TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Houston/Galveston/Brazoria Modeling Update

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Technical Analysis Division

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36 Pages

Houston/Galveston/Brazoria Modeling Update

- **Background**
- Modeling for the One- and Eight-Hour Ozone Standards
- Base Case Model Performance
- 2007 Future Case Modeling
- What's Next

Background

- December, 2000 Attainment Demonstration:
  - September 8 - 11, 1993 episode
  - Showed attainment of one-hour ozone standard in 2007.
  - 90% reduction in industrial NO_X emissions.
- December, 2002 State Implementation Plan revision:
  - Aug. 22 - Sep. 1 2000 TexAQS* episode
  - Replaced 10% of NO_X reductions (i.e. 90% to 80%) with large reductions in Highly-Reactive VOC (HRVOC) emissions
  - HRVOC emissions were first "adjusted" based on TexAQS findings
  - Included plans for 2004 Mid-Course Review

* TexAQS - The 2000 Texas Air Quality Study

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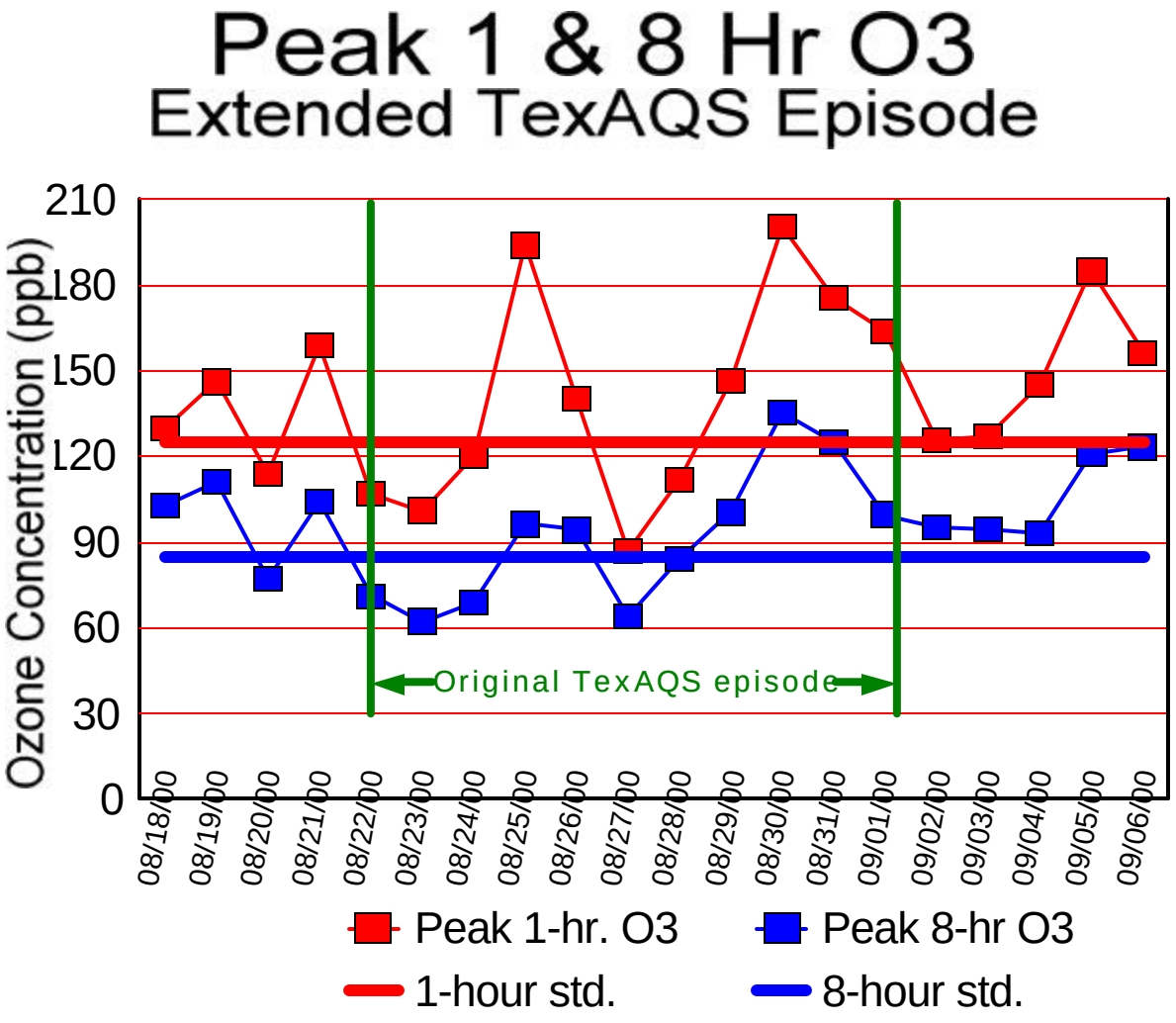
Modeling for the One- and Eight-Hour Ozone Standards

- Focus is shifting from one-hour to eight-hour standards.
- Eight-hour attainment year for HGB is still uncertain (probably 2010 or 2013).
- Combined one- and eight-hour Ozone Modeling Analysis (COMA):
  - Satisfies requirements for one-hour Mid-Course Review.
  - Addresses eight-hour "No Backsliding" provision.
  - Provides early assessment of eight-hour control requirements.

New for COMA: Extended TexAQS Episode (Aug. 18 - Sep. 6, 2000)

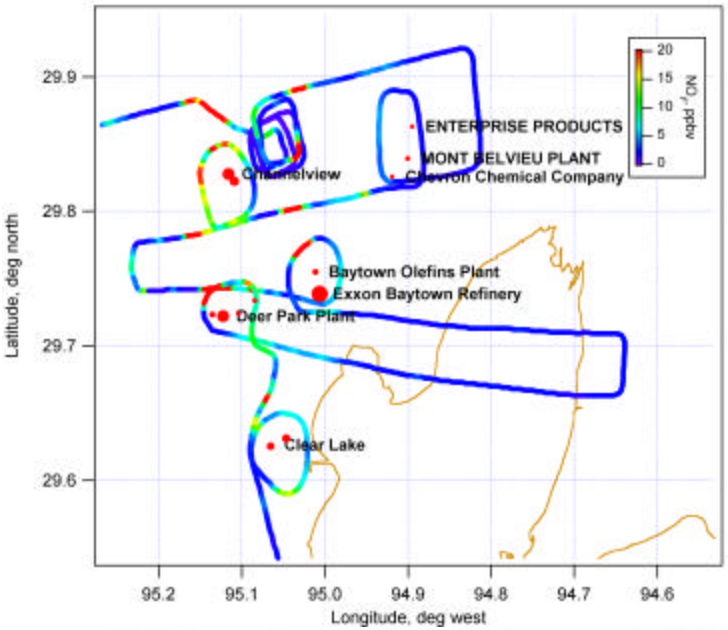


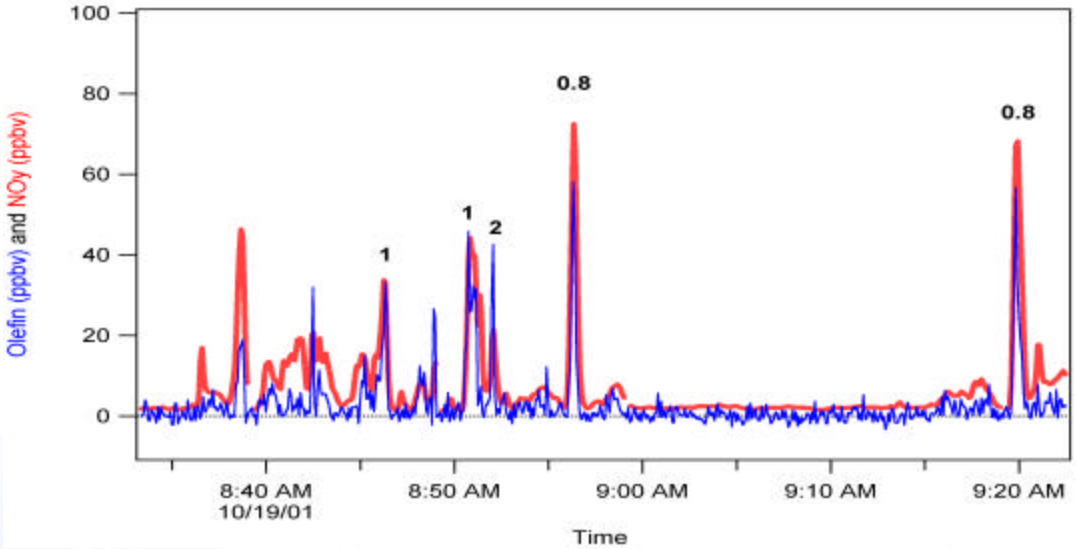
New for COMA: Revised Olefin-to-NO_X Adjustment

- Similar to adjustment used in 2002 SIP revision.
- Based on improved source chemical speciation.
- More consistent with cap allocation.

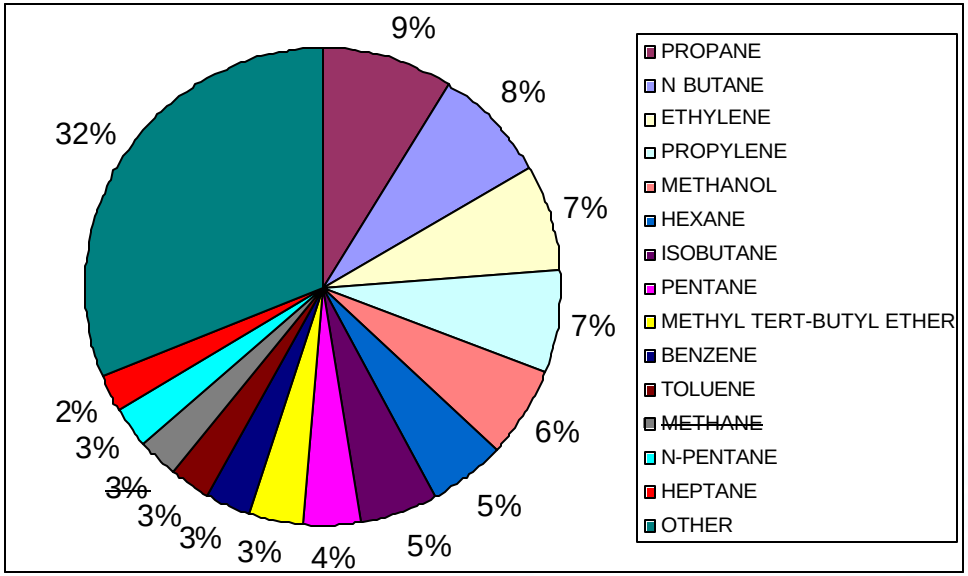
Twin Otter flight path and continuous NO_Y and olefin measurements, 10/19/01.

Measurements suggest that emissions of olefins ≈ emissions of NO_X from many industrial sources.

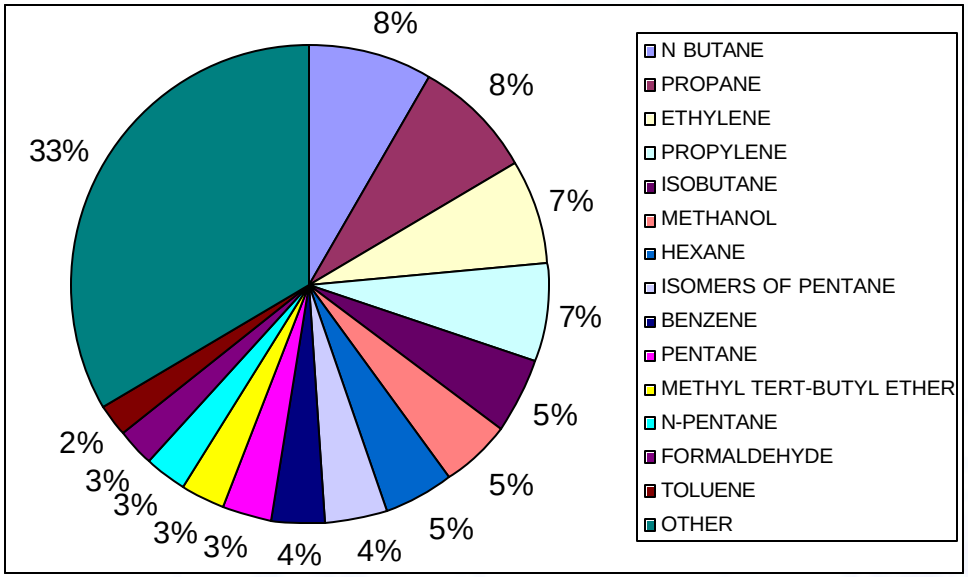




Original Speciation

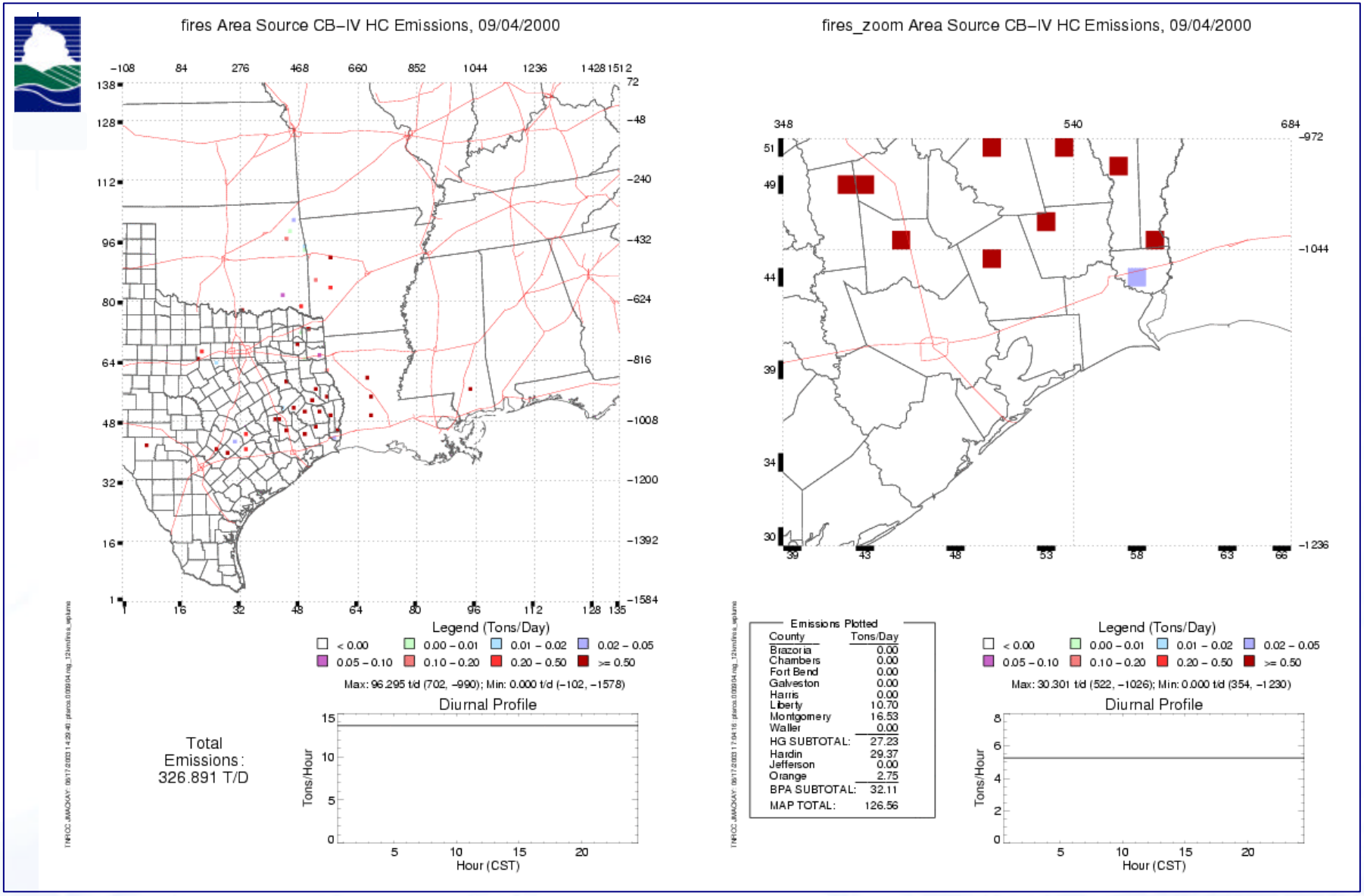


Revised Speciation

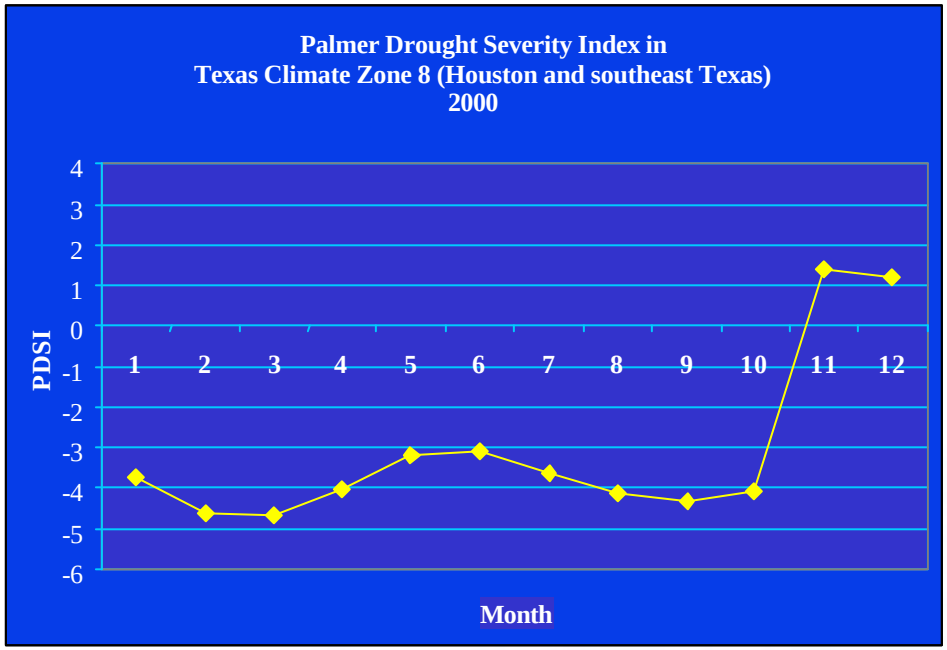


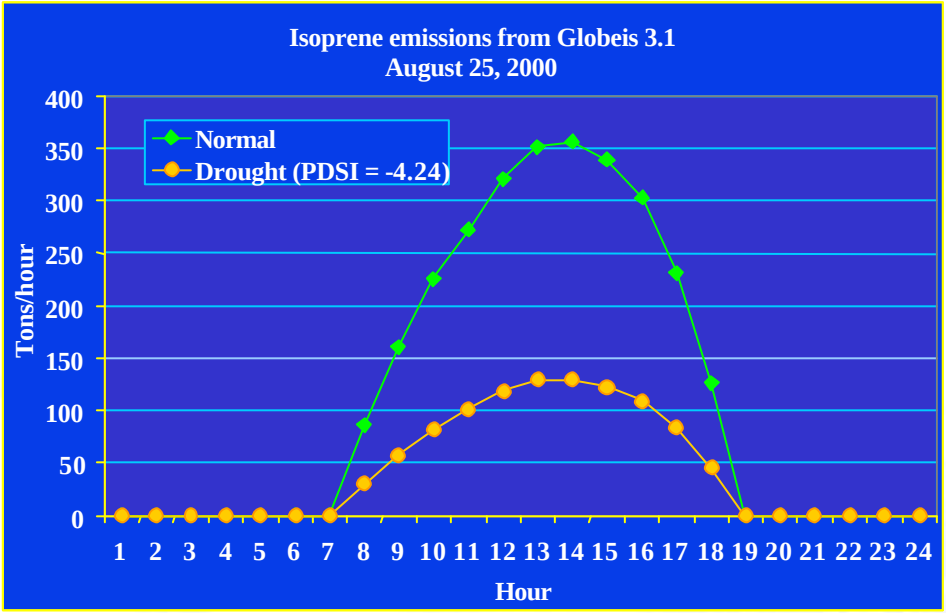
New for COMA: Emissions Inventory Improvements

- Explicit treatment of wildfire emissions.
- Advanced biogenic emission estimation options: Drought, Heat Stress.
- Humidity-based adjustment to diesel NO_X emissions.
- One-kilometer emissions for most sources.
- Numerous updates, minor enhancements.


fires Area Source CB–IV HC Emissions, 09/04/2000
Legend (Tons/Day)
< 0.00
0.00 – 0.01
0.01 – 0.02
0.02 – 0.05
0.05 – 0.10
0.10 – 0.20
0.20 – 0.50
>= 0.50
Max: 96.295 t/d (702, –990); Min: 0.000 t/d (–102, –1578)
Diurnal Profile
Tons/Hour
Hour (CST)
Total Emissions: 326.891 T/D
fires_zoom Area Source CB–IV HC Emissions, 09/04/2000
Emissions Plotted
County Tons/Day
Brazoria 0.00
Chambers 0.00
Fort Bend 0.00
Galveston 0.00
Harris 0.00
Liberty 10.70
Montgomery 16.53
Waller 0.00
HG SUBTOTAL: 27.23
Hardin 29.37
Jefferson 0.00
Orange 2.75
BPA SUBTOTAL: 32.11
MAP TOTAL: 126.56
Max: 30.301 t/d (522, –1026); Min: 0.000 t/d (354, –1230)

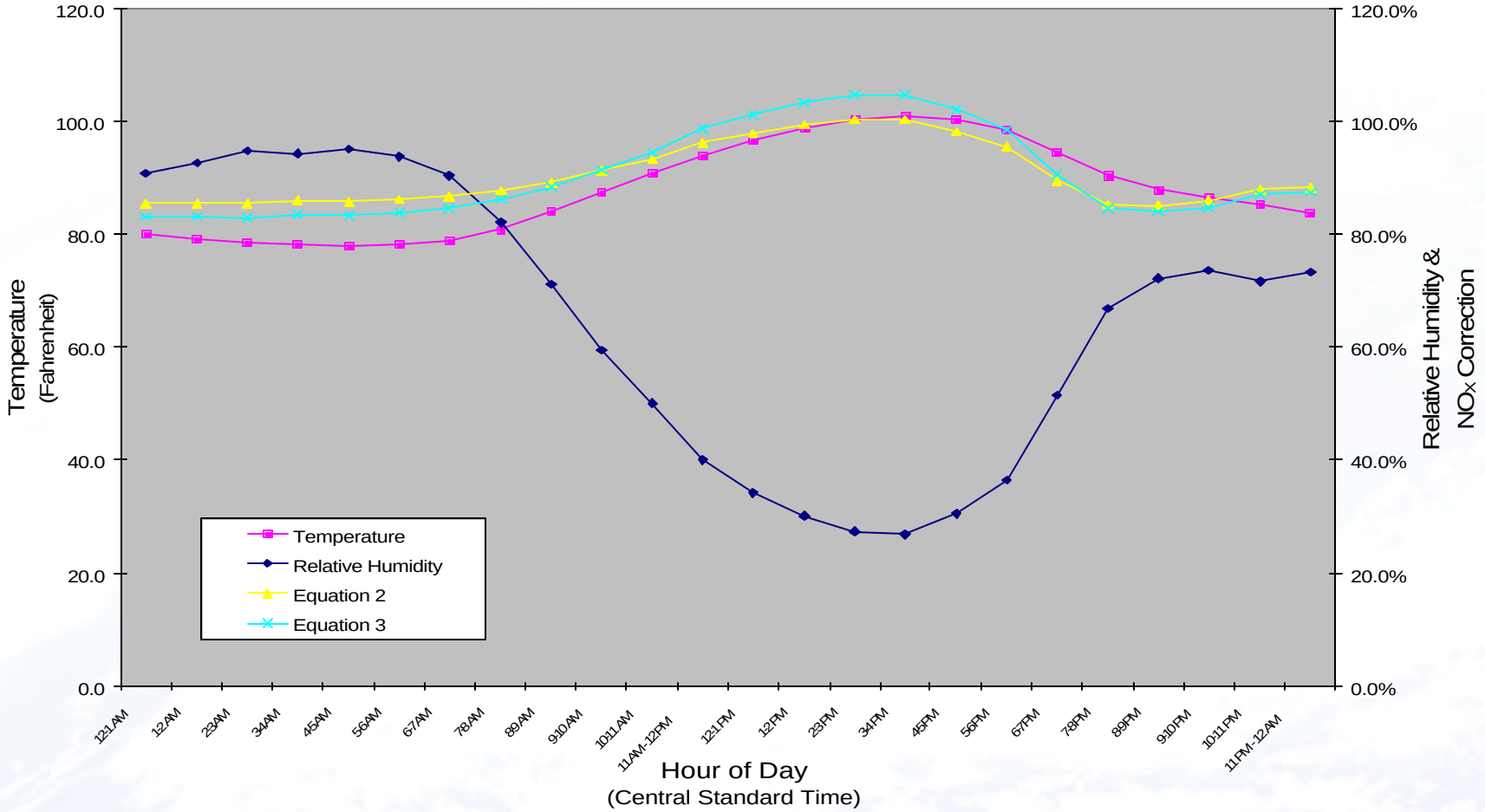
Biogenic enhancements (Drought, Heat Stress)



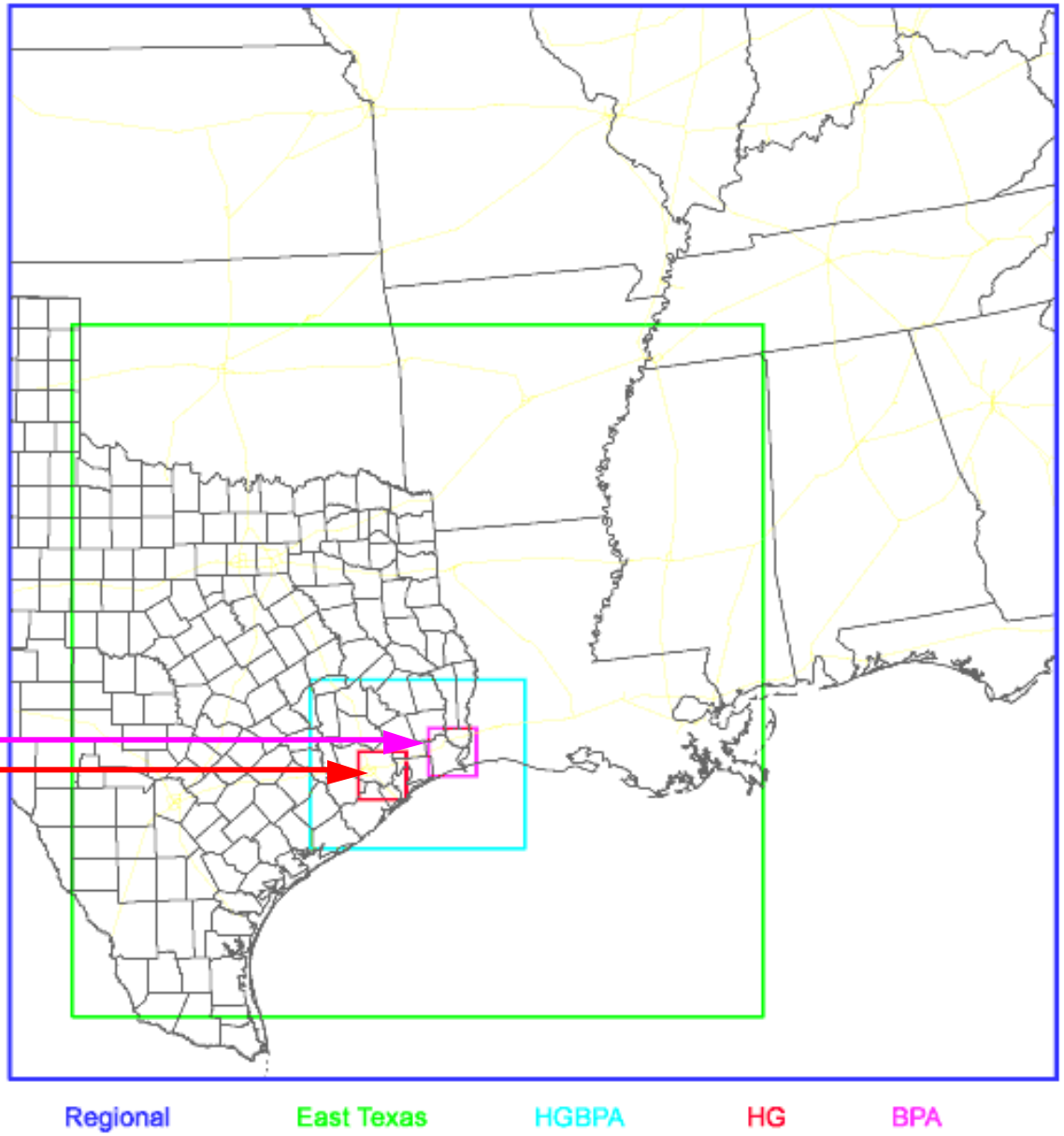


Diesel NO_X Corrections by Hour
Harris County Temperature & Humidity Data

Wednesday August 30, 2000

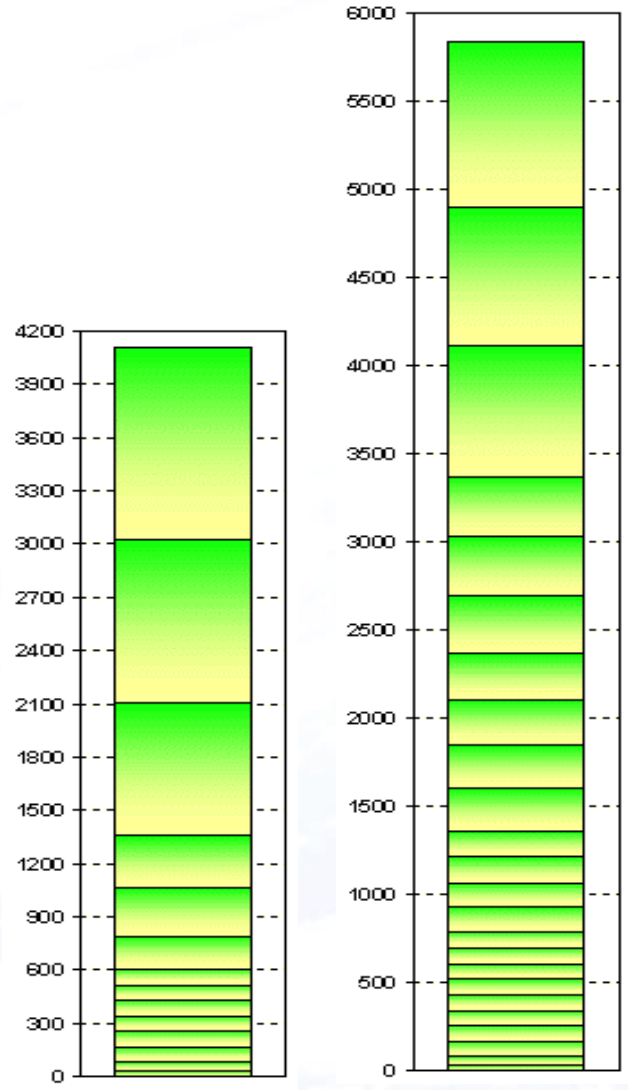


One-kilometer super-fine grids (HGB & BPA)



New (24 layers)

New for COMA: Vertical layer structure designed to reduce discontinuities associated with PBL rise.

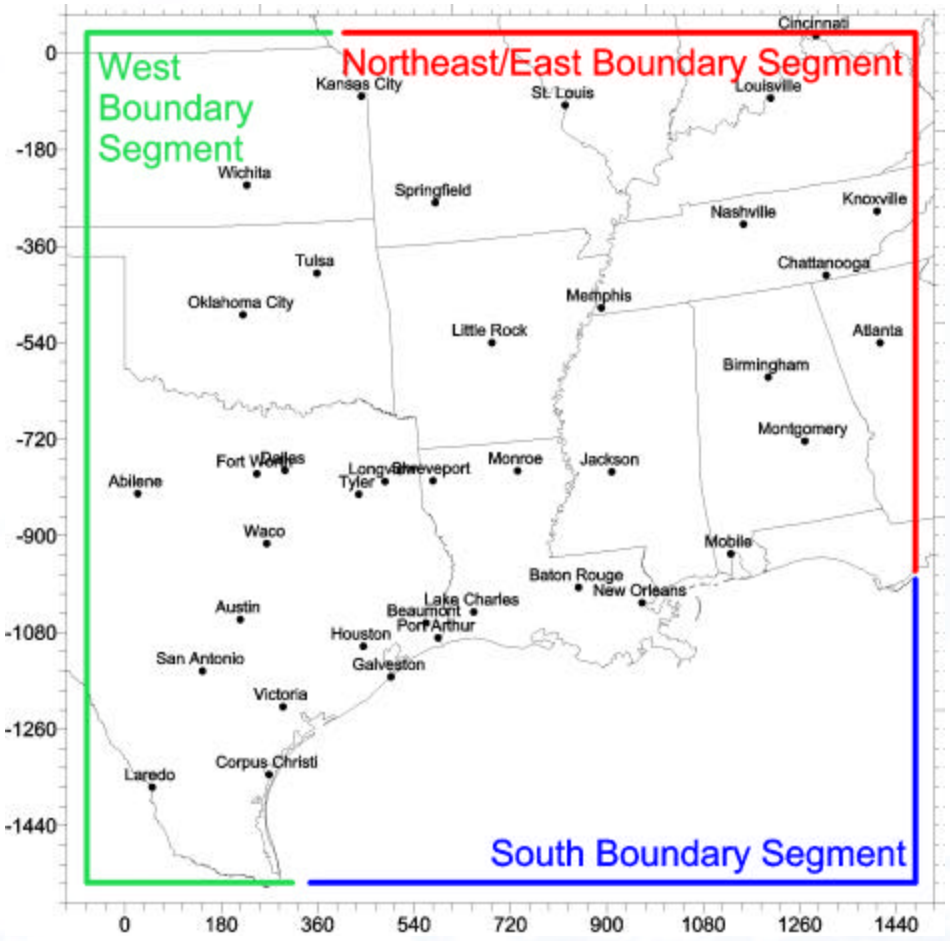


Original (14 layers)

New for COMA: "SOS" Boundary Conditions

Developed by Environ as part of DFW modeling.

Northeast/East Segment uses pollutant concentrations developed for by SOS.



Default ("Clean") Boundary Conditions

Species	Concentration (ppb)
O3	40.0
NO	0.000049
NO2	0.08555
CO	100.0
PAR	3.078
HCHO	1.068
ETH	0.005315
ALD2	0.1051
TOL	0.006043
PAN	0.03834
HNO2	0.000728
HNO3	1.525
H2O2	2.263
Total NOx	0.086
Total VOC (ppbC)	4.4

"SOS" Boundary Conditions

Species	East/Northeastern Boundary Below 1700 m (ppb)	Western Boundary Below 1700 m (ppb)	Southern Boundary and Above 1700 m (ppb)
O3	40.0	40.0	40.0
NO	0.1	0.1	0.1
NO2	1.0	1.0	1.0
CO	200.0	200.0	100.0
PAR	14.9	14.9	14.9
HCHO	2.1	2.1	0.05
ETH	0.51	0.51	0.15
ALD2	0.555	0.555	0.05
TOL	0.18	0.18	0.0786
PAN	0.1	0.1	0.1
HNO2	0.001	0.001	0.001
HNO3	3.0	3.0	1.0
H2O2	3.0	3.0	1.0
OLE	0.3	0.3	0.056
XYL	0.0975	0.0975	0.0688
ISOP	3.6	0.1	0.001
MEOH	8.5	0.001	0.001
ETOH	1.1	0.001	0.001
Total NOx	1.1	1.1	1.1
Total VOC (ppbC)	50.5	22.3	9.3

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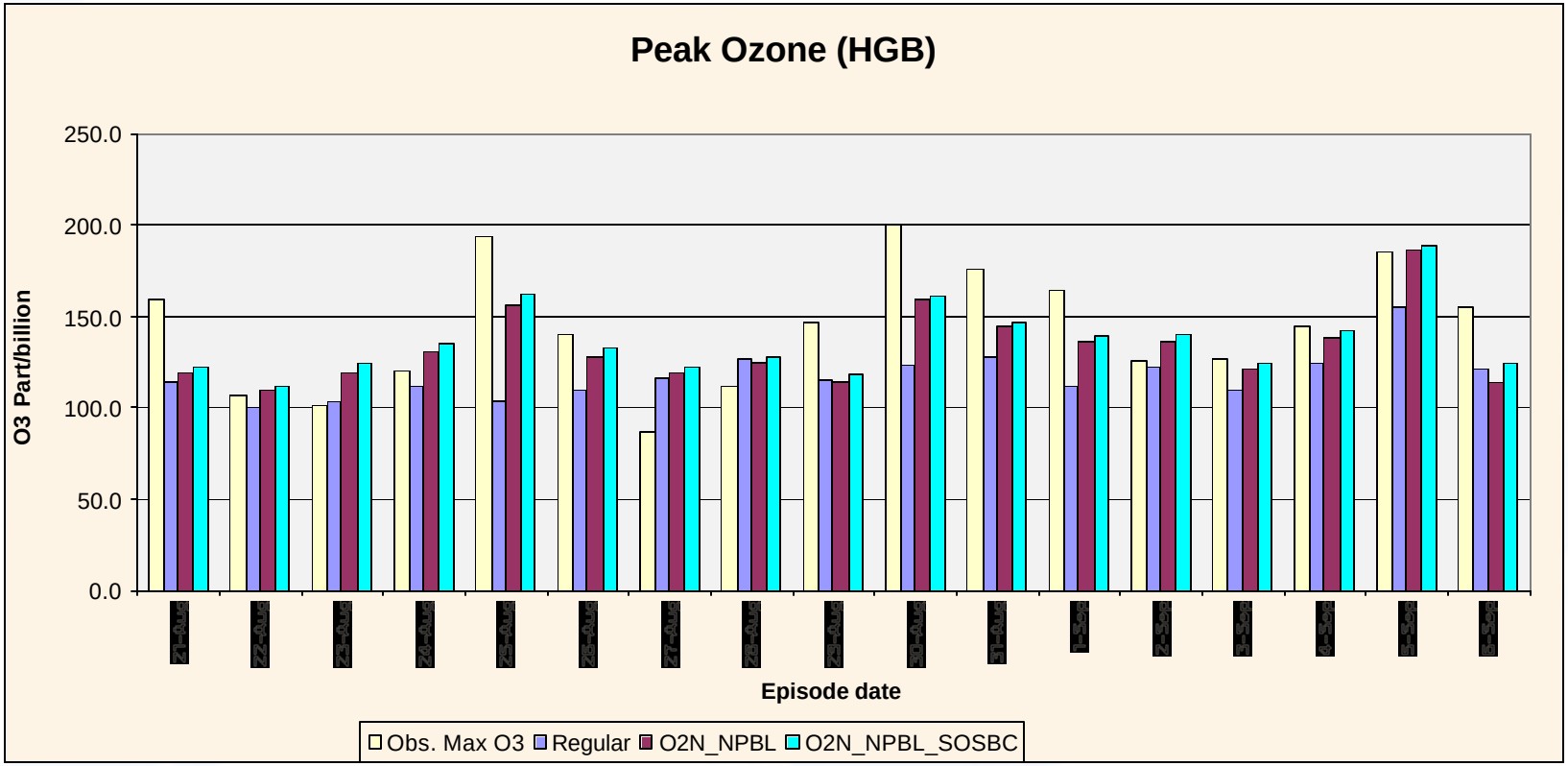
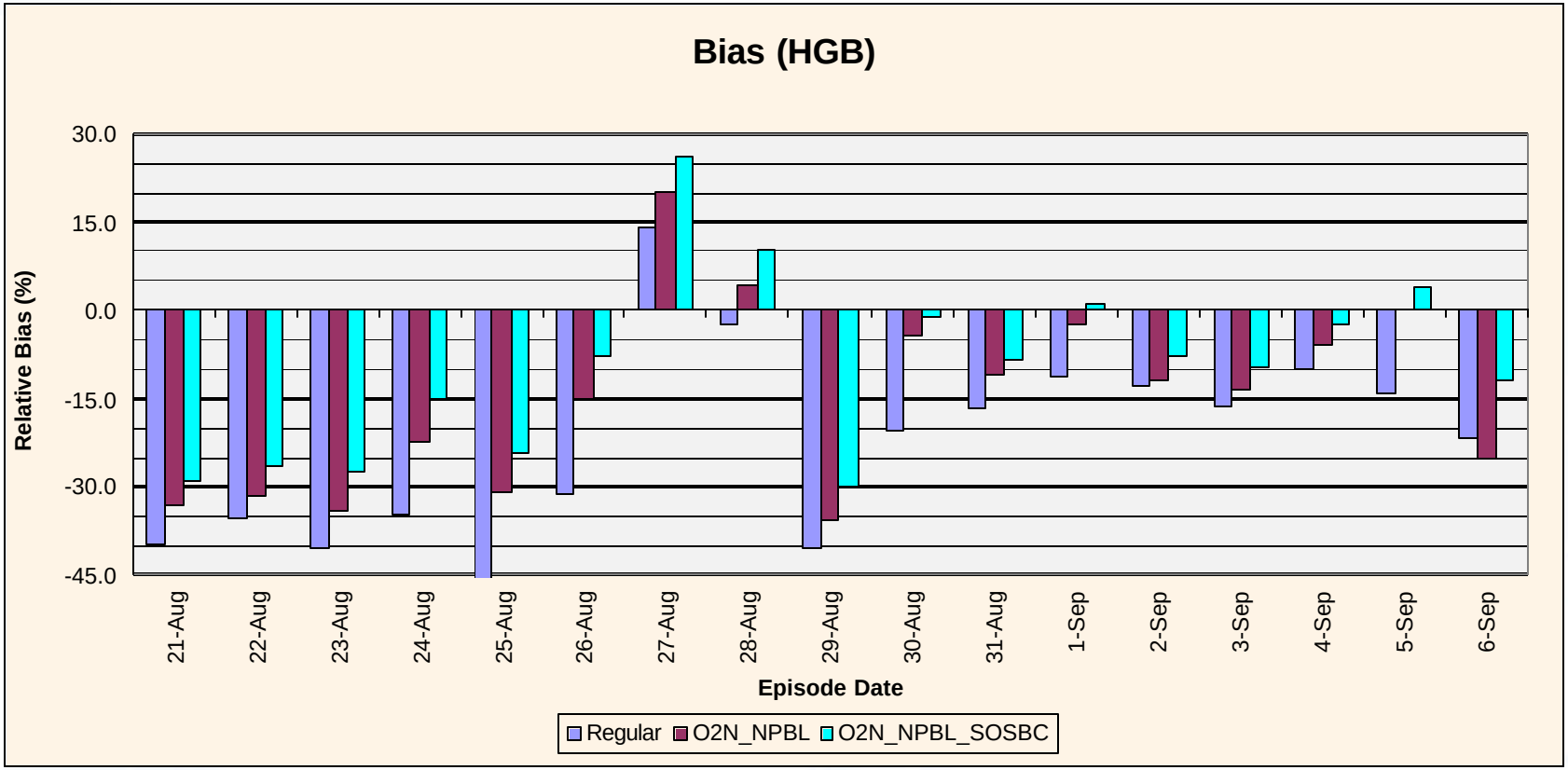
Model Performance for Three Initial Base 5 runs



Regular - No adjustments.
O2N_NPBL - Olefin-to-NO_X emissions adjustment plus PBL adjustment.
O2N_NPBL_SOSBC - Same as O2N_NPBL plus new "SOS" boundary conditions.

Model Performance for Three Initial Base 5 runs



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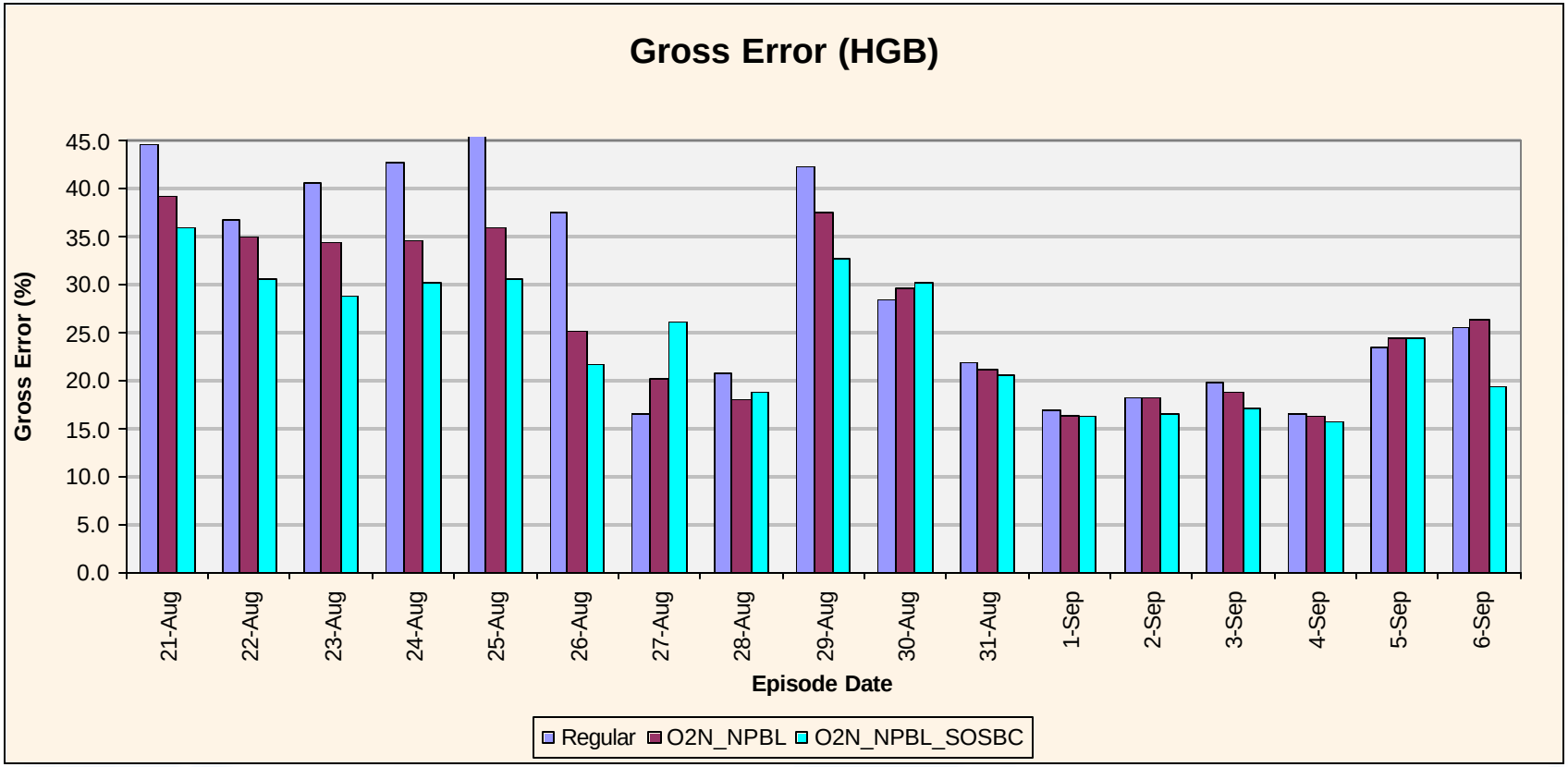
Model Performance for Three Initial Base 5 runs



Regular - No adjustments.

O2N_NPBL - Olefin-to-NO_X emissions adjustment plus PBL adjustment.

O2N_NPBL_SOSBC - Same as O2N_NPBL plus new "SOS" boundary conditions.

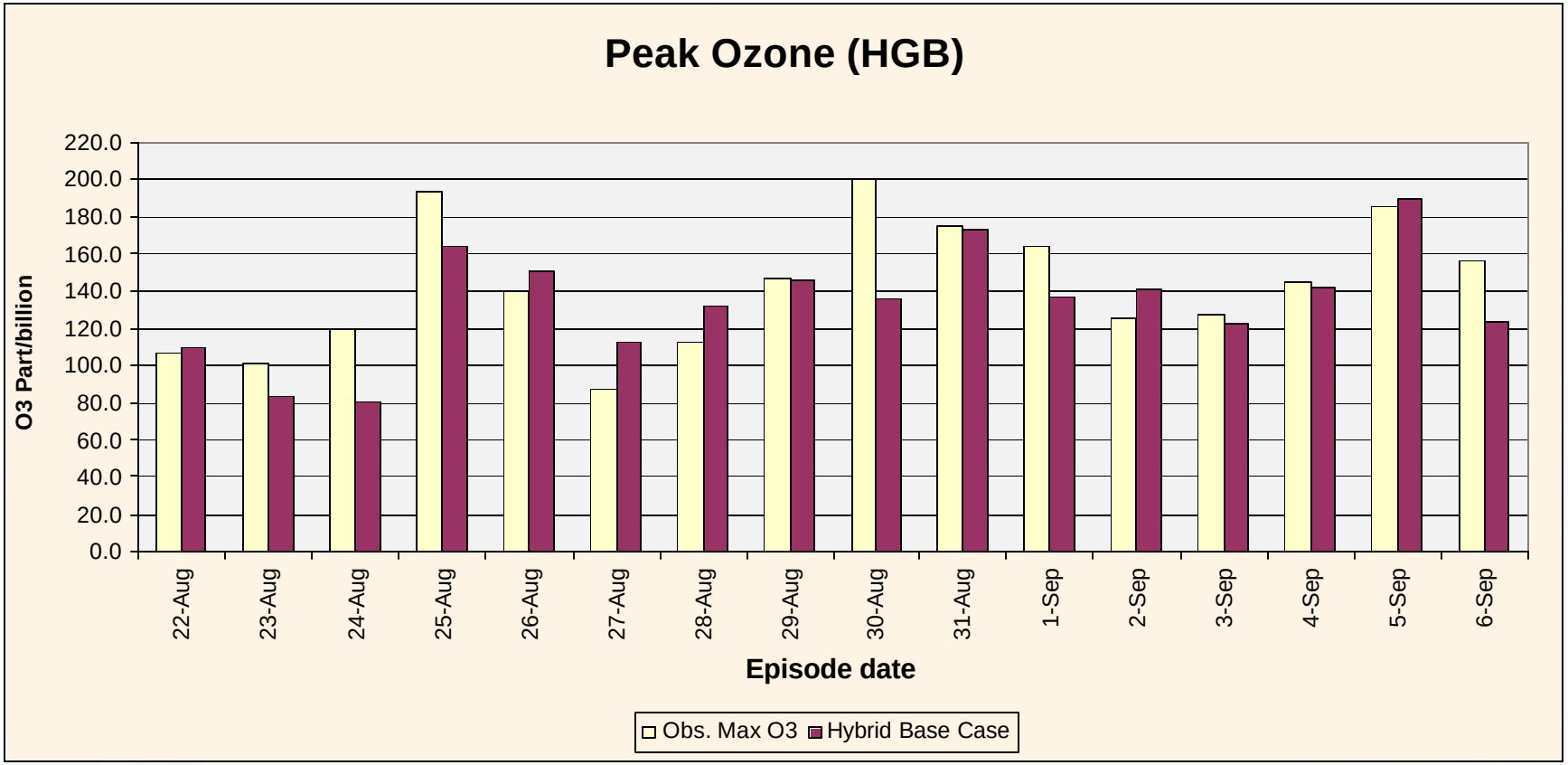
Goes Meteorology & the Hybrid Base Case

- New meteorological characterization for "core" episode (August 22 - Sept 1).
- Modified version of MM5 uses GOES data to diagnose soil moisture from **?** skin temperature.
- <u>Don't need to adjust PBL with GOES.</u>
- Added land use-based minimum K_V.

Goes Meteorology & the Hybrid Base Case

- Hybrid Base Case (Base5a):
  - Run August 22 - September 1 using GOES meteorology.
  - Run September 2 - 6 using standard MM5 meteorology with corrected profiler-based PBL adjustment.
  - August 18 - 21 shelved for now.

Model Performance for the Hybrid Base Case



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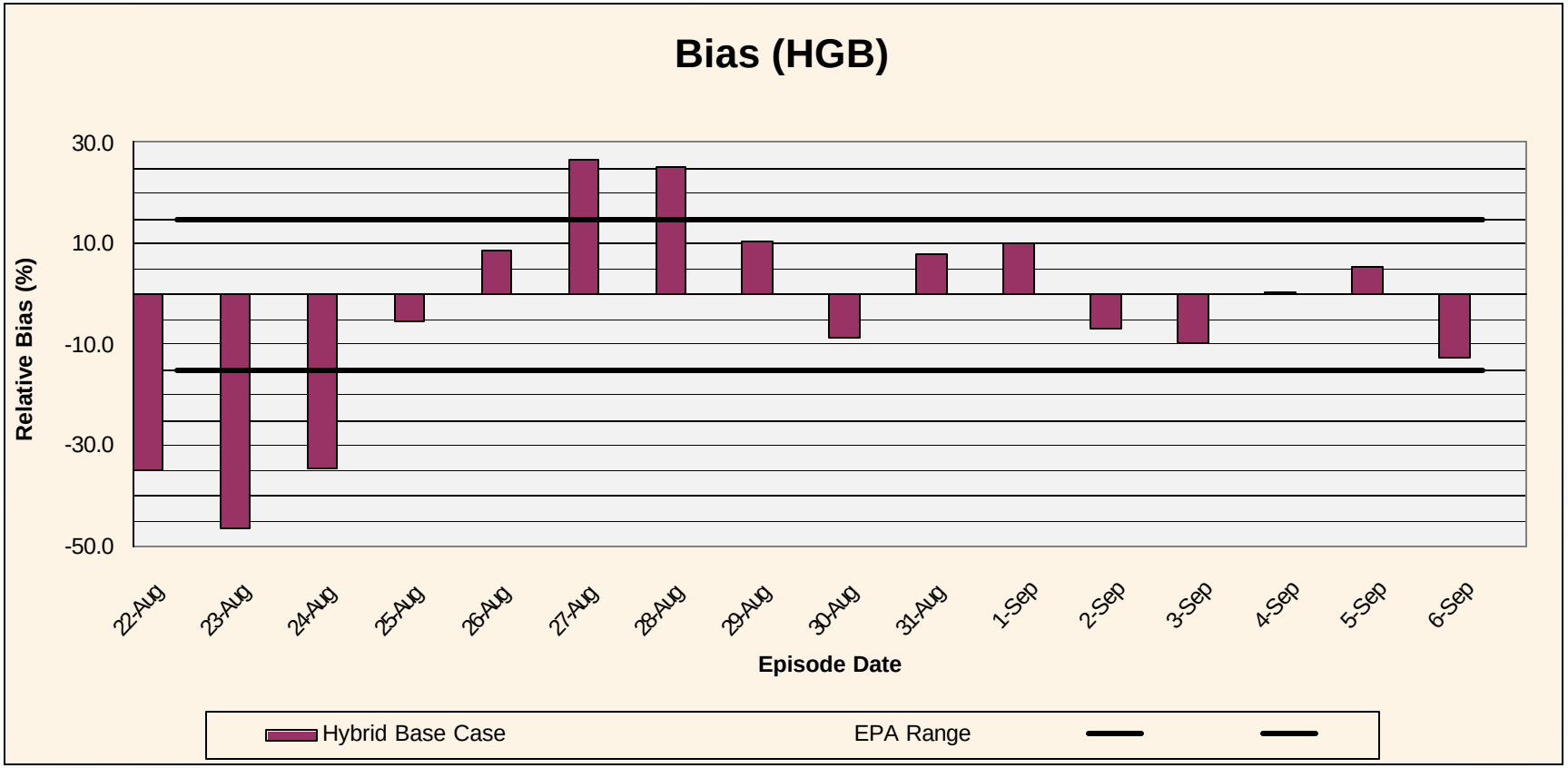
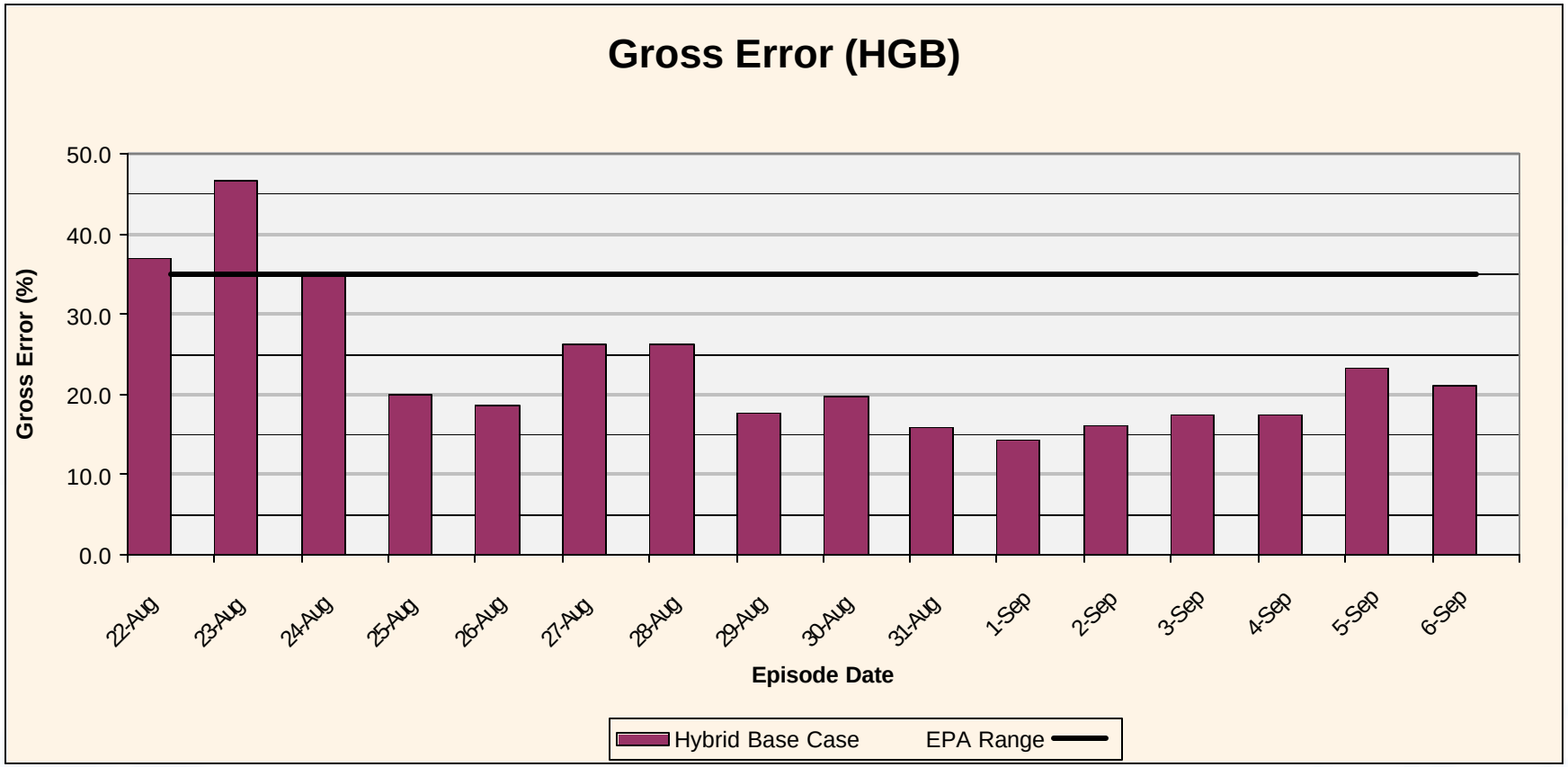


Model Performance for the Hybrid Base Case



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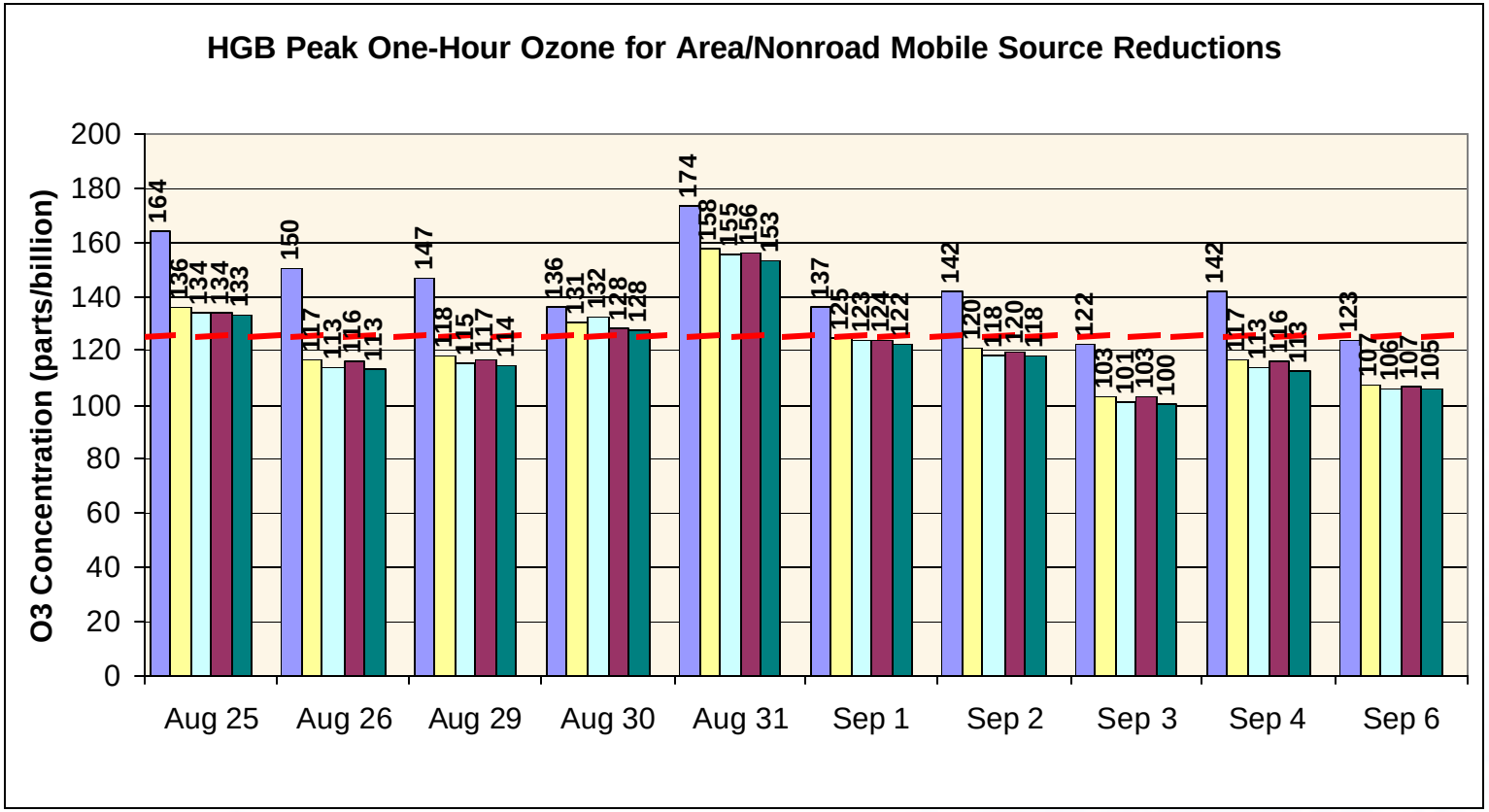
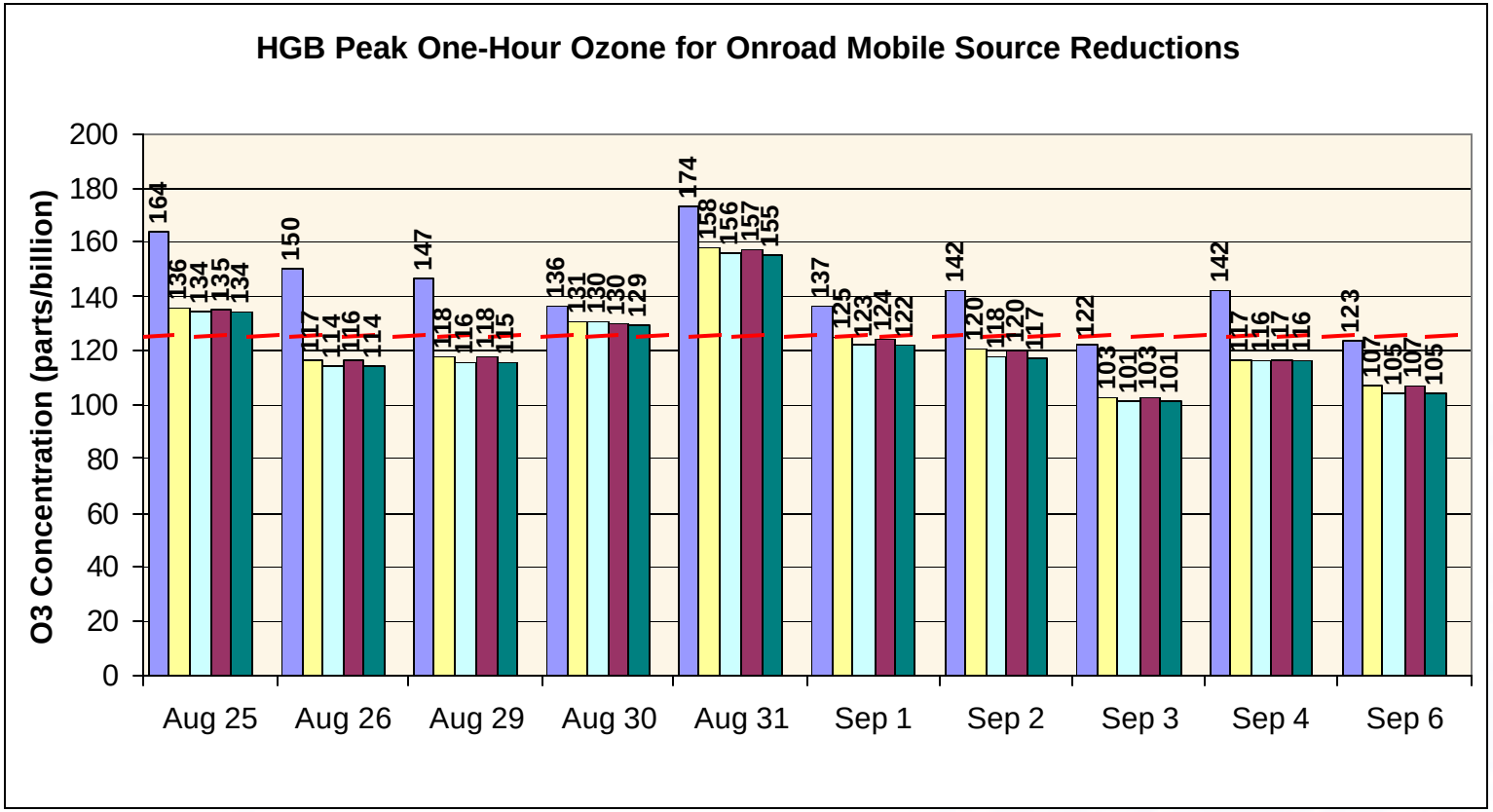
2007 Future Case

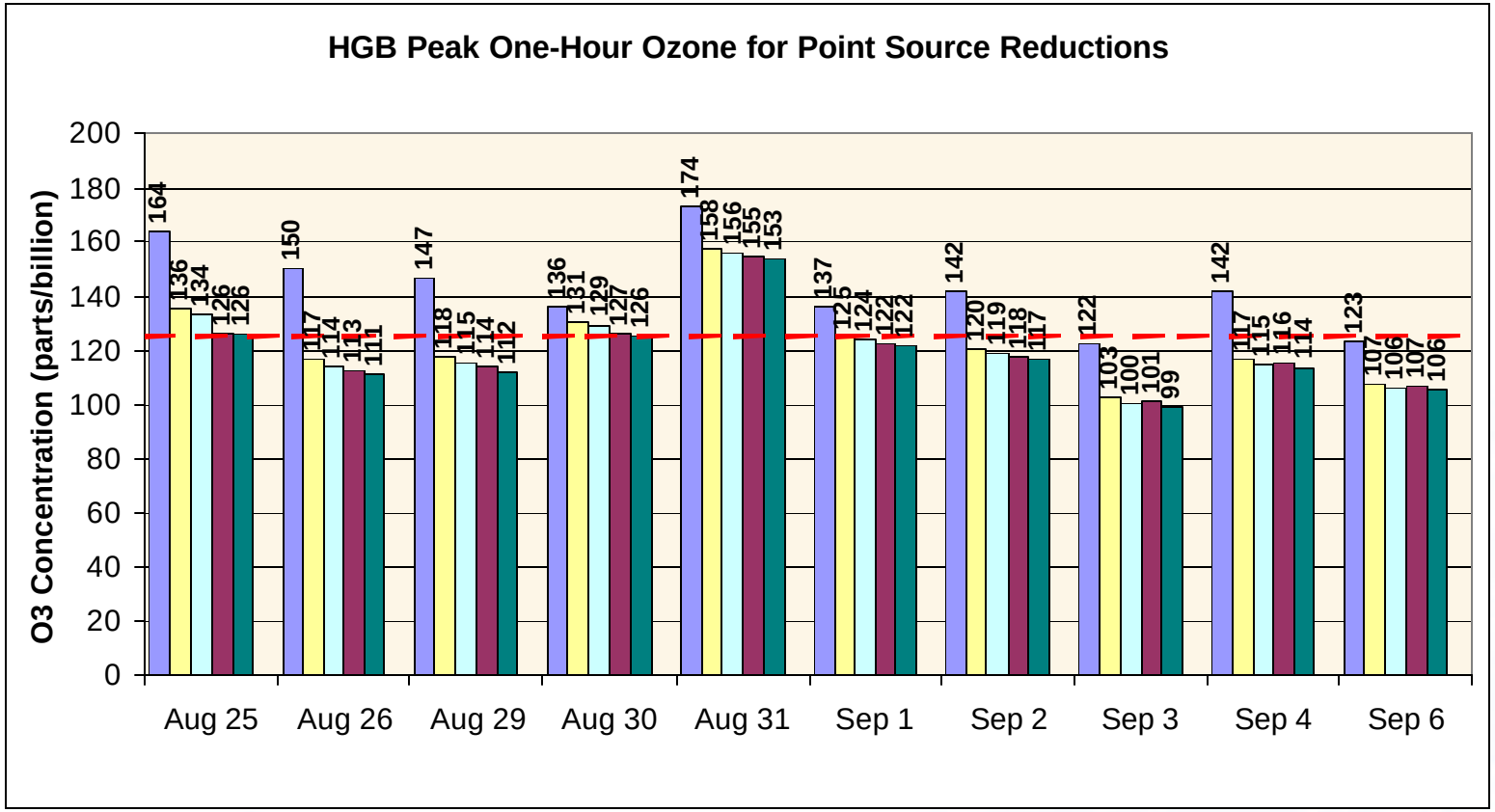
- Similar growth & controls to those in the 2002 SIP Revision, including "80%" NO_X reduction and HRVOC rules.
- Includes 33 tons/day additional NO_X reductions from TERP.
- Tested 25% across-the-board reductions of VOC, NO_X, & both from Area/Nonroad, Onroad Mobile, and Point Sources. **These are sensitivity analyses only, and do not represent any actual or proposed control strategies.**



- 2000 Base Case
- 2007 Control Strategy 3
- 25% Reduction in Area/Nonroad NO_X Emissions (from Control Strat. 3)
- 25% Reduction in Area/Nonroad VOC Emissions (from Control Strat. 3)
- 25% Reduction in Area/Nonroad NO_X & VOC Emissions (from Control Strat. 3)
- One-Hour Ozone NAAQS (125 parts/billion)



- 2000 Base Case
- 2007 Control Strategy 3
- 25% Reduction in Onroad Mobile NO_X Emissions (from Control Strat. 3)
- 25% Reduction in Onroad Mobile VOC Emissions (from Control Strat. 3)
- 25% Reduction in Onroad Mobile NO_X & VOC Emissions (from Control Strat. 3)
- One-Hour Ozone NAAQS (125 parts/billion)



- 2000 Base Case
- 2007 Control Strategy 3
- 25% Reduction in Point Source NO_X Emissions (from Control Strat. 3)
- 25% Reduction in Point Source VOC Emissions (from Control Strat. 3)
- 25% Reduction in Point Source NO_X & VOC Emissions (from Control Strat. 3)
- One-Hour Ozone NAAQS (125 parts/billion)

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What's Next?

- Complete 2010 modeling inventory.
- Perform 2010 analysis for eight-hour ozone.
- Base-case sensitivity analyses, including Not-so-Highly-Reactive VOC emissions adjustment.
- Continued analysis of TexAQS aircraft data.
- Documentation.

On the Horizon

- GOES meteorology for entire extended episode.
- Eight-hour attainment demonstration.
- Analysis of new Auto-GC data.
- Preparation for 2005-6 field study (TexAQS-2).

Houston/Galveston/Brazoria Modeling Update

Contributors:

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- Mark Estes (TCEQ)
- Chris Kite (TCEQ)
- Sonoma Technology
- Environ