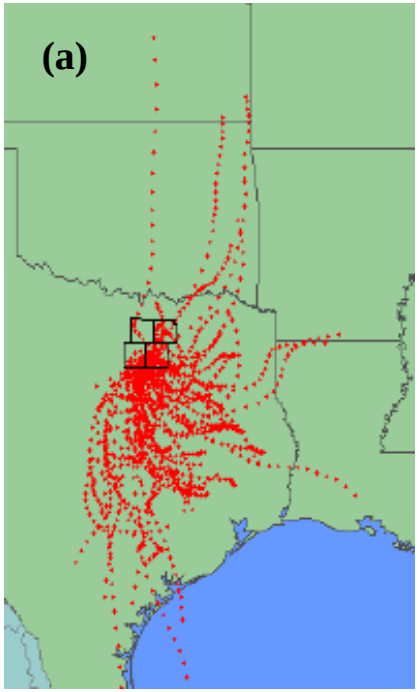
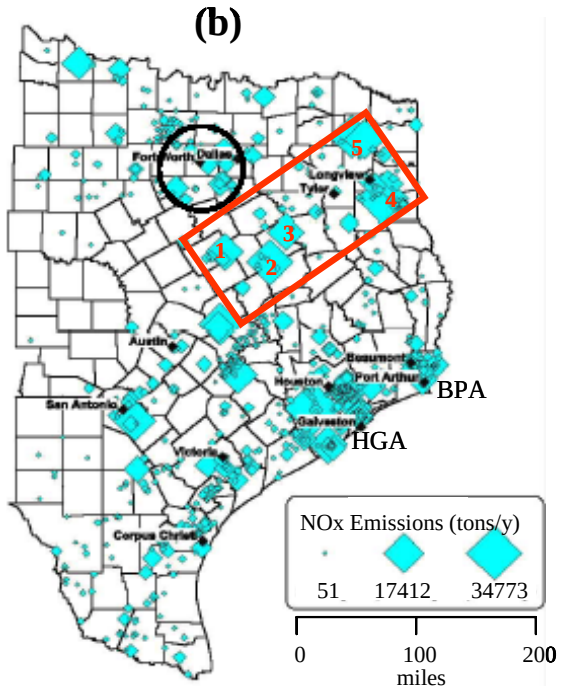



# Study of the Role of Transport in Shaping the Air Quality in DFW and E. Texas

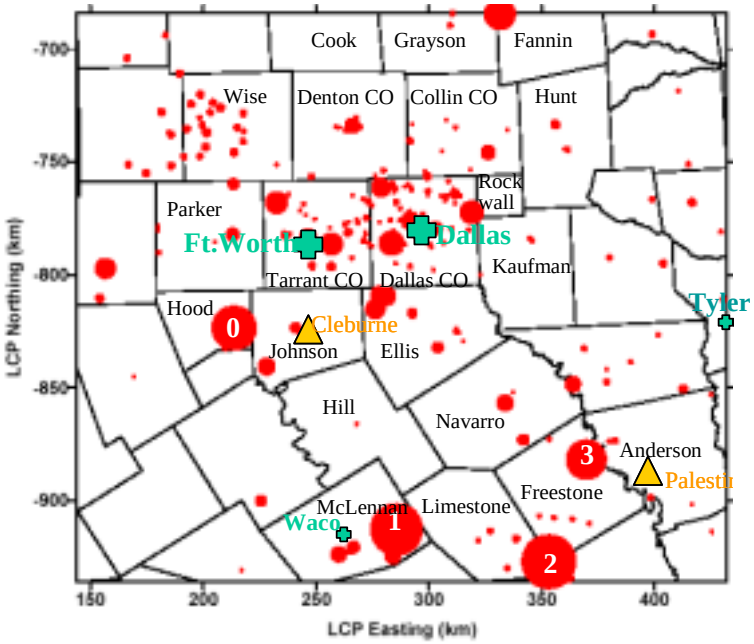
## 1. The NE Texas Plume Study

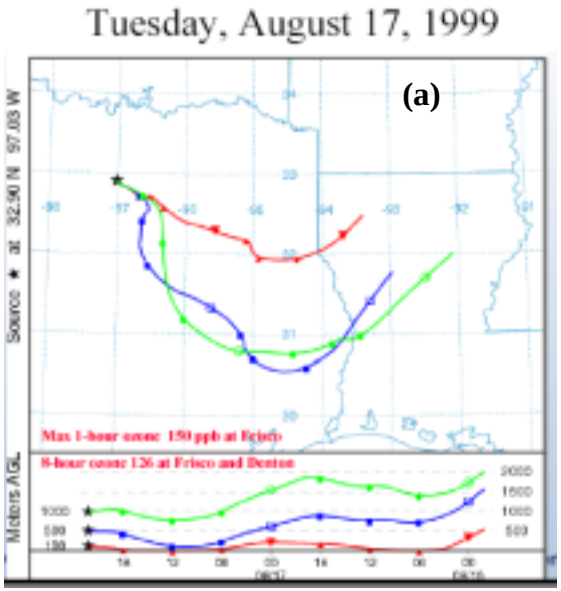
Quantitative exploration of the impact of upwind VOC, NOx emissions on DFW ozone based on field measurements (aircraft/sfc/met) and diagnostic modeling

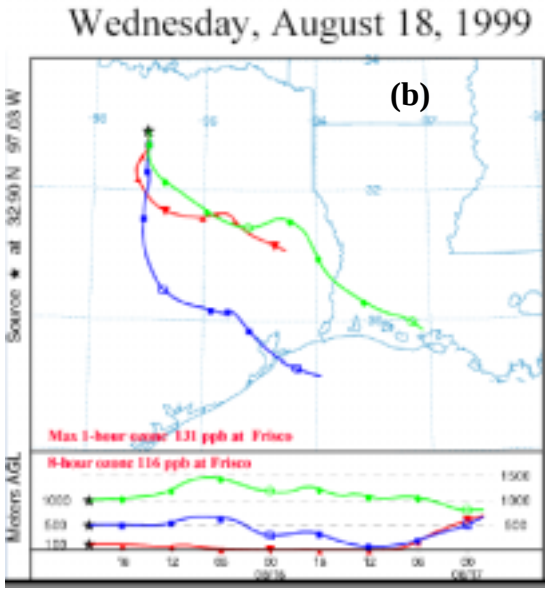
Sources within ~200km of DFW

## 2. The E. Texas Tetroon study

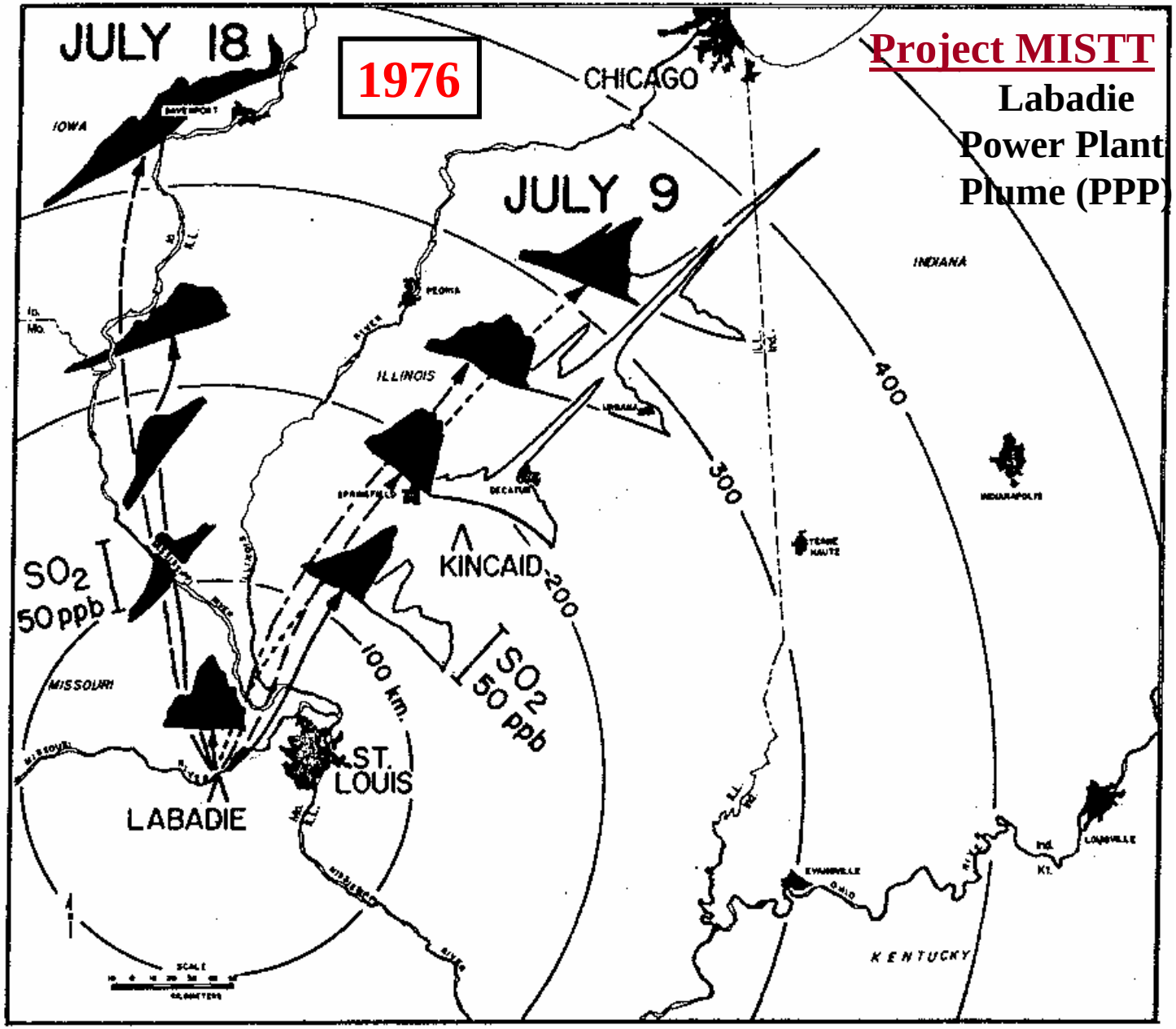
Longer range transport-chemistry



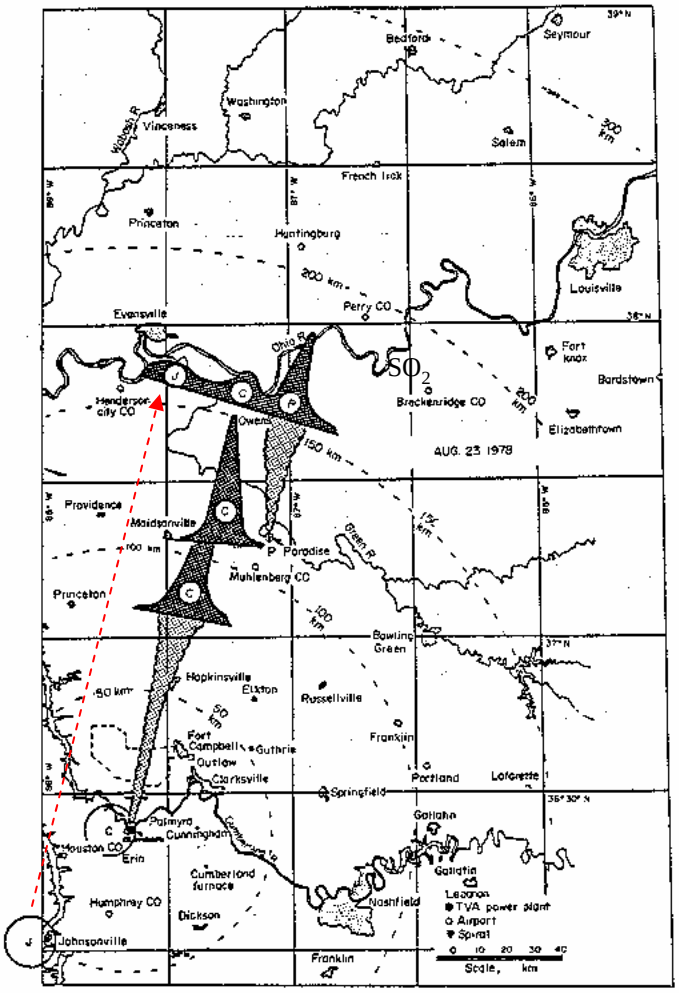



# Long-range airborne plume sampling



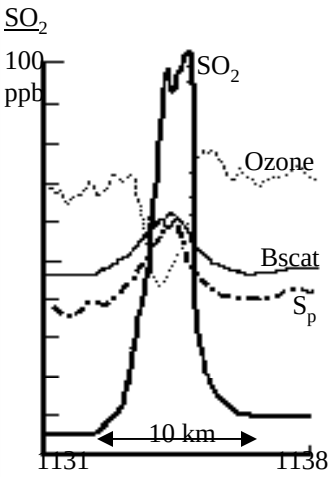
# Lagrangian Chemical Evolution of A Power Plant Plume (PPP)




C = Cumberland above
J = Johnsonville
P = Paradise
(all three are large TVA power plants within about 150 km of Nashville TN)

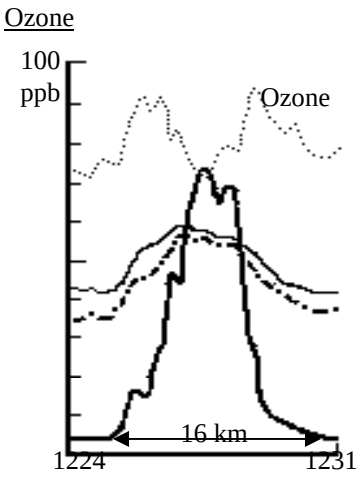
## Cumberland PPP of 8/23/1978

(~0700-0800 release)



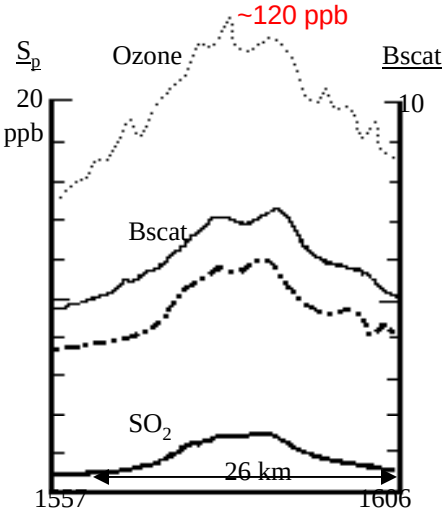

**Stage 1**

VOC-limited




**Stage 2**

Transition



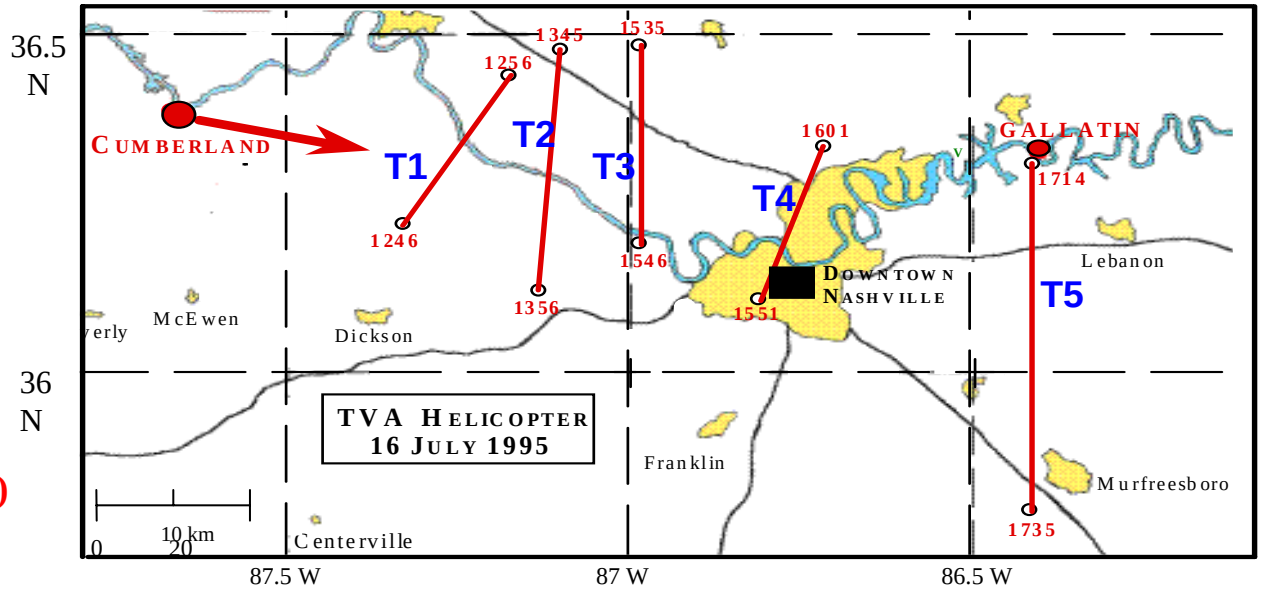

**Stage 3**

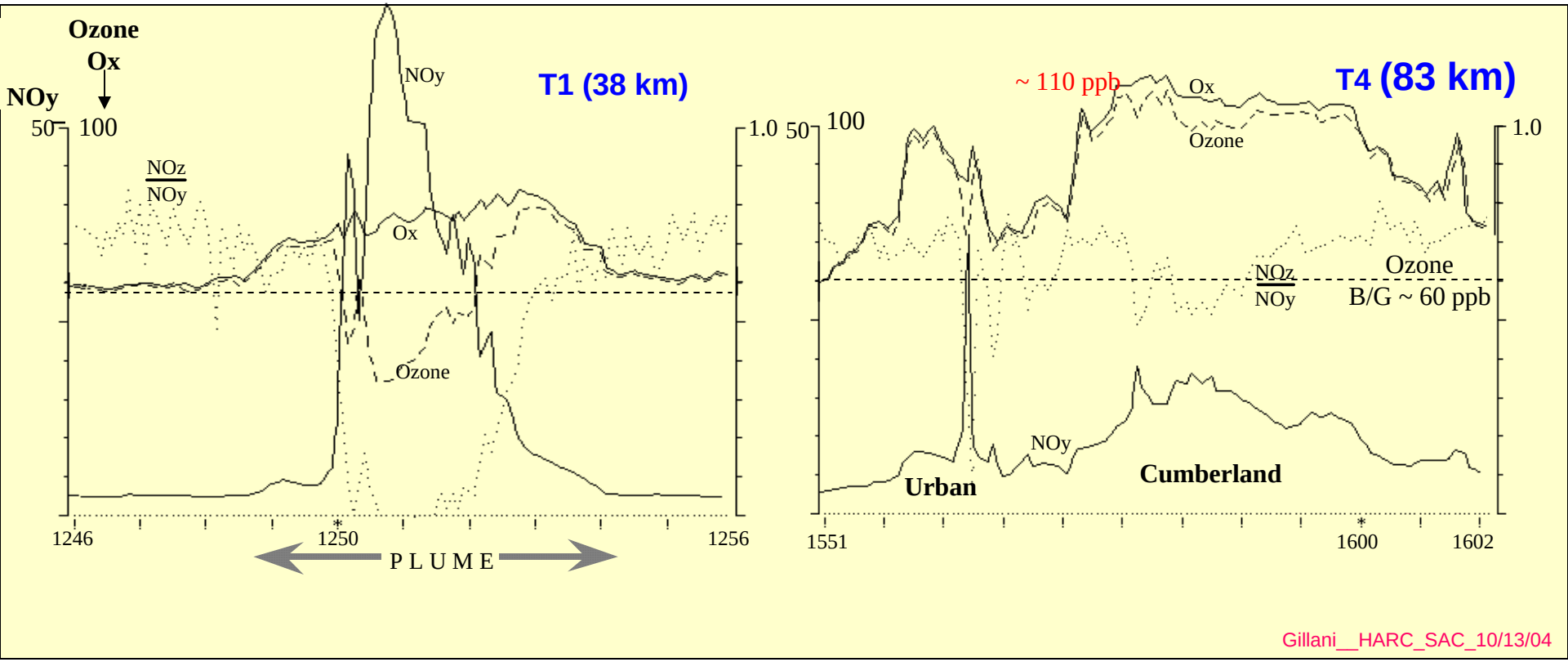
$NO_x$-limited

**160 km downwind**

# Cumberland Plume
# 16 July 1995

**(T1,T2,T4 ~ Lagrangian air parcel)**

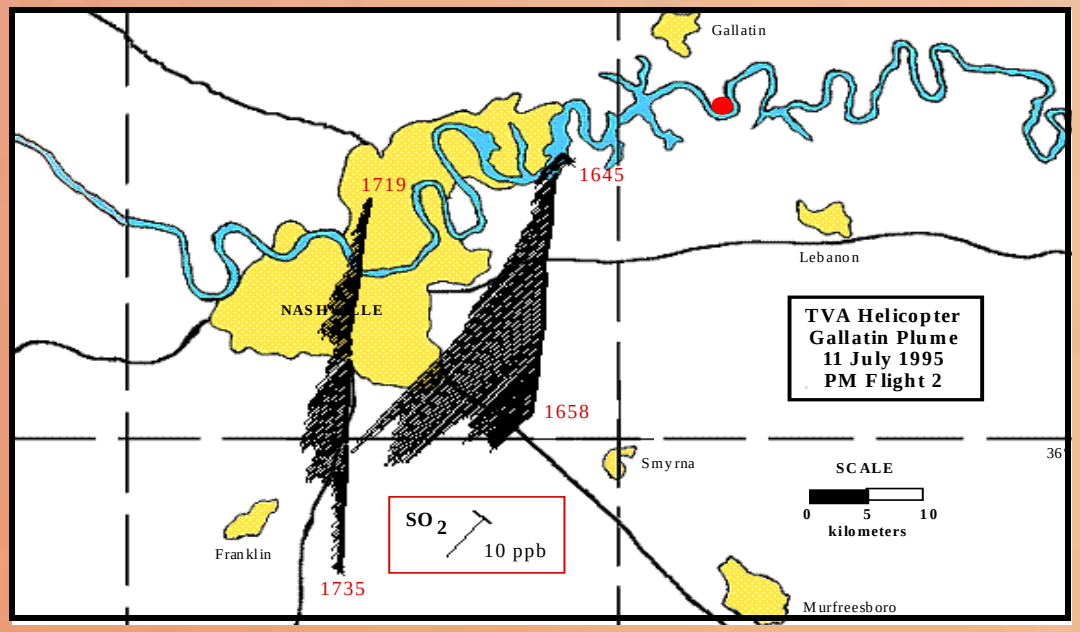


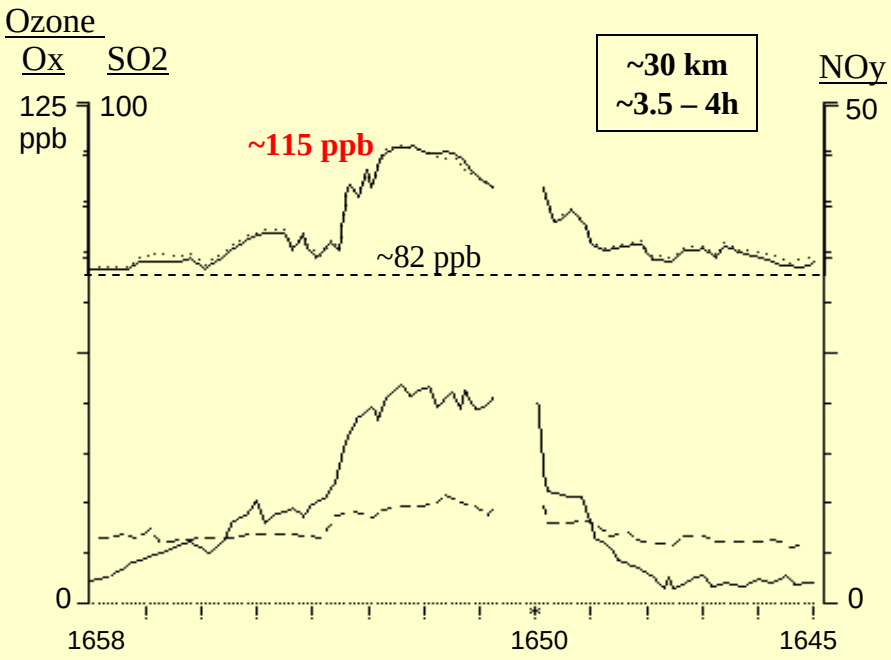



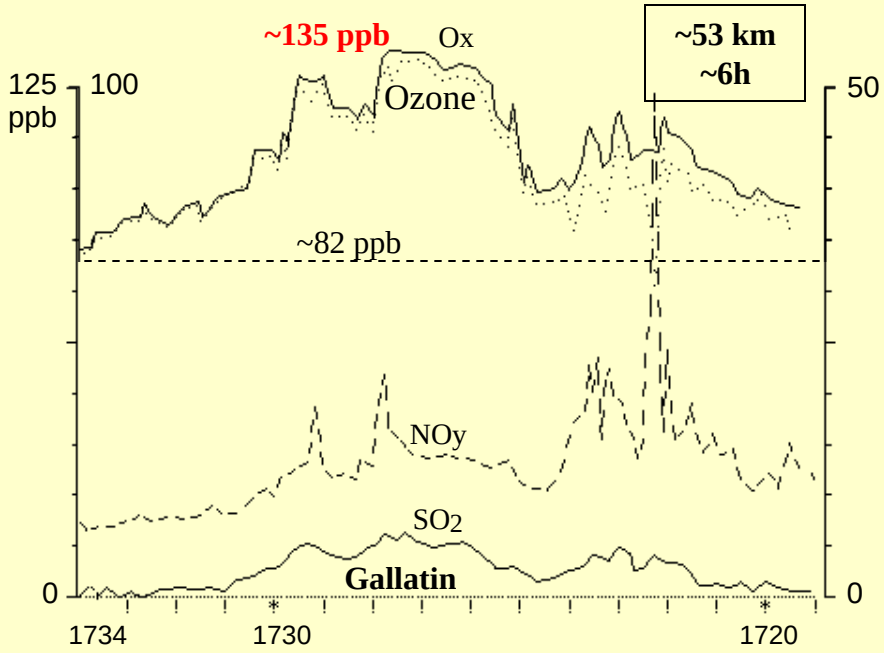
# Gallatin Plume

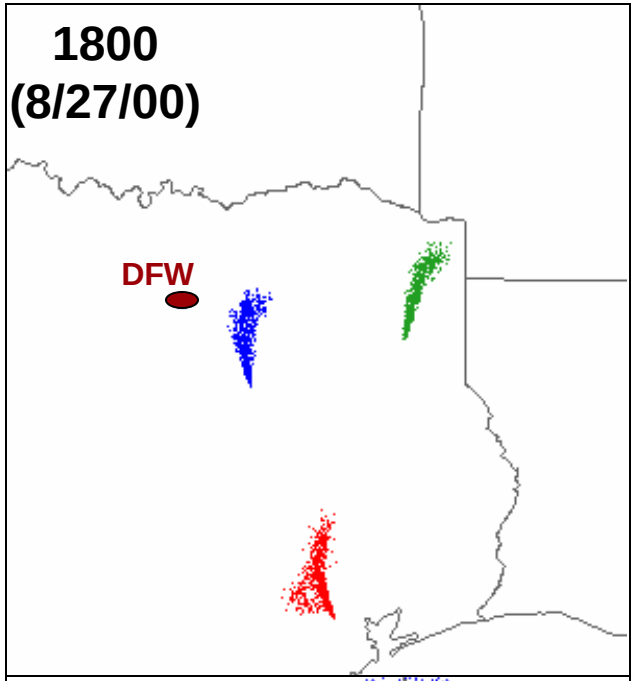
## Late afternoon

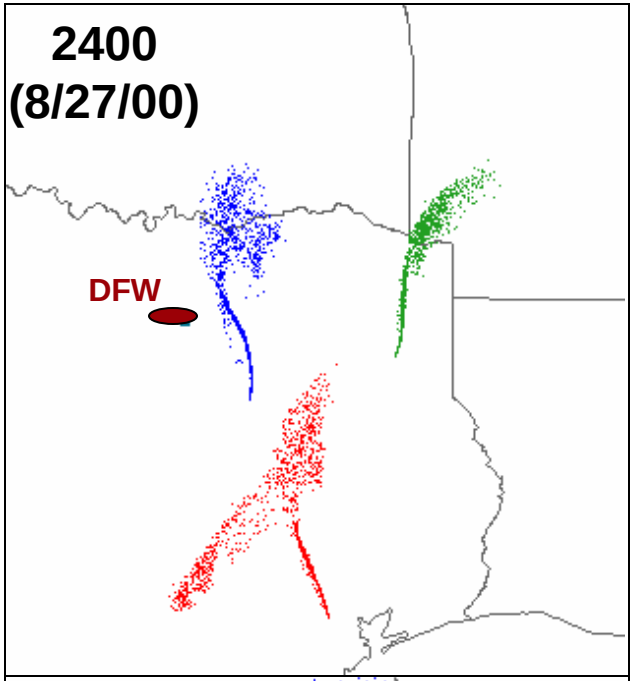
## 11 July 1995

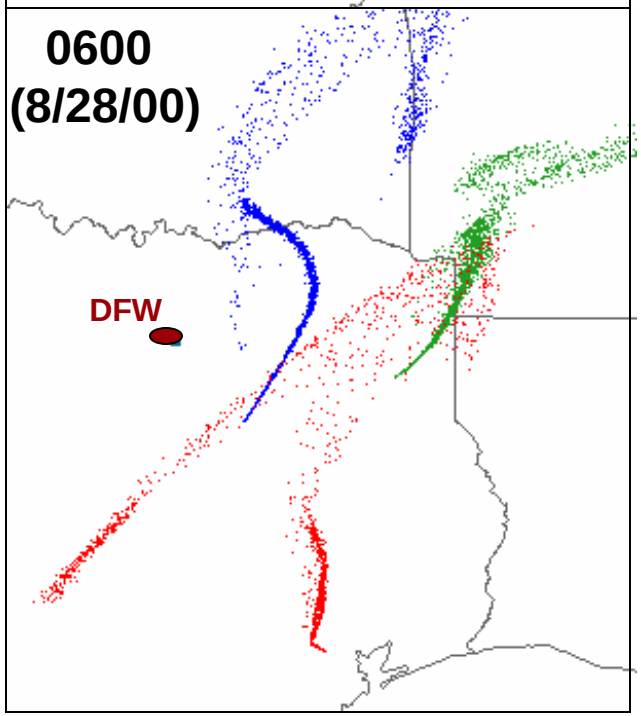


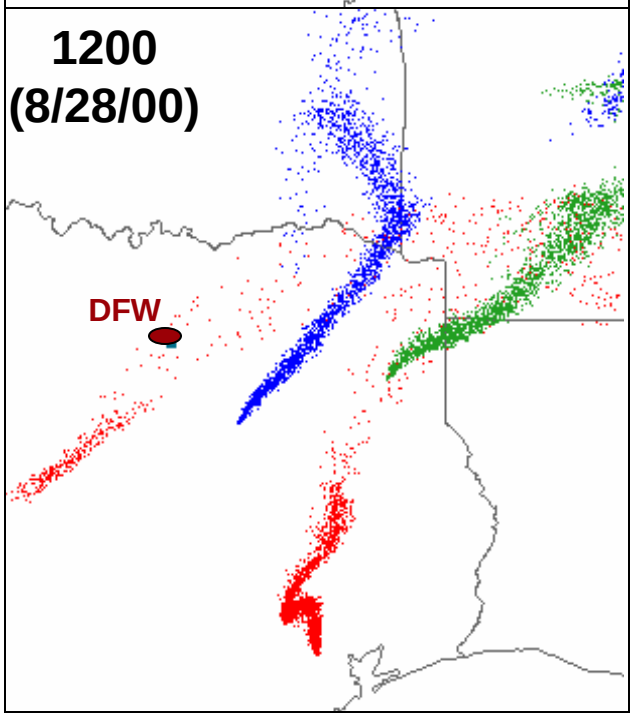





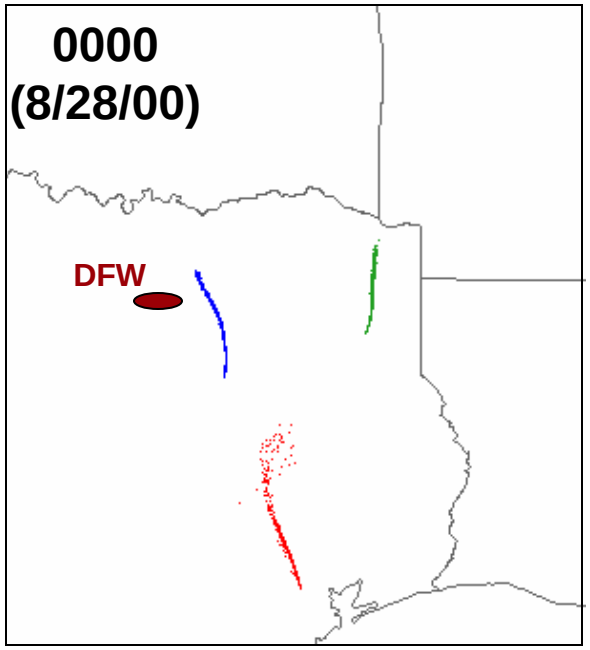



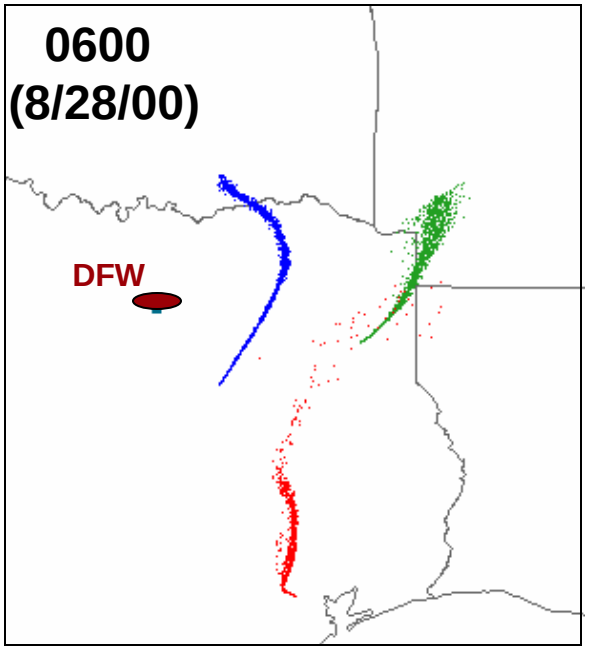



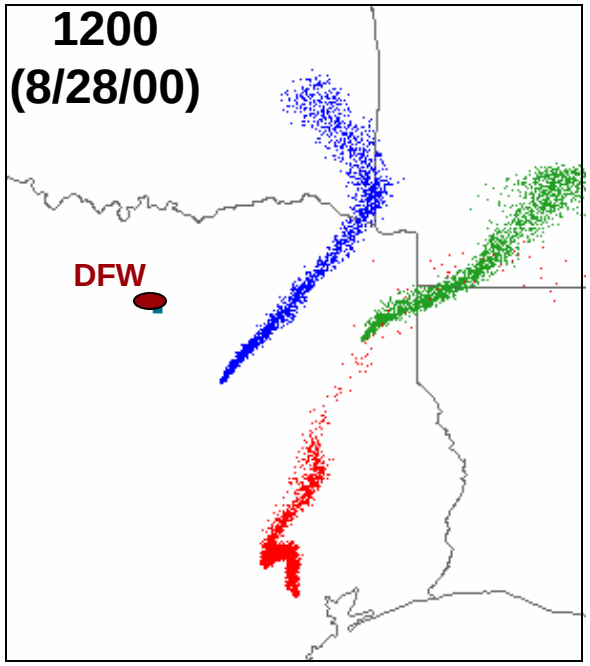

**UAH-LPDM(p) Simulation of three continuous particle releases (every 30 s) Starting at noon on 27 Aug 2000**

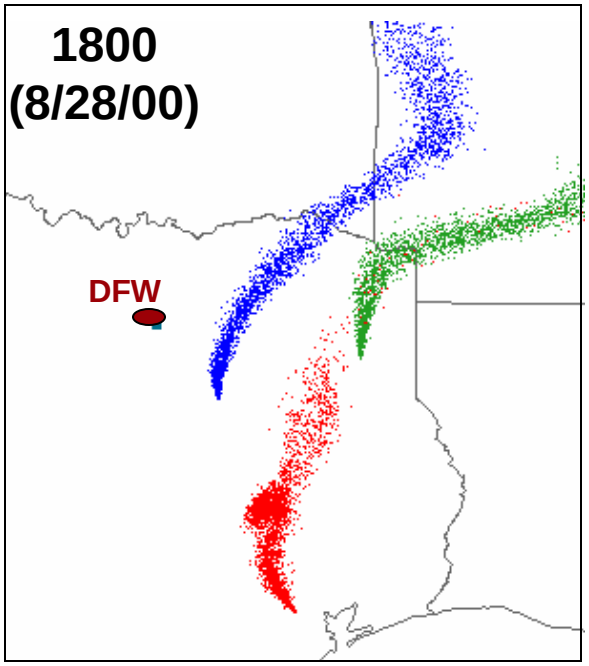
## The Releases

- Downtown Houston (30 m)
- Martin Lake, Longview (30 m)
- Limestone Power Plant (100 m)




**UAH-LPDM(p)**
**Simulation**
**of three**
**continuous**
**particle releases**
**(every 30 s)**
**Starting at**

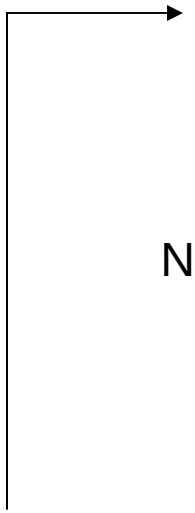
**1800**

**on**
**27 Aug 2000**

## The Releases

- Downtown Houston (30 m)
- Martin Lake, Longview (30 m)
- Limestone Power Plant (100 m)

# Night-time Chemistry of HNO3 Production



$NO_2 + O_3 \rightarrow NO_3 + O_2$

$NO_2 + NO_3 \rightarrow N_2O_5$

$N_2O_5 + H_2O + (M) \rightarrow 2HNO_3$

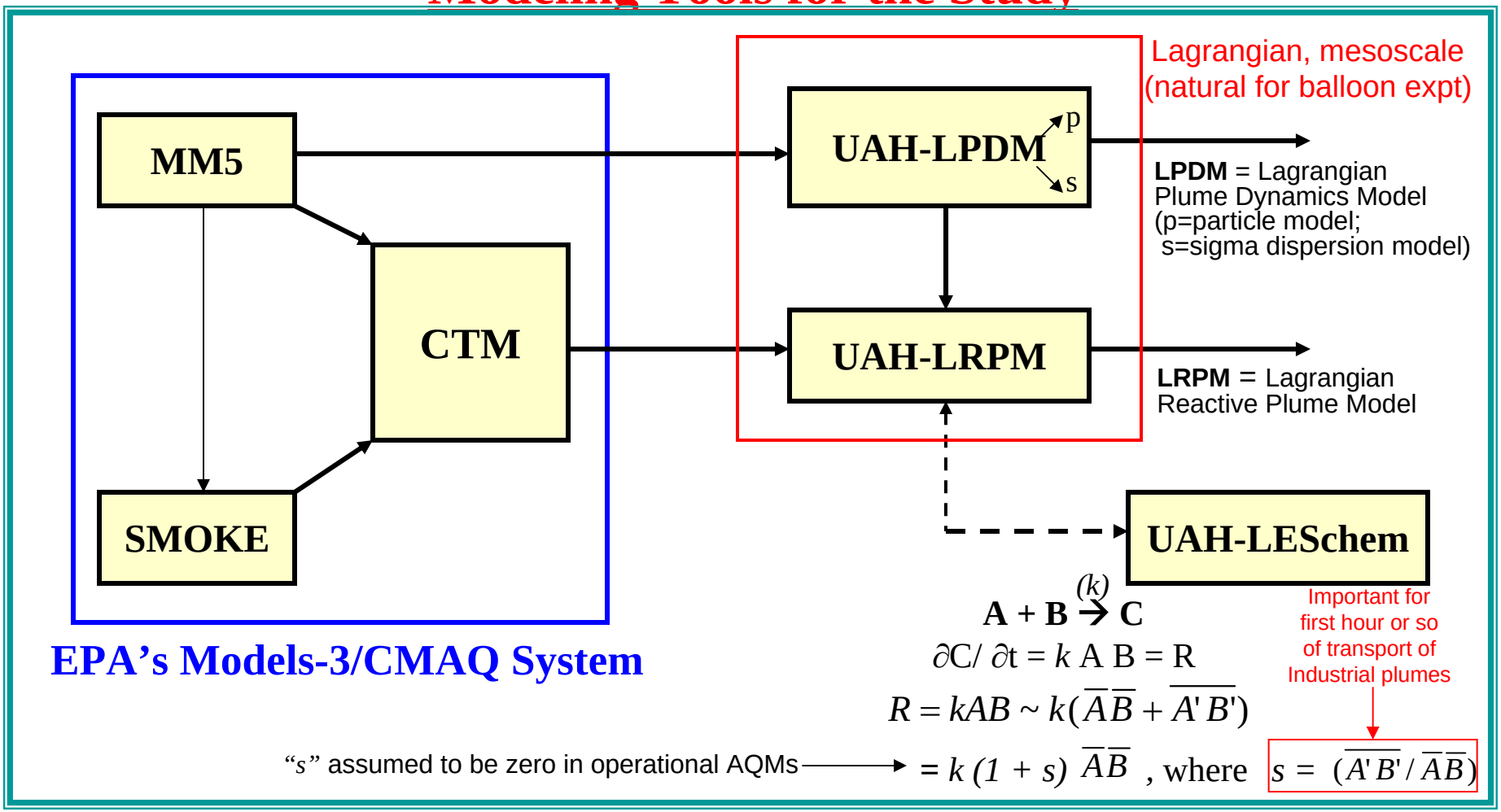
(M) = aerosol

Usually means chemically-processed airmass, e.g., well-mixed daytime plume in the nocturnal residual layer

# Lagrangian and LES Modeling of the Transport and Chemistry of Tagged Air Parcels In Support of the TexAQS Balloon Study

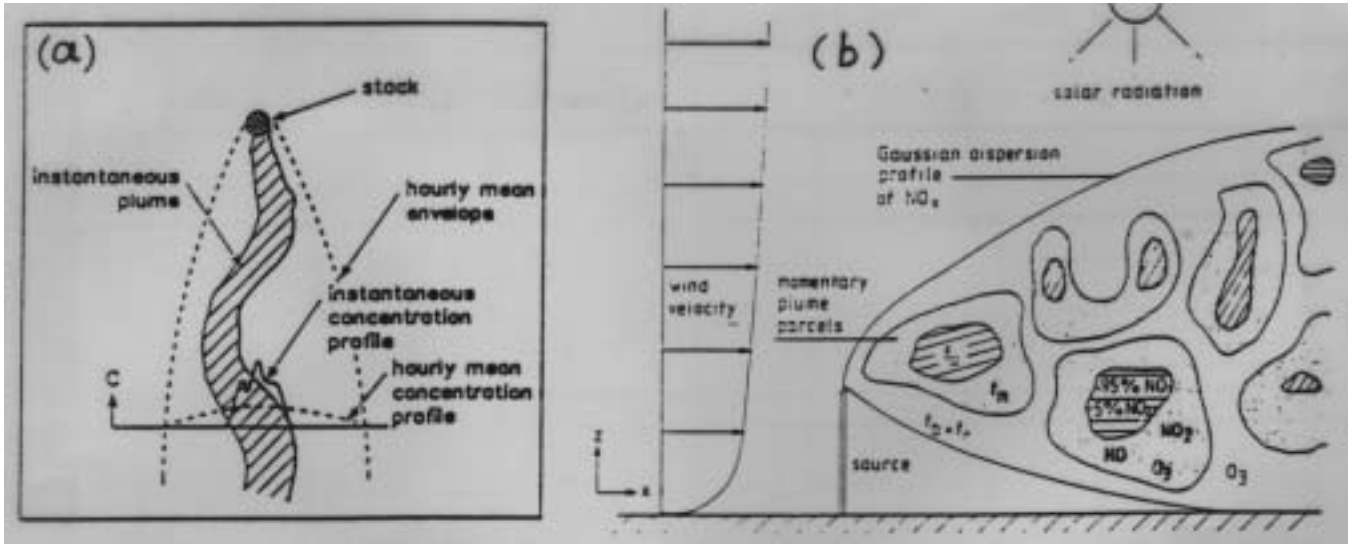
"Air parcel" = Dispersing plume and background

## Modeling Tools for the Study

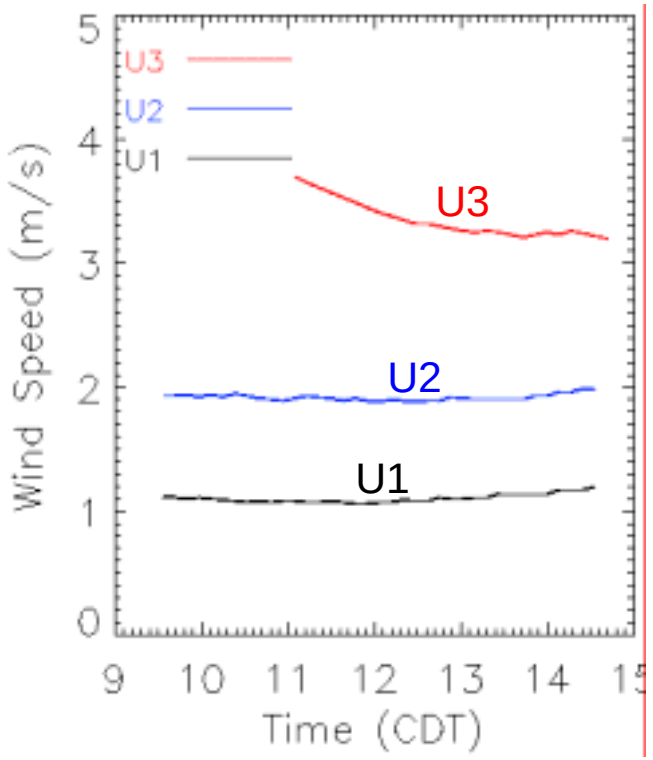


**Some processes resolved in LES but not in Operational AQMs**

Operational plume models usually assume Gaussian distribution of emissions within hourly-average envelopes, but the reality is quite different.



# LESchem simulation
# Sweeny plume, 8/28/2000
## (t = 2h after continuous emission)




U1

U2

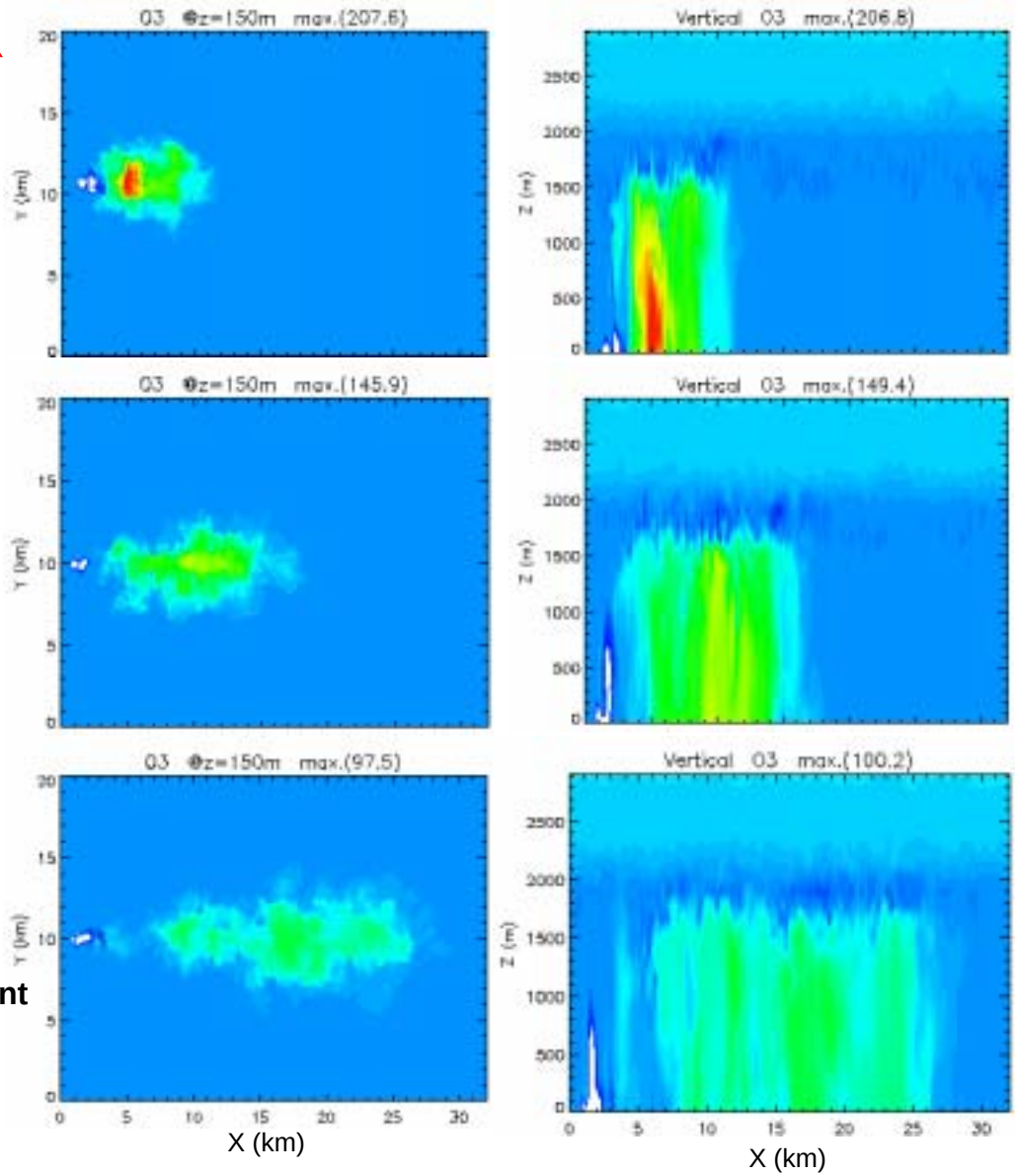
U3

**The measurement scenario)**

**X-Y plane**

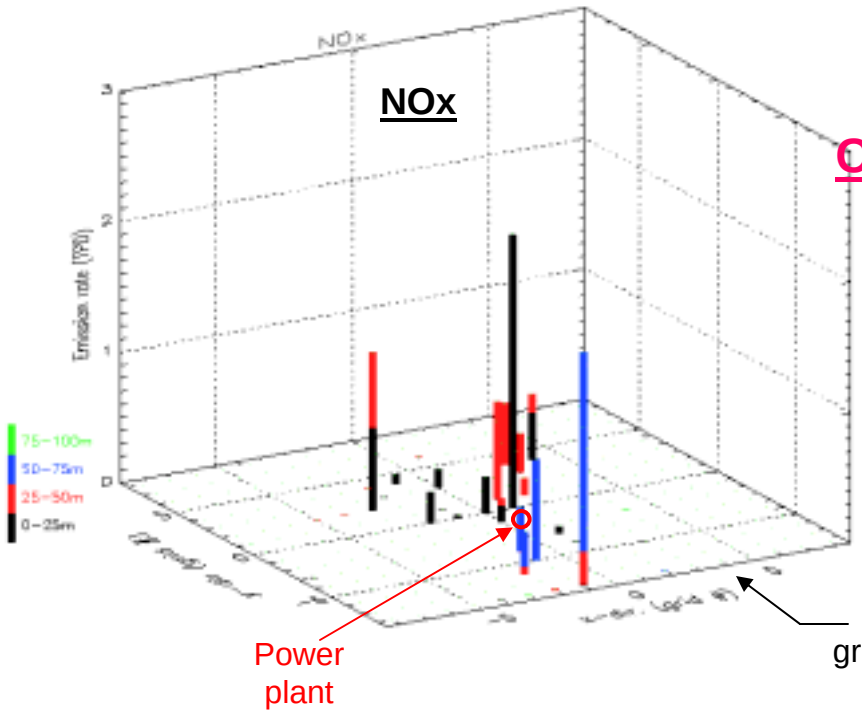
Emission @ x = 1km

**X-Z plane**



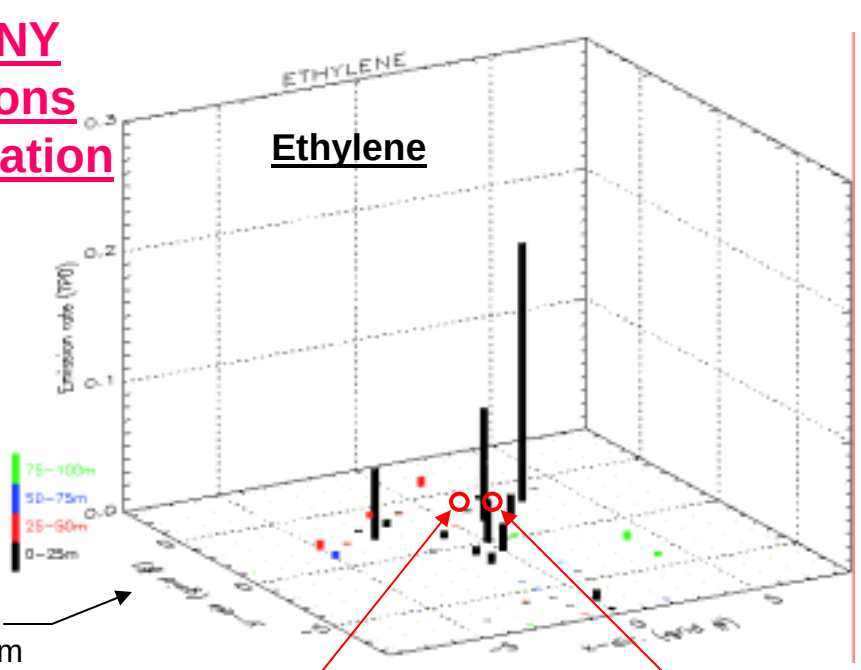

**Plume ozone peaks at plume age of just over 1 hour in all three scenarios**

# SWEENY Emissions Configuration



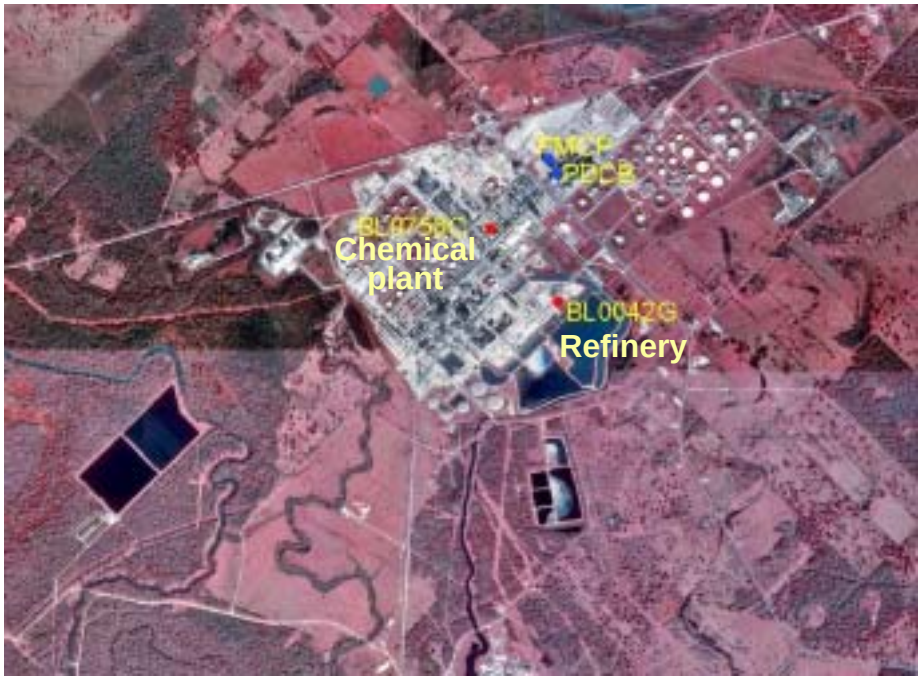

Power plant

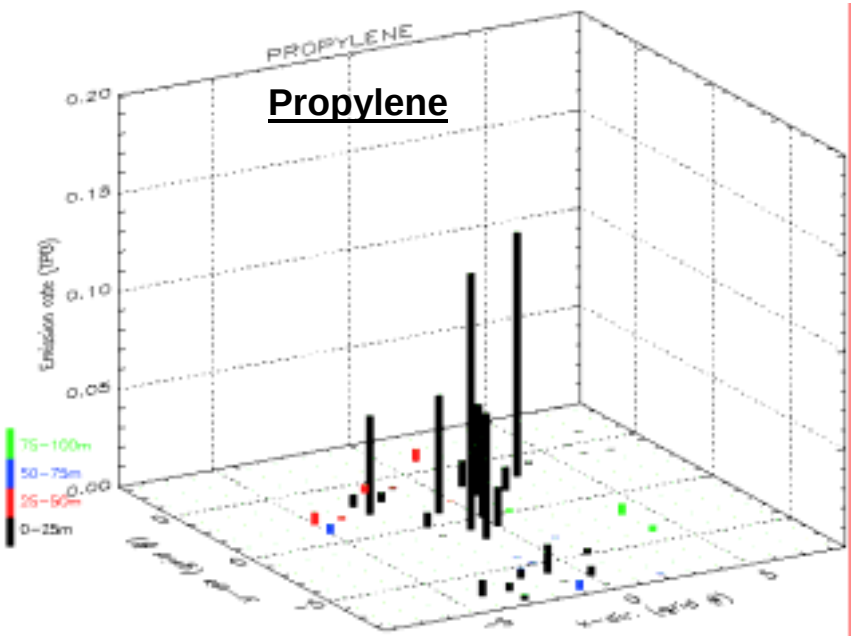
Horizontal gridsize = 100m




PMCP

PDCB



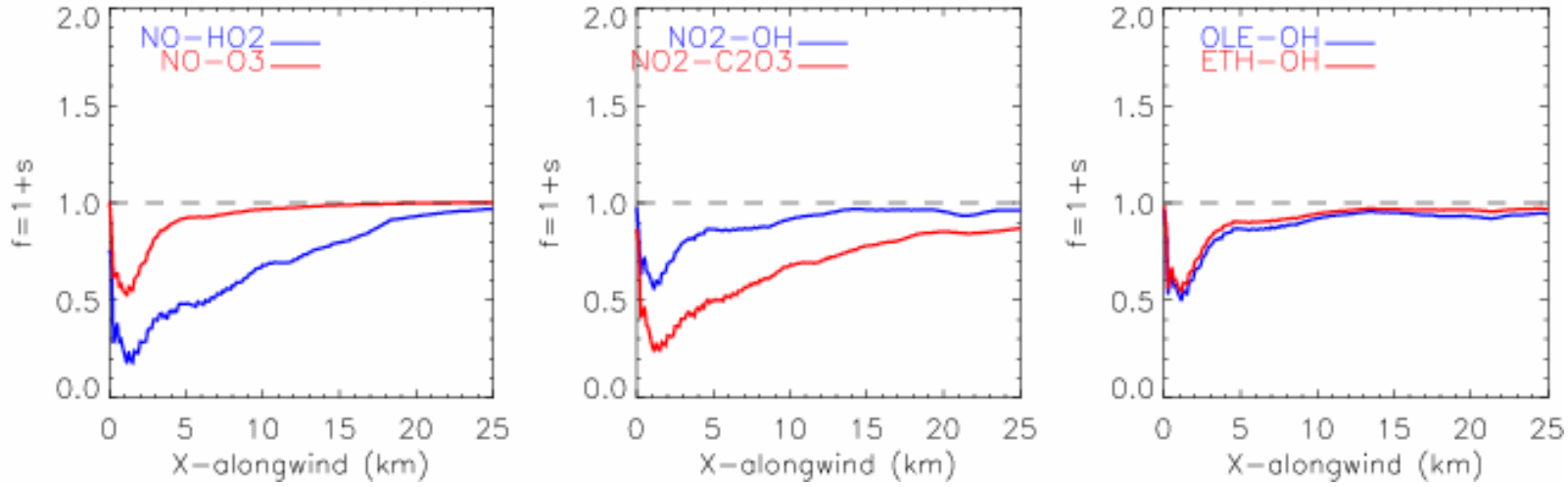



"s" is typically quite different from zero in the first hour of plume transport when ozone production is most pronounced

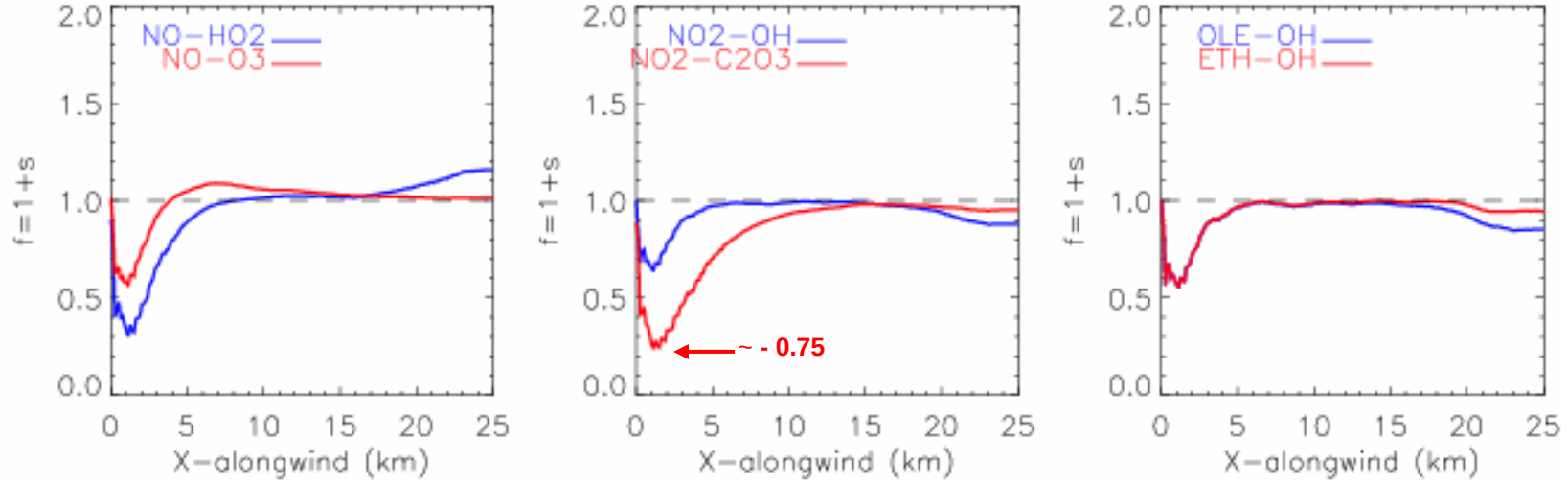
# Sweeny Plume, 28 Aug 2000

(WS ~ 3.7 m/s)

## Low-VOC Case (as per EI)




## High-VOC Case (as per "corrected" EI)

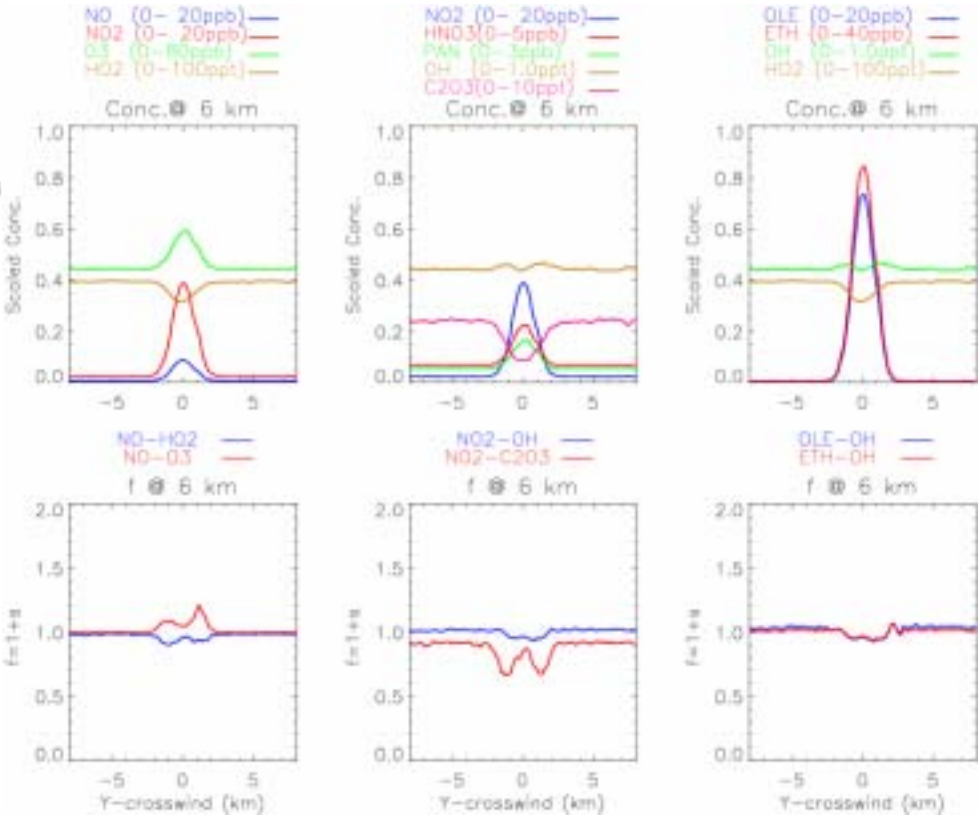


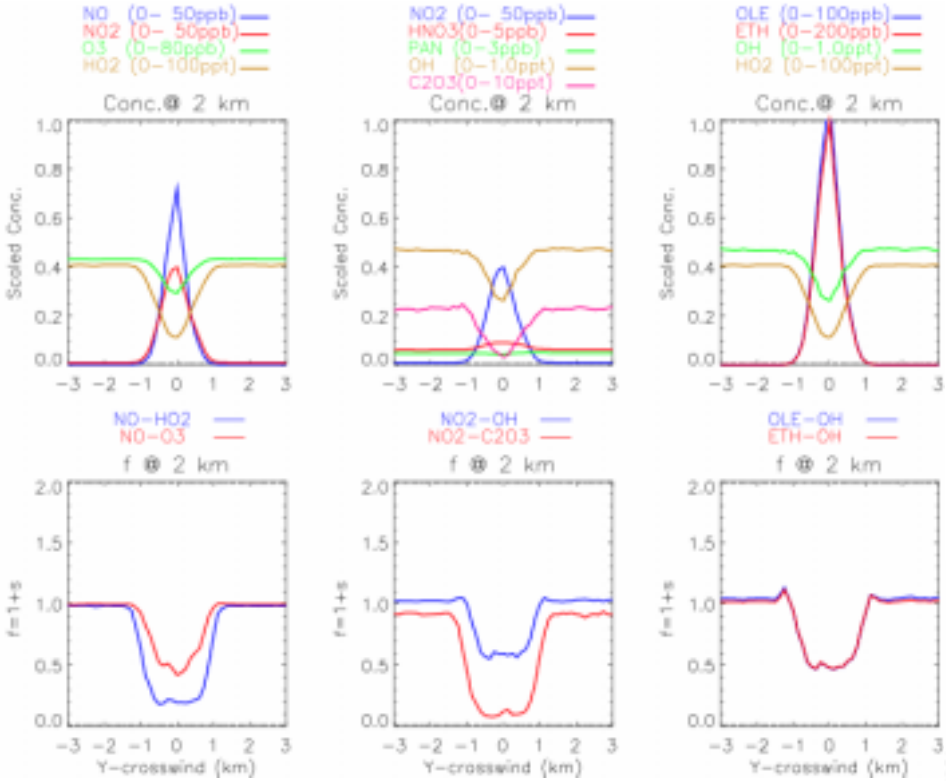
# Sweeny Plume, 28 Aug 2000

(WS ~ 3.7 m/s)

## High-VOC Case

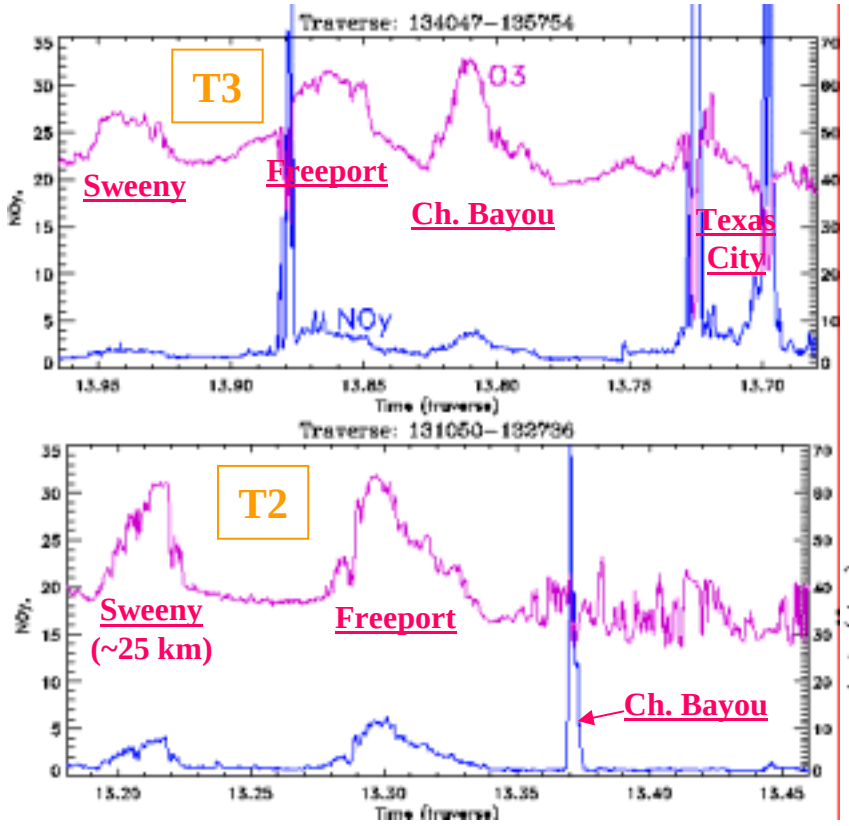
**X = 6 km**

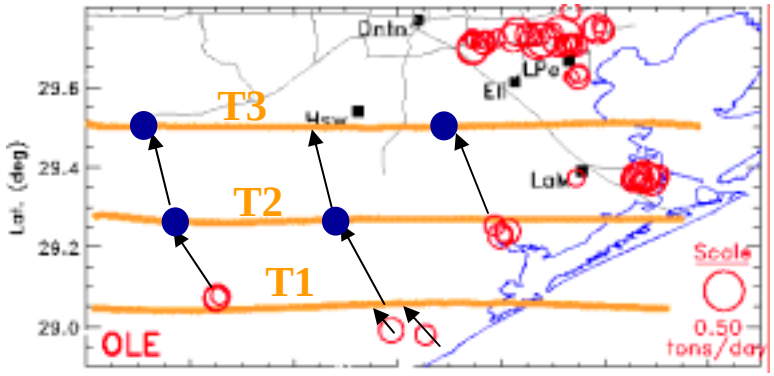



**X = 2 km**

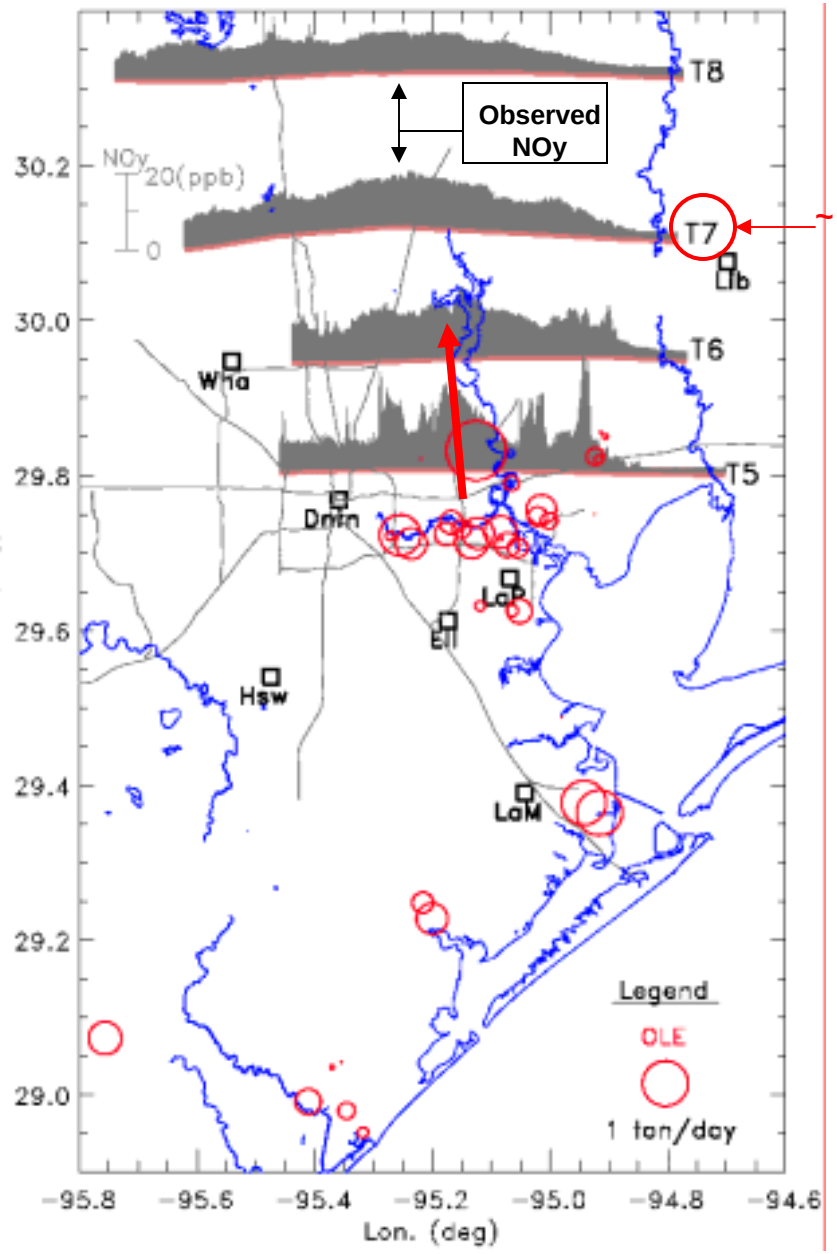
Why $s < 0$ in the industrial plume
in which NOx and VOC are co-emitted?




**NCAR-Electra mission**
**Of 28 Aug 2000**

## 35 Aggregate Sources

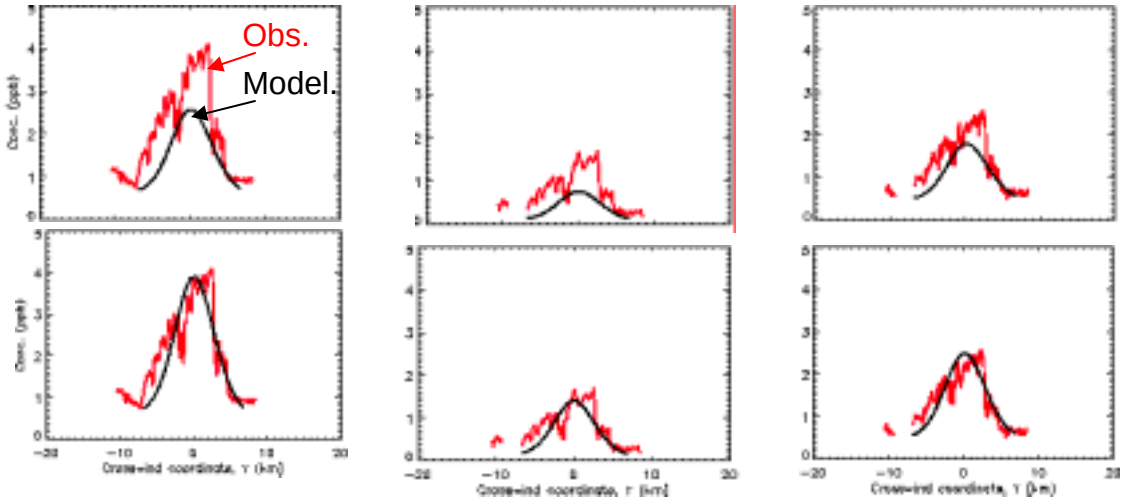



**Top 200 point sources composited into**
**35 simulated sources**

$Q_{NOx} = Q_{NOx}(EI)$
$= 14.5$ Kmol/h

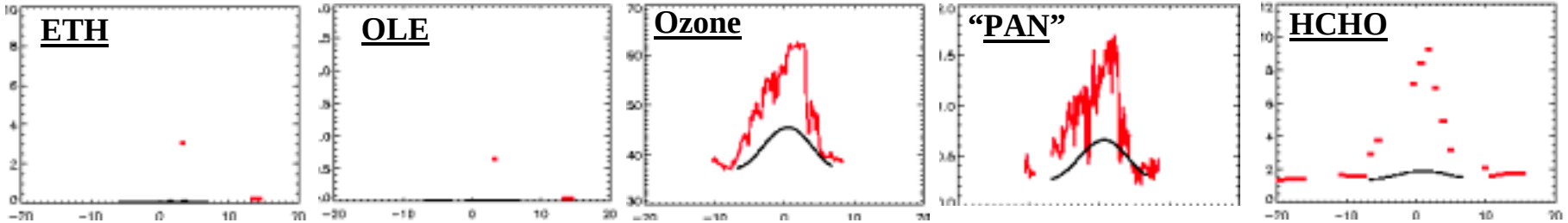
EI = Emission Inventory

$Q_{NOx} = 1.66\ Q_{NOx}(EI)$
$= 24.1$ Kmol/h

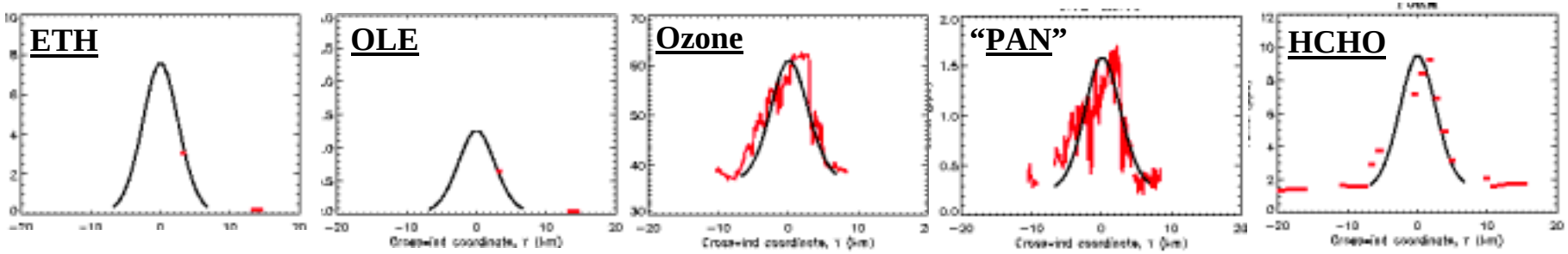



# Diagnostic application of LRPM to SWEENY @ T2 ~ 25 km

$Q_{ETH}$ and $Q_{OLE}$ as per their Emissions Inventory

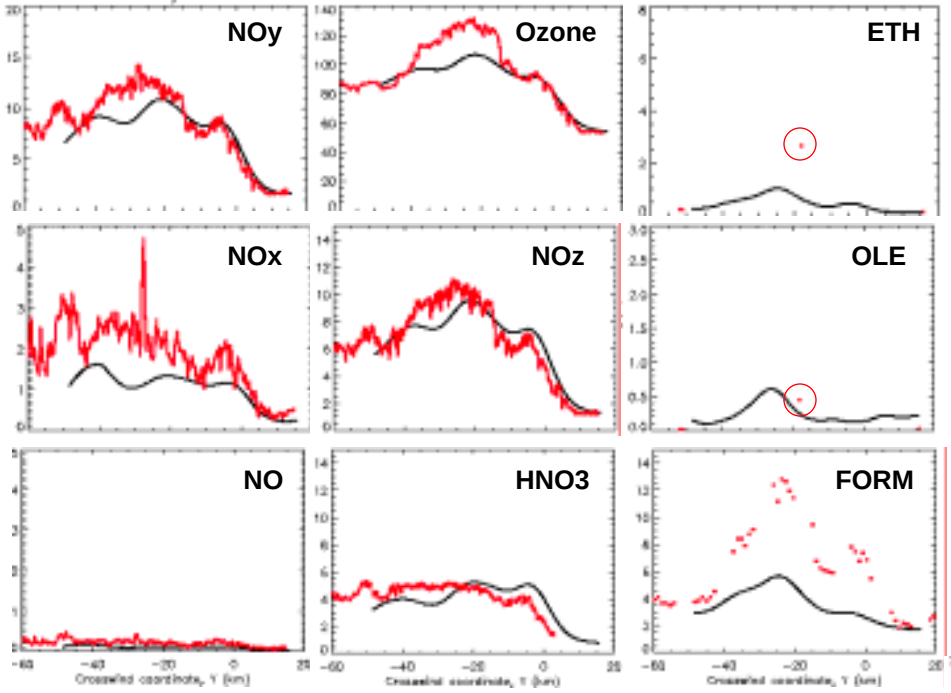



$Q_{ETH} = 3.6 \times Q_{NOx}$ ; $Q_{OLE} = 2 \times Q_{NOx}$

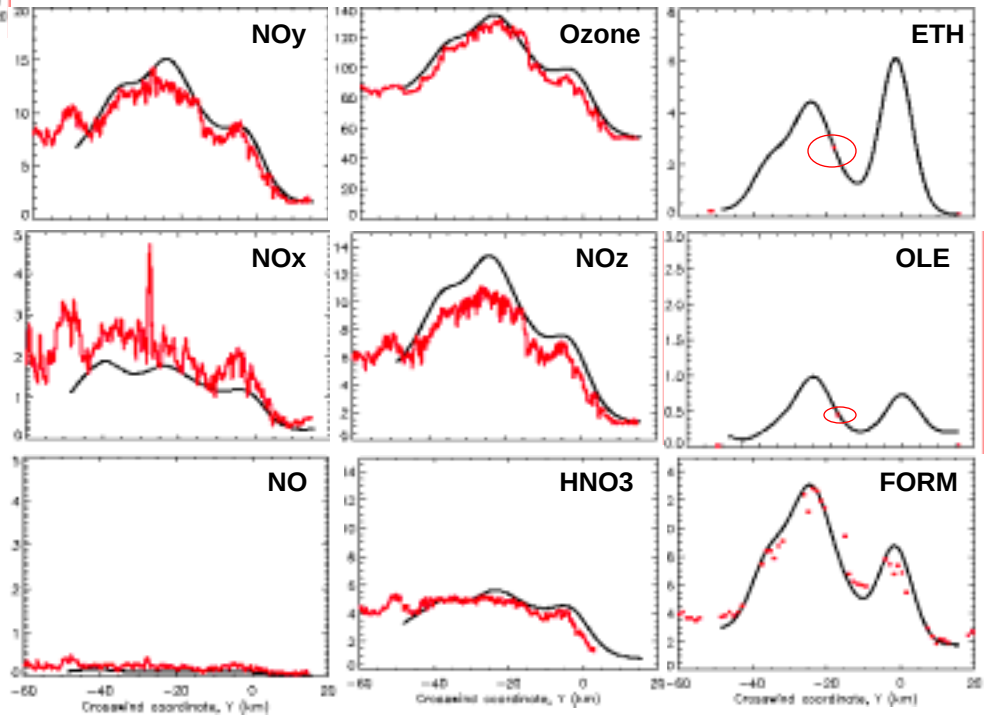


# UAH-LRPM Simulation Of the Ship Channel Megaplume

## (NCAR-Electra traverse T7 ~ 50 km downwind of the ship channel)




80 km




**NOx, ETH, OLE emissions based on EI**

**NOx, ETH, OLE emissions "corrected"** →

# Proposed UAH Role in E. Texas Transport Study

## *NE Texas Plume Study (assuming Baylor aircraft, about 6 day-missions?)*

-Experimental design in collaboration with TCEQ and Baylor (overall design and daily mission design)
~2 missions each aimed at
(a) sources immediately upwind of DFW (e.g., Ellis, Hood COs etc);
(b) sources generally to the S of DFW (< 150km upwind);
(c) sources in the Tyler-Longview area
involving supplemental data from instrumented aircraft and at least a SODAR for met sounding near the source area (The Cleburne and Palestine profilers should provide adequate other met soundings)

-Participation in field study and on-site data quality review

-Post-facto diagnostic data analysis (LPDM/LRPM for powerplant plumes; LESchem and LPDM/LRPM for industrial plumes), with observed plume dynamics as much as possible; MM5/SMOKE/C-CTM for input, as appropriate, with adjustments to emissions and background met/chem based on observations.

## *E Texas Tetroon Study (assuming tetroons, chase airplane, SODAR near release?)*

-Participation in study design (overall/daily) with TCEQ, Pacific NWL, Baylor, Texas A&M, etc.

-Post-facto data analysis: (a) evaluation of trajectory/dispersion based on LPDM(p)
(b) diagnostic modeling of chemistry (LRPM mainly; possibly also LESchem if release is from industrial source(s), e.g., Houston ship channel