2006 DFW Modeling

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Photochemical Modeling Technical Committee

August 31, 2010

Modeling in SIP Development
The Big Picture

Base Case	**Day-specific emissions; replicate what actually happened**
Baseline Case	**Typical emissions; used in Relative Response Factor (RRF) to predict future design values**
Future Base Case	**Apply future growth + on-the-books controls to estimate future ozone**
Control Strategy Testing	**Determine control strategies that will effectively reduce ozone**
SIP	**Document modeling procedures**

Modeling in SIP Development

Base Case – Historical Episode

Meteorological Modeling (MM5, WRF)
Winds, Mixing Depth, Temperature, etc.

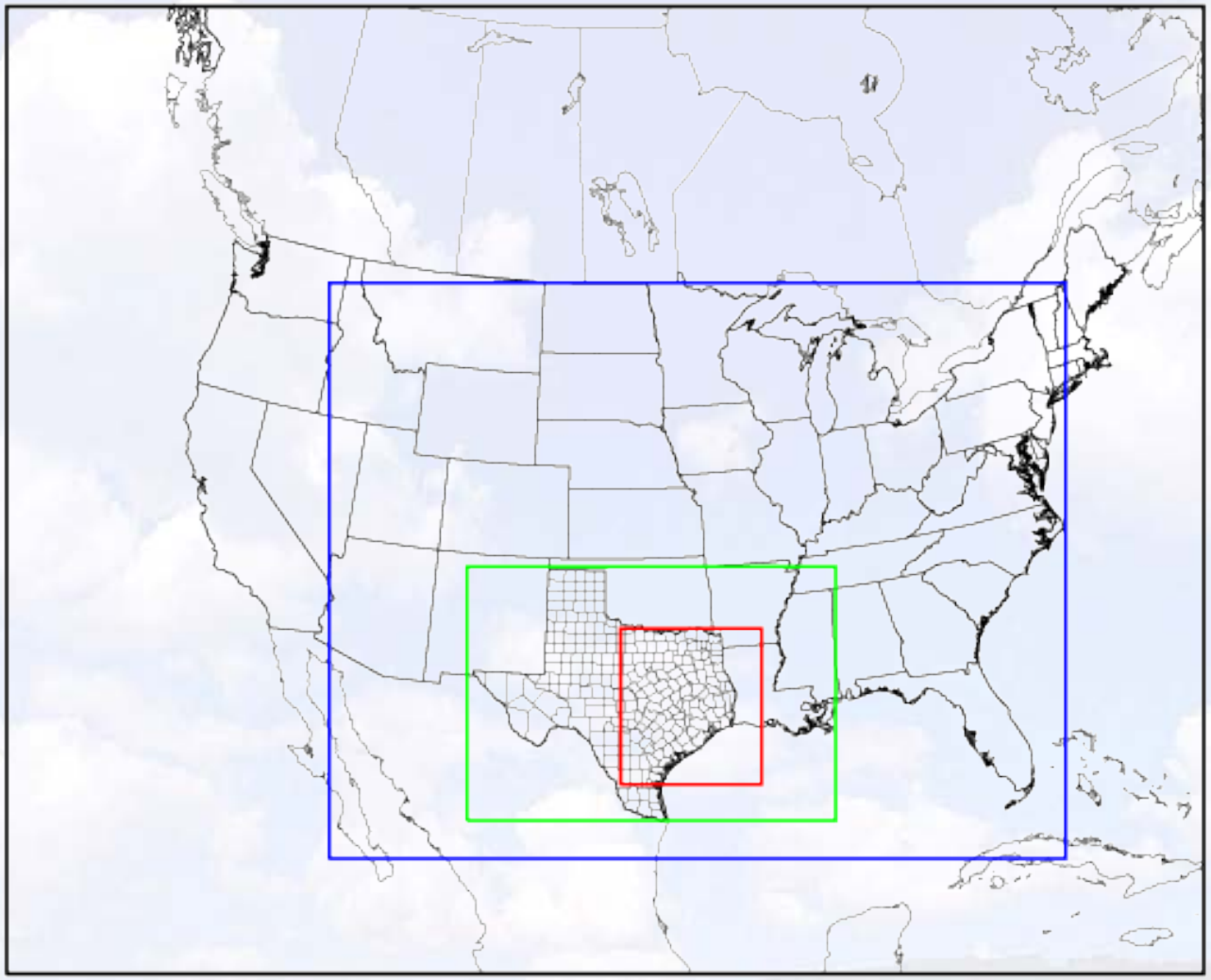
Emissions Modeling
VOC, CO & NO_X
Point, Area, On- & Non-Road, & Biogenic

Photochemical Modeling (CAMx)
O_3, NO_X, VOC, CO, etc.

CAMx Performance Evaluation
(How well does the model replicate the episode?)
Bias, Time Series, Contour Plots

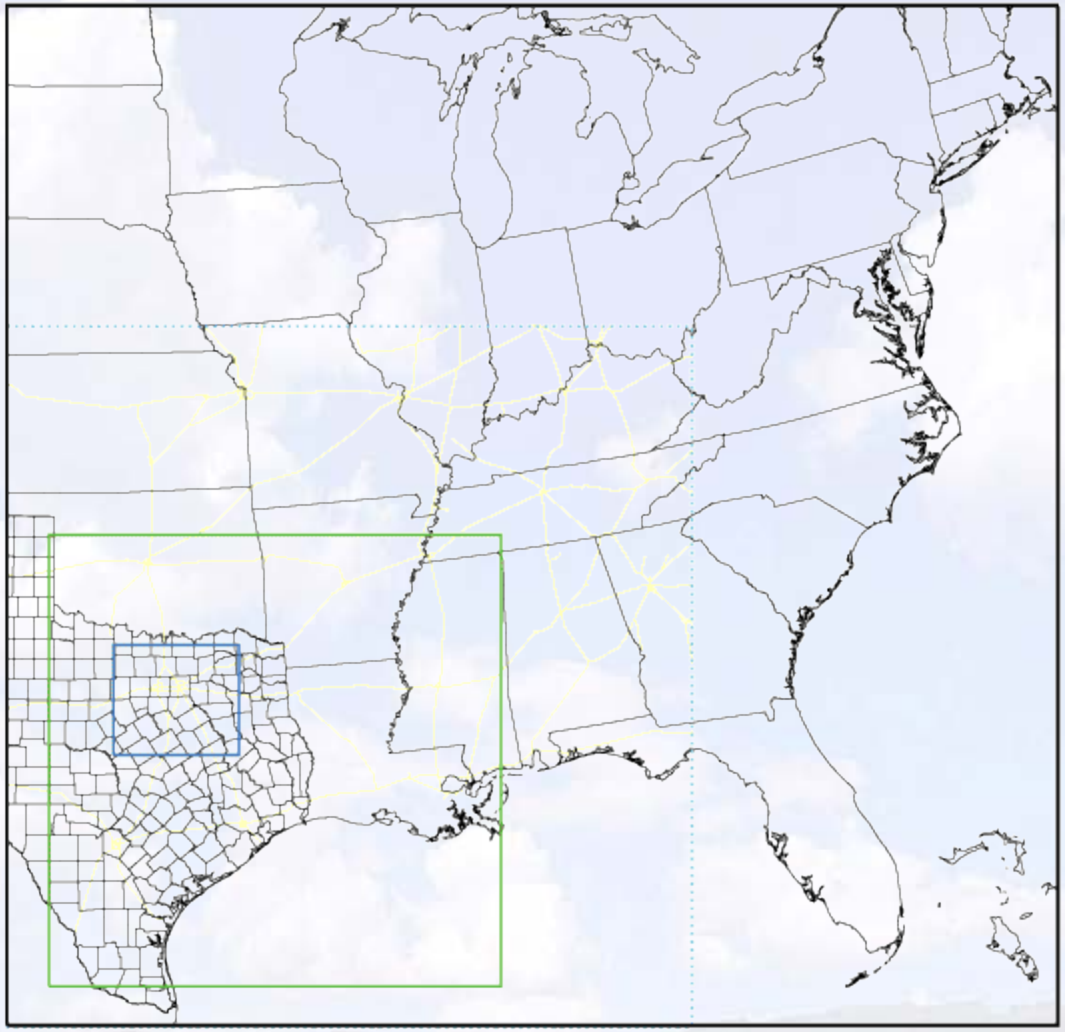
Suitable Base Case

Met Modeling domains



Continental US South US East Texas

CAMx Modeling domains



Regional (1-Hour SIP) East US (8-Hour) East Texas DFW

Modeling in SIP Development

Extended June 2006 Episode: Base Case Setup

Emissions

- Points: 2006 State of Texas Air Reporting System (STARS), Hourly Acid Rain
- On-Road Mobile: MOBILE6.2 2006 link-based for DFW
  - MOVES Sensitivities
- Non-Road Mobile: 2006 TexN
- Area: 2005 TexAER
- Barnett Shale: Drill Rigs and Production data projected back from 2008 TexAER data. Production separated from Area Oil & Gas
- Biogenics: GloBEIS w/ updated Texas A&M land use

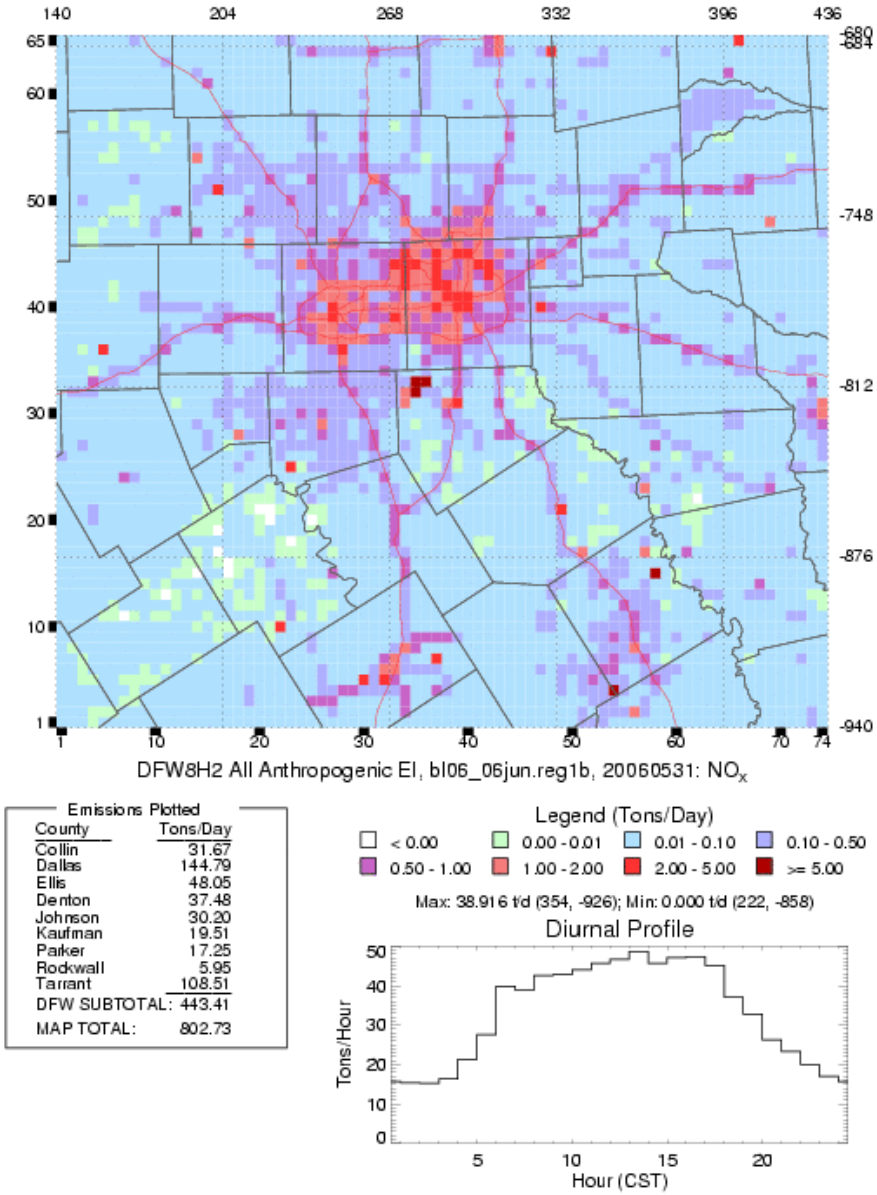
Meteorology

- Optimized for DFW based on previous Environ/TCEQ work
- 2006 TexAQS II radar profiler data assimilation
- Satellite-based land use and sea surface temperature data

June 2006 Episode: Base Case Setup

Category	2006 NOx Tons/day	%	2006 VOC Tons/day	%
On-road Mobile	225	51%	115	24%
Area w/o Oil/Gas	16	4%	214	44%
Elevated Points	44	10%	8	2%
Low-level Points	6	1%	30	6%
Non-Road	85	19%	64	13%
Off-Road	40	9%	7	1%
Oil & Gas Production	10	2%	48	10%
Oil & Gas Drilling	18	4%	1	0%
9-County Total	444		487	

2006 Anthropogenic NO_x



June 2006 Episode: Base Case Setup

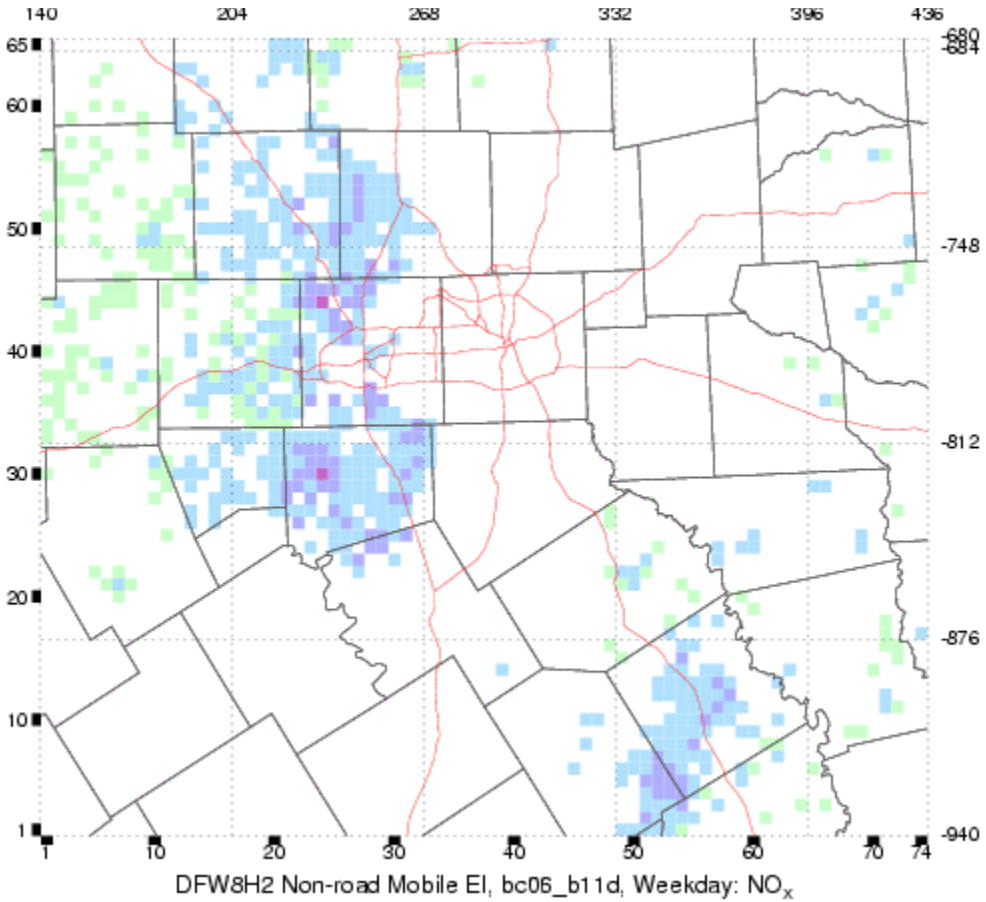
2006 Oil & Gas EI Improvement

- **Drill Rigs weren't in previous DFW modeling inventories**

- **Barnett Shale Oil & Gas has been separated in our inventory for reporting, quality assurance, and sensitivity work**

- **Barnett Shale Rig count based on Industry estimates of active drill rigs (RigData.com; BakerHughes.com)**

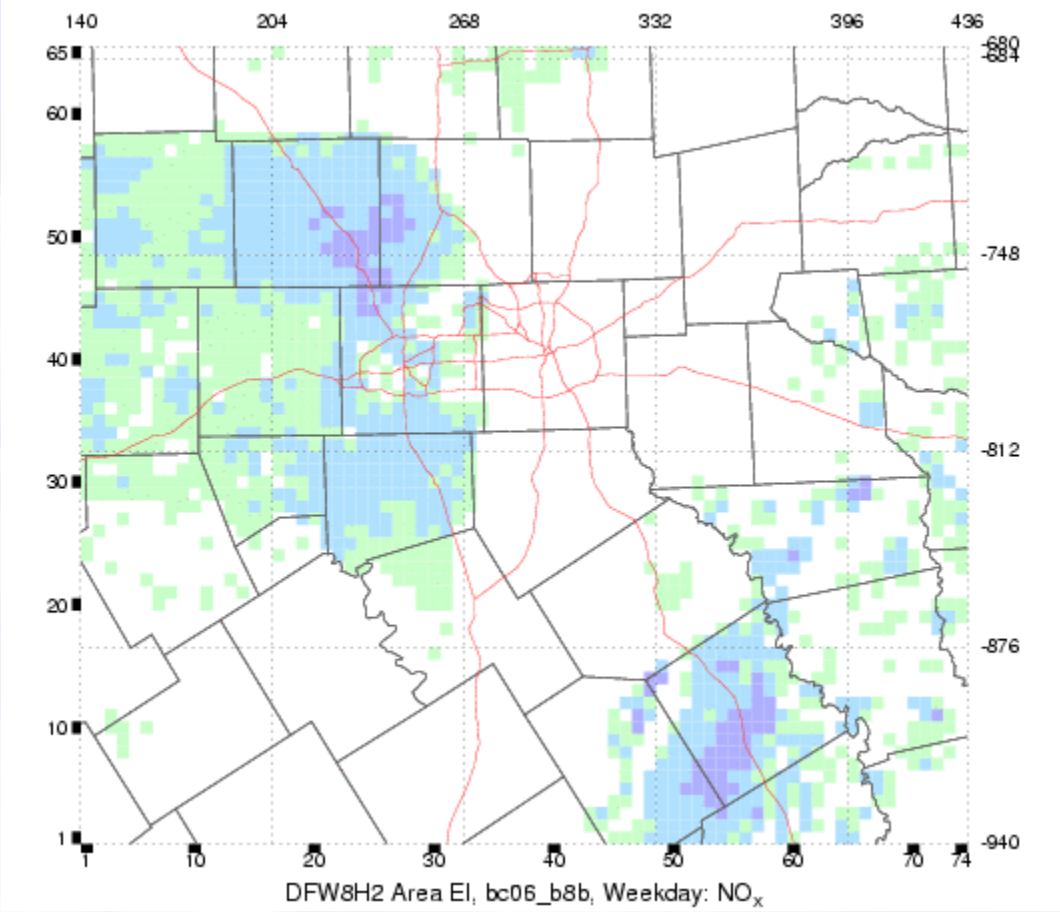
2006 Drill Rigs EI, NO_X



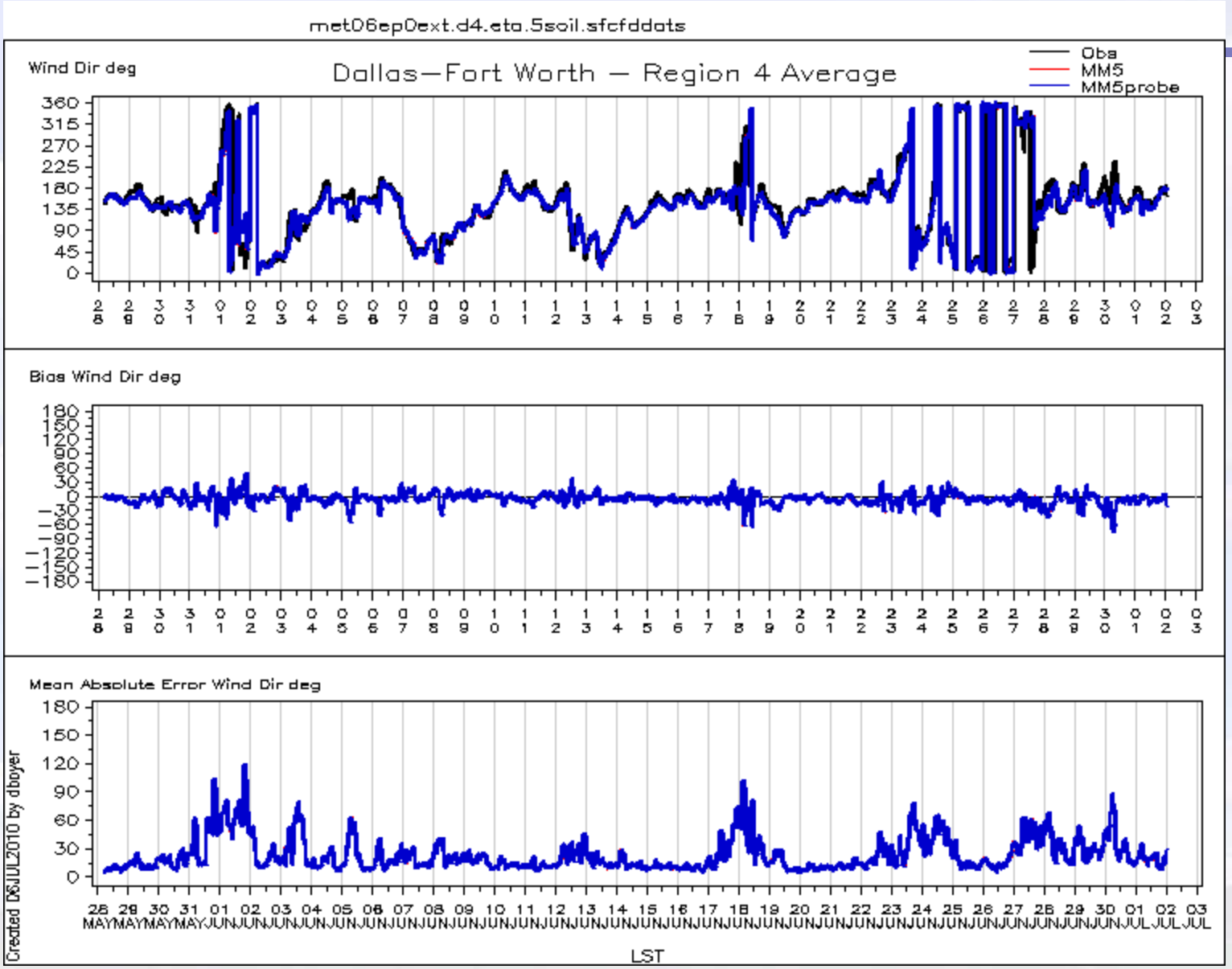
June 2006 Episode: Base Case Setup

2006 Oil & Gas Production

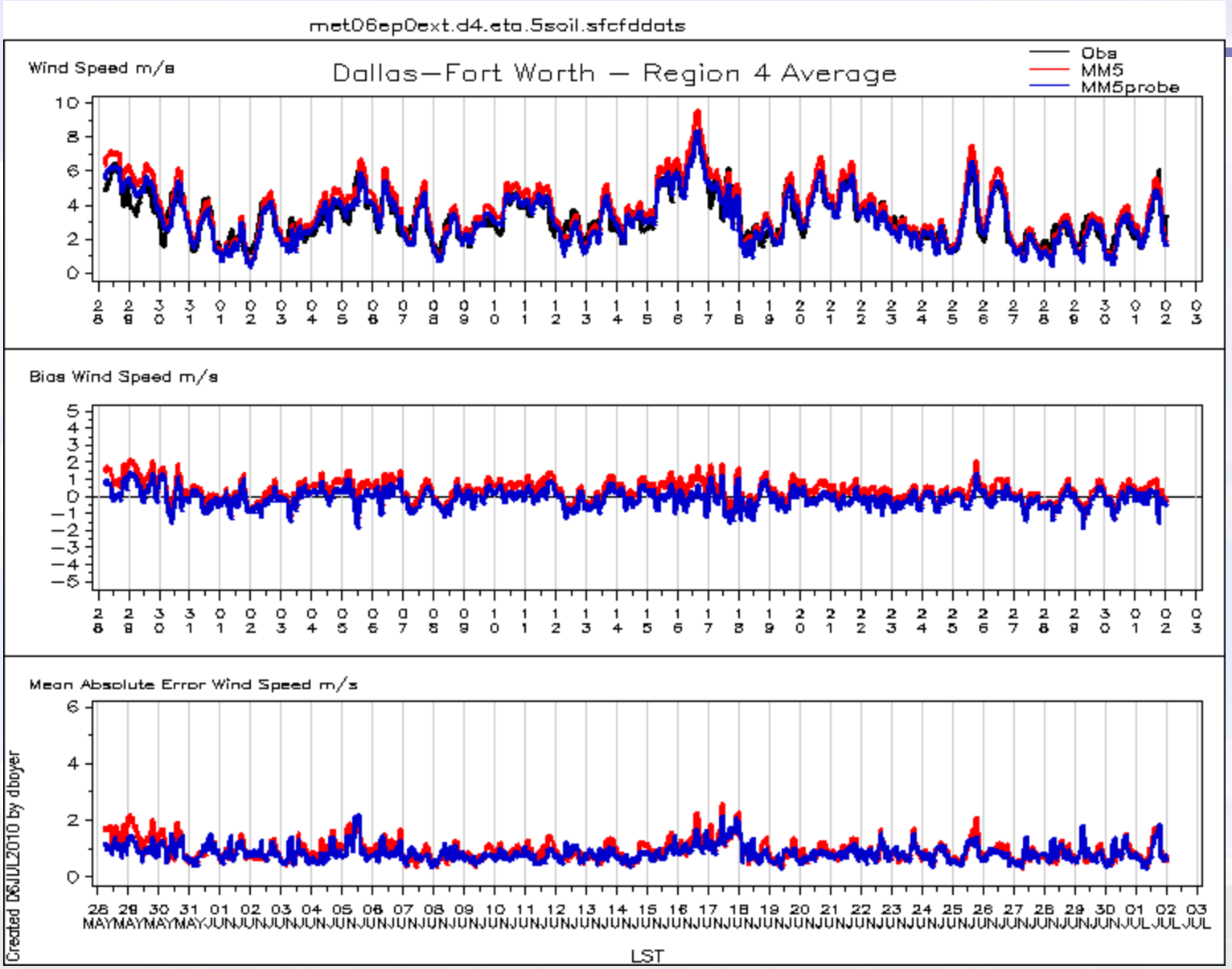
- **2008 TexAER gives more SCCs**
- **2008 back-cast to 2006 using RR Commission production data**
- **Most NO_X from compressors**
- **Most VOC from condensate tanks**



2006 Base Case Met Evaluation

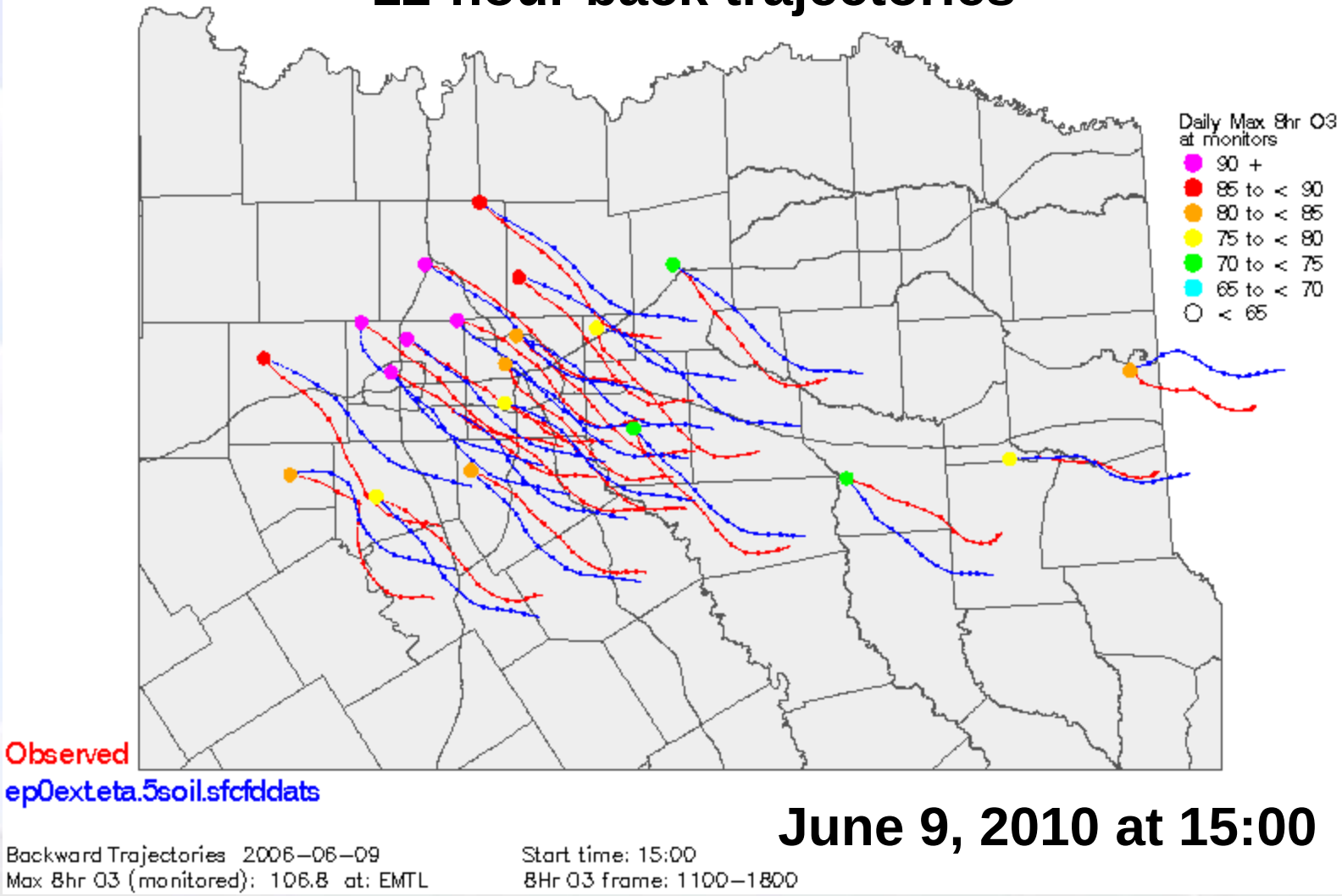


2006 Base Case Met Evaluation



2006 Base Case Met Evaluation

12-hour back trajectories

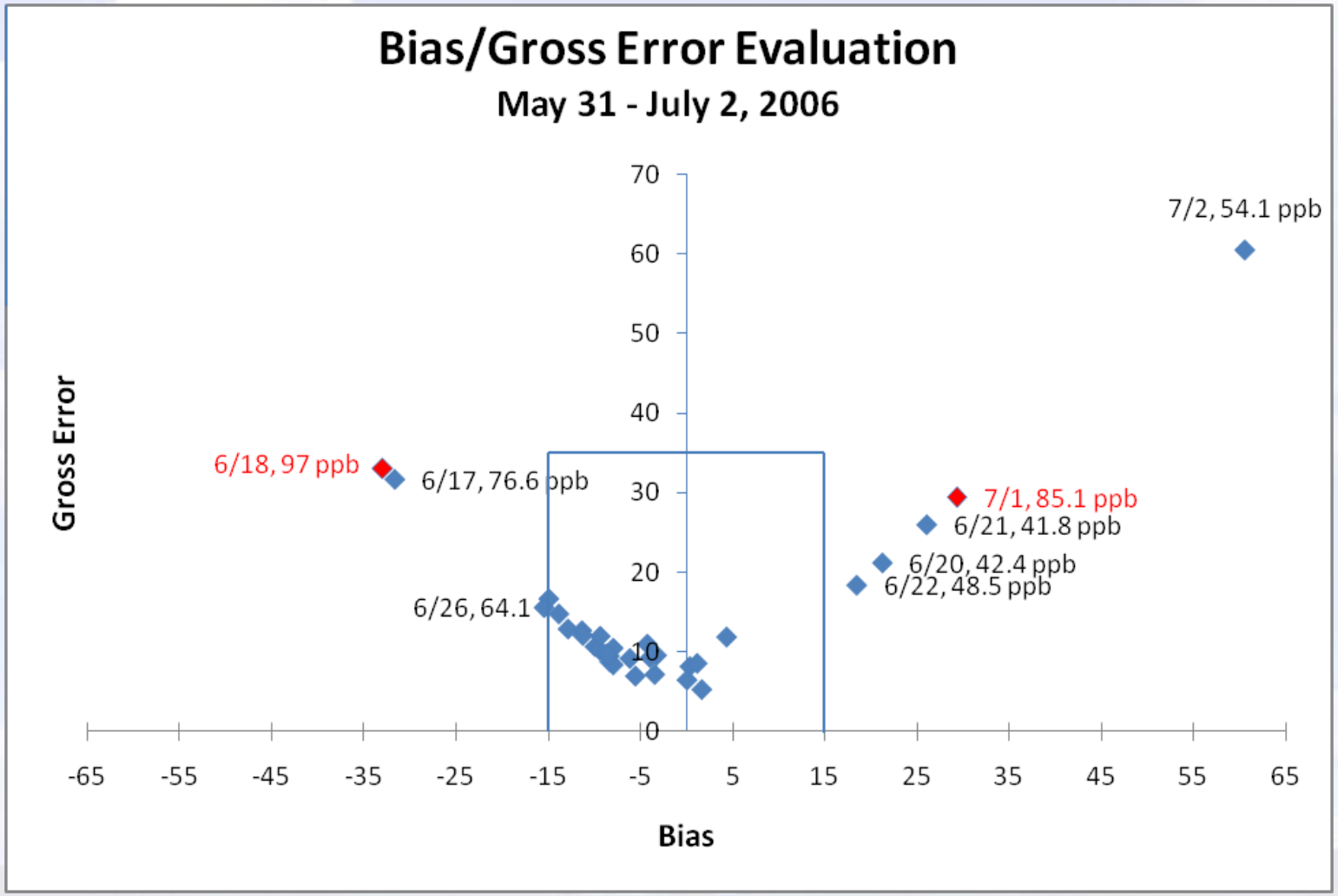


June 9, 2010 at 15:00

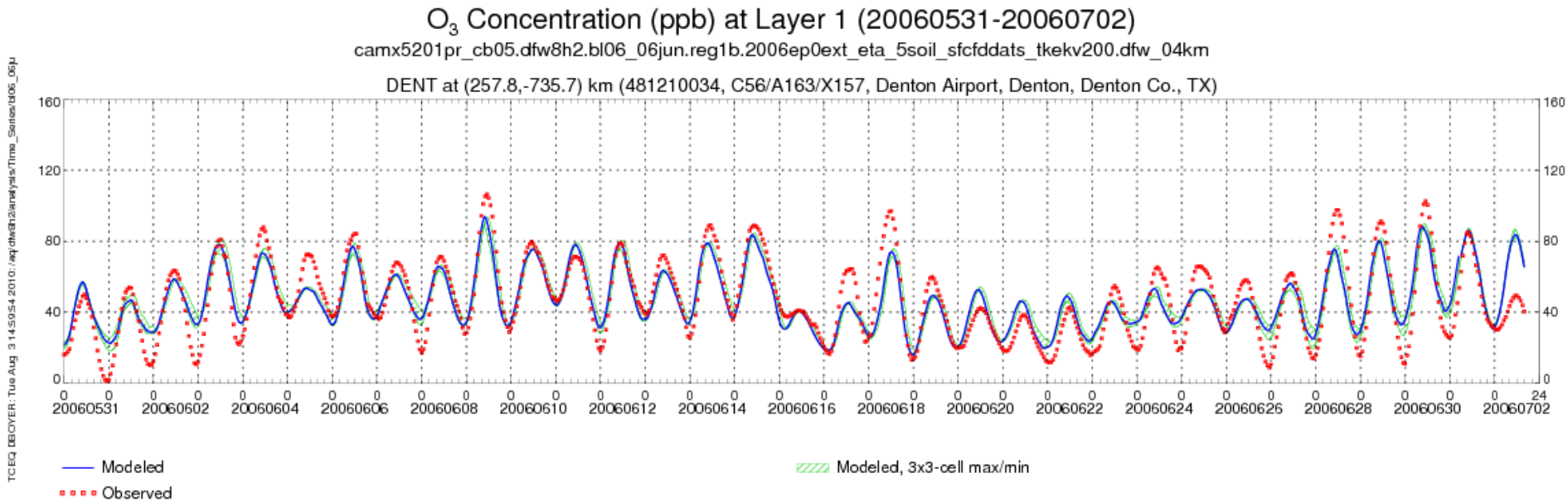
2006 Base Case Evaluation

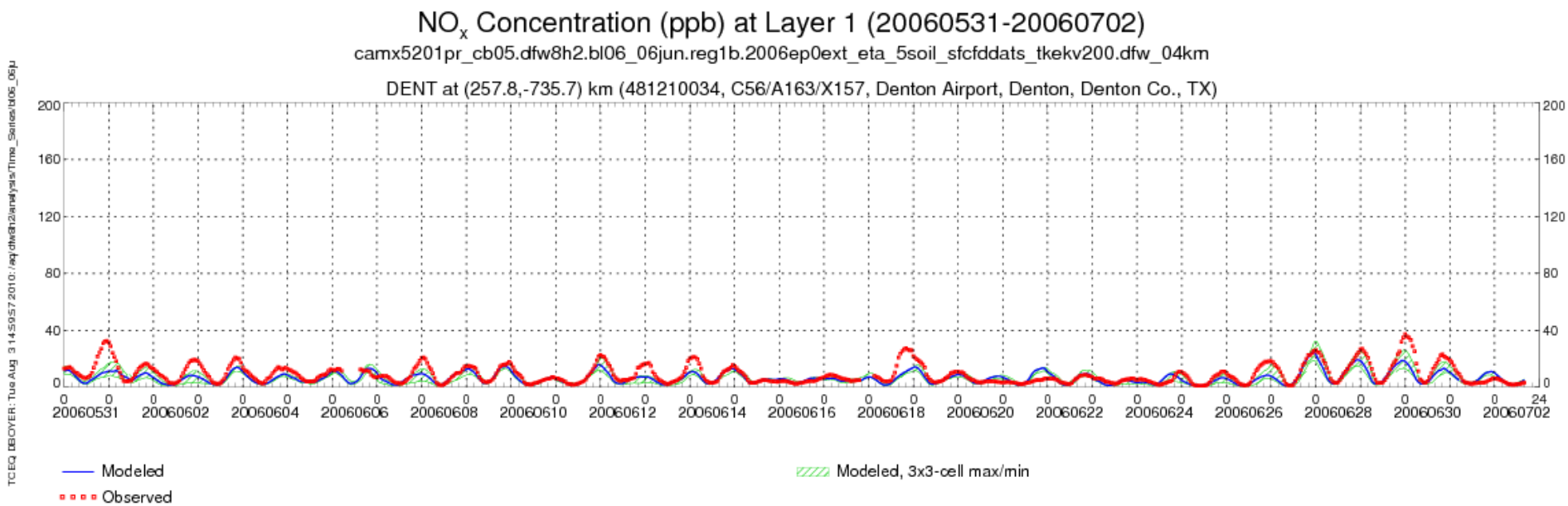
☆ **Stars show high ozone days.**

2006 Base Case Evaluation

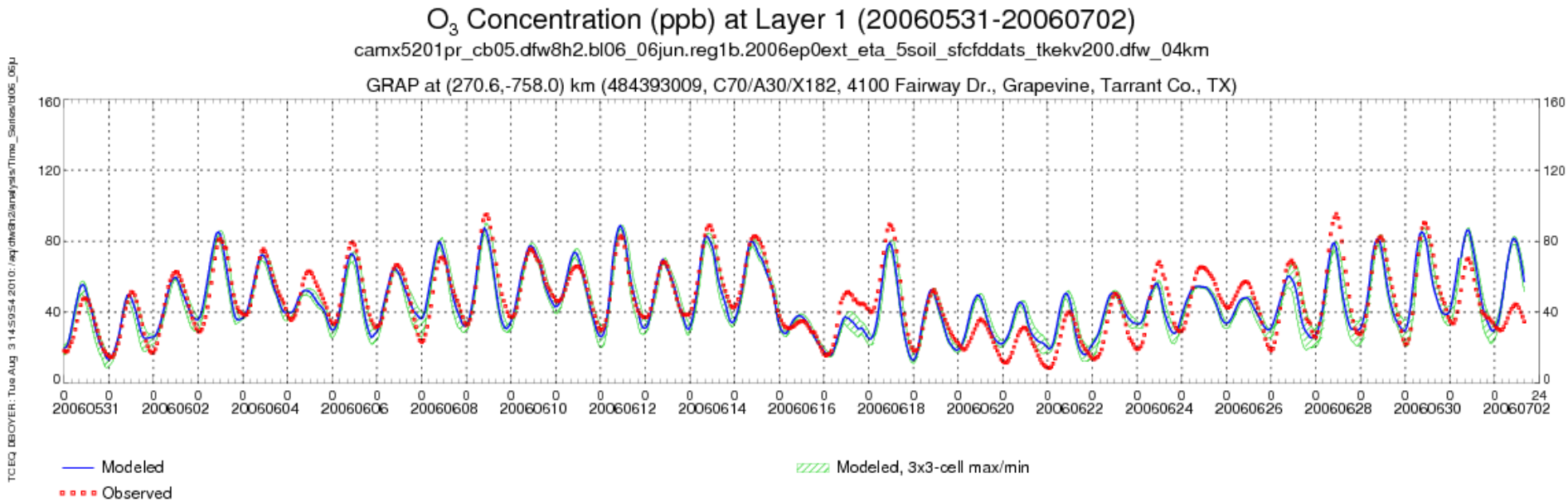


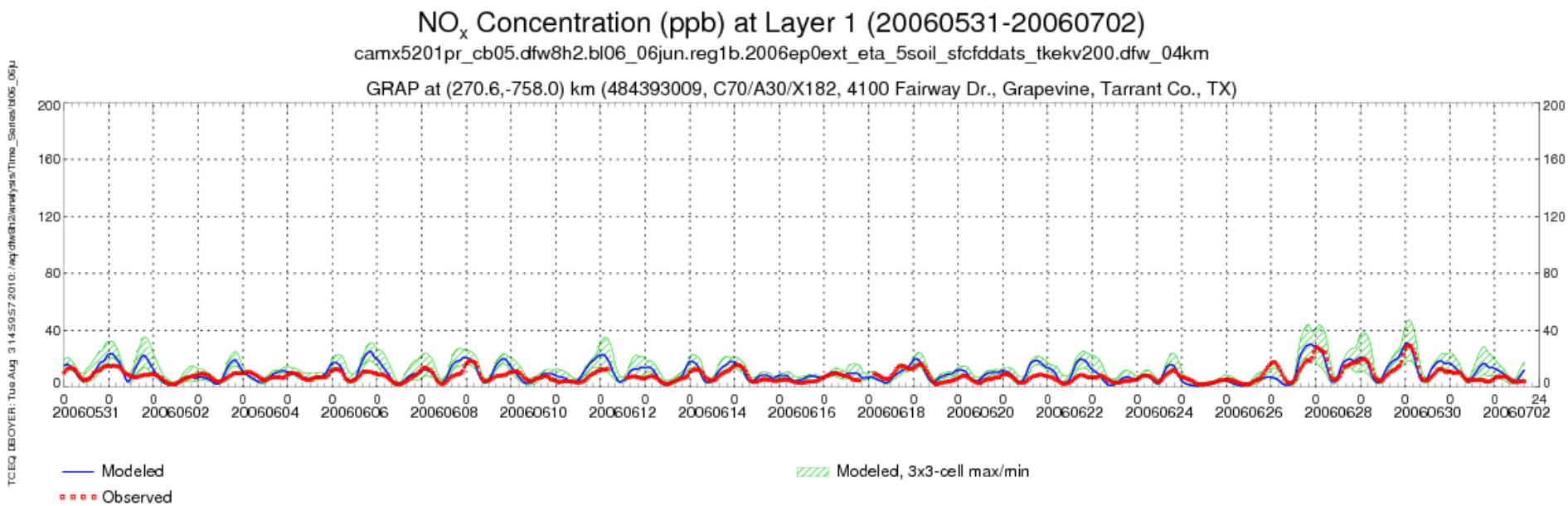
2006 Base Case Evaluation



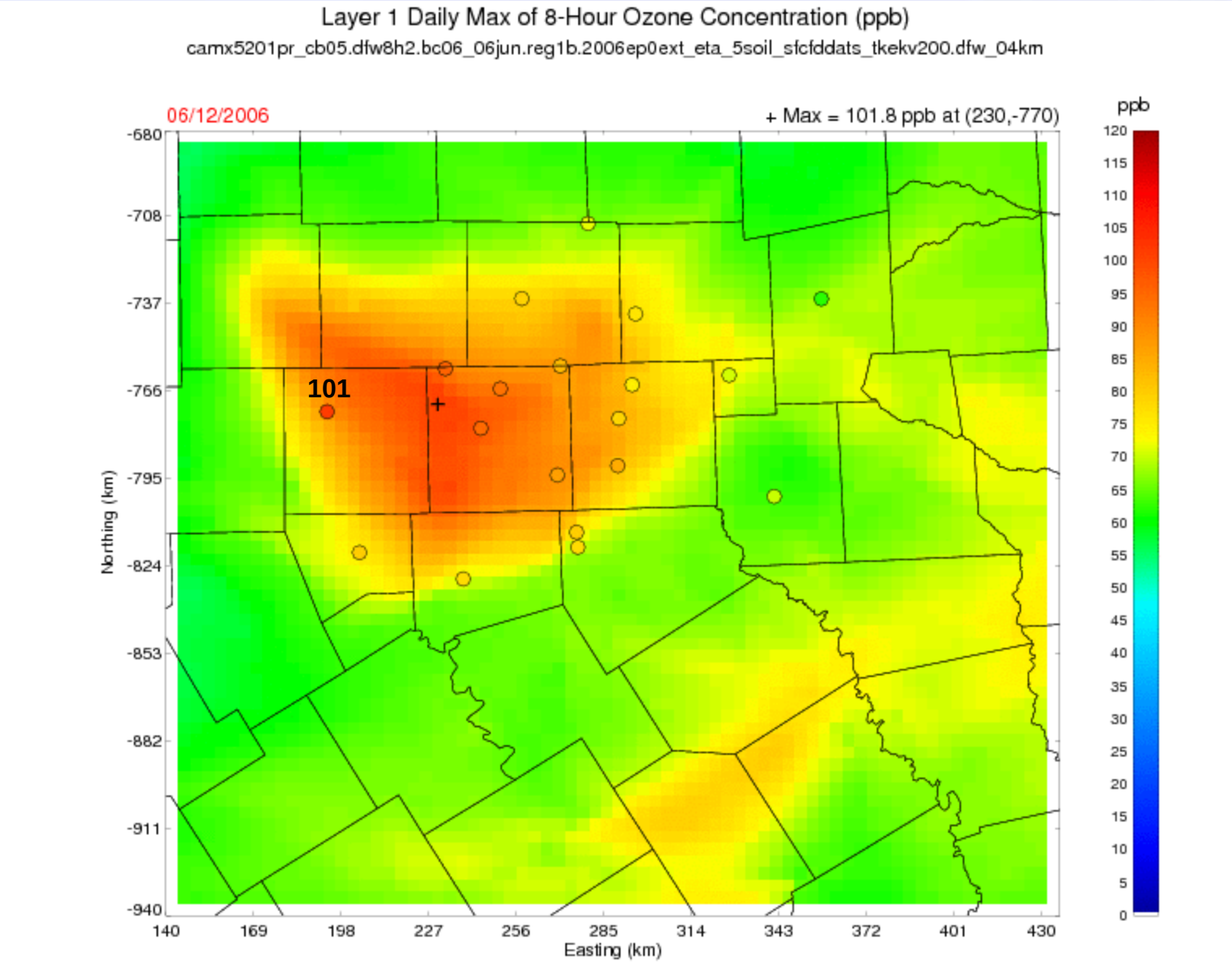


2006 Base Case Evaluation

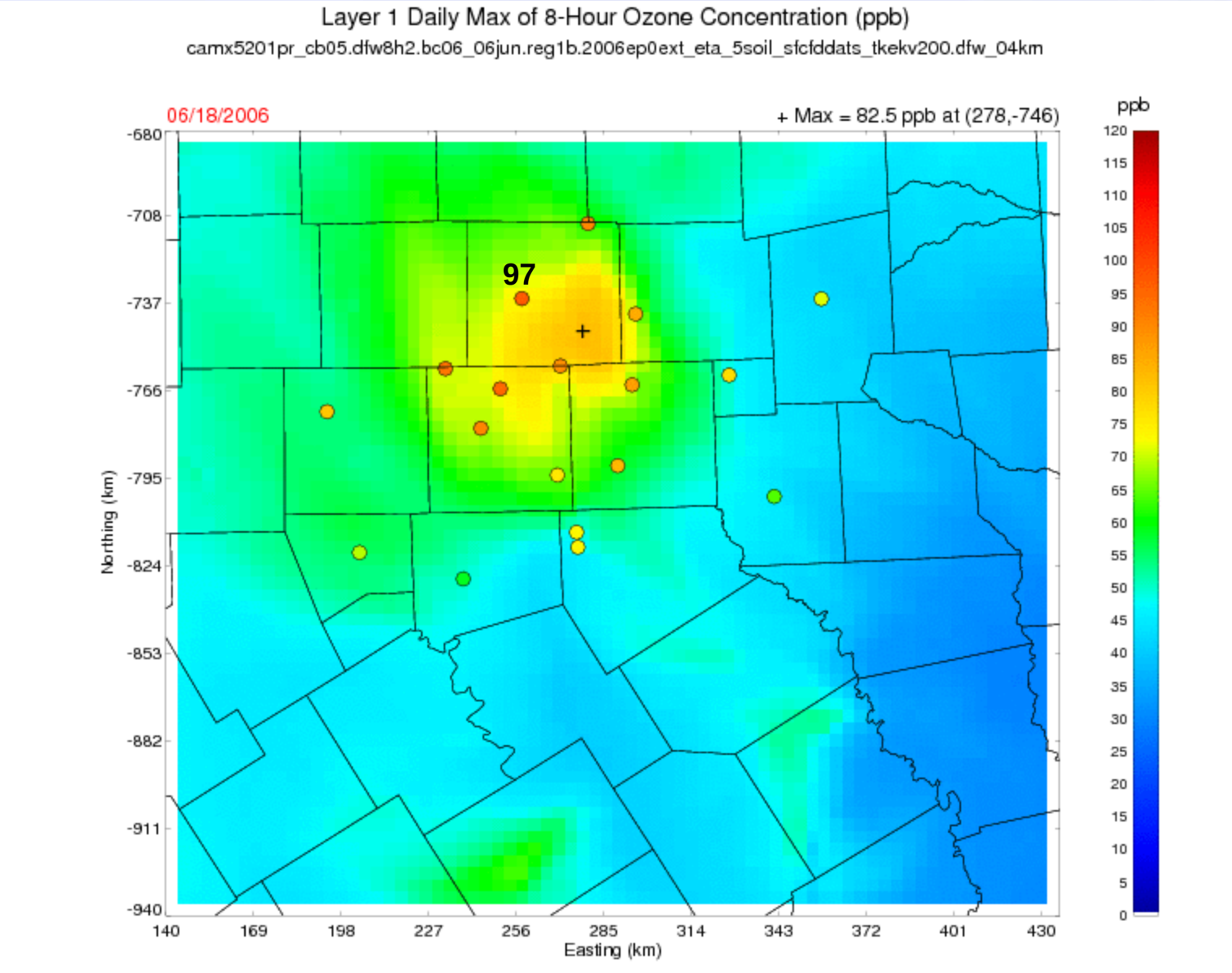




June 12, 2006 – Daily Max Ozone



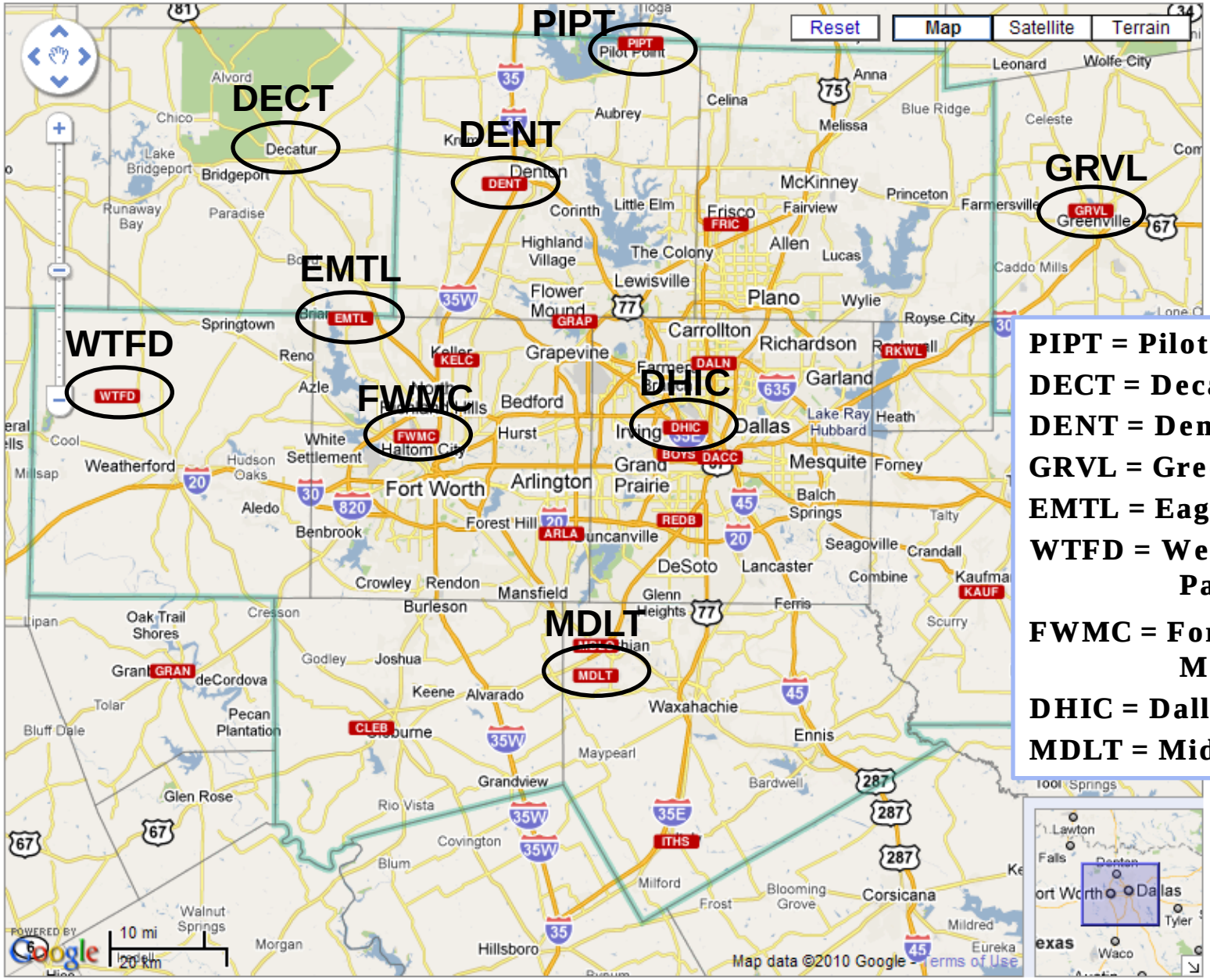
June 18, 2006 – Daily Max Ozone



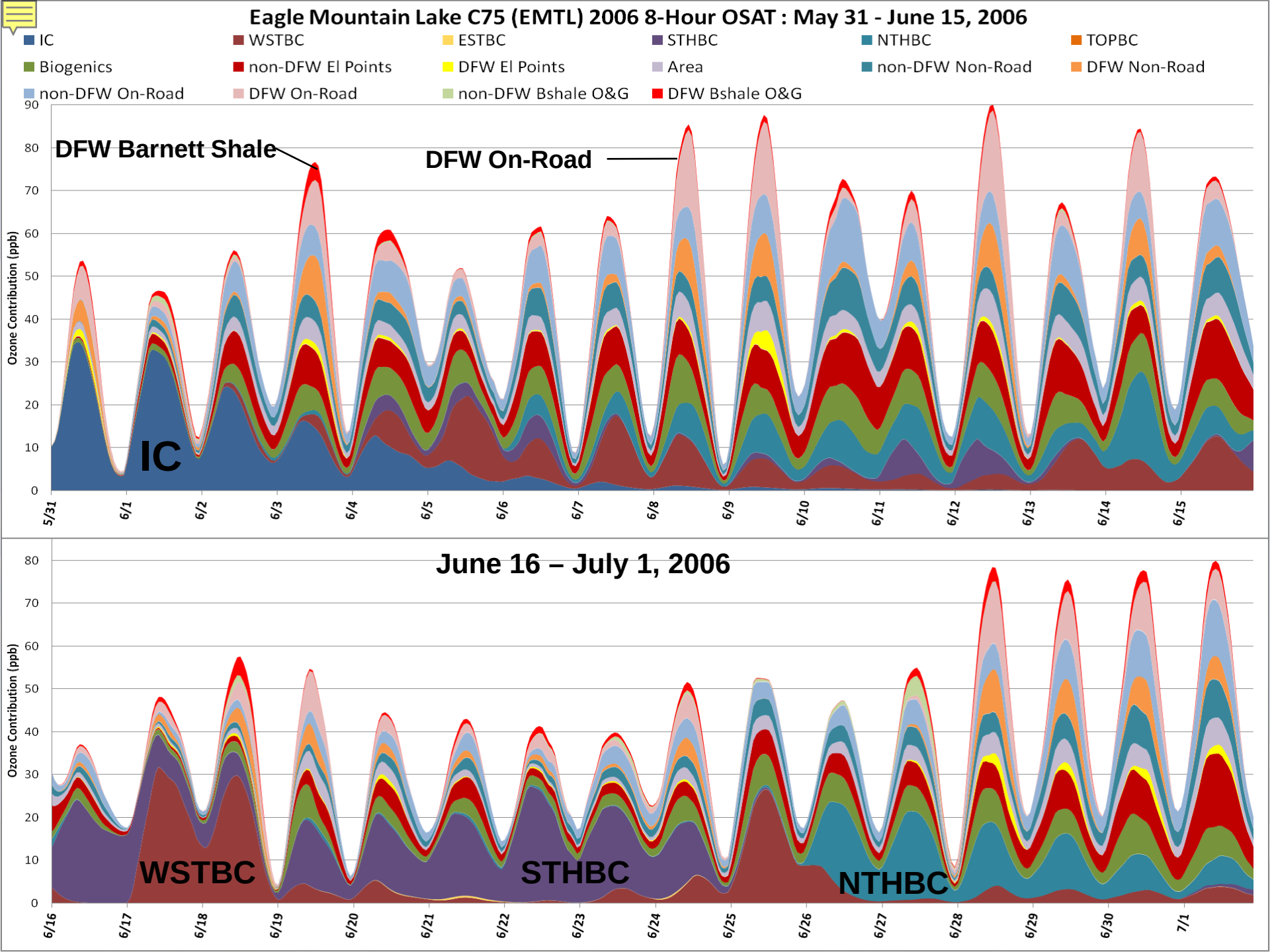
Ozone Source Apportionment Tool (OSAT)

- OSAT keeps track of the origin of the NO_X and VOC precursors creating the ozone
- Ozone can then be “apportioned” to specific sources
- Source groups and source regions are defined
  - DFW and non-DFW
- Emission source groups include, for example:
  - Initial and boundary conditions
  - On-road mobile and non-/off-road mobile
  - Area
  - Barnett Shale
  - Elevated Points

OSAT Receptors

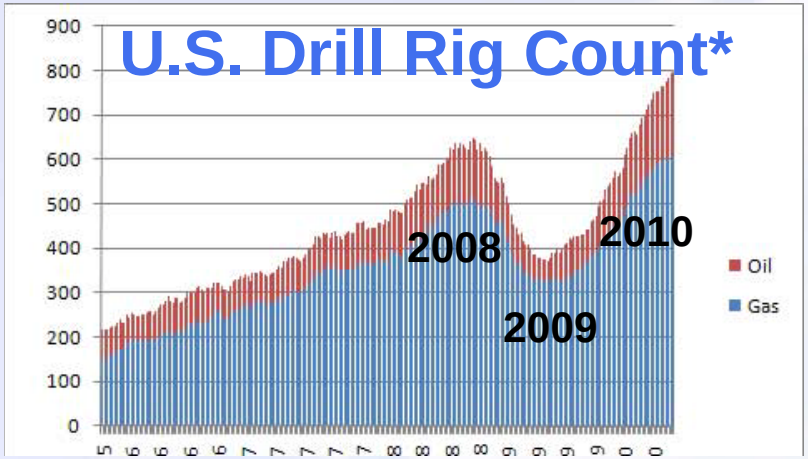


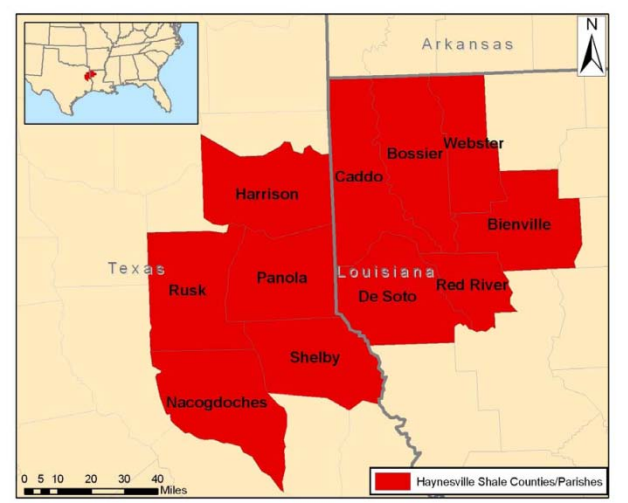
PIPT = Pilot Point
DECT = Decatur
DENT = Denton Airport
GRVL = Greenville
EMTL = Eagle Mtn. Lake
WTFD = Weatherford Parker County
FWMC = Fort Worth NW Meacham Field
DHIC = Dallas Hinton
MDLT = Midlothian Tower


Eagle Mountain Lake C75 (EMTL) 2006 8-Hour OSAT : May 31 - June 15, 2006
IC
WSTBC
ESTBC
STHBC
NTHBC
TOPBC
Biogenics
non-DFW El Points
DFW El Points
Area
non-DFW Non-Road
DFW Non-Road
non-DFW On-Road
DFW On-Road
non-DFW Bshale O&G
DFW Bshale O&G
Ozone Contribution (ppb)
DFW Barnett Shale
DFW On-Road
IC
5/31
6/1
6/2
6/3
6/4
6/5
6/6
6/7
6/8
6/9
6/10
6/11
6/12
6/13
6/14
6/15
June 16 – July 1, 2006
Ozone Contribution (ppb)
WSTBC
STHBC
NTHBC
6/16
6/17
6/18
6/19
6/20
6/21
6/22
6/23
6/24
6/25
6/26
6/27
6/28
6/29
6/30
7/1

2012 Oil & Gas Emissions

- Barnett Shale
  - How will well drilling change geographically?
  - Growth rate?
- Haynesville Shale in Northeast Texas
  - Environ created a 2012 EI with low, moderate, and aggressive development scenarios based on Barnett Shale growth
  - Current drilling appears to track the aggressive scenario
  - Will Growth of Haynesville Shale affect DFW?





Source: Environ Haynesville Shale EI Development, 2009

*** http://blogs.bakerhughes.com/rigcount/2010/06/11/total-number-of-horizontal-rigs-split-by-oil-vs-gas/**

Notable Point Source changes since 2006

- Midlothian Cement Kiln Reductions
  - TXI wet kilns shutdown
  - Overall cap to Midlothian Kilns
- Saint-Gobain glass plant shutdown (Waxahachie)
  - 2008 NO_X = 281 Tons/year
- Clean Air Interstate Rule (CAIR) I for 2012 Point Sources
  - Clean Air Transport Rule (CATR) will replace CAIR in 2012/2013?

Ongoing and Upcoming DFW Projects

- Barnett Shale
  - Special Inventory Phase II (2009 emissions data)
  - New Auto-GCs active at DISH and Eagle Mountain Lake
  - More Auto-GCs to be installed including Flower Mound, Decatur, and southeast Tarrant County
  - NO_X monitors have been added to Eagle Mountain Lake and Parker County
- Modeling Support via Environ
  - Updated/alternative boundary and initial conditions
  - New tool to evaluate back trajectories from modeled wind fields
- CAMx Improvements
  - Plume rise, cloud representation, dry deposition

Upcoming DFW Projects

- Air Quality Research Projects (AQRP) Work
  - Quantifying Emission Estimates from Biogenic and Oil and Gas Production Sources in Texas (NCAR)
  - NO_X Reactions and Transport in Nighttime Plumes and Impact Ozone on Next-Day (NOAA, Environ)
  - Dallas Measurements of Ozone Production (Univ. of Houston, Penn State)
- AQRP Contingency Projects
  - Surface Measurements and One-Dimensional Modeling Related to Ozone Formation in the Suburban DFW Area (NCAR, University of Michigan, Others)
  - Airborne Measurements to Investigate Ozone Production and Transport in the DFW Area During the 2011 Ozone Season (Univ. of Houston)

Upcoming Modeling Work

- Continued Development of the 2012 Inventory
  - Barnett and Haynesville Shale
  - Updating Airport, Locomotive, and Ship inventories
  - Evaluating CAIR/CATR point source caps
- 2012 Future Year Runs
  - Ozone Source Apportionment
  - Matrix Runs to support rule development
- 1999 Retrospective Analysis
  - Test the model's ability to predict ozone design values in a previous year

Questions?

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The Air Modeling team contributed to these results.

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