

Results from NETAC's 2006 Aircraft Study

Presentation to the NETAC Technical Committee
December 19, 2007

Baylor University
Air Quality Design, Inc.
ENVIRON

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Program Overview

- Sponsored by NETAC: Northeast Texas Air Care
- Seven science flights between August 9 and November 3, 2006
 - Investigate emissions from Eastman Complex in Longview
 - Characterize ozone from local sources and regional transport
 - Coordinate with TexAQS II flights along TX-LA border by NOAA Twin Otter

Project Team



- **Baylor University:**
 - Flight Operations
 - Piper Aztec
 - Data QA and Presentation
- **ENVIRON:**
 - Study Design
 - Data Interpretation
 - Conceptual Model

Today's Presentation

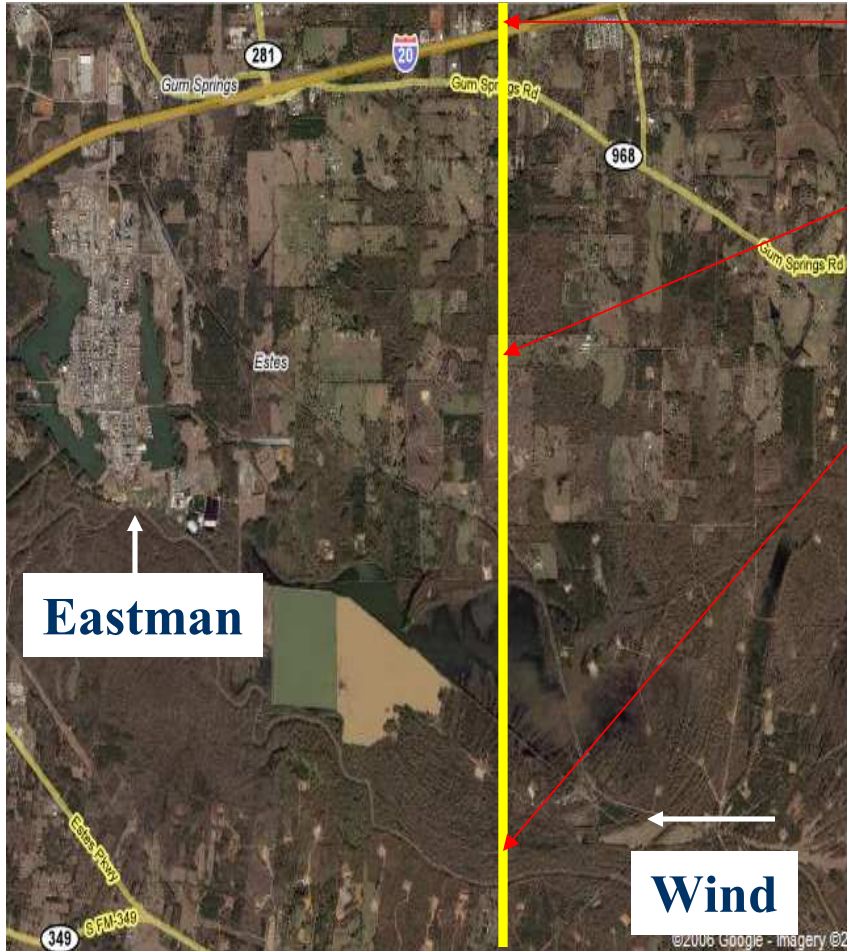
- November 3 flight: Eastman complex
- August 9 flight: power plant plumes
- September 9 flight: regional transport
- August 17 flight: stagnation event

November 3, 2006 Flight



- **Purpose:** characterize emissions from the Eastman Complex
- Easterly winds ~10 mph
- Background ozone ~40 ppb

Flight Objectives: Upwind



I-20: NO_x, SO_x, formaldehyde?

Biogenics: Mixed rural

Biogenics: River bottom

Objectives: Obtain background for chemical plant. Also, gather data on biogenic emissions over two different environments.

Upwind

Flight Objectives: Downwind



Eastman cracking furnaces (olefins) and flare (olefins/NOx)

Cogeneration Plant (NOx stacks)

Huntsman production (propene)

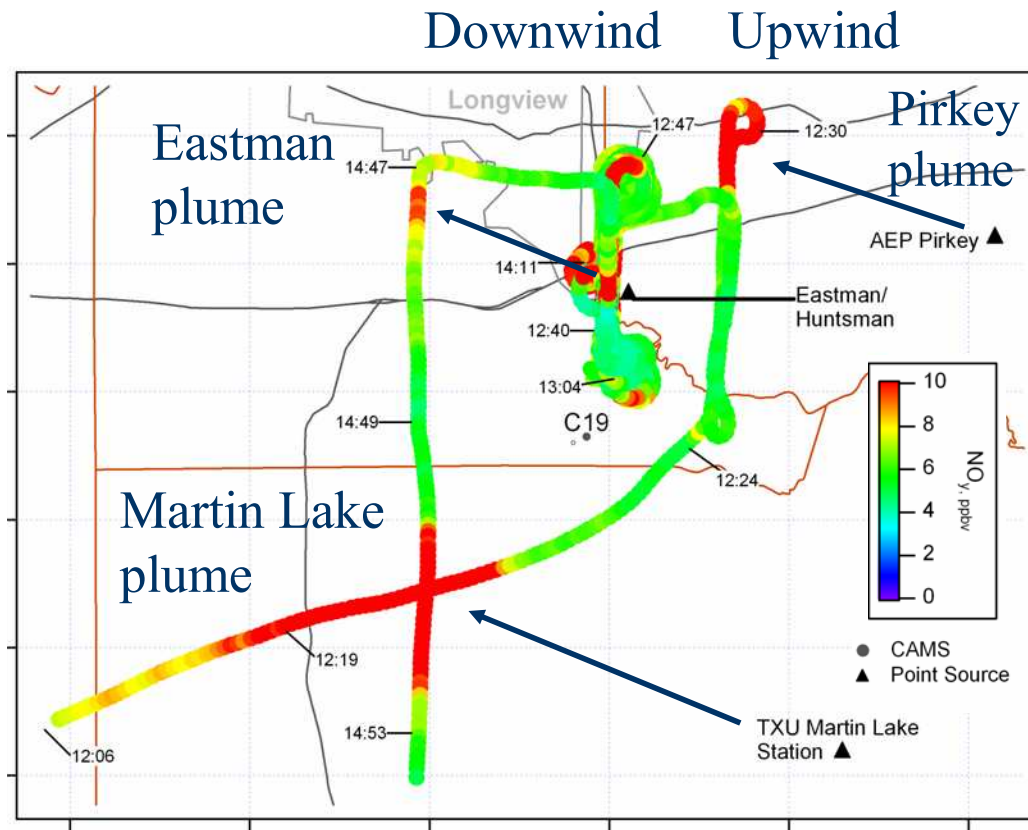
Huntsman flare (propene/NOx)

X Areas with clusters of NOx sources (e.g., large compressors)

Objective: identify individual plumes from the plant by flying slowly at several altitudes.

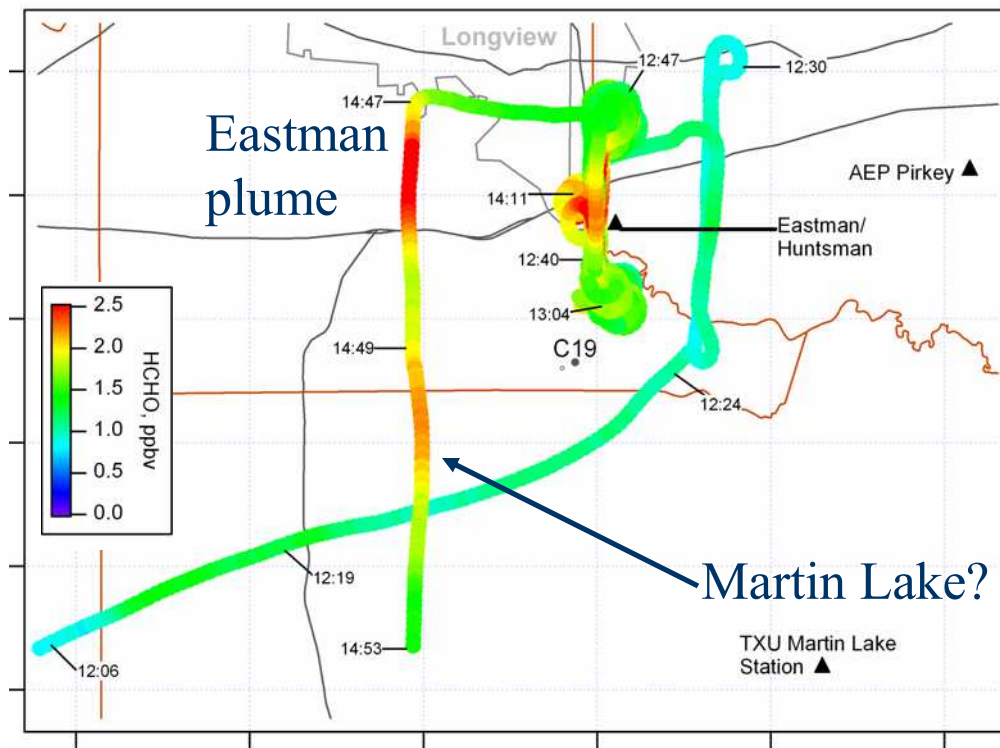
Downwind

November 3: Reactive Nitrogen (NO_y)



- $\text{NO}_y = \text{NO}_x +$ (Compounds that result from atmospheric processing of NO_x)
- HNO_3 , PAN, organic nitrates, HONO, etc.
- Plumes from Martin Lake, Eastman, and Pirkey

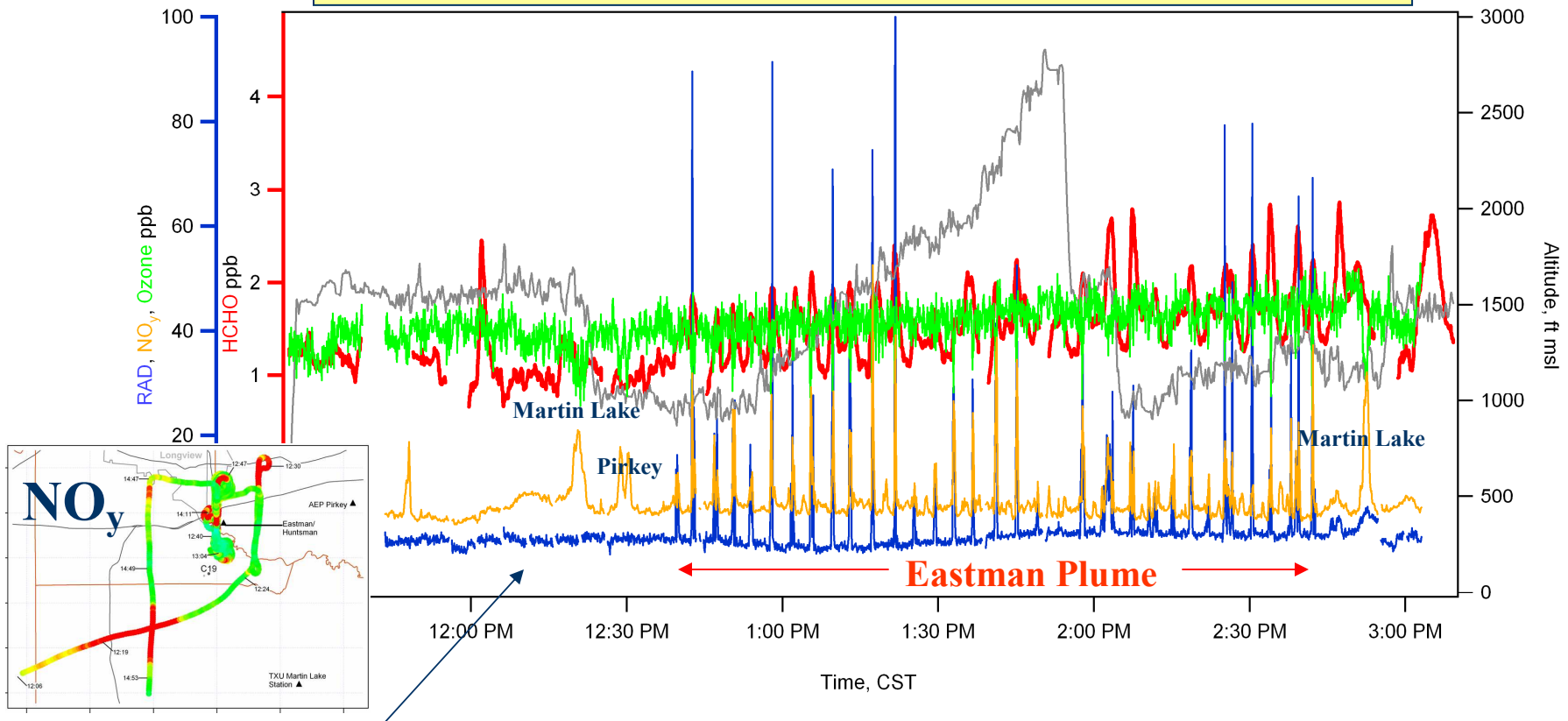
November 3: Formaldehyde



- Formaldehyde produced from atmospheric processing of isoprene, propene, ethene
- Upwind leg
 - I20 impact small
 - Biogenic signal small
 - Trees dormant in Nov.
- Downwind Leg
 - Strong signal in vicinity of Eastman
 - Plume extends downwind of Eastman

November 3: HRVOCs, NO, and Ozone

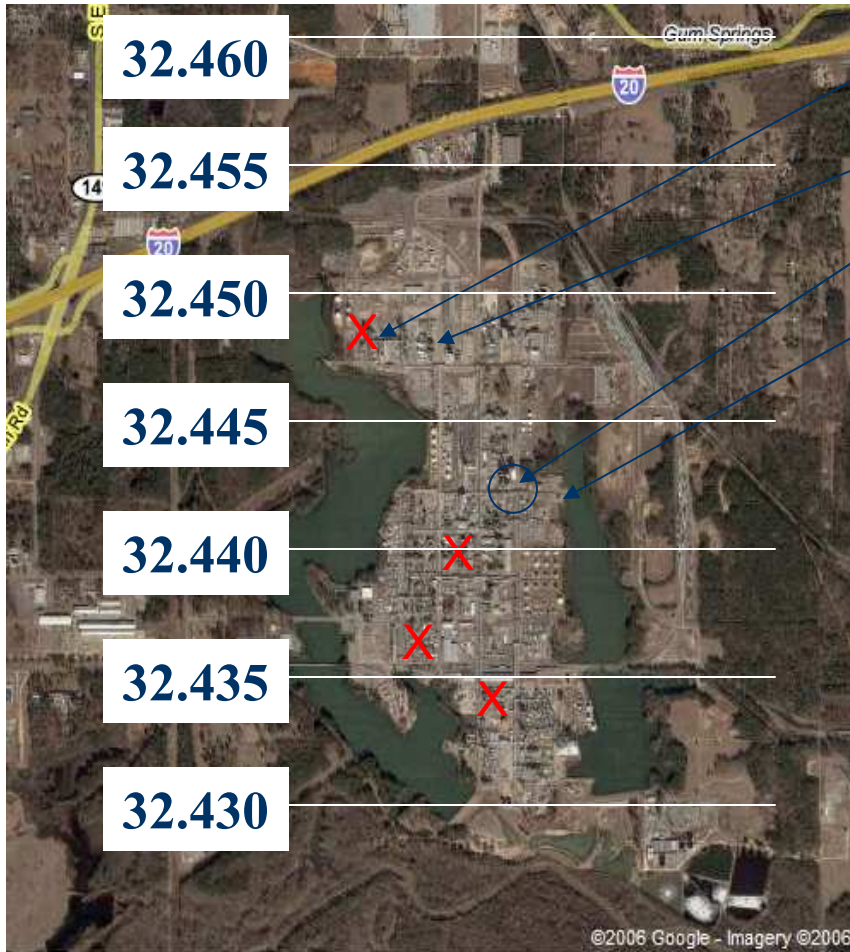
12:45-2:45--Aircraft flies downwind of Eastman, co-located spikes of NO, formaldehyde, and HRVOCs from multiple sources



Upwind leg
Small signal from biogenics

No ozone spikes:
temps, sunlight low

November 3: HRVOCs



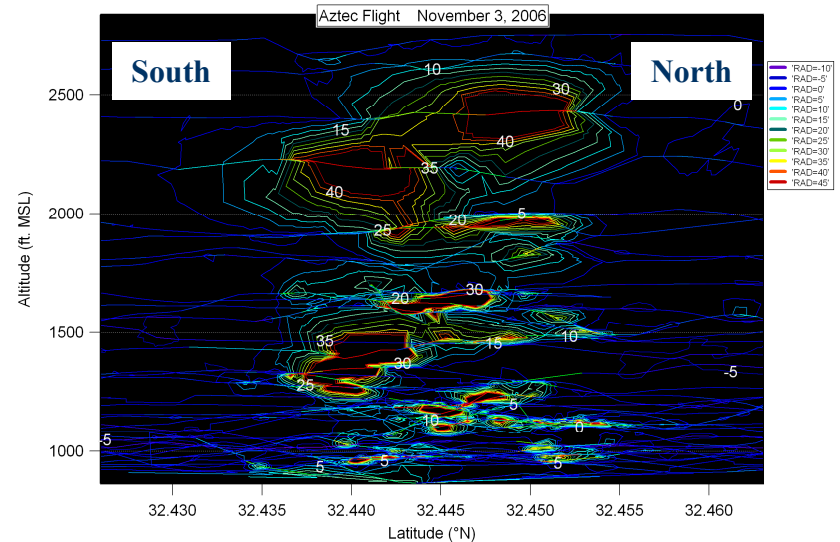
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Huntsman flare (propene/NOx)

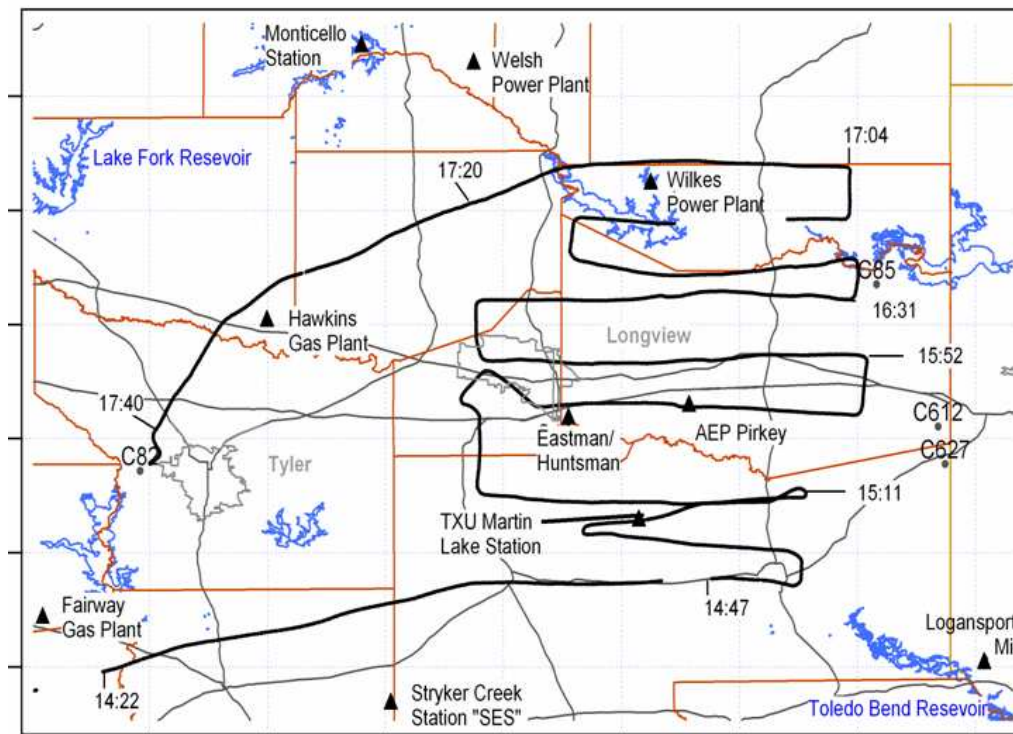
X Areas with clusters of NOx sources (e.g., large compressors)



Findings from Eastman Flight

- Multiple HRVOC sources within the plant
- Flight at a single height may not reveal this
- HRVOC signal much larger than biogenics (November)
- Small ozone production on this day (November)
- Is formaldehyde too large to be secondary?

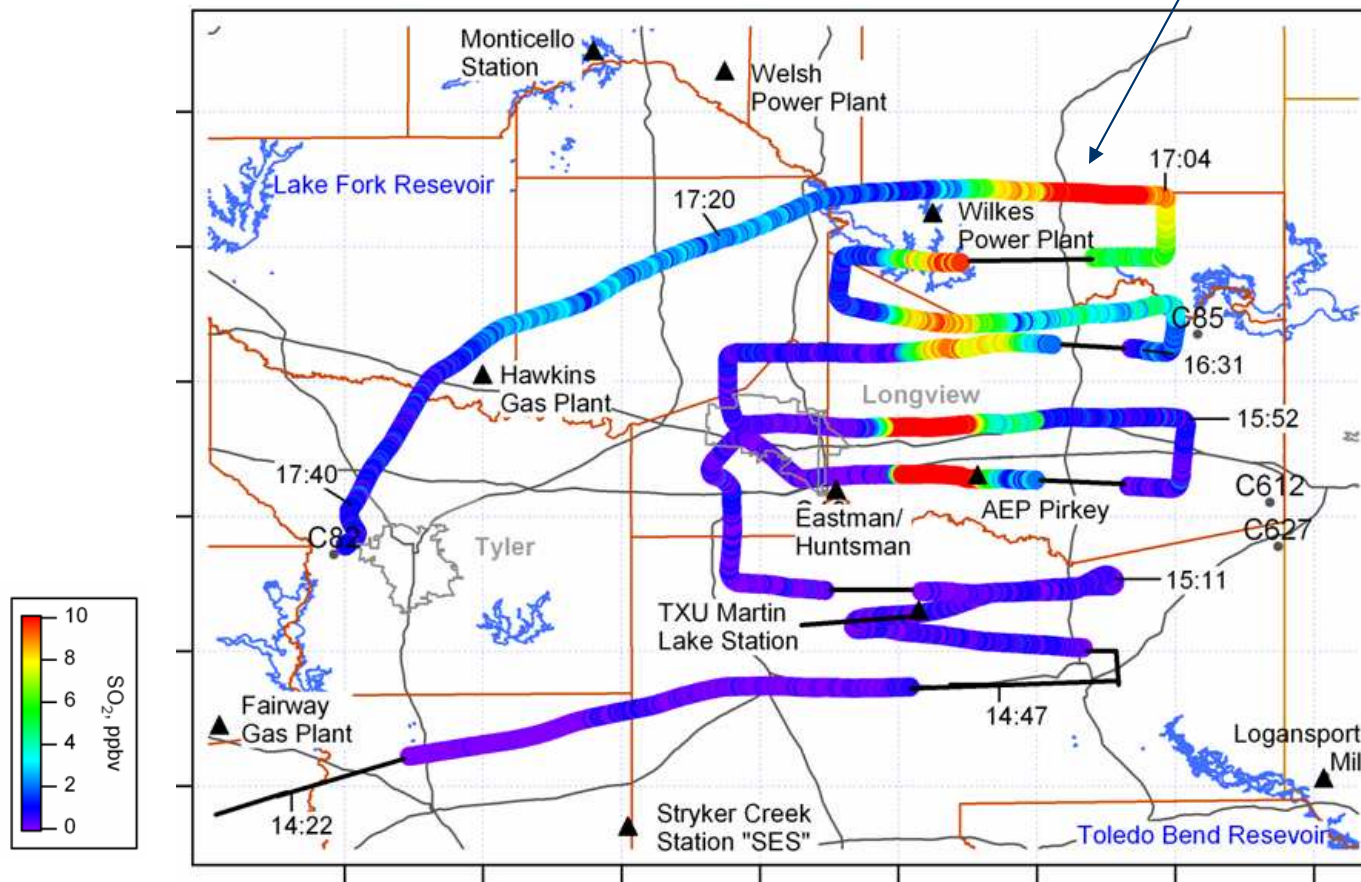
August 9, 2006 Flight



- **Purpose:** Sample TXU/AEP Pirkey/Eastman plumes
- Investigate ozone production in these plumes
- Southerly winds during flight

August 9: SO₂ Track

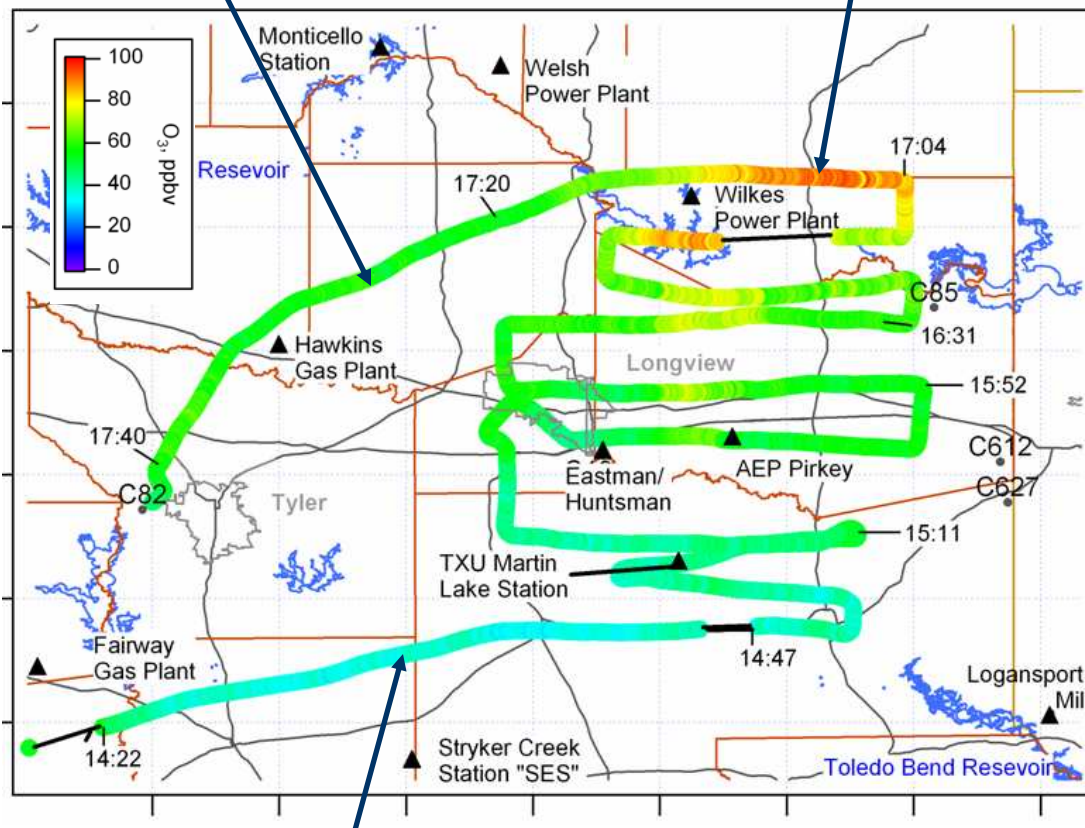
Martin Lake/
Pirkey plumes



August 9: Ozone Track

~55 ppb

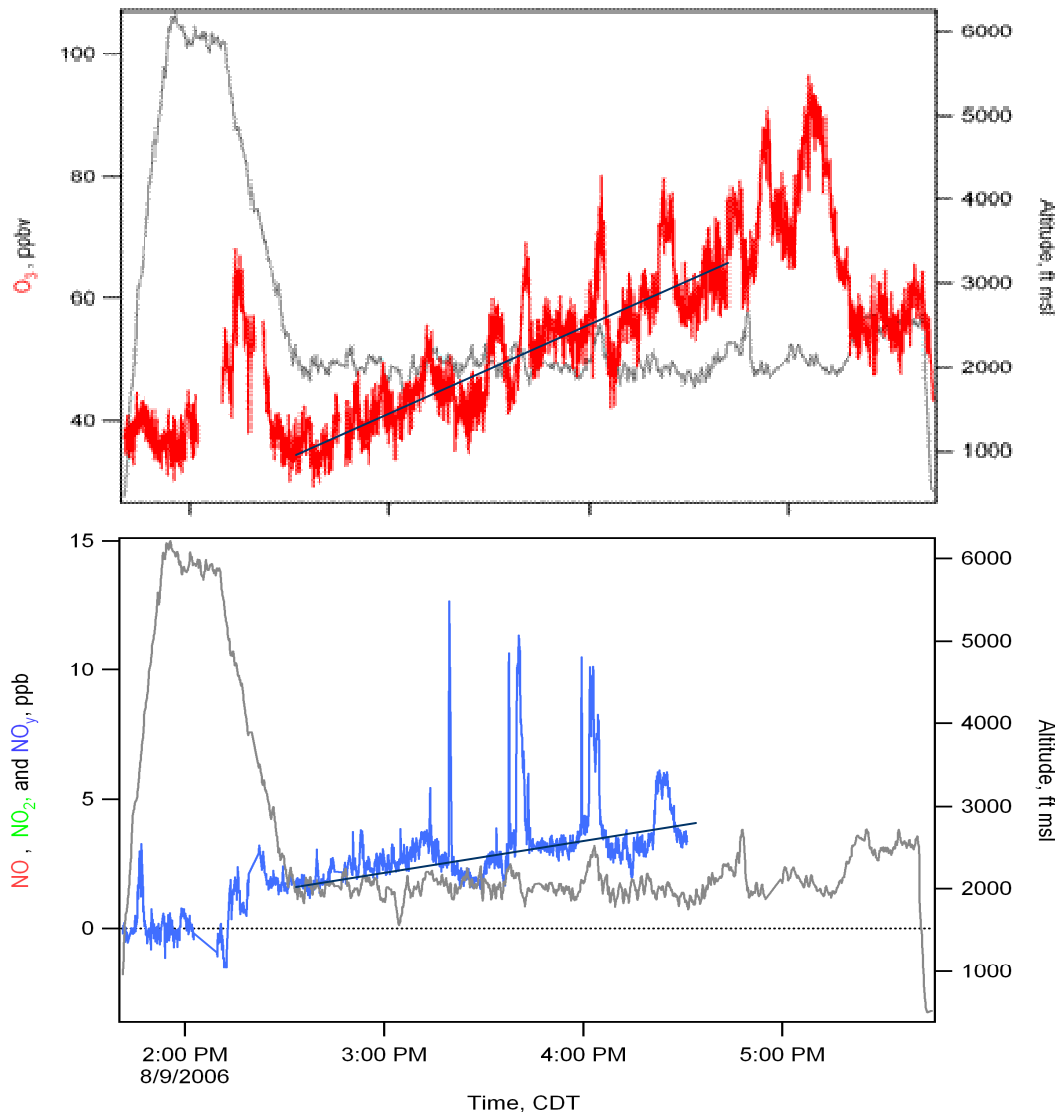
Martin Lake/
Pirkey plume



37 ppb

- On last downwind plume transect, average ozone 81 ppb
- Enhancement of ~26 ppb
- No plume visible downwind of Eastman complex
- Average ozone on upwind transect was 37 ppb
- Background ozone increased to ~55 ppb during the flight

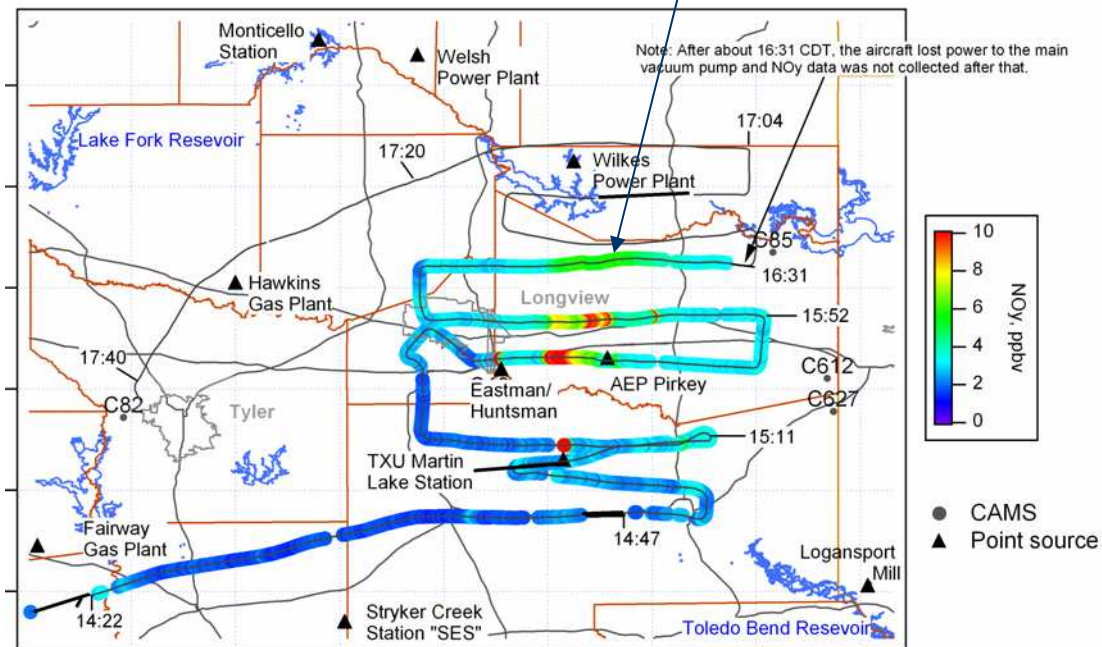
August 9: Ozone and NO_y Time Series



- During flight, background ozone increased from 37 ppb to 55 ppb
- Background NO_y increased also
- Over a given time period, ozone increase is about 3x bigger than the NO_y increase
- Increase in NO_y implies NO_x emissions--possible sources?

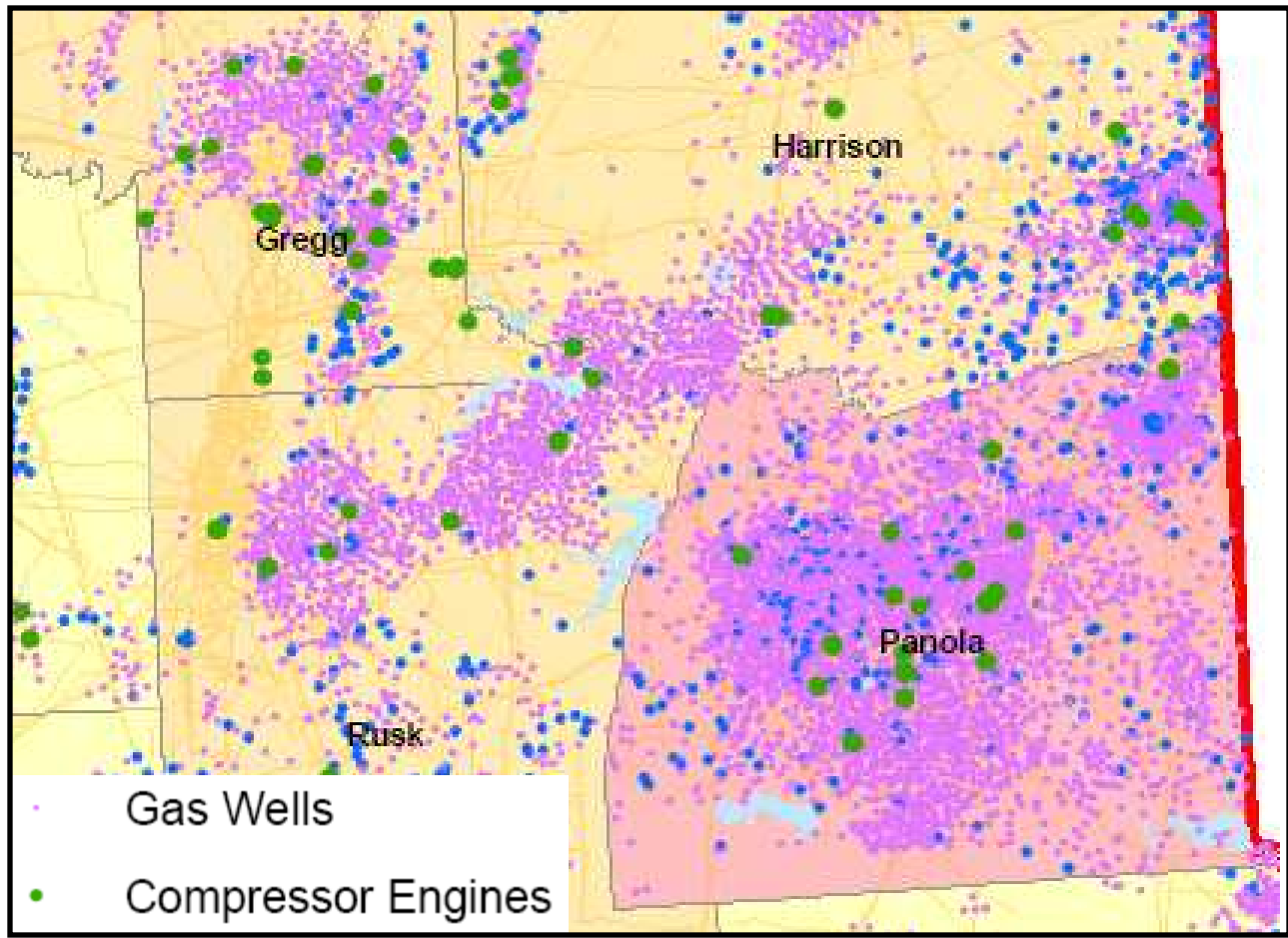
August 9: NO_y Track

Martin Lake/ Pirkey plumes



- Background NO_y increases over entire track
- Wind out of the south
- Distributed source?
- One possible explanation: NO_x emissions from compressor engines

Natural Gas Production Activity



(Only large compressor engines shown)

Source: TCEQ

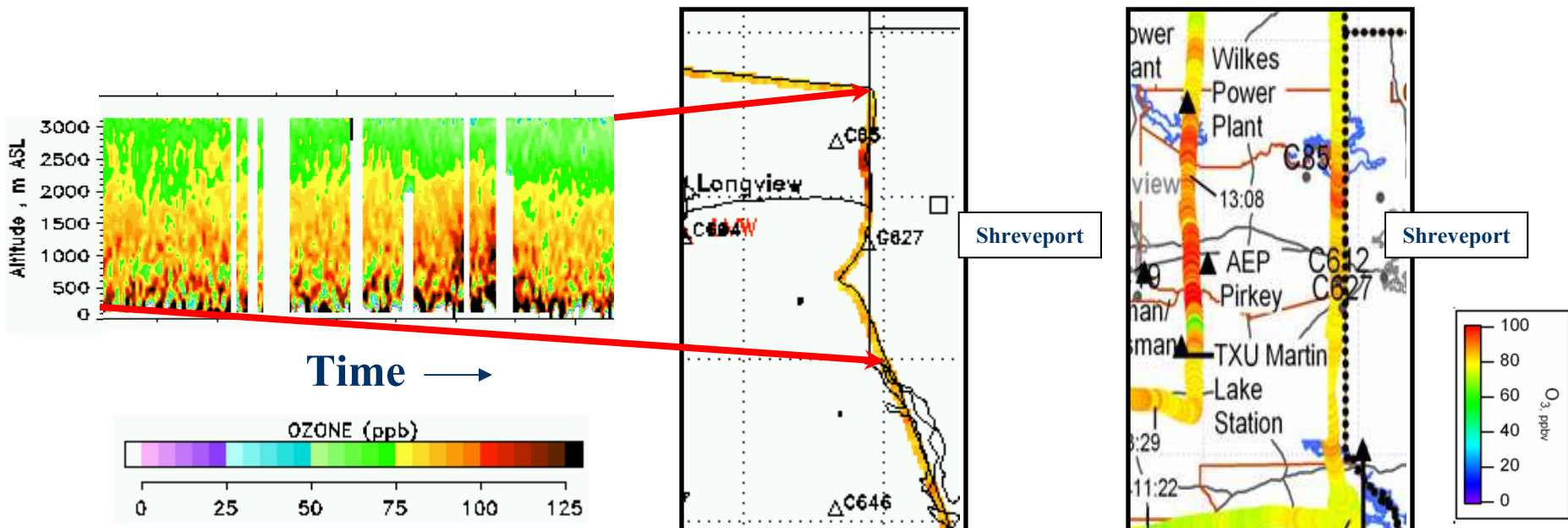
September 8, 2006 Flight

- **Purpose:** Coordinate with TexAQS II to measure background ozone coming into Northeast Texas
- Easterly winds
- Baylor aircraft and NOAA Twin Otter flew along LA border; Baylor aircraft flew track 1 hour 45 min ahead of the Twin Otter
- Twin Otter has LIDAR instrument that measures vertical distribution of ozone

September 8: Background Ozone

NOAA Twin Otter

Baylor Aircraft

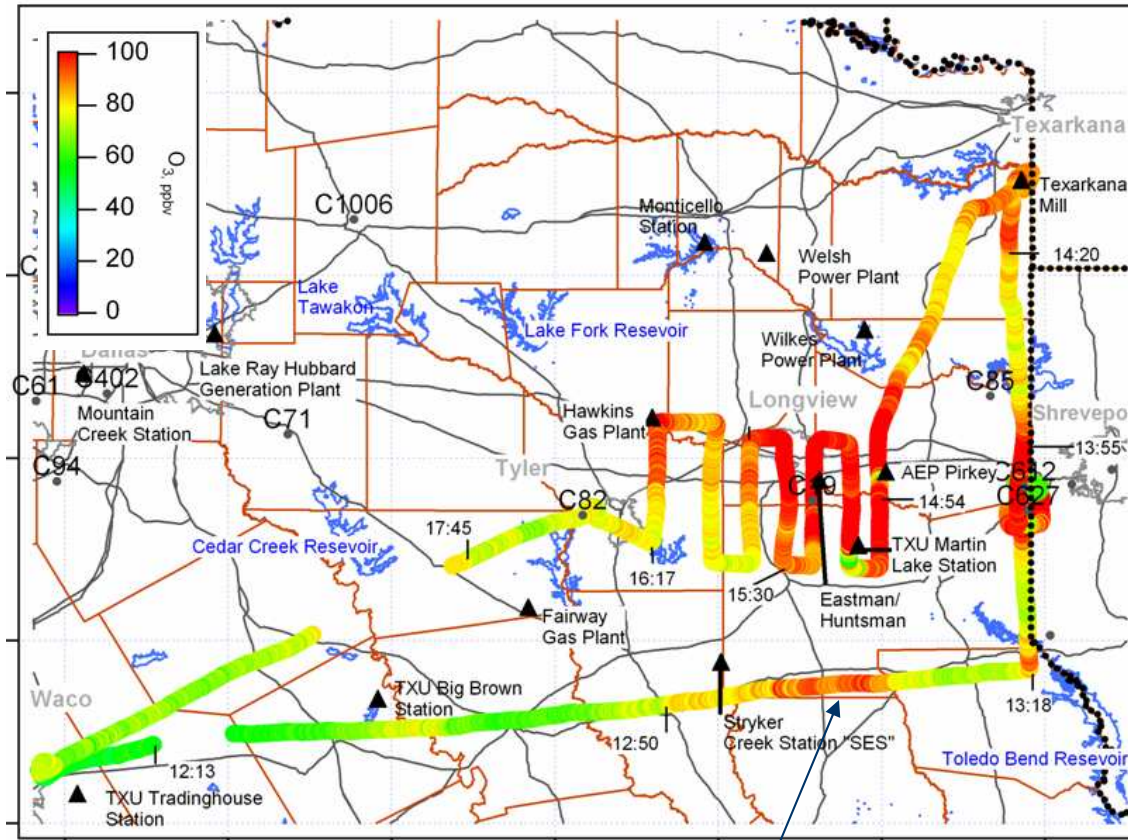


- Baylor and NOAA aircraft find 75-80 ppb ozone along LA border
- Both detect ozone enhancement in Shreveport urban plume

August 17, 2006 Flight

- **Purpose:** examine interaction of transported pollutants with Tyler/Longview urban plumes and nearby point sources
- CAMS 19 in Longview had peak 8-hour ozone value of 88 ppb
- Light and variable winds, stagnation.
- Plumes difficult to track
- Large concentrations of ozone, formaldehyde measured in vicinity of CAMS 19

August 17: Ozone Track



- Ozone peaked at 140 ppb near Martin Lake
- High ozone (72-107 ppb) along the LA border
- High ozone from unknown source east of Stryker Creek-also observed during 2005 flight

High ozone of unknown origin