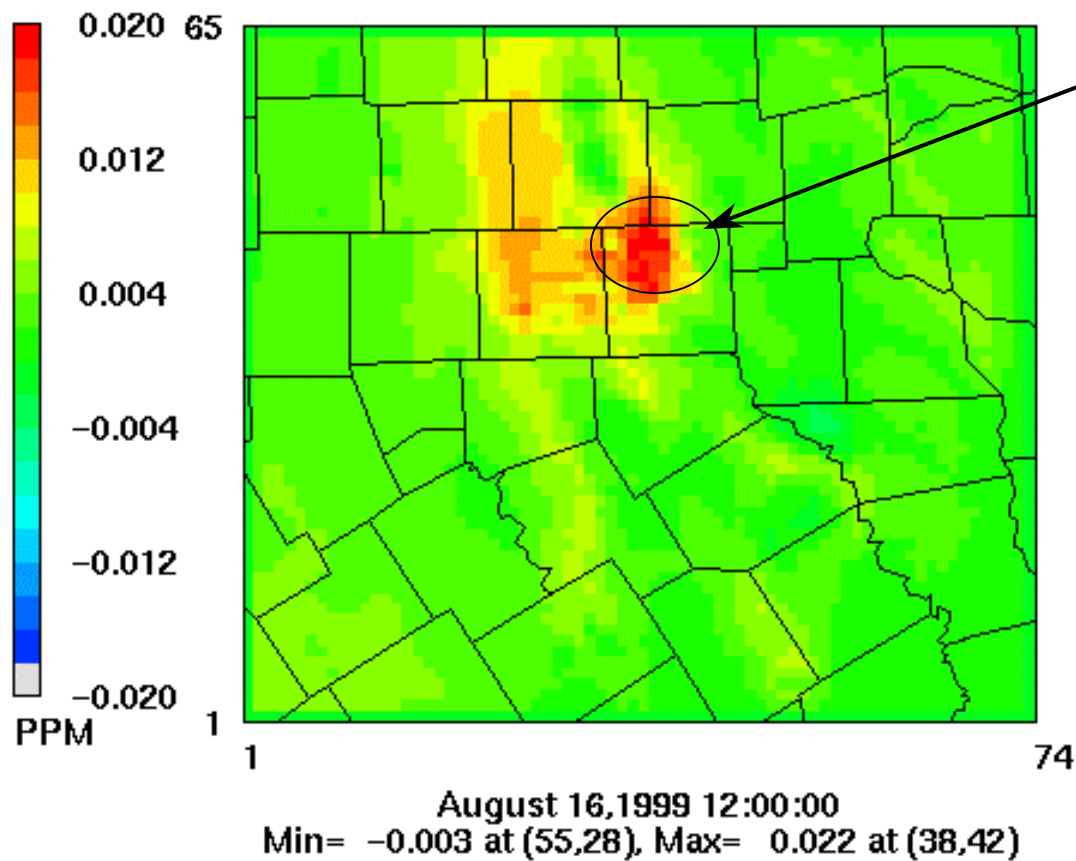
## Change in NO<sub>x</sub> with increased mixing

16 Aug 1999, run17b0\_kv3 - base case  
Row 42, central Dallas, 4km domain



# Change in O3 with increased mixing

16 Aug 1999, run17b0\_kv3 - run17b0



...which increases O3 formation in urban area of Dallas

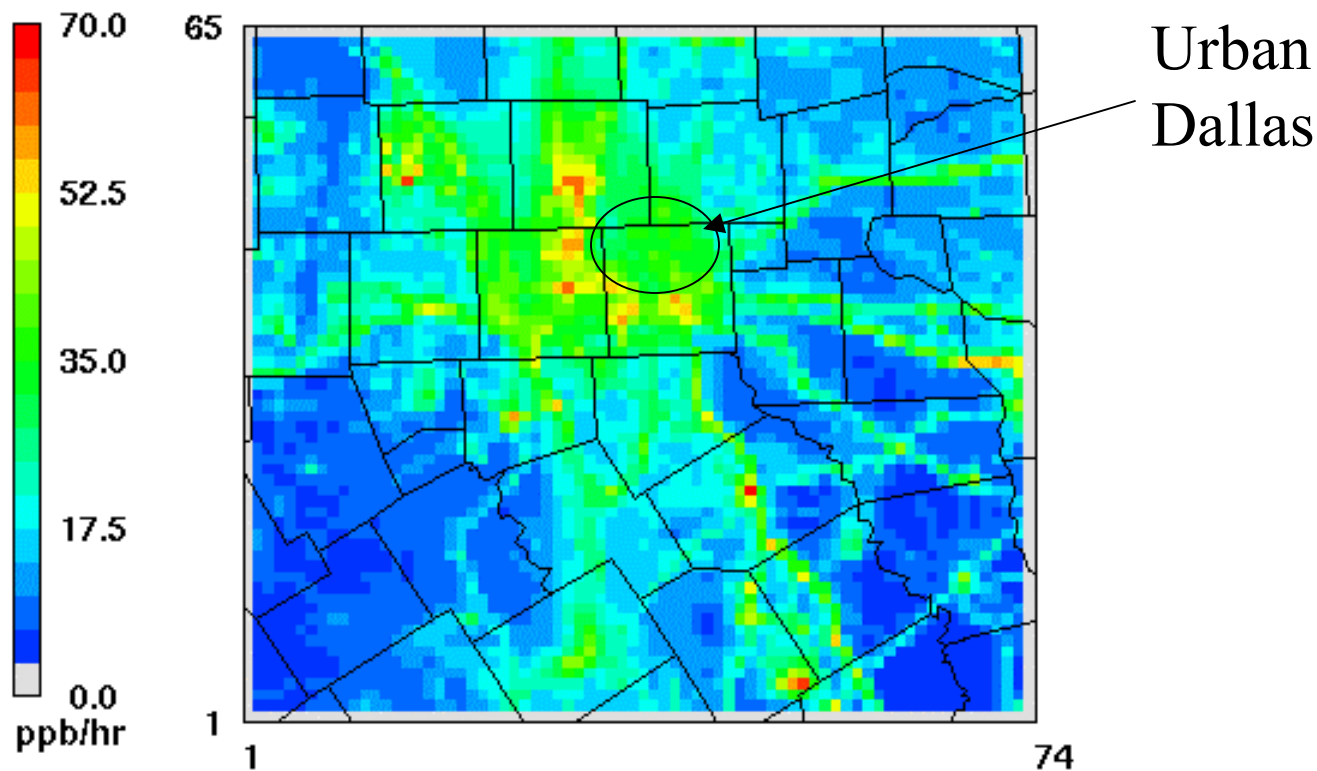
# Ox production on different episode days

- Ox is produced at the greatest relative rates at approximately the same locations in the 4-county area on most episode days.
- However, the absolute rates of Ox production can vary substantially from day to day.
- South of DFW, there are some Ox hotspots, from power plants, whose location varies with prevailing wind direction. Other hotspots appear to be small cities (e.g., Waco, Corsicana).



# Ox Production

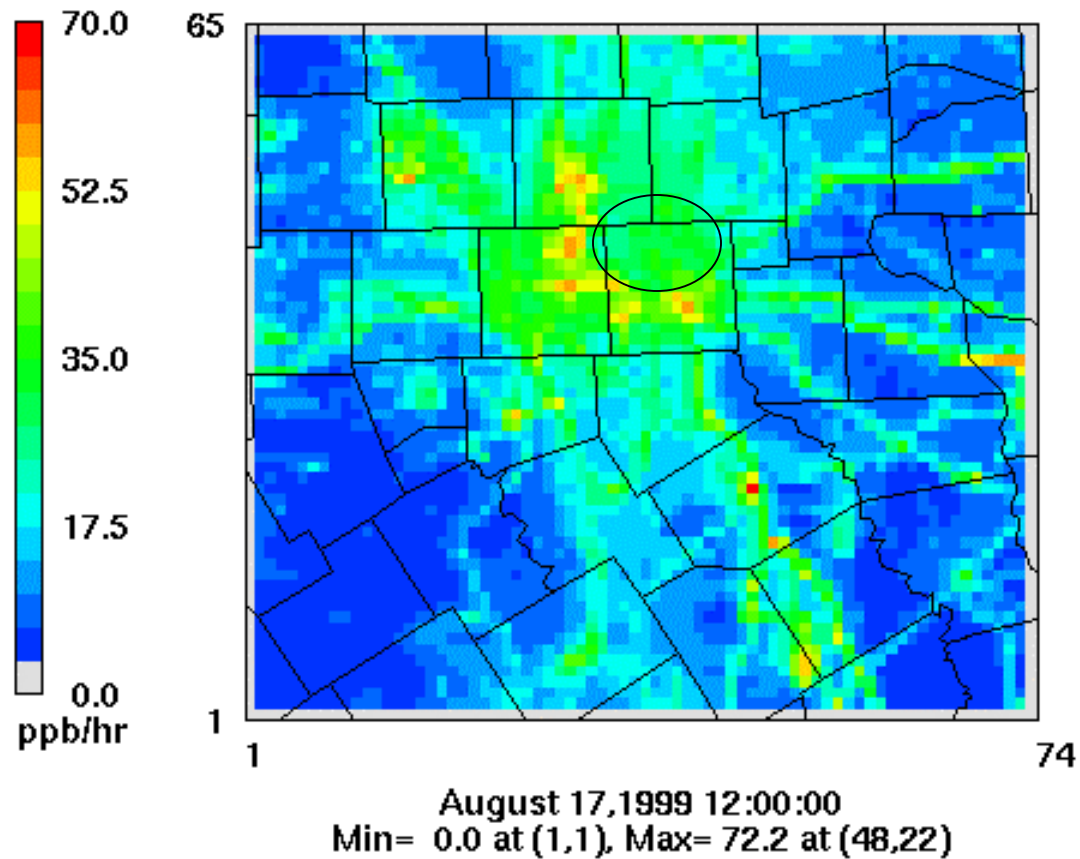
16 Aug 1999, CAMx v4.03 run17b0\_pa1  
b=camx403\_cpa.19990816.1999.run17b0\_pa1.dfw\_04km



August 16, 1999 12:00:00  
Min= 0.0 at (1,1), Max= 72.7 at (48,22)

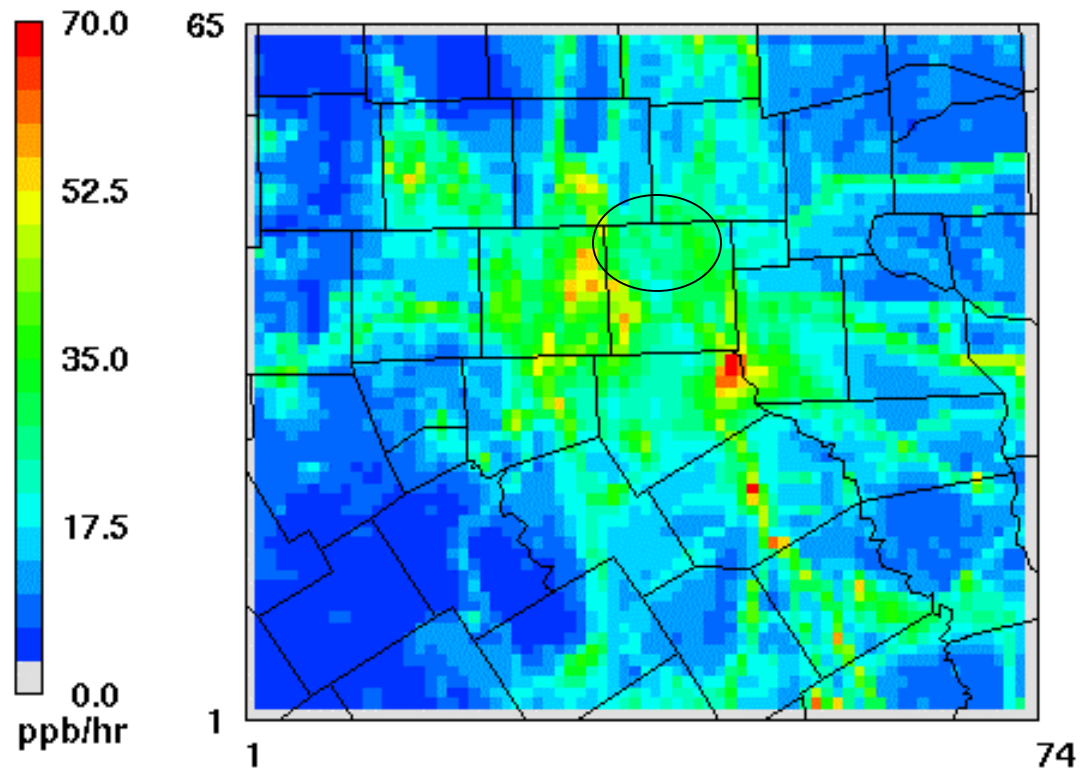
# Ox Production

17 Aug 1999, CAMx v4.03 run17b0\_pa1  
d=camx403\_cpa.19990817.1999.run17b0\_pa1.dfw\_04km



# Ox Production

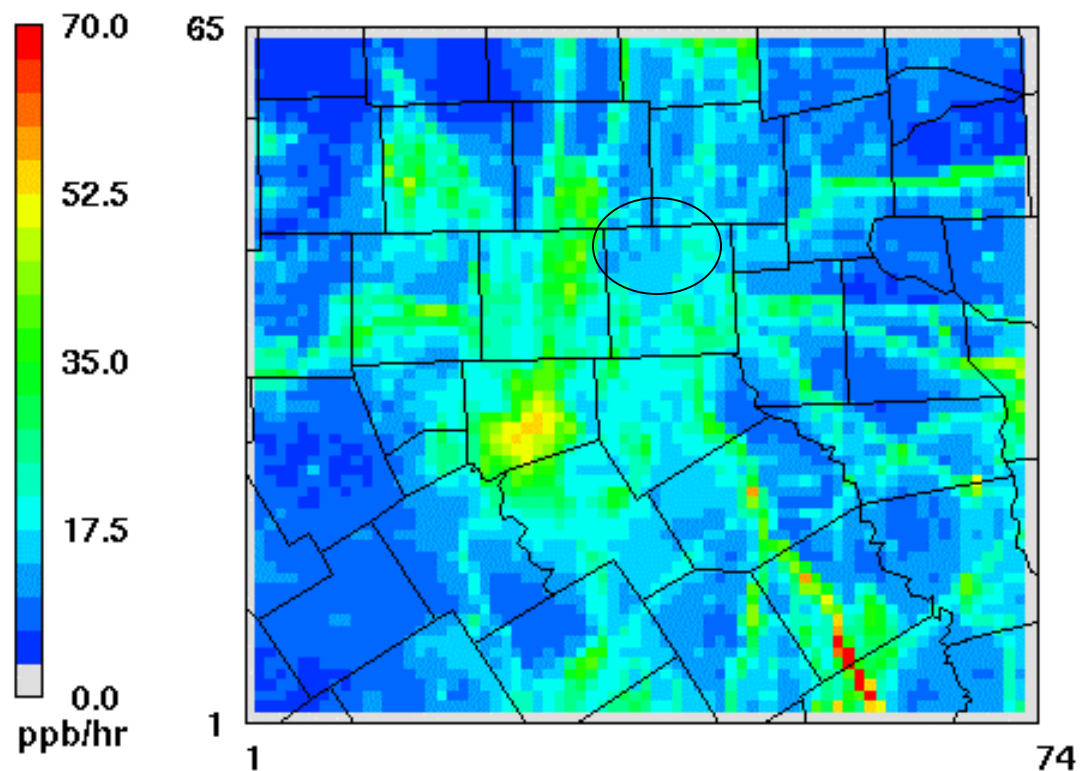
19 Aug 1999, CAMx v4.03 run17b0\_pa1  
h=camx403\_cpa.19990819.1999.run17b0\_pa1.dfw\_04km



August 19, 1999 11:00:00  
Min= 0.0 at (1,1), Max= 69.7 at (46,34)

# Ox Production

20 Aug 1999, CAMx v4.03 run17b0\_pa1  
g=camx403\_cpa.19990820.1999.run17b0\_pa1.dfw\_04km



August 20, 1999 12:00:00  
Min= 0.0 at (1,1), Max= 77.3 at (56,8)