

# Modeling Northeast Texas Ozone for the Summer of 2005

Presentation to the NETAC  
Technical Committee

December 19, 2006

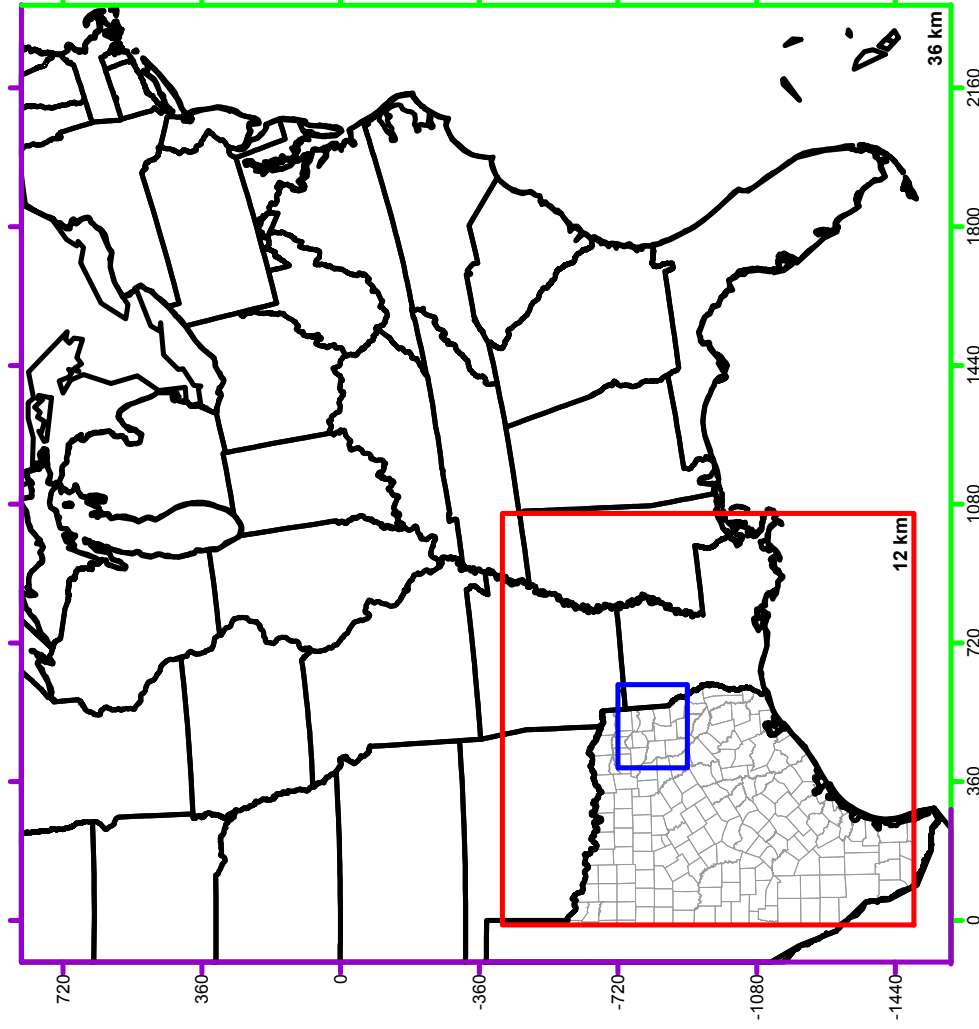
Sue Kemball-Cook and Greg Yarwood  
ENVIRON

[skemball-cook@environcorp.com](mailto:skemball-cook@environcorp.com)

## Objectives

- Develop a seasonal ozone model for summer of 2005
  - Evaluate model performance using EPA guidelines
- Enhance the seasonal model for two episode periods in June and September
  - Evaluate model performance using EPA guidelines
  - Compare with Baylor aircraft flight data
  - Can the models be used to test control strategies?

# 2005 Seasonal Ozone Model



- MM5 meteorology from Texas A&M
- Model run for May-September, 2005
- 36 km/12 km nested grids in CAMx
- 2005 Emissions

## Seasonal Model Performance Evaluation

- Seasonal model tends to overpredict surface ozone concentrations in NE Texas
- Simulates observations at Karnack and Panola monitors with good fidelity, but overestimates at Longview and Tyler
- Best performance during two high-ozone episodes in June and August-September

## Causes of Seasonal Model Performance Issues

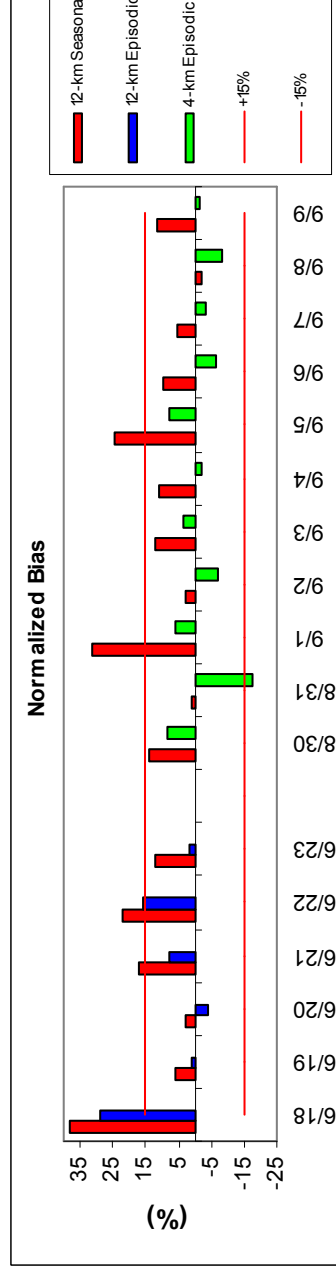
- Initial 2005 emission inventory lacked detail
  - Built from 2002 National Inventory (NEI)
  - Lacks day-specific point source data
  - Point sources (EGUs) play an important role in ozone formation in NE Texas
- Refinement to meteorological fields needed? (2002 seasonal modeling worked better)

## 2005 Episodic Ozone Modeling

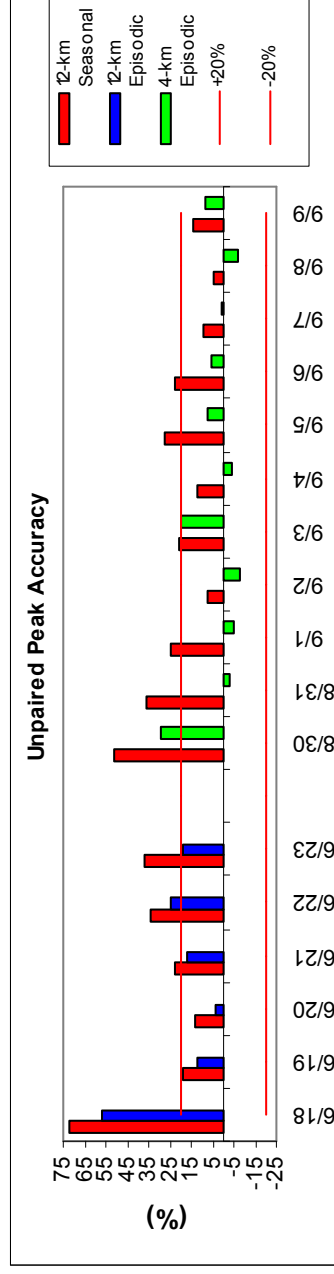
- Two episode periods
  - June 18-23
  - August 30-September 9
- Improved emissions with day-specific CEM data for major NO<sub>x</sub> sources
- For August-September episode, added 4-km grid in NE Texas
  - 4-km meteorology from Texas A&M

# Episodic Model Performance Evaluation

Normalized Bias (%)



Unpaired Peak Accuracy (%)



June 18-23      Aug 30 – Sept 9

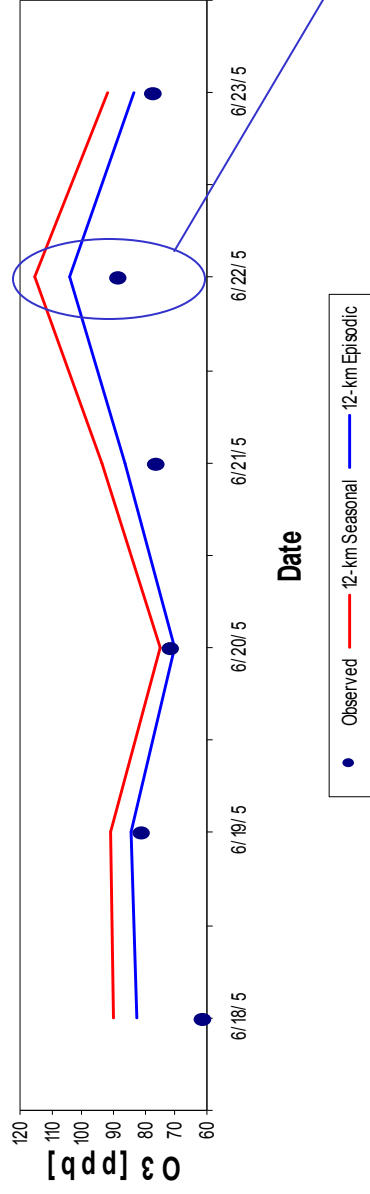
- Seasonal model (red bars) overestimated ozone

- Episodic model (blue and green bars) generally within EPA benchmarks

- Improved for both June (12-km grid) and Sept (4-km grid)

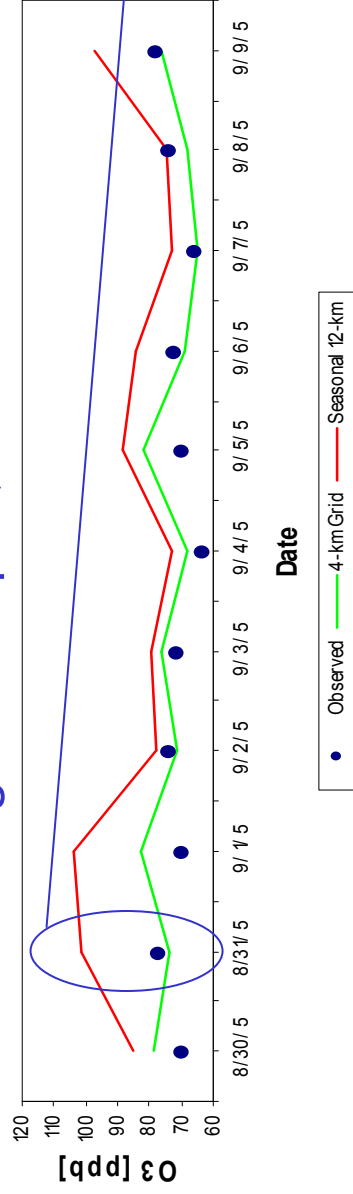
# Longview Monitor: Ozone Time Series

June 18-23, 2005



- Episodic model performs better in both periods
  - Emission inventory improvements

Aug 30 – Sept 9, 2005



- June 22 ozone results from a plume impact at Longview
- August 31 is a flow reversal and stagnation event

# Comparison with Baylor Aircraft



- Baylor University: Flight Operations
  - Piper Aztec
  - Pilots: Max Shauck and Sergio Alvarez
  - Instrumentation: Jimmy Flynn
  - Study Design: Grazia Zanin
- University of Houston: Flight Plans and Independent Data QA
- ENVIRON: Flight Plans

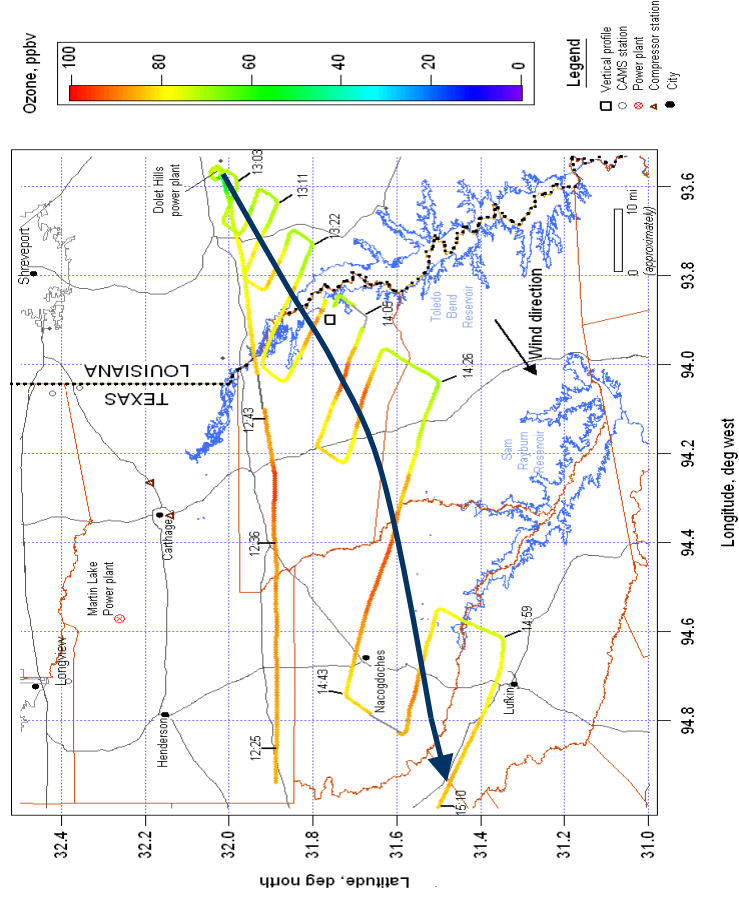
# Dolet Hills EGU, September 8, 2005



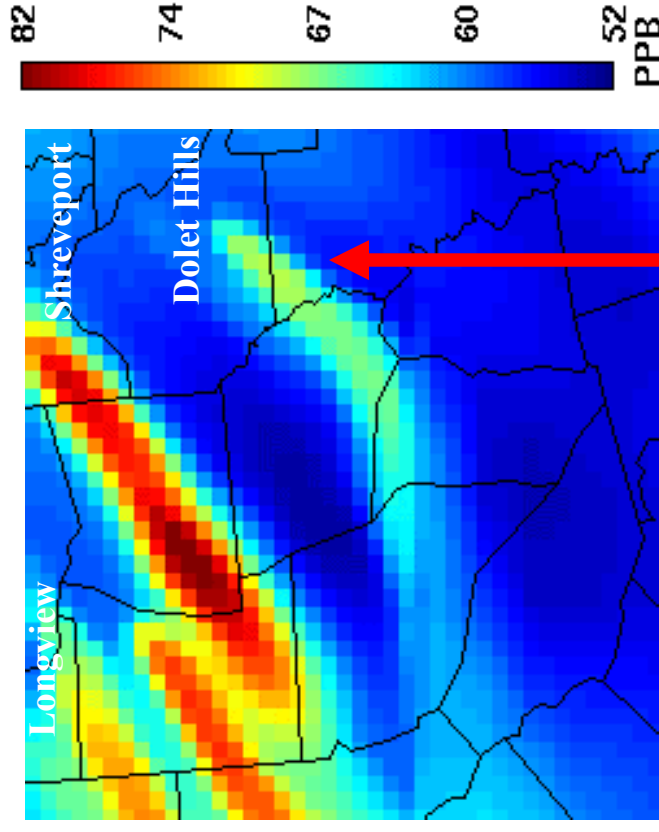
- Single, 650 MW, lignite fired EGU near Mansfield in Desoto Parish, LA
- Isolated source location and northeasterly wind direction kept the Dolet Hills plume separated from other major sources
- Good case study for CAMx EGU plume simulation

# Baylor Aircraft Ozone Comparison

## Aircraft



## CAMx

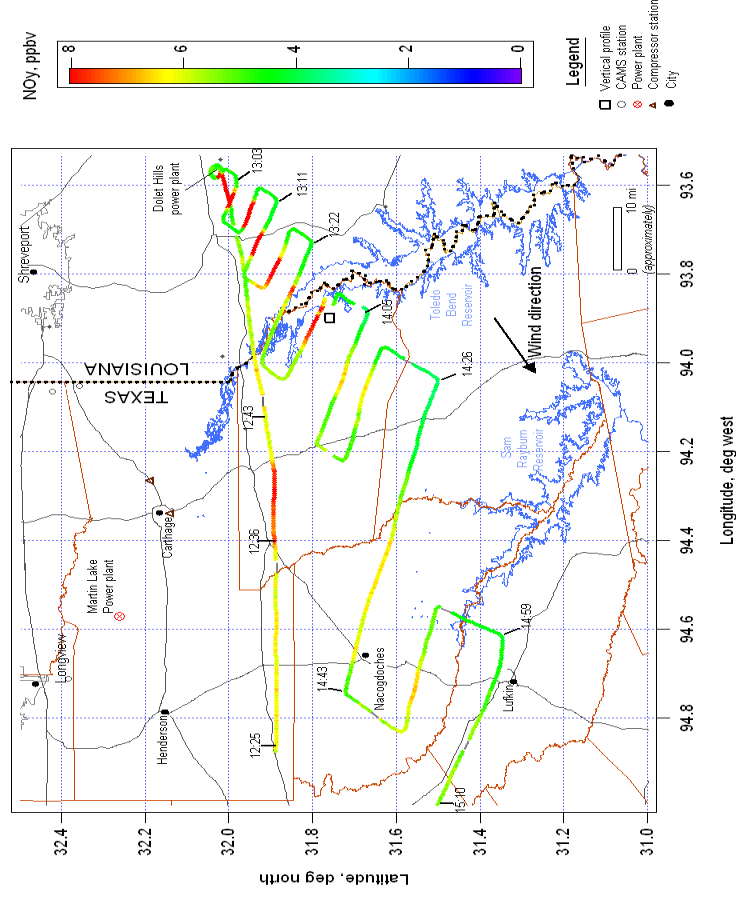


Model captures plume curvature, but displaced SE by 10-20 miles (MM5 bias)

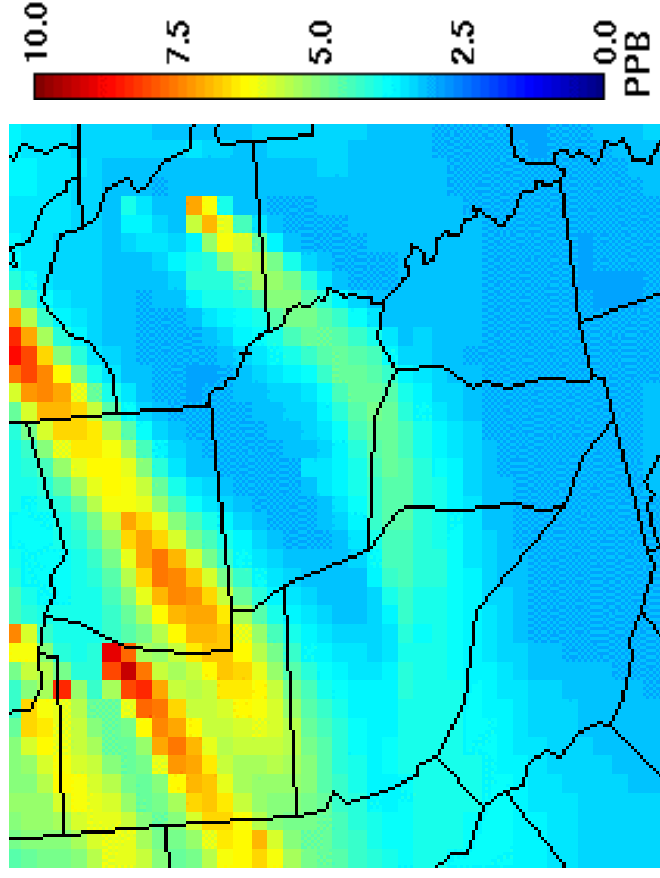
Ozone forms sooner in model than observed

# Baylor Aircraft NOy Comparison

## Aircraft



## CAMx



- NO<sub>y</sub> “measures” the NO<sub>x</sub>, even after chemical reaction
- Model NO<sub>y</sub> plume has max near source, as observed

# Baylor Aircraft Ozone/NOy Comparison

	Ozone		NOy	
	Background	Plume Enhancement	Background	Plume Enhancement
<b>Aircraft</b>	70	10-15	4-5	2-3
<b>CAMx</b>	54-58	10-15	4-7	3-4

- Model reproduces NOy and ozone plume enhancements
- Model underestimates background ozone
- Background NOy well-simulated

## Baylor Aircraft Ozone Comparison

- CAMx simulates Dolet Hills plume reasonably well, given
  - Grid resolution
  - Small bias in wind direction/speed supplied by MM5
- CAMx replicates ozone and NO<sub>y</sub> plume enhancements and plume structure
  - Forms ozone more rapidly than observed
  - Try full-chemistry plume-in-grid model (IRON-PiG)

## Recommendations

- Further develop 2005 ozone models for control strategy modeling
- Which period(s) to focus on?
  - Consider pros and cons
  - Review ambient data
  - Recommendation to model May/June 2005

## Using 2005 Ozone Model for Control Strategy Modeling: Pros and Cons

- Pros
  - High ozone year
  - Recent emission inventory
  - Longview profiler data after June 16, 2005
  - Aircraft observations for model evaluation in August/September
  - Promising model performance with 4-km grids
- Cons
  - September episode is post-Katrina
    - Atypical and/or poorly characterized upwind emissions

# 2005 High Ozone Days

**Table 3-1.** Days in summer 2005 when 8-hour ozone measured at Northeast Texas monitors exceeded 85 ppb.

Date	Number of Monitors Exceeding 85 ppb	Monitor	Maximum 8-Hour Ozone (ppb)
22-May-05	1	Longview	94
25-May-05	1	Longview	90
15-Jun-05	1	Longview	88
22-Jun-05	1	Longview	88
28-Jun-05	1	Karnack	85
31-Aug-05	1	Panola	92
1-Sep-05	1	Tyler	88
10-Sep-05	1	Karnack	87

June Episode

September Episode

- Existing June and September episodes were developed from available Texas A&M episode periods
  - September episode includes 2 high days, none at Longview
  - June episode includes 1 high day at Longview
  - These dates are not optimal

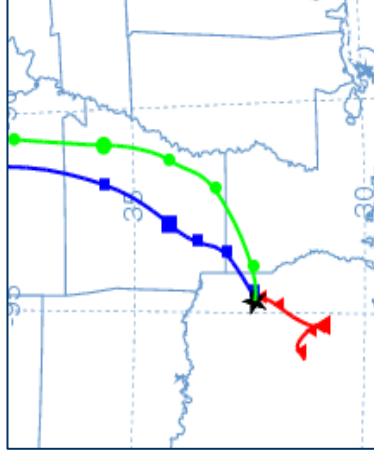
# 2005 High Days – All Monitors

Day	Max 8-hour Ozone (ppb)			
	Longview	Karnack	Panola	Tyler
May 22, 2005	<b>94</b>	68	64	70
May 27, 2005	<b>90</b>	74	79	77
June 15, 2005	<b>88</b>	59	76	81
June 22, 2005	<b>88</b>	76	73	70
June 28, 2005	83	<b>85</b>	72	72
August 31, 2005	77	84	<b>92</b>	78
September 1, 2005	70	62	60	<b>88</b>
September 10, 2005	79	<b>87</b>	77	73

# High Days in May/June 2005

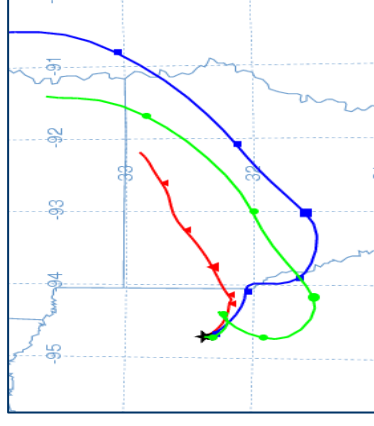
**May 22**

Regional plus local plume (M. Lake?) at Longview



**May 27**

Regional plus local plume (M. Lake?) at Longview



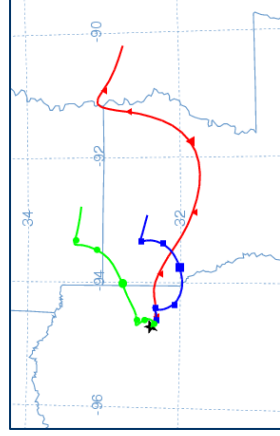
**June 15**

Complex winds, difficult day to interpret from data



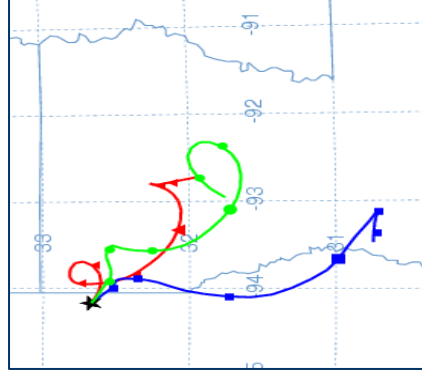
**June 22**

Complex winds at Longview, modeling finds local plume impacts

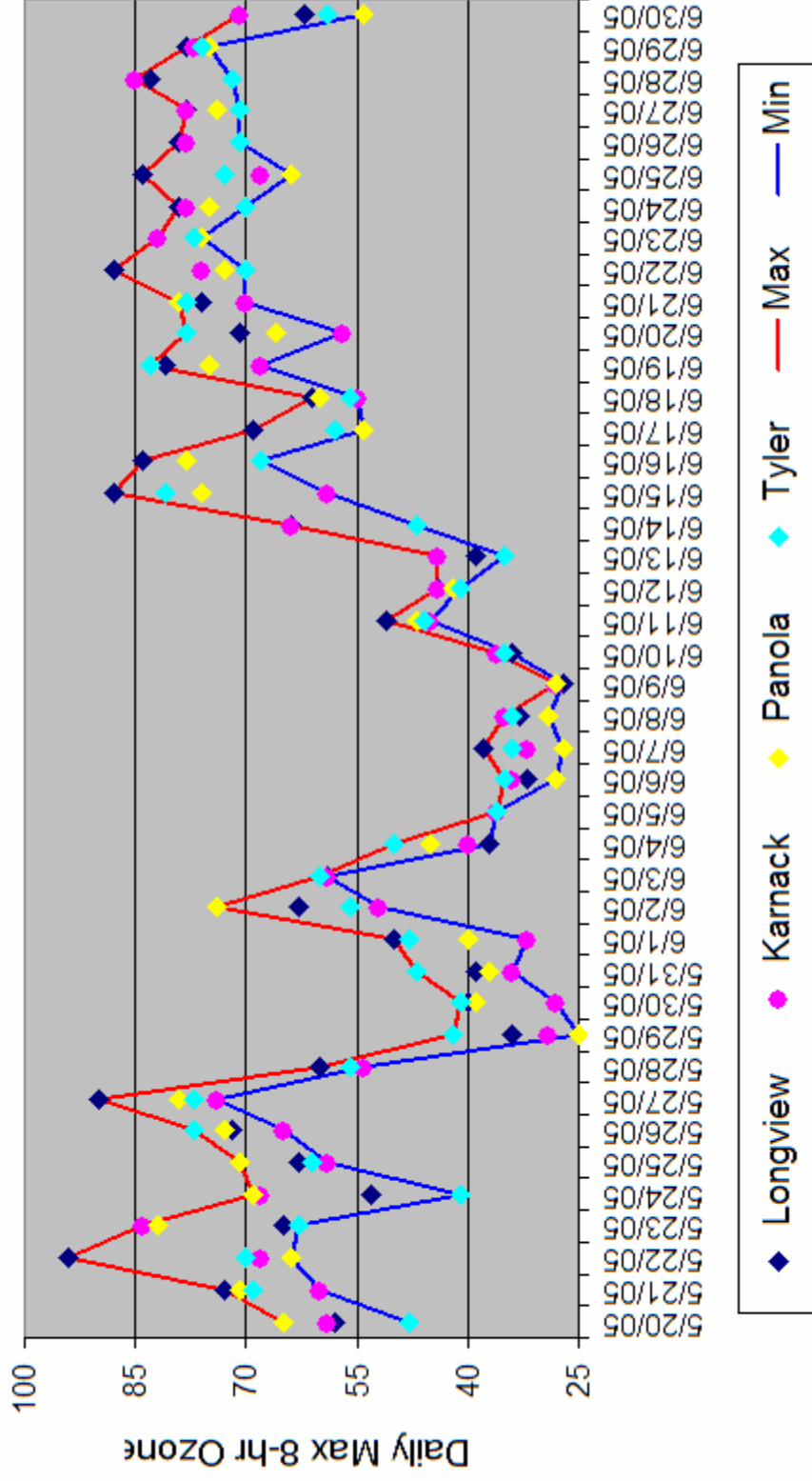


**June 28**

Stagnation across NE Texas and Louisiana



# Daily Max 8-hr Ozone in May/June 2005



Data for May 20 to June 30, 2005

# Modeling Recommendation

- Modeling should focus on Longview episodes
  - Extend the June episode to include June 15, 22 and 28?
  - Develop a May episode including May 22 and 25?
- Recommendation:
  - Develop an extended May-June “mini-seasonal” model with 36/12-km resolution
  - Add a 4-km grid for all five 8-hr exceedance days in May/June, plus other days close to 85 ppb
  - Begin by developing a **Modeling Protocol**