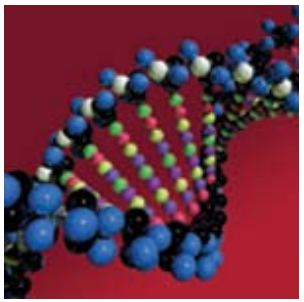
2012 Ozone Projections


Presentation to the NETAC Technical Committee

March 12, 2010

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Outline of Presentation

- Brief description of 2005/2012 modeling strategy
- Changes in Northeast Texas ozone: 2005 to 2012
  - Local and regional NOx emission trends
- Ozone design value projections for 2012 using EPA method
- Comparison of model results with 2005-2009 trends in observed Northeast Texas ozone

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Background

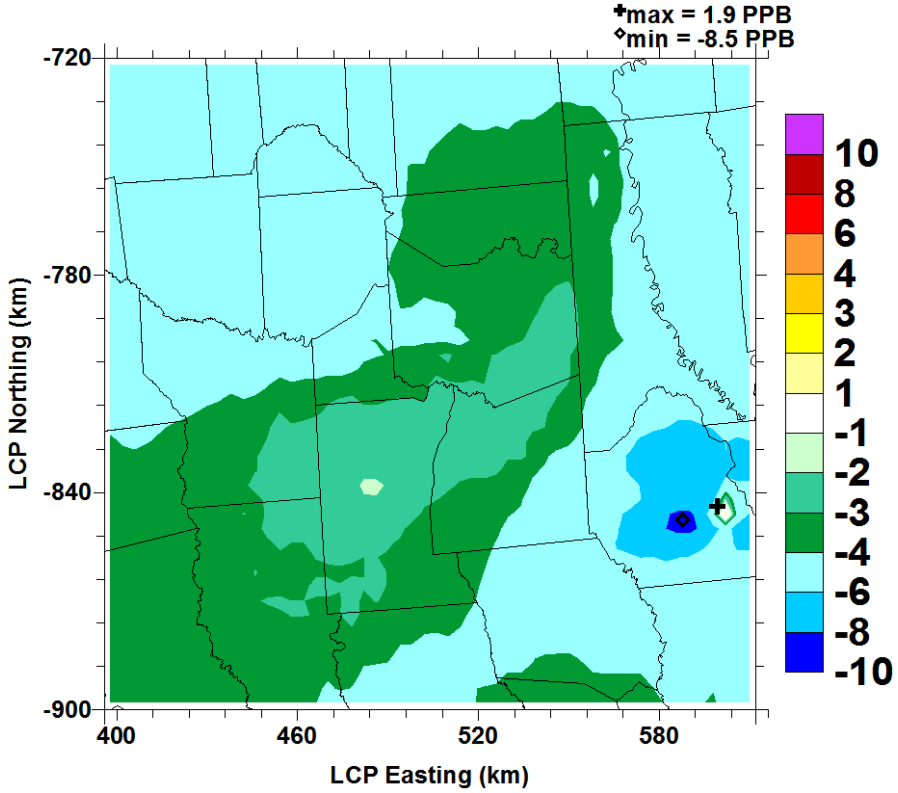
- Perform future year modeling that shows emissions reductions leading to attainment of the ozone standard
- Modeled 2005 base year, evaluated against observations of ozone and precursors
  - 2005 model performed well, and is suitable for use in SIP planning and control strategy development
- 2012 is the future year modeled with CAMx
  - 2005 meteorology and biogenic and fire emissions
  - Developed emission inventory for human activities for 2012
- How do 2005 to 2012 emission changes from human activities affect Northeast Texas ozone?

CAMx 2012 Modeling Strategy

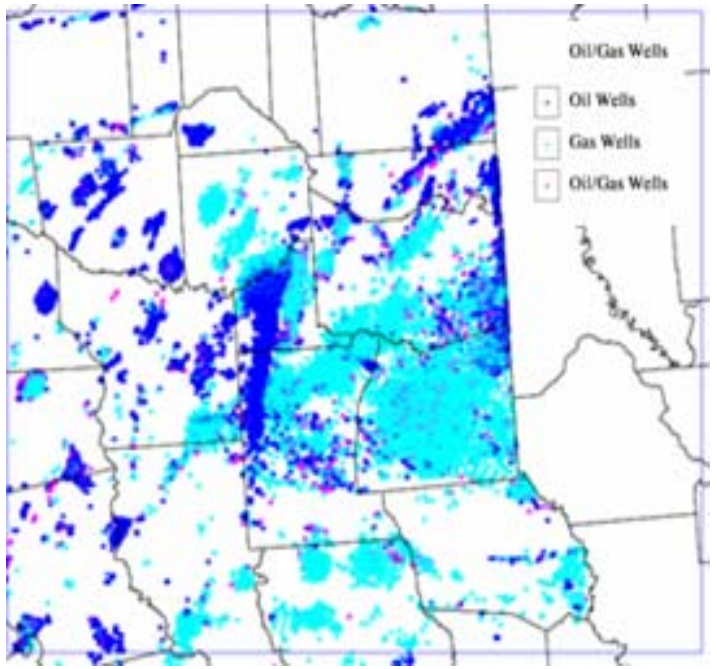
- Begin with Baseline 2012 emission inventory with no additional local controls
  - Emissions from Northeast Texas EGUs and Eastman Complex held fixed at 2005 levels
  - Likely overestimates 2012 Eastman emissions (e.g. 2 of 3 cracking plants operating in 2005 expected to be shut down in 2010)
  - Project local emissions from oil and gas sources using 2005-2008 TRRC production data
- Project future year design values using EPA's MATS tool
- Perform emissions sensitivity tests
  - Haynesville Shale
  - East Texas Combustion Rule
- Compare impacts of transport and local sources

Change in 8-Hour Ozone: 2012-2005

Episode Average Difference In Daily Max 8-Hour Ozone

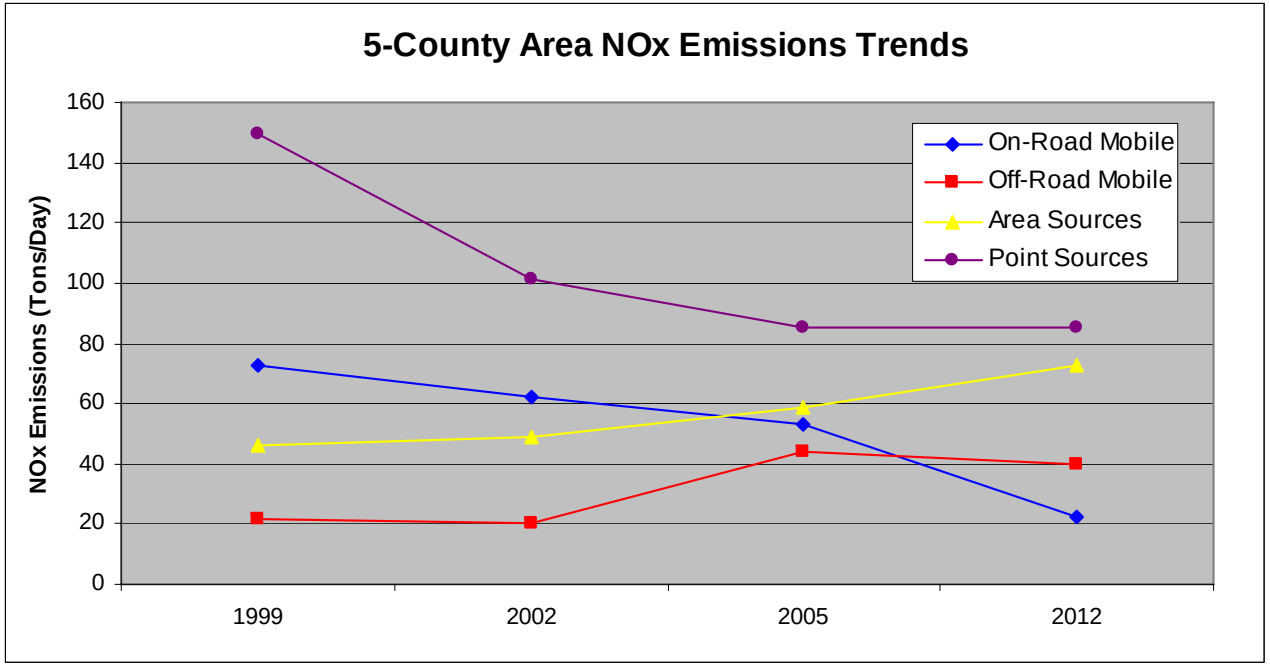


TCEQ Map of 2005 Oil And Natural Gas Wells



- Regional ozone reduction of 4-6 ppb in 2012
- Smaller ozone reductions in oil and gas production region
- Reduction in Dolet Hills (LA) power plant NOx emissions

5-County Area NOx Emissions

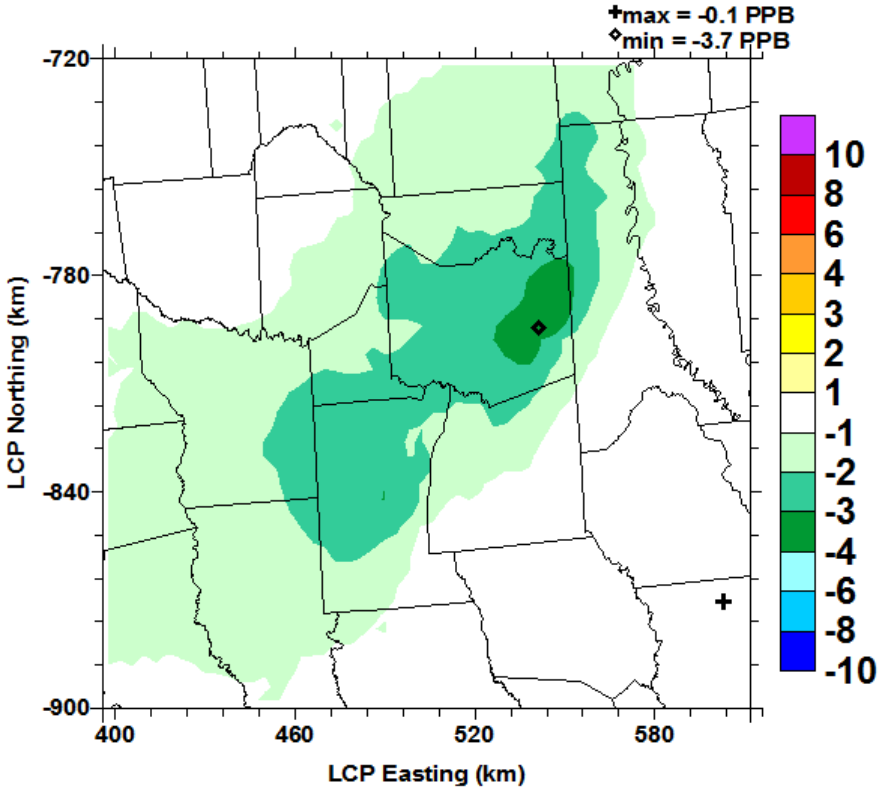


- Focus on NOx because ozone formation in Northeast Texas is generally NOx-limited
- Overall NOx reduction of ~20 tpd from 2005-2012 in 5-County area
- Only area sources (includes oil and gas) increase from 2005 to 2012
  - Oil & Gas: +11 tpd -> 45 tpd in 2012
  - Non-Oil & Gas: +3 tpd -> 28 tpd in 2012

Area Source Emission Inventory Sensitivity Test

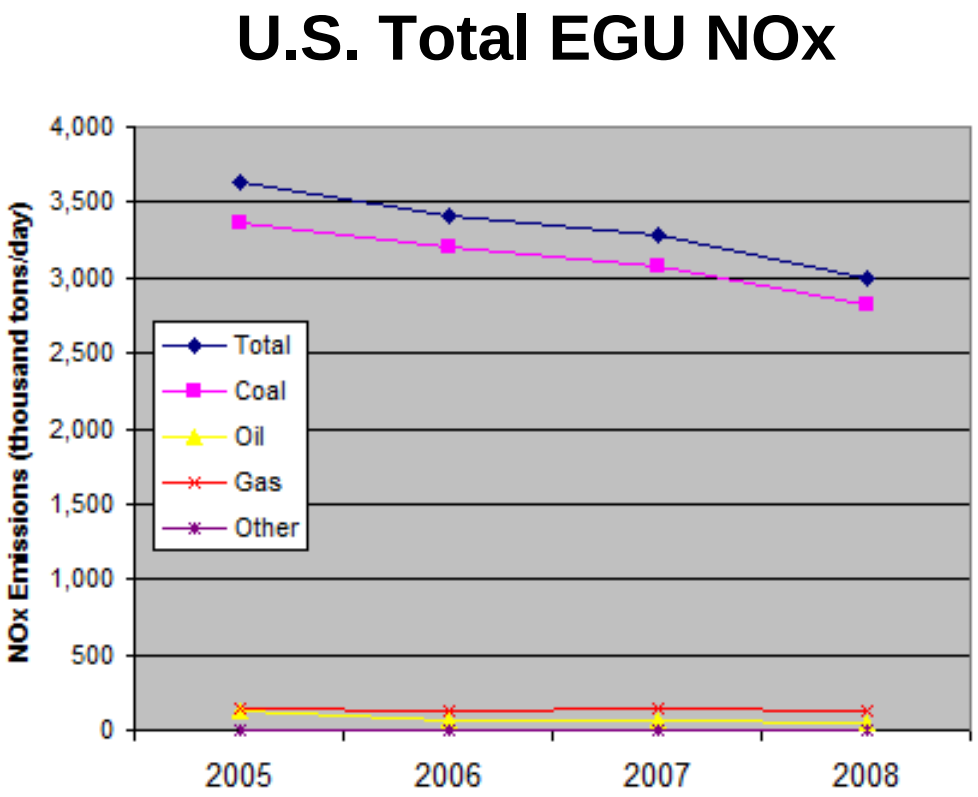
Episode Average Difference In Daily Max 8-Hour Ozone

2012 (2005 Area Sources) – 2012 Baseline



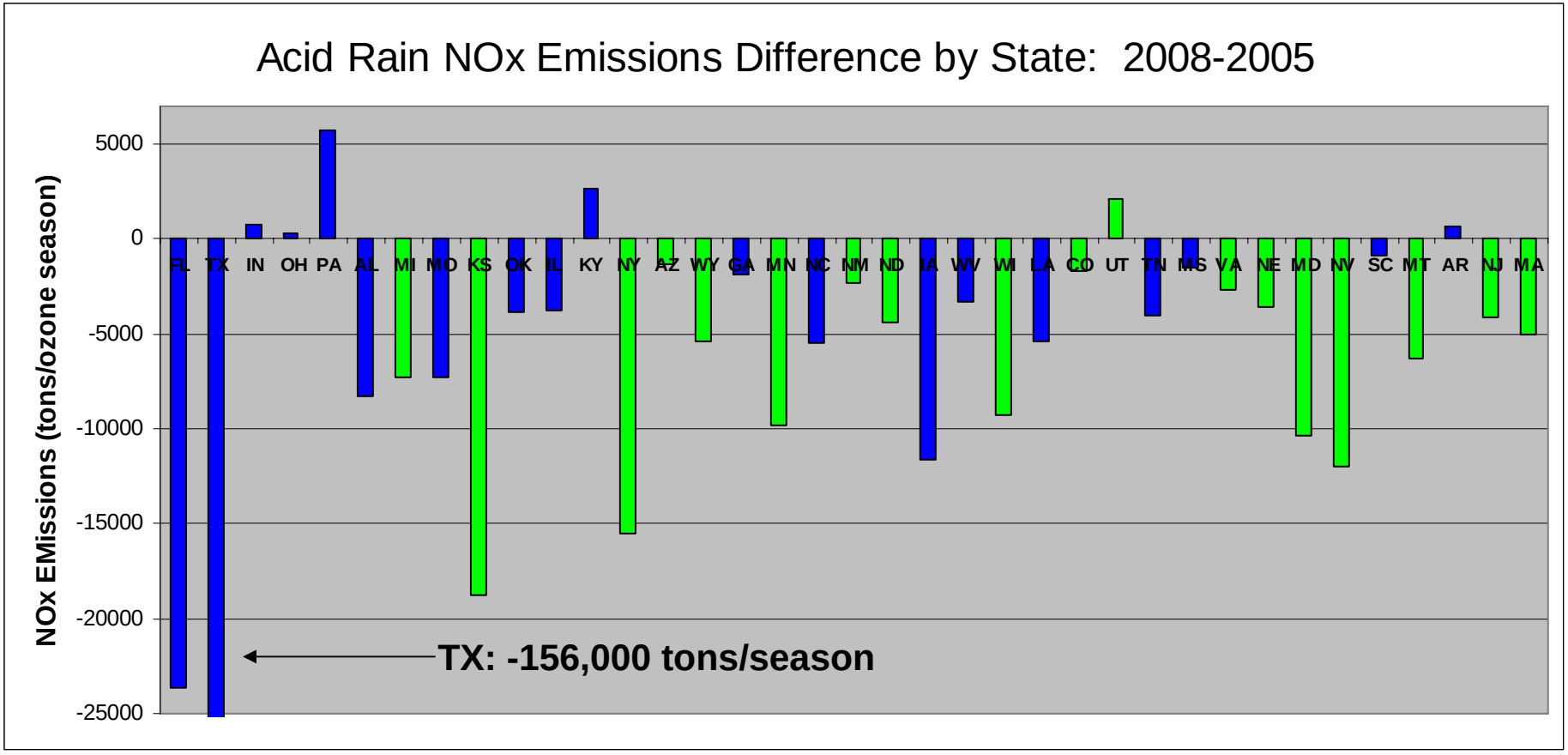
- Replaced 2012 area source inventory with 2005 inventory, reran model
- Ozone differences similar in shape to differences in 2012-2005 baseline runs
  - Magnitude of reductions similar to difference between 5-County area reductions and regional reductions in baseline runs
- Suggests that increase in area source O&G NOx inventory is causing 5-county area to show smaller ozone reductions than surrounding region

Where Are the Regional Reductions Coming From?



- NOx emissions reductions from NOx SIP call and first phase of CAIR
- Federal controls on mobile source NOx emissions

EGU NOx Trends by State



Data from EPA Clean Air Markets Database (CAMD) http://camddataandmaps.epa.gov/gdm/index.cfm?fuseaction=factstrends.topnox_byprogram

- EGU NOx emissions generally decreased from 2005 to 2008 in states typically upwind (blue bars) of Northeast Texas high ozone days
- Expect reductions in ozone and NOx transported into Northeast Texas

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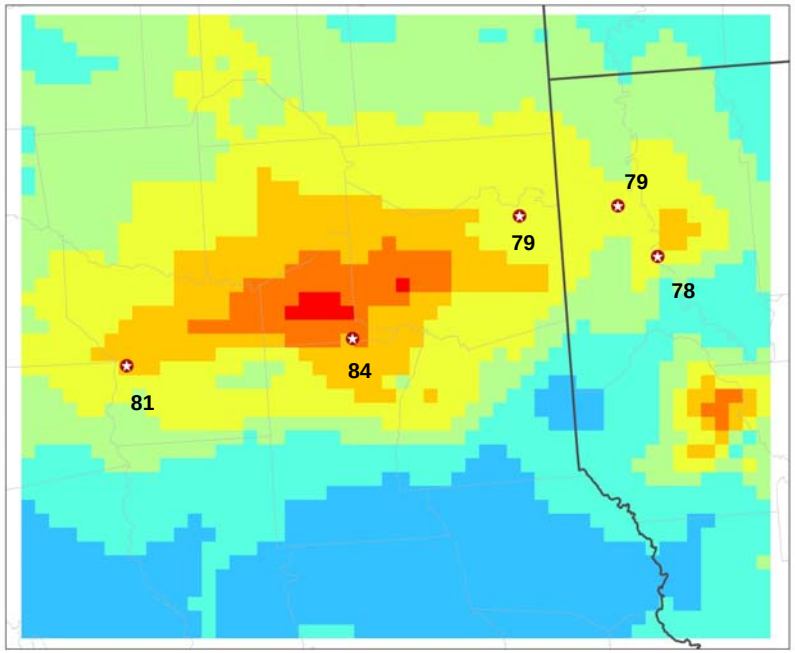
EPA Modeled Attainment Test Software (MATS)

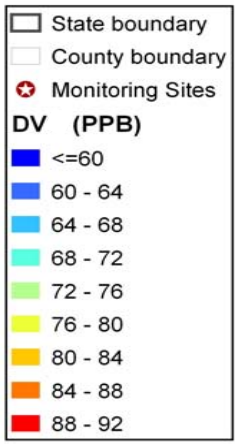
- EPA-recommended method for estimating future 8-hour ozone concentrations
  - Technique is designed to minimize effect of model uncertainties on future year ozone projections
- Start with observed base year (2005) design values, DV_{2005}, at the monitors
- Interpolate DV_{2005} from monitoring sites to each grid cell in modeling domain
  - Use model concentration gradients in interpolation to pick up modeled higher and lower ozone in unmonitored areas
- Calculate future year design value DV_{2012} at each monitor and grid cell by multiplying DV_{2005} by a model-derived response factor (RRF)
  - RRF is the ratio of the model's 2012 to 2005 ozone predictions at each monitor

$$DV_{2012}^{C19} = DV_{2005}^{C19} \; x \; RRF^{C19}$$

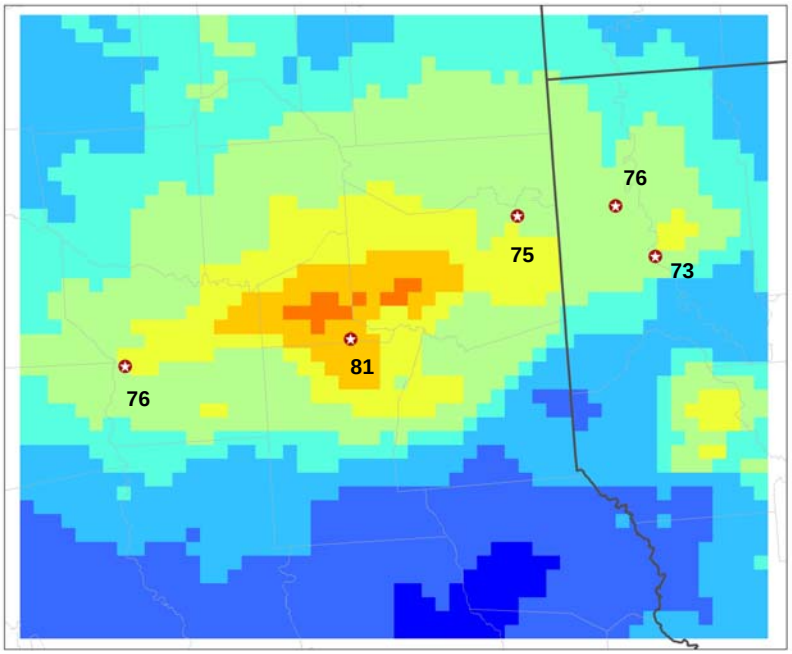
8-Hour Ozone Design Value Projections

2005 MATS Design Value



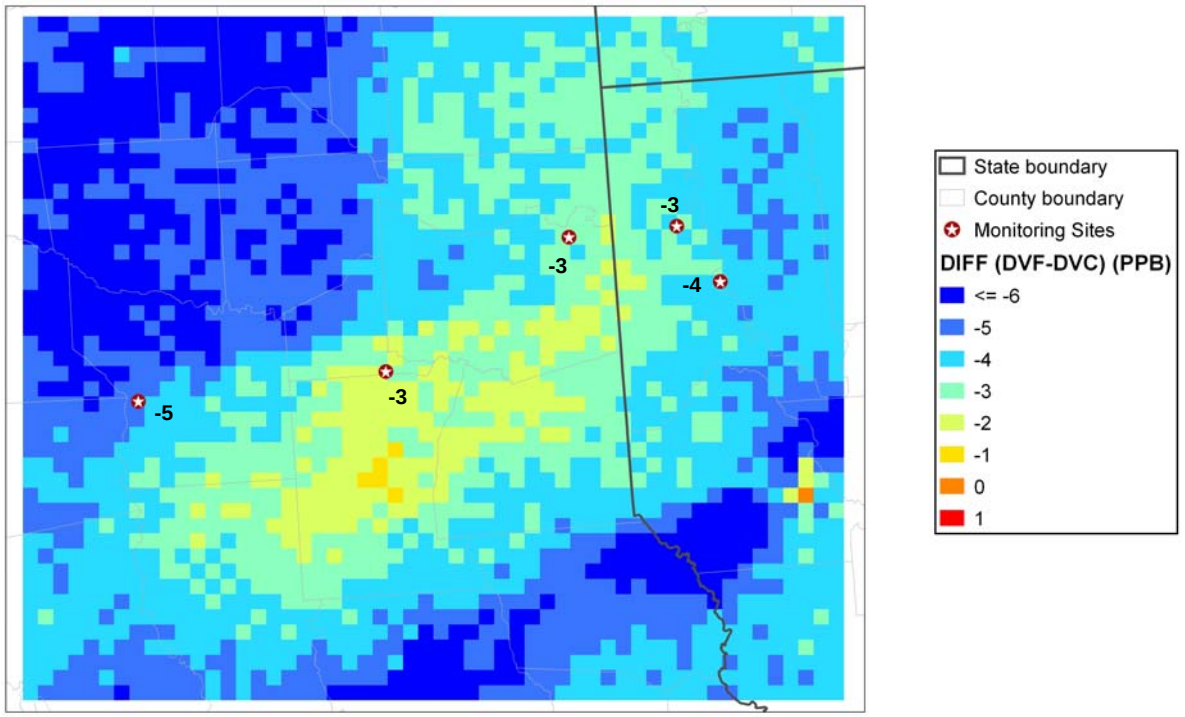


2012 MATS Design Value



- Yellow and red indicate DV > 75 ppb: violation of 2008 standard
- Regional reductions in DV going from 2005 to 2012
- 2of 3 Northeast Texas monitors exceed the 2008 ozone standard in 2012 (Longview=81 ppb, Tyler 76 ppb, and Karnack=75 ppb)

2012-2005 Design Value Difference



- Regional reduction of ~4-6 ppb in design value
- Decrease is smaller in area of intensive oil and gas development and production
- Haynesville Shale emissions are not included in this baseline 2012 run

Compare Modeled and Observed Ozone Trends in Northeast Texas

- Between 2005 and 2009, observed DV decreased for all three Northeast Texas monitors
  - Modeled DV 2005 to 2012 decrease smaller than observed 2005-2009 decrease
- After 2009, all three Northeast Texas monitors attain the 75 ppb standard
  - *Model projects non-attainment in 2012 for two of the three monitors*
- Why is this? Is this model a useful tool for control strategy development?

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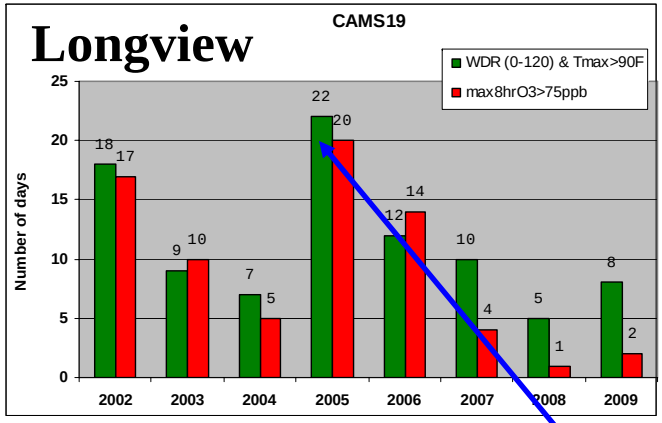
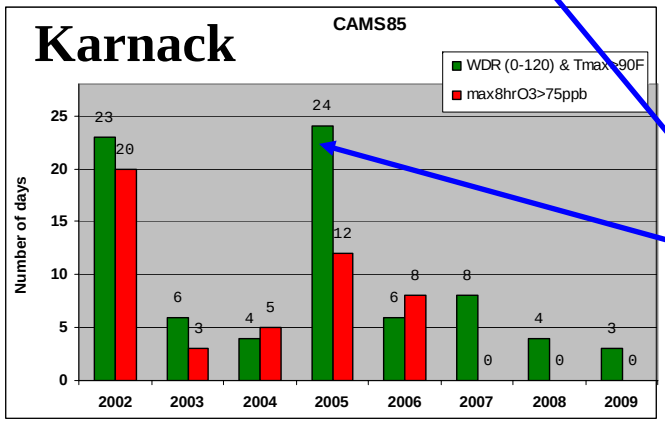
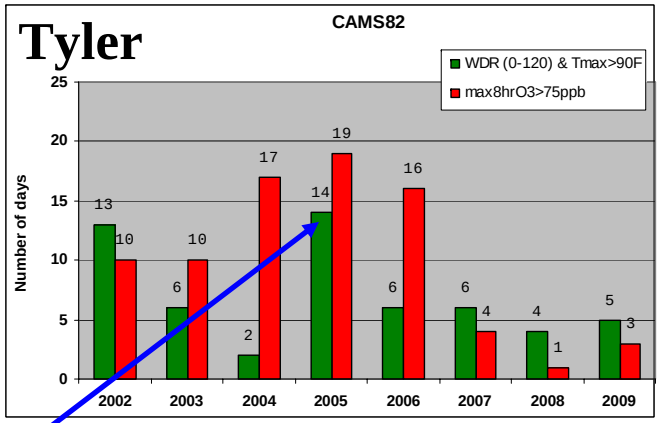
Potential Factors

- 2012 inventory does not account for the effects of the recent economic slowdown
  - Area sources are the only category with increasing NOx emissions from 2005 to 2012
    - Area source oil and gas emissions in 5-county area extrapolated from 2005-2008 TRRC data, so do not include effects of slowdown, but also do not include Haynesville Shale emissions
- 2005 was an unusually severe year in terms of weather conditions
  - 2006-2009 years had fewer days when weather was conducive to high ozone in Northeast Texas

Weather and Ozone: 2005-2009





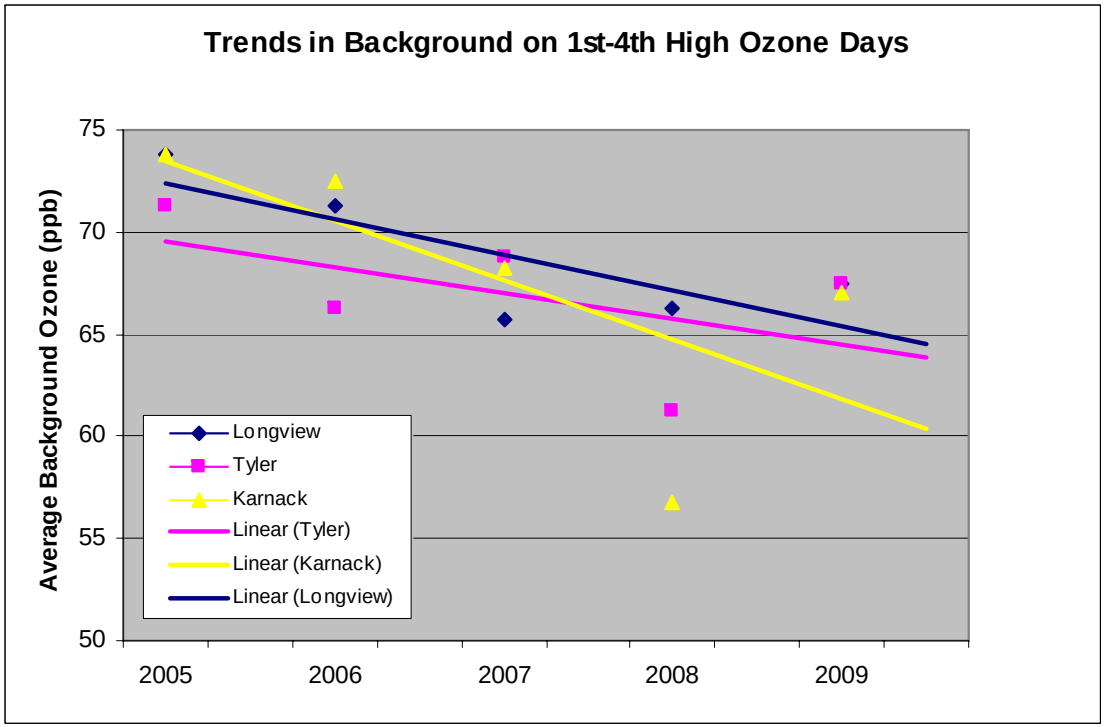


2005 had more days with weather favorable to ozone formation than any year during 2006-2009

Green Bars: # days with weather conditions favorable for ozone Formation

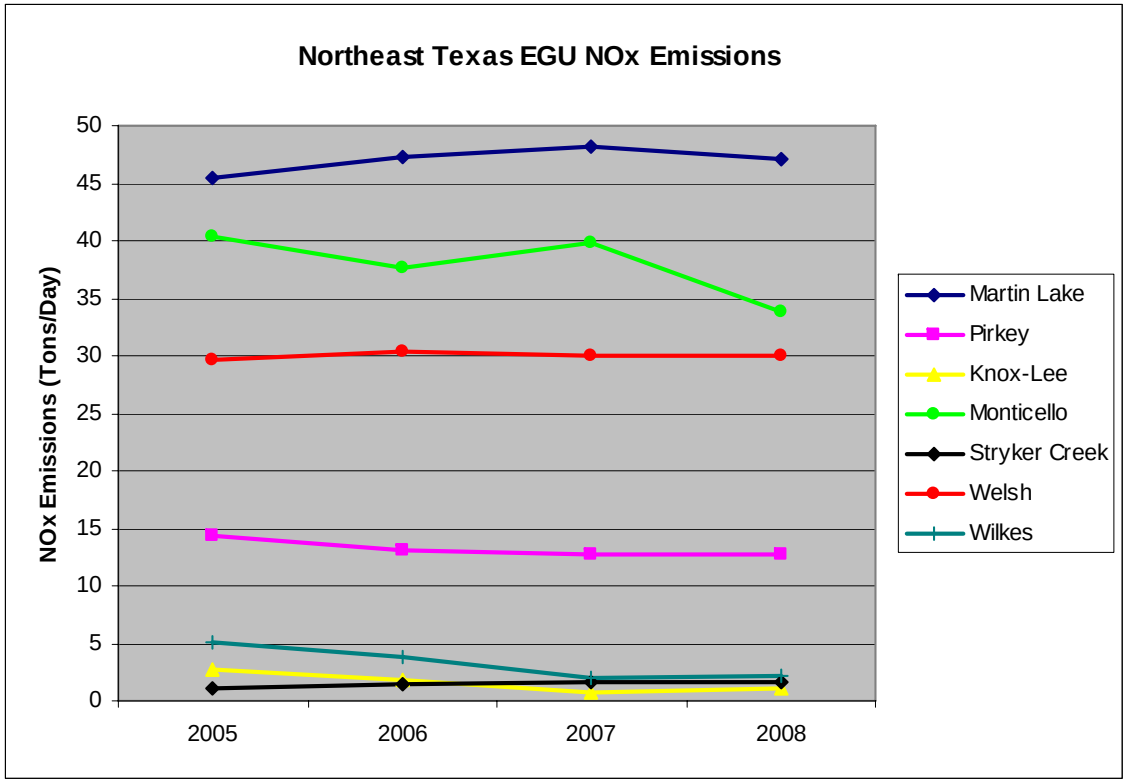
Red Bars: # of high ozone days

Trends in Diagnosed Background Ozone



- Average the peak background ozone on the four highest ozone days each year, look at trend from 2005-2009
- Background ozone declining, ~4-7 ppb decrease from 2005-2009
  - Consistent with modeling results

Northeast Texas EGU Measured NOx Emission Trends



- Data are ozone season averages of CEM data from EPA CAMD
- EGU emissions generally show little change or slight decline during 2005-8
  - Data suggest that holding EGU emissions fixed at 2005 levels is not a major cause for error in future year modeling

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Summary

- Model predicts nonattainment of 75 ppb standard for Longview and Tyler in 2012; Karnack attains the standard
  - 2005 had unfavorable meteorological conditions which have not repeated during 2006-2009 period, but could recur
- Modeled decrease in background ozone is consistent with observed trends
- Local NOx emissions decrease overall from 2005-2012, but area source emissions increase, lessening effects of regional ozone reductions within 5-County area
  - Results emphasize importance of oil and gas sources to regional air quality
- Model results are reasonable given trends in observed ozone and emissions and can be used to assess effects of emissions growth as well as control strategies

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End

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EPA's Ozone Projection Approach

1. Develop current year 8-hour ozone Design Value (DVC) as starting point for projections.

2. Select the maximum modeled 8-hour ozone *near a monitor* for *several days* and generate RRFs as the ratio of future to current year modeled ozone

$$RRF_{monitor\ i} = \frac{\sum_{days}(daily\ \max 8-hour\ ozone)_{future\ \ year}}{\sum_{days}(daily\ \max 8-hour\ ozone)_{current\ \ year}}$$

3. Apply RRF to DVC to obtain projected future year 8-hour ozone Design Value (DVF)

$$DVF_{monitor\ i} = DVC_{monitor\ i} \text{x } RRF_{monitor\ i}$$

4. Attainment demonstrated if all DVFs are less than NAAQS at all monitoring sites

EPA's RRF Ozone Projection Approach

- Unmonitored Area Analysis (UAA)
  - Examine future year projected DVFs away from the monitoring sites
  - Interpolate DVCs from monitoring sites to each grid cell in modeling domain
    - Use model concentration gradients in interpolation procedures to pick up modeled higher and lower ozone areas
  - Project future year DVFs using RRFs in each grid cell
  - EPA (2007) guidance notes that the UAA is less certain than the monitor-based DVF projections

Northeast Texas Design Value Trends