HGB Modeling Update

Dick Karp

Environmental Trade Fair

May 10, 2006

Select Modeling Episode and Establish Modeling Domain

Conduct Meteorological and Emissions Modeling

Conduct Photochemical Modeling of the Selected Episode

Conduct Base Year Emissions Modeling (i.e., Baseline)

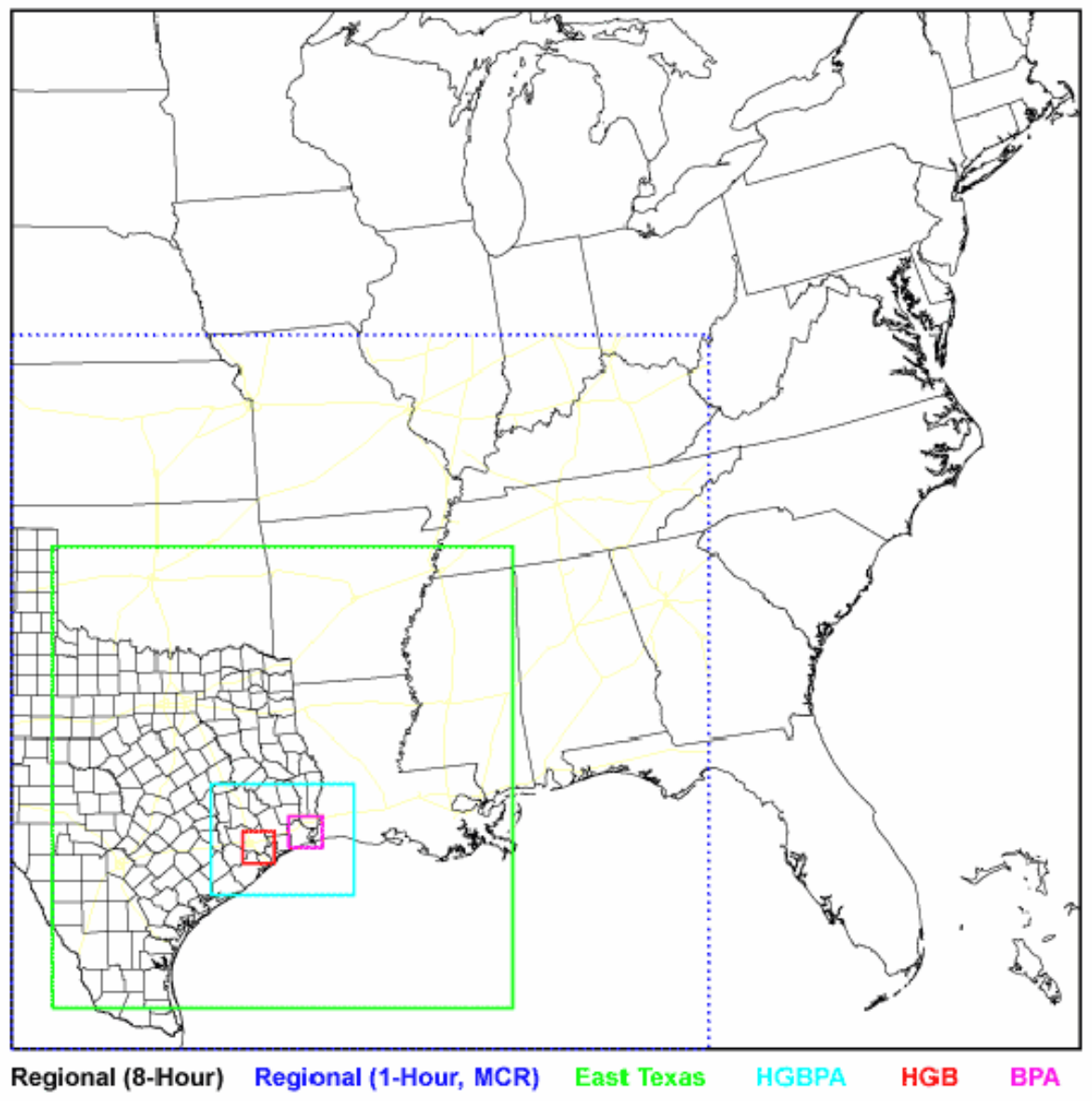
Conduct Future (Attainment) Year Emissions Modeling

Conduct Photochemical Modeling of Baseline

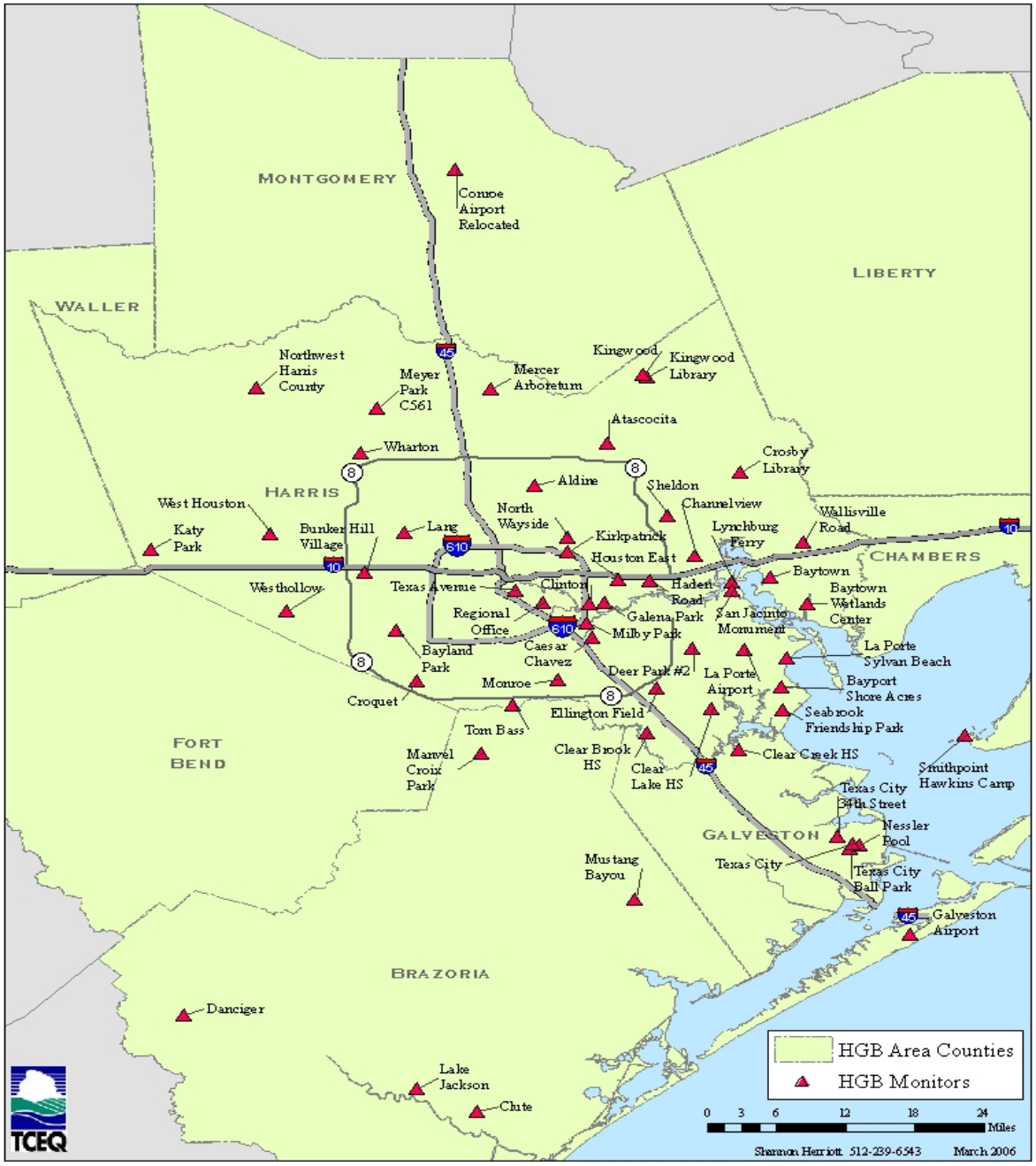
Conduct Photochemical Modeling of the Attainment Year

Conduct Photochemical Modeling of Control Strategies

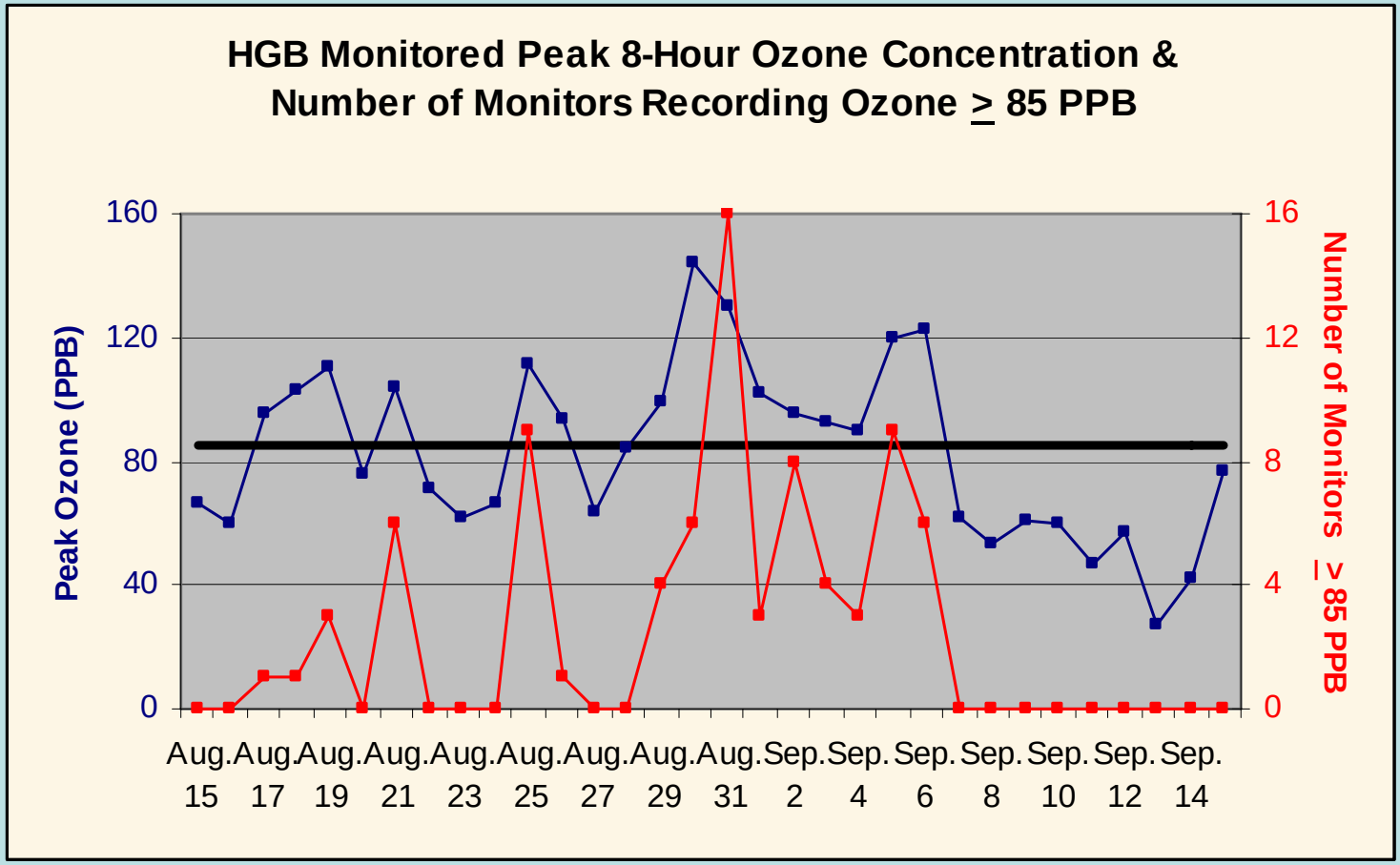
Modeling Domain



Houston-Galveston-Brazoria Air Quality Monitors

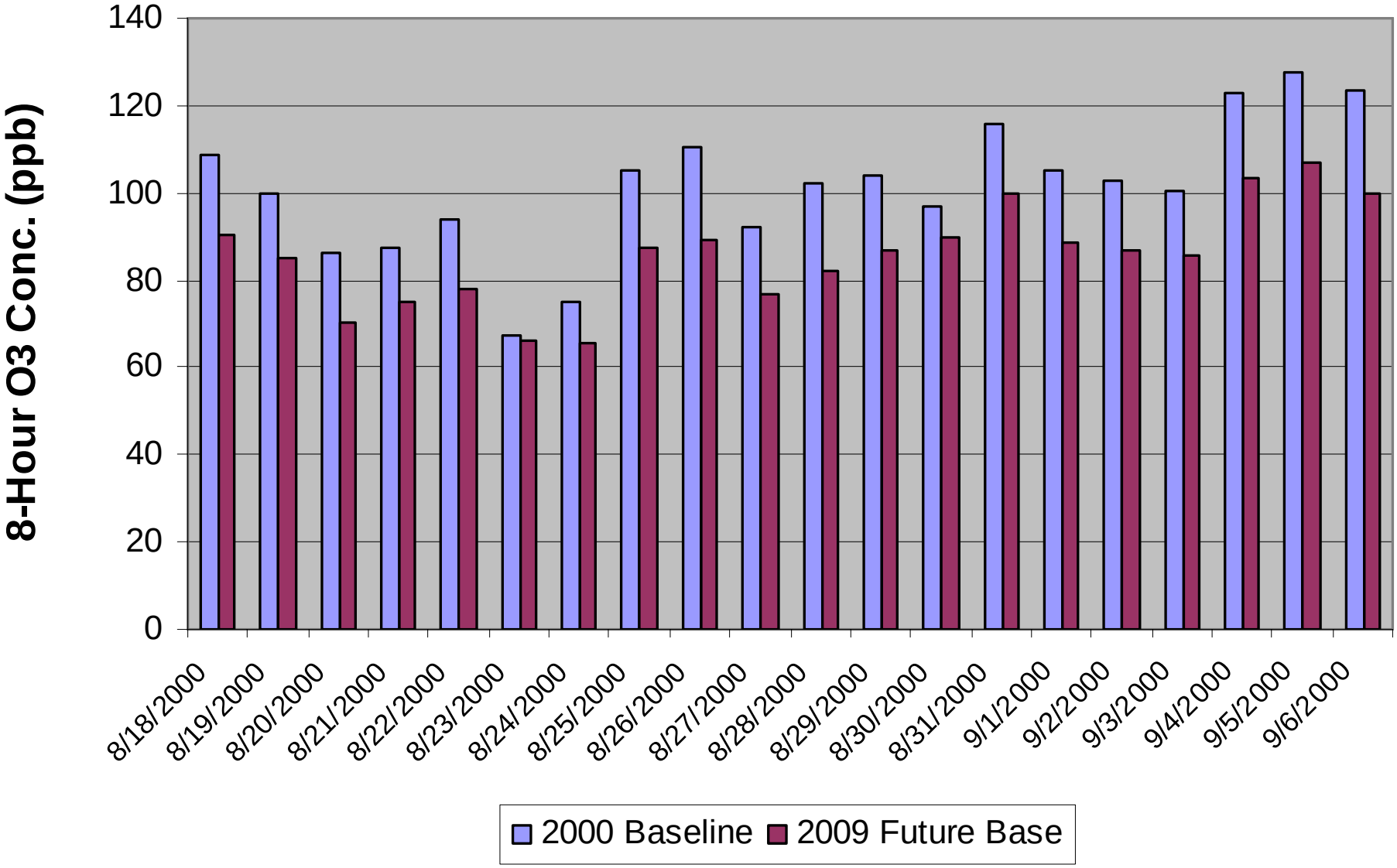


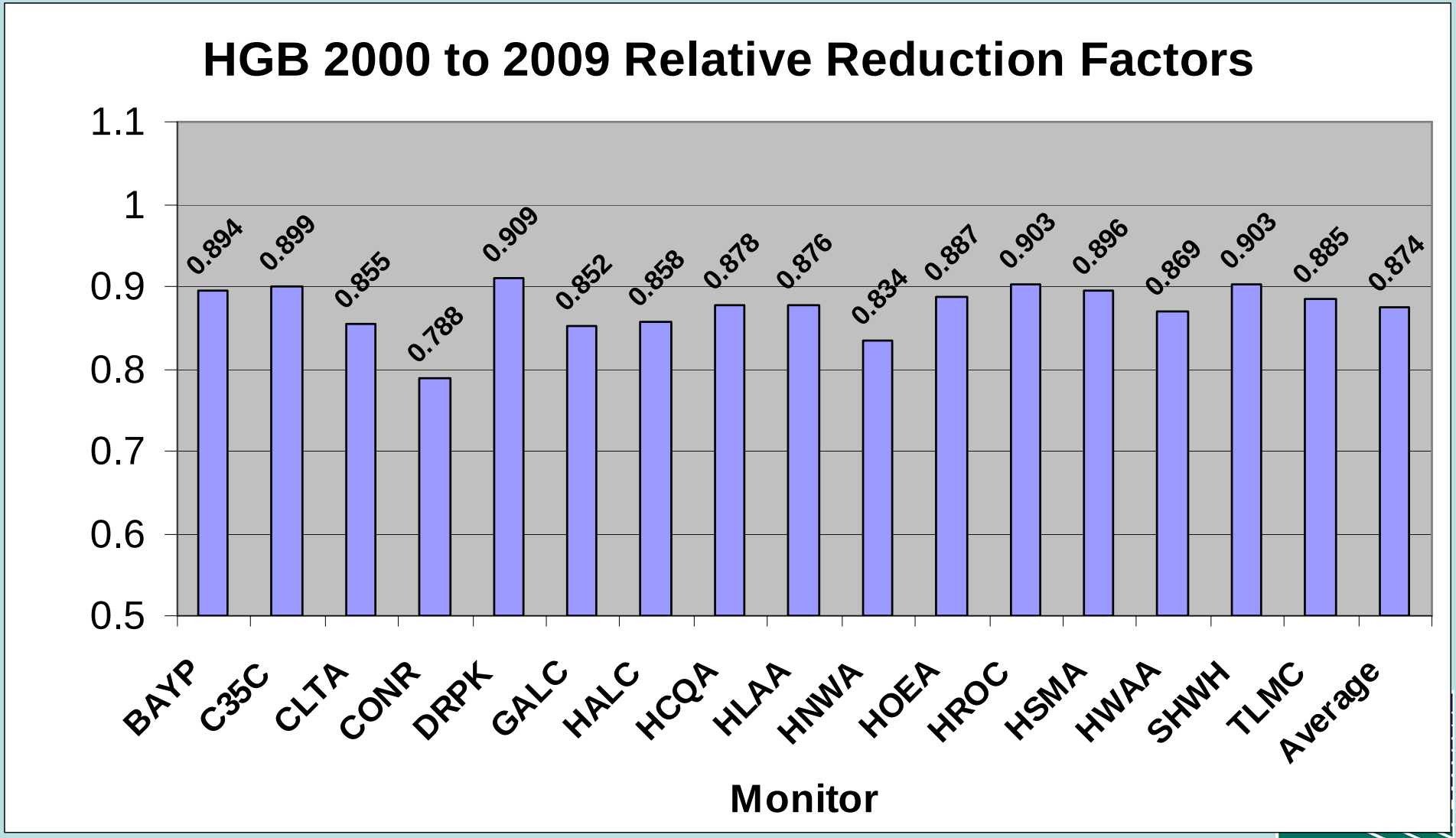
Modeling Episode: Aug-Sept 2000

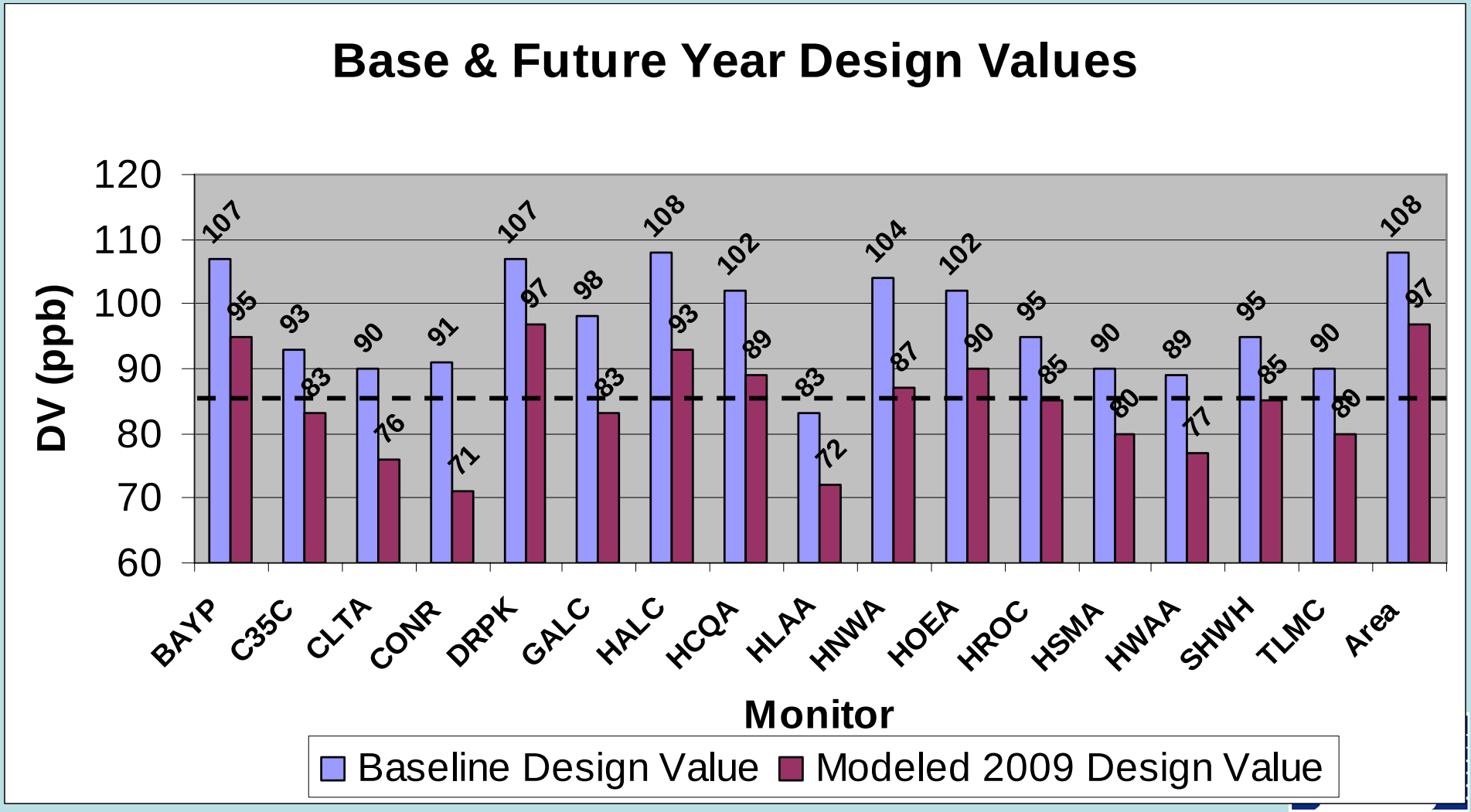


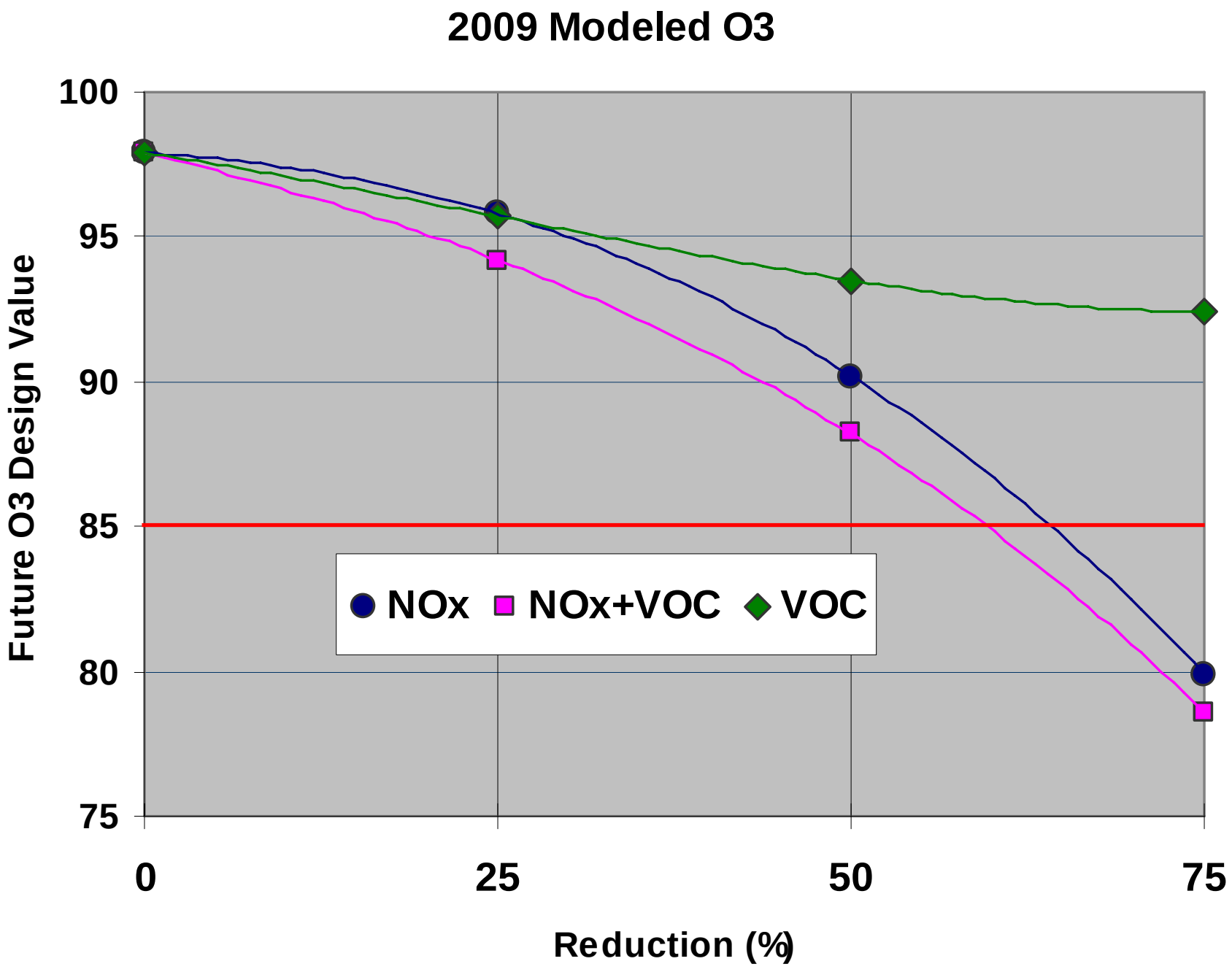
Modeling Results for the Year 2000 Baseline and 2009 Attainment Year

HGB Modeled Peak 8-Hour Ozone




HGB 2000 to 2009 Relative Reduction Factors
1.1
1
0.9
0.8
0.7
0.6
0.5
0.894
0.899
0.855
0.788
0.909
0.852
0.858
0.878
0.876
0.834
0.887
0.903
0.896
0.869
0.903
0.885
0.874
BAYP
C35C
CLTA
CONR
DRPK
GALC
HALC
HCQA
HLAA
HNWA
HOEA
HROC
HSMA
HWAA
SHWH
TLMC
Average
Monitor

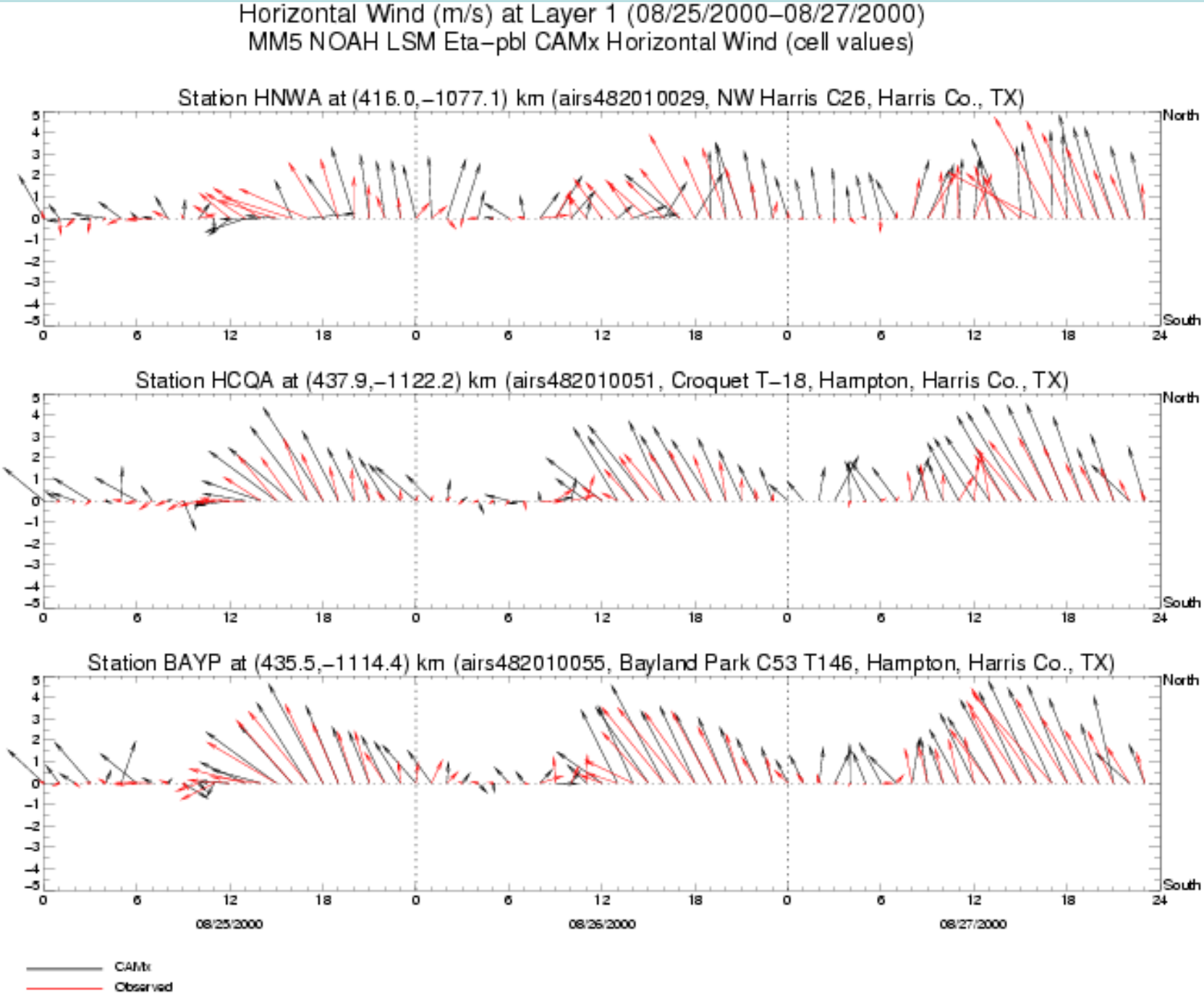

Base & Future Year Design Values
DV (ppb)
120
110
100
90
80
70
60
107
95
93
83
90
76
91
71
107
97
98
83
108
93
102
89
83
72
104
87
102
90
95
85
90
80
89
77
95
85
90
80
108
97
BAYP
C35C
CLTA
CONR
DRPK
GALC
HALC
HCQA
HLAA
HNWA
HOEA
HROC
HSMA
HWAA
SHWH
TLMC
Area
Monitor
Baseline Design Value
Modeled 2009 Design Value


2009 Modeled O3
100
95
90
85
80
75
Future O3 Design Value
0
25
50
75
Reduction (%)
NOx
NOx+VOC
VOC

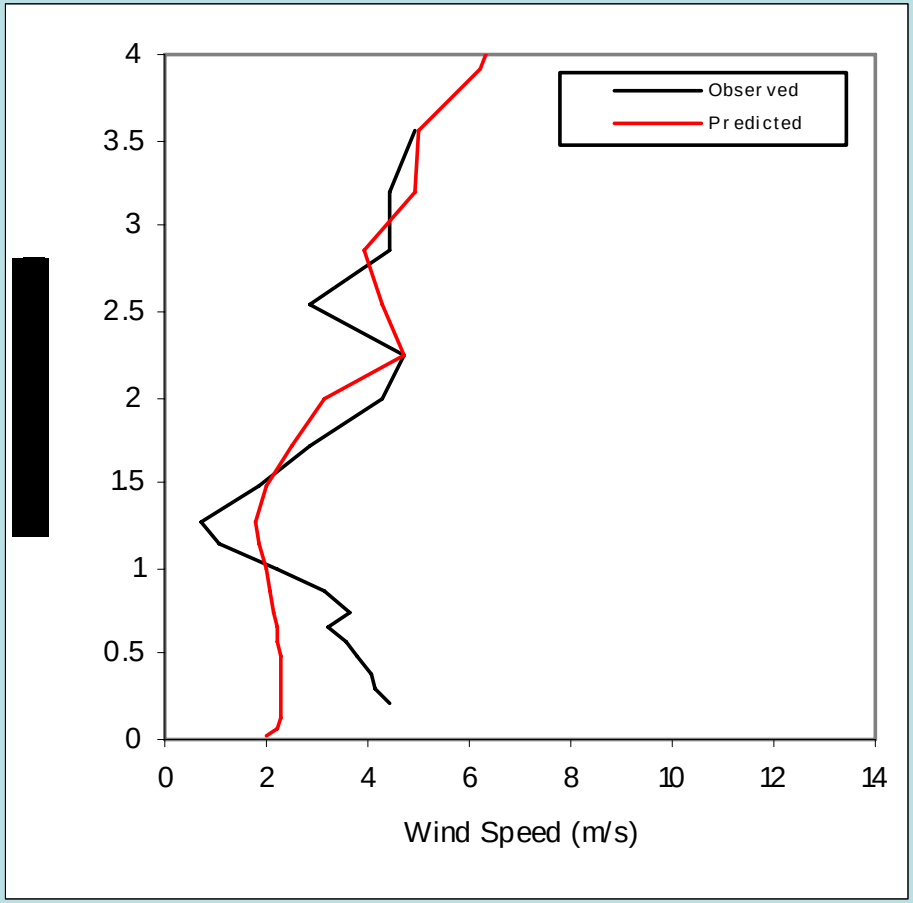
MM5 Meteorological Model as Configured by the Univ. of Houston and Modified by TCEQ Staff

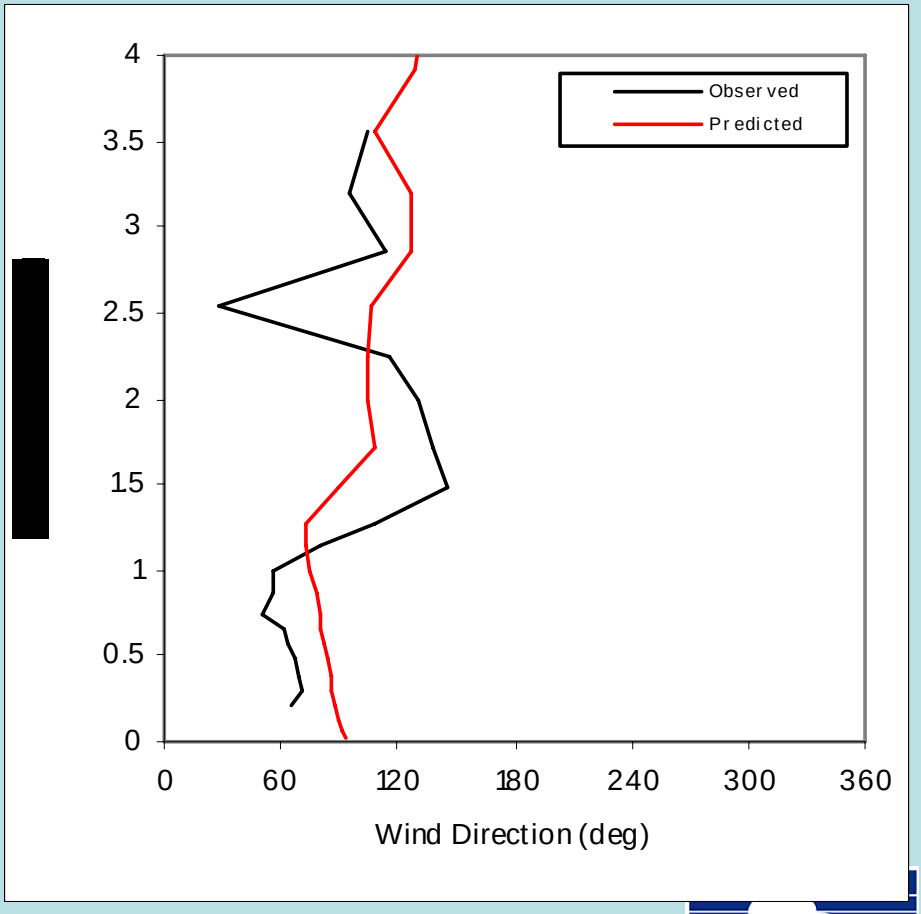
MM5 Results (e.g., winds, mixing heights) are compared to monitored data

Modeling is repeated in an iterative process until satisfactory comparisons are achieved

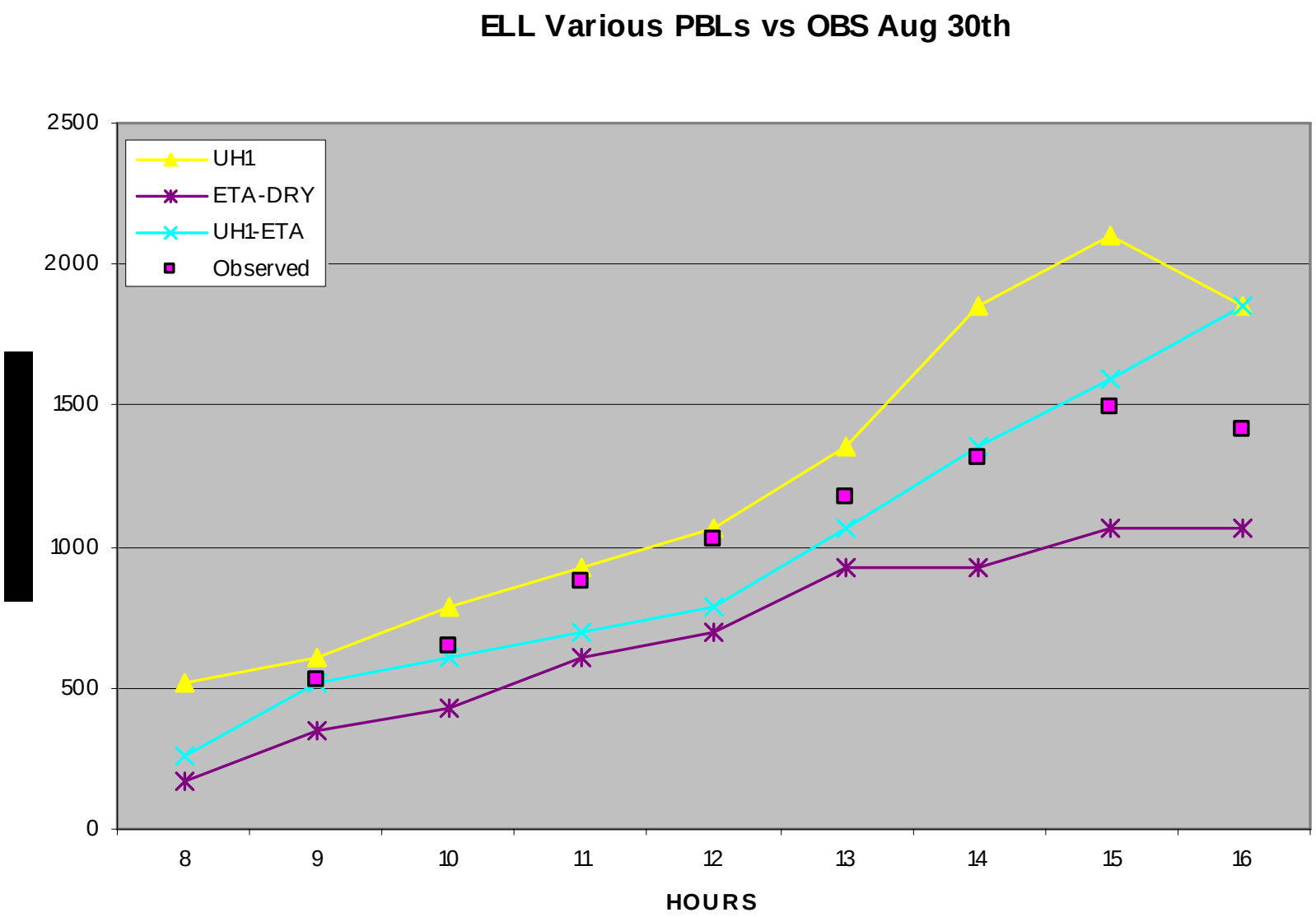

Horizontal Wind (m/s) at Layer 1 (08/25/2000–08/27/2000)
MM5 NOAH LSM Eta–pbl CAMx Horizontal Wind (cell values)
Station HNWA at (416.0,–1077.1) km (airs482010029, NW Harris C26, Harris Co., TX)
Station HCQA at (437.9,–1122.2) km (airs482010051, Croquet T–18, Hampton, Harris Co., TX)
Station BAYP at (435.5,–1114.4) km (airs482010055, Bayland Park C53 T146, Hampton, Harris Co., TX)
North
South
08/25/2000
08/26/2000
08/27/2000
CAMx
Observed

Ellington Field August 25, 2000 – 12 Noon





MM5 Predicted PBL vs Measured PBL
Ellington Field Profiler, August 30, 2000



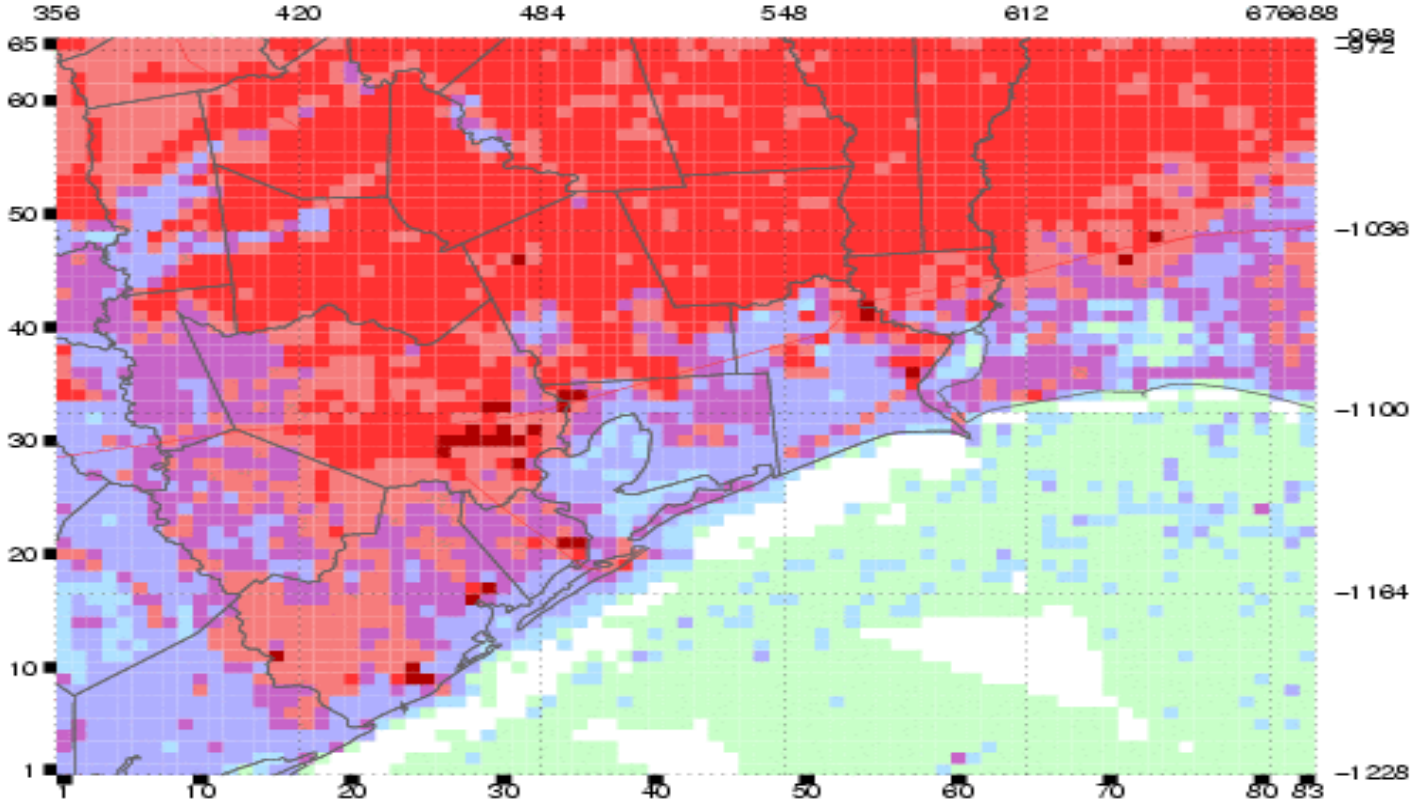
Emissions Modeling for the Selected Episode, Baseline & Future Attainment Year

On-Road Mobile using EPAs MOBILE & Transportation Demand Models

Area Sources & Off-Road Mobile using EPAs NON_ROAD Model

Point Sources using an Emission Processing System

Biogenic Sources using a Vegetative Species Land Cover/Land Use Model



base1c.psito2n2.hgbpa_04km Total CB–IV HC Emissions, 08/30/2000

Emissions Plotted

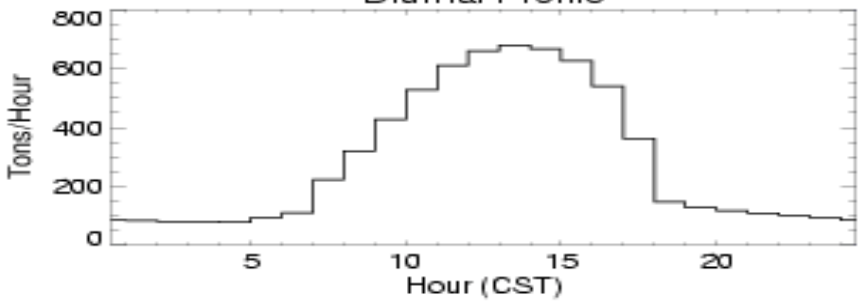
County	Tons/Day
Brazoria	274.96
Chambers	74.97
Fort Bend	149.76
Galveston	93.17
Harris	812.82
Liberty	474.42
Montgomery	486.94
Waller	105.72
HG SUBTOTAL:	2472.76
Hardin	429.99
Jefferson	170.01
Orange	130.83
BPA SUBTOTAL:	730.83
MAP TOTAL:	6956.74

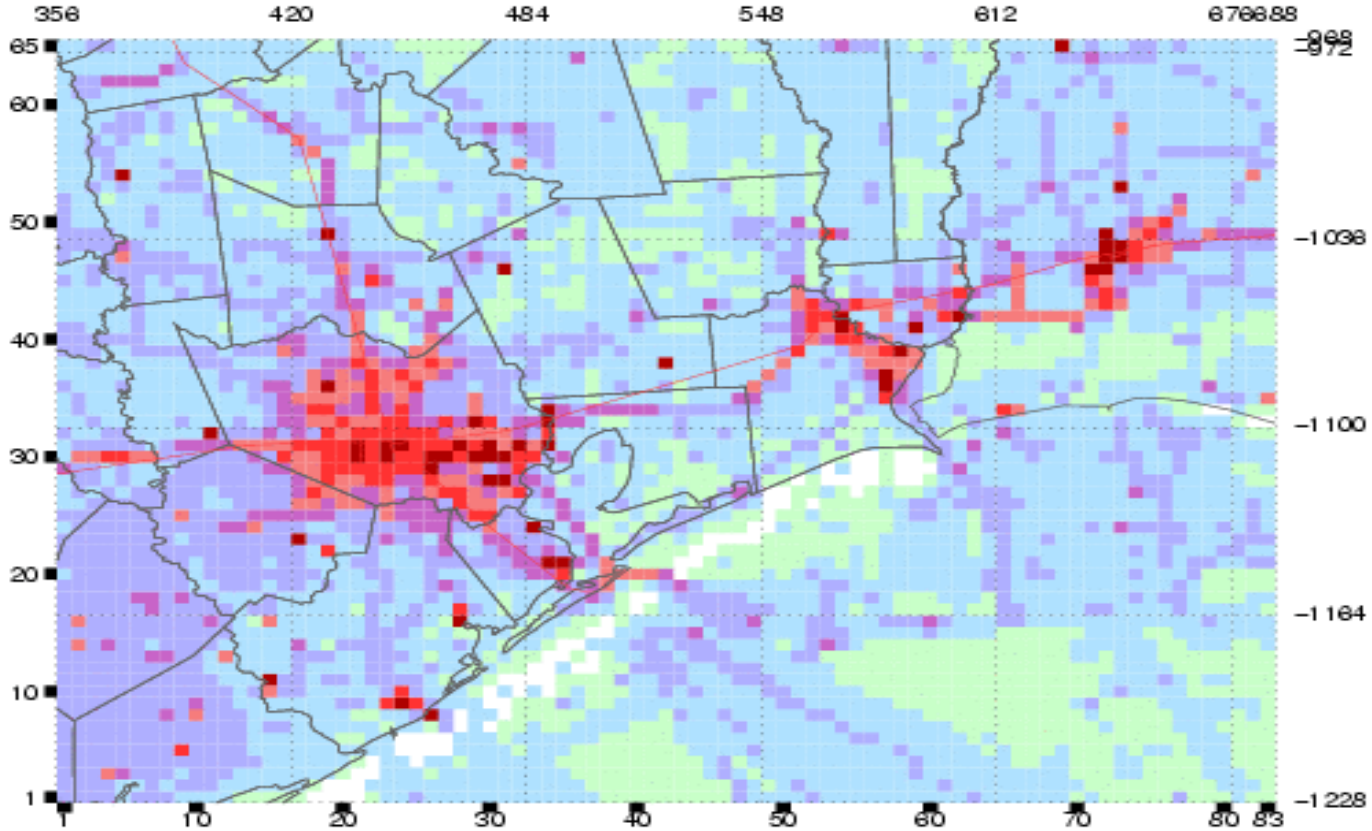
Legend (Tons/Day)

< 0.00 | 0.00 – 0.01 | 0.01 – 0.10 | 0.10 – 0.50 | 0.50 – 1.00 | 1.00 – 2.00 | 2.00 – 5.00 | >= 5.00

Max: 38.309 t/d (470, –1110); Min: 0.000 t/d (428, –1228)

Diurnal Profile

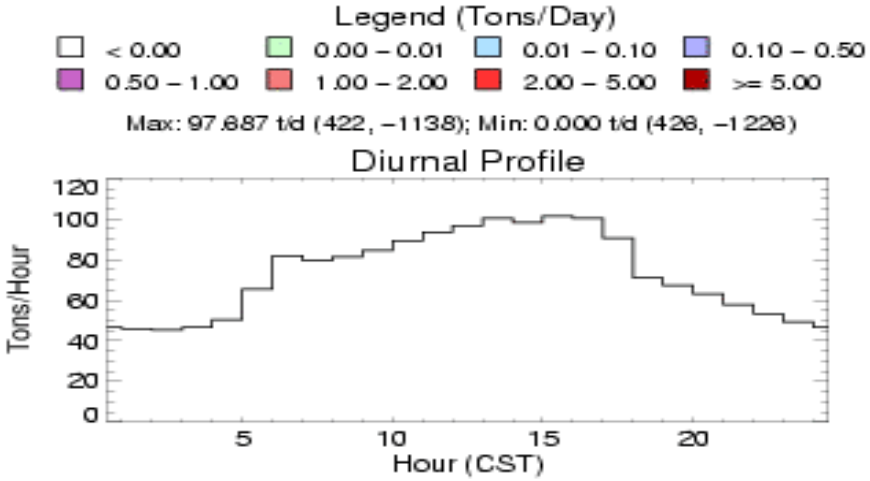




base1c.psito2n2.hgbpa_04km Total NO_x Emissions, 08/30/2000

Emissions Plotted

County	Tons/Day
Brazoria	90.93
Chambers	19.42
Fort Bend	154.78
Galveston	114.97
Harris	561.29
Liberty	40.19
Montgomery	44.06
Waller	14.90
HG SUBTOTAL:	1040.54
Hardin	11.76
Jefferson	127.08
Orange	69.78
BPA SUBTOTAL:	208.63
MAP TOTAL:	1760.62



Photochemical Modeling (w/CAMx) of the Selected Episode

Input Episode Specific Meteorology

Input Episode Specific Emissions

Evaluate Model Performance by Comparing with Monitored Data

Repeat Modeling Iteratively until Performance is Satisfactory

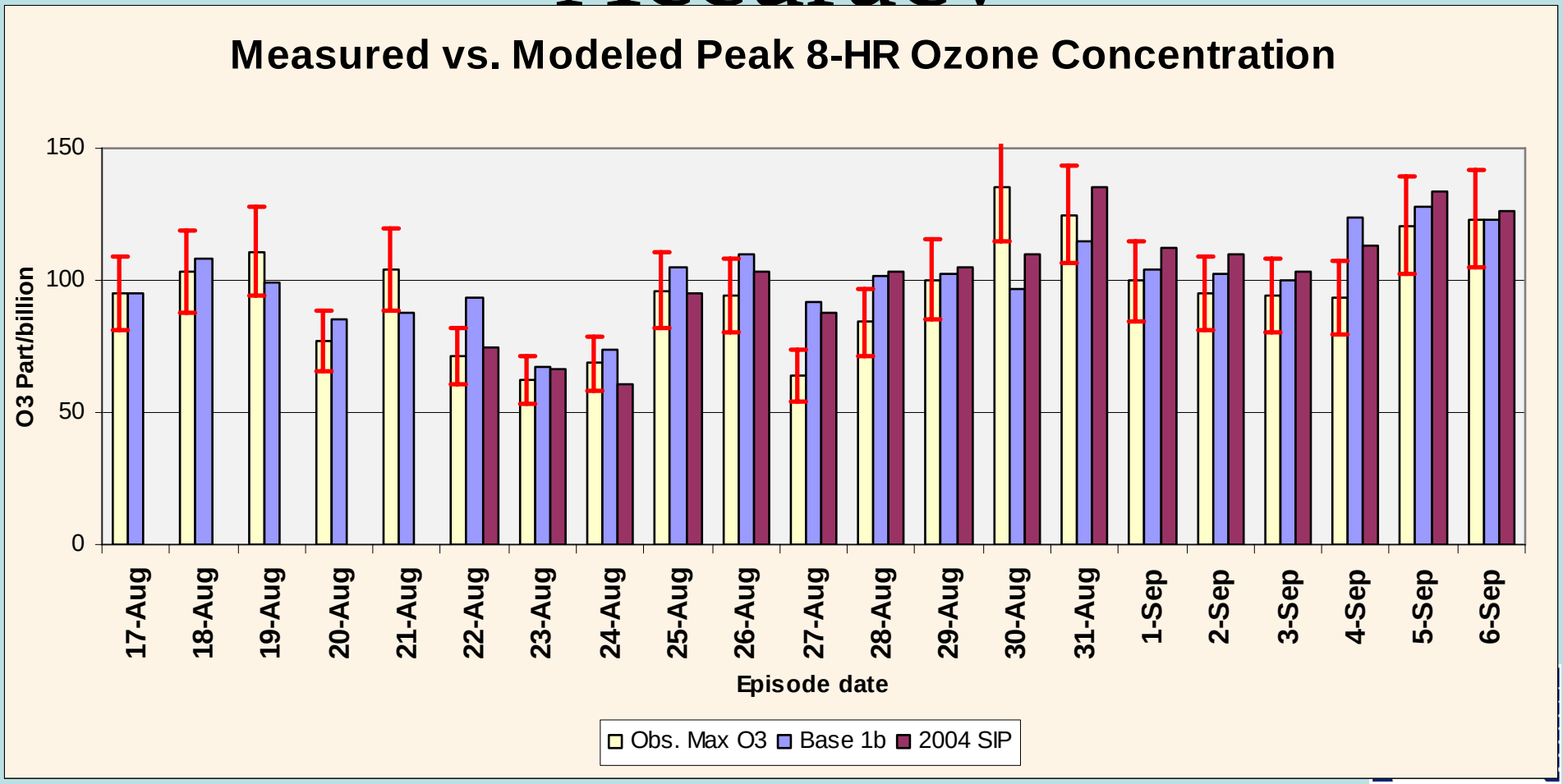
Model Performance Evaluation

Statistical Comparisons

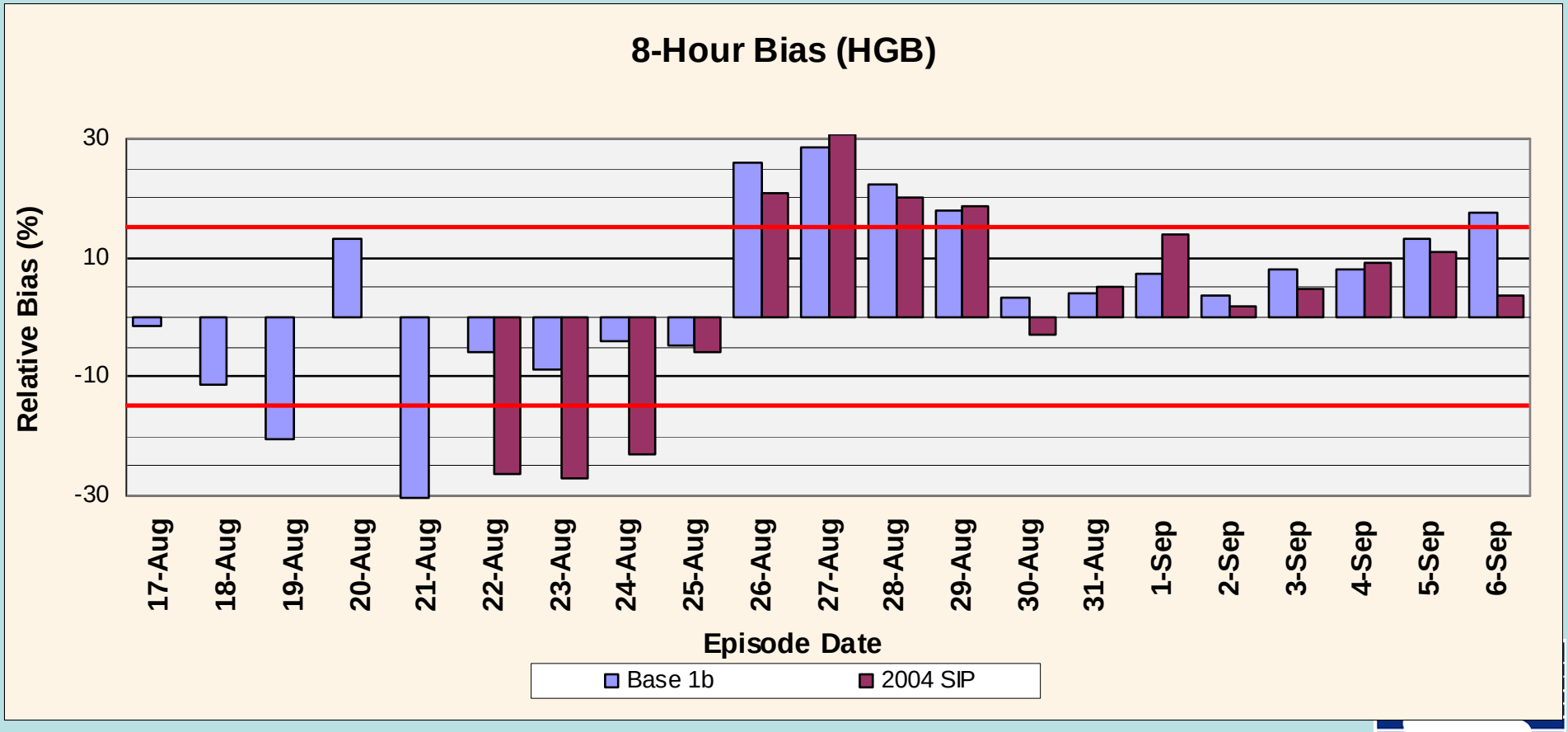
Time Series Comparisons

Ozone Concentration Maps

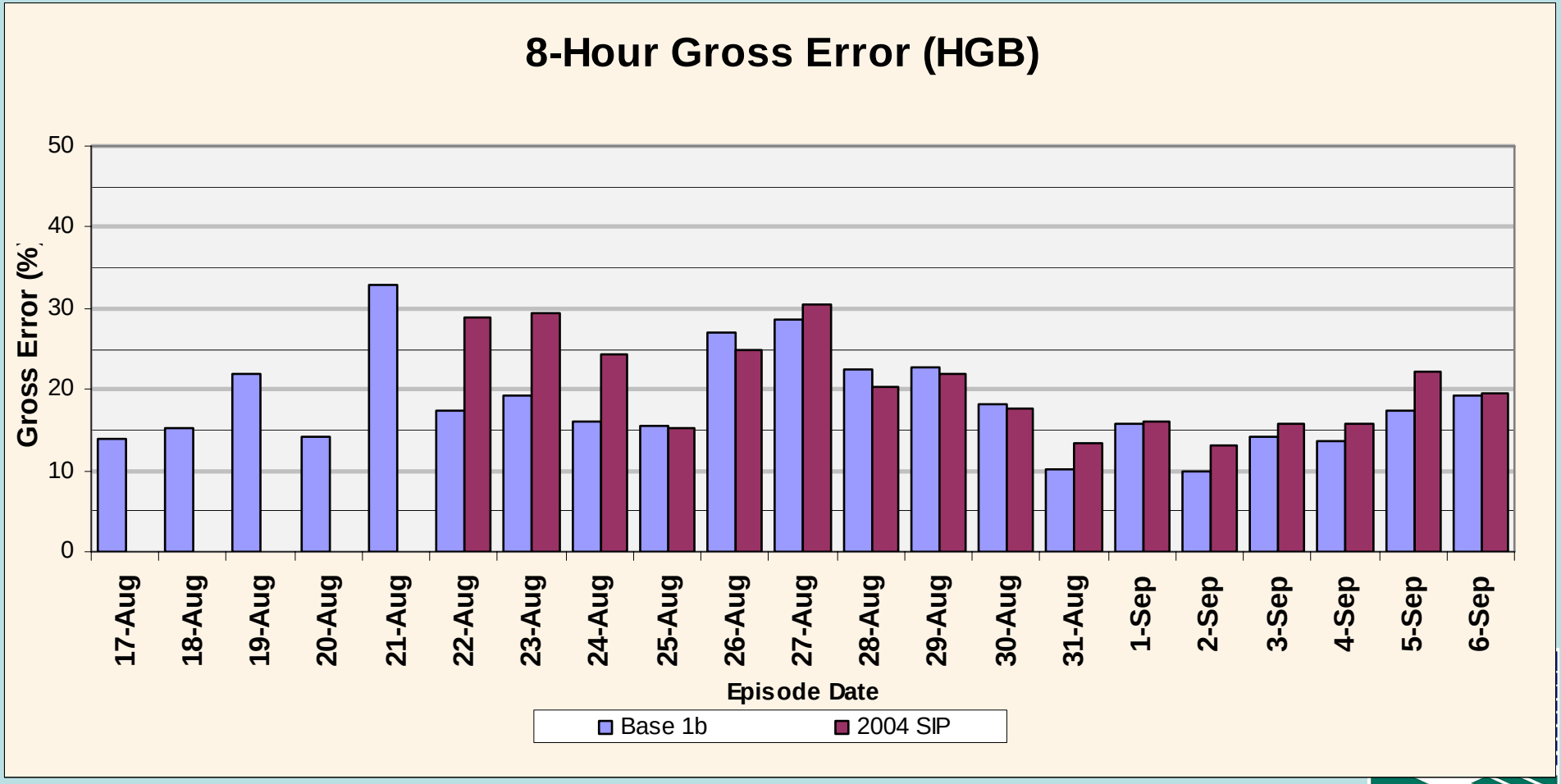
8-Hour Unpaired Peak Accuracy

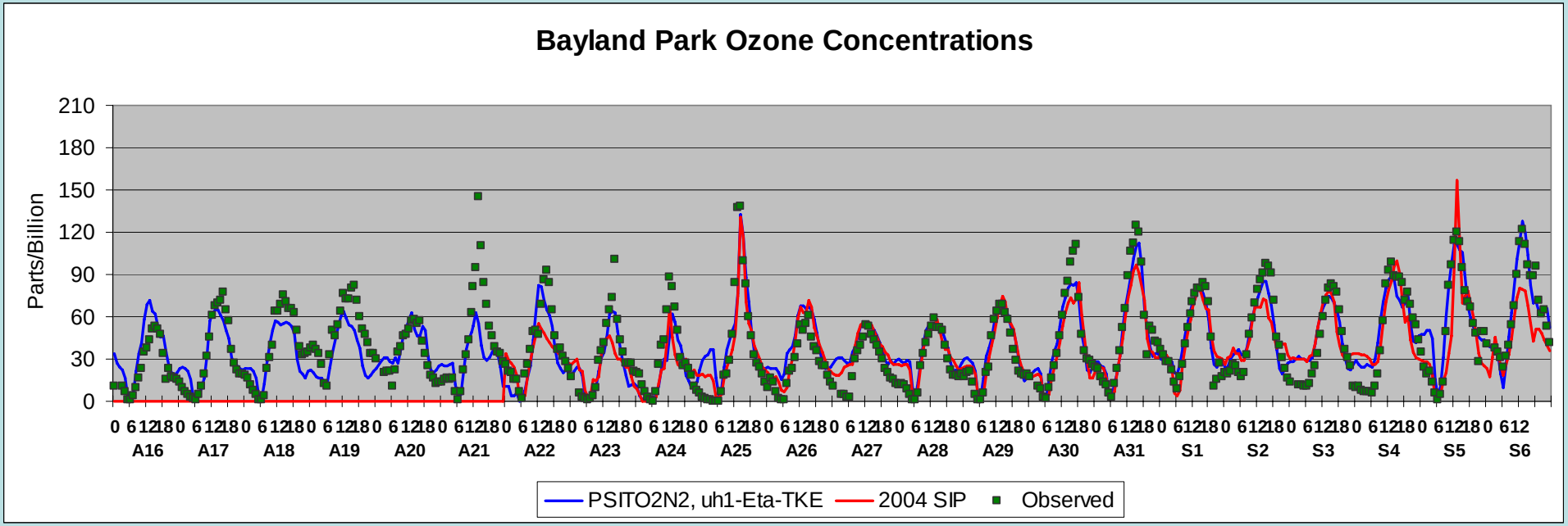


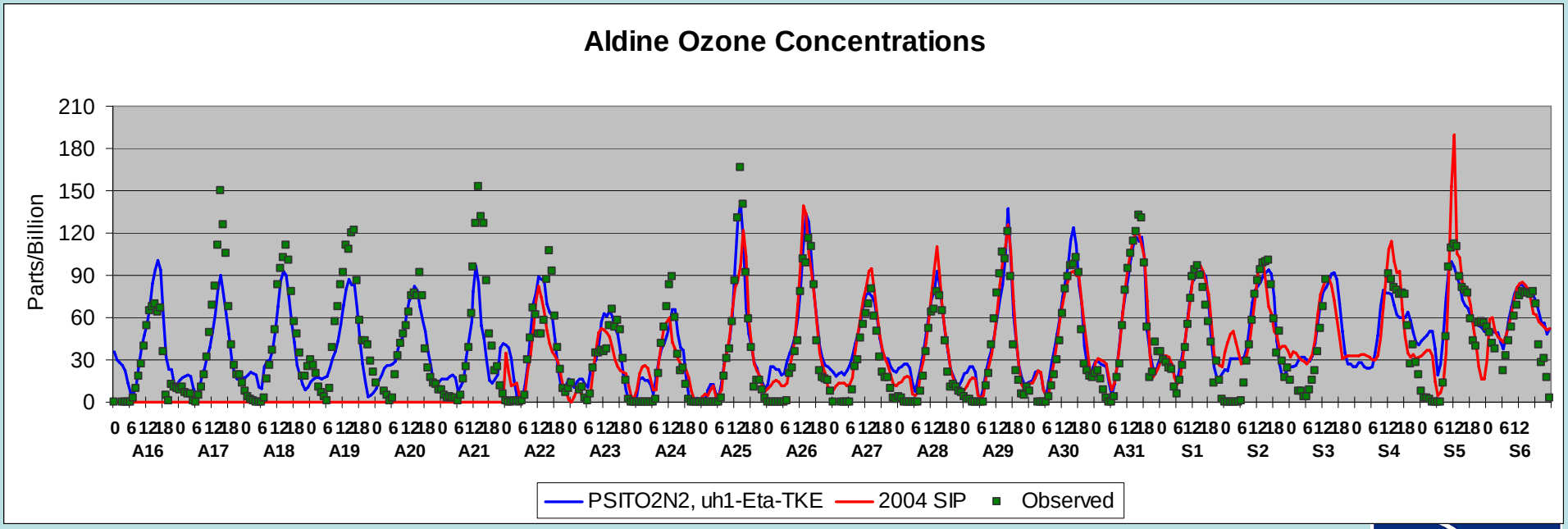
8-Hour Bias

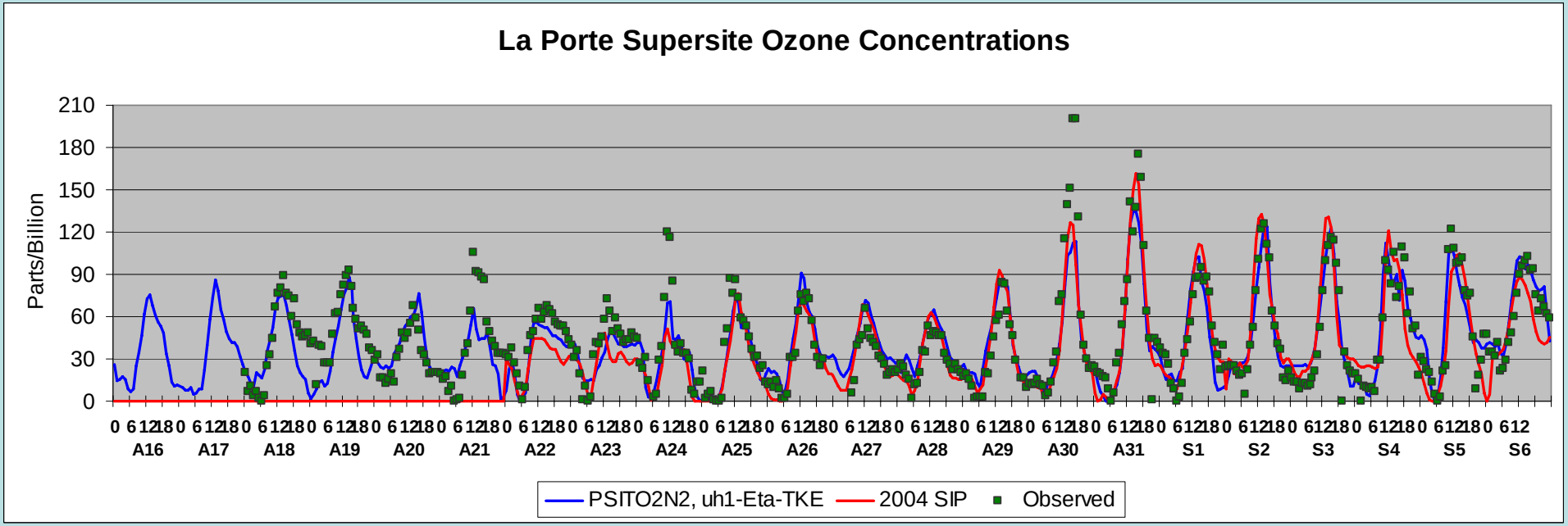

8-Hour Bias (HGB)
Relative Bias (%)
30
10
-10
-30
17-Aug
18-Aug
19-Aug
20-Aug
21-Aug
22-Aug
23-Aug
24-Aug
25-Aug
26-Aug
27-Aug
28-Aug
29-Aug
30-Aug
31-Aug
1-Sep
2-Sep
3-Sep
4-Sep
5-Sep
6-Sep
Episode Date
Base 1b
2004 SIP

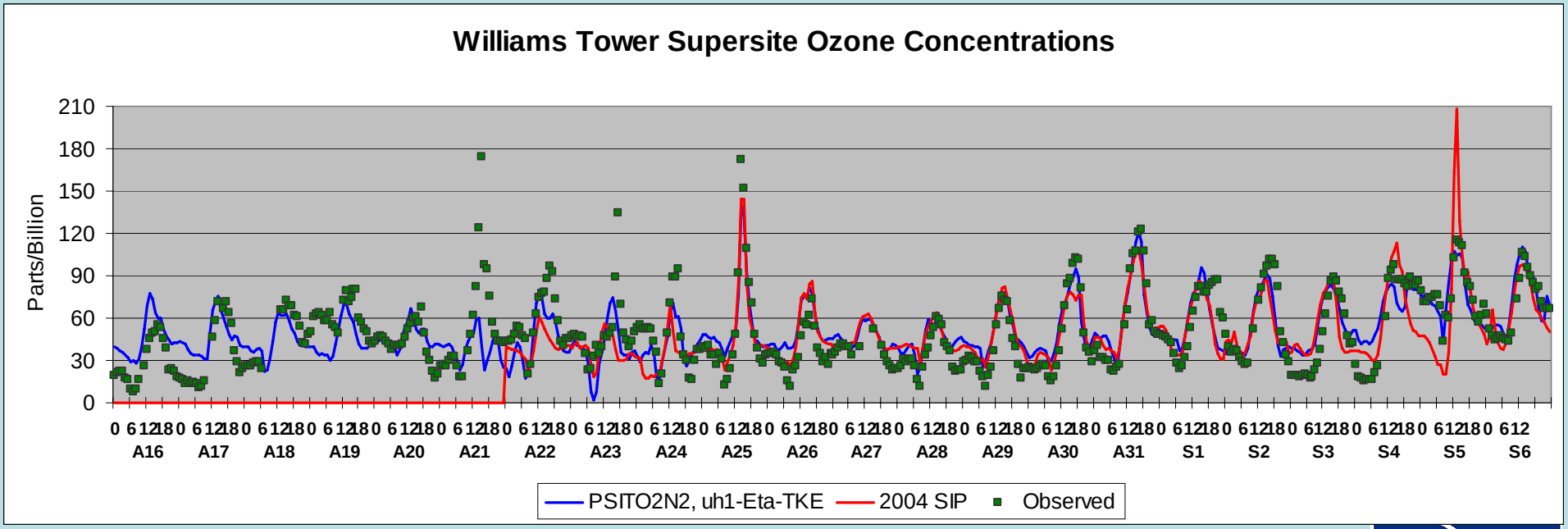
8-Hour Gross Error




Bayland Park Ozone Concentrations
Parts/Billion
210
180
150
120
90
60
30
0
A16
A17
A18
A19
A20
A21
A22
A23
A24
A25
A26
A27
A28
A29
A30
A31
S1
S2
S3
S4
S5
S6
PSITO2N2, uh1-Eta-TKE
2004 SIP
Observed


Aldine Ozone Concentrations
Parts/Billion
210
180
150
120
90
60
30
0
A16
A17
A18
A19
A20
A21
A22
A23
A24
A25
A26
A27
A28
A29
A30
A31
S1
S2
S3
S4
S5
S6
PSITO2N2, uh1-Eta-TKE
2004 SIP
Observed

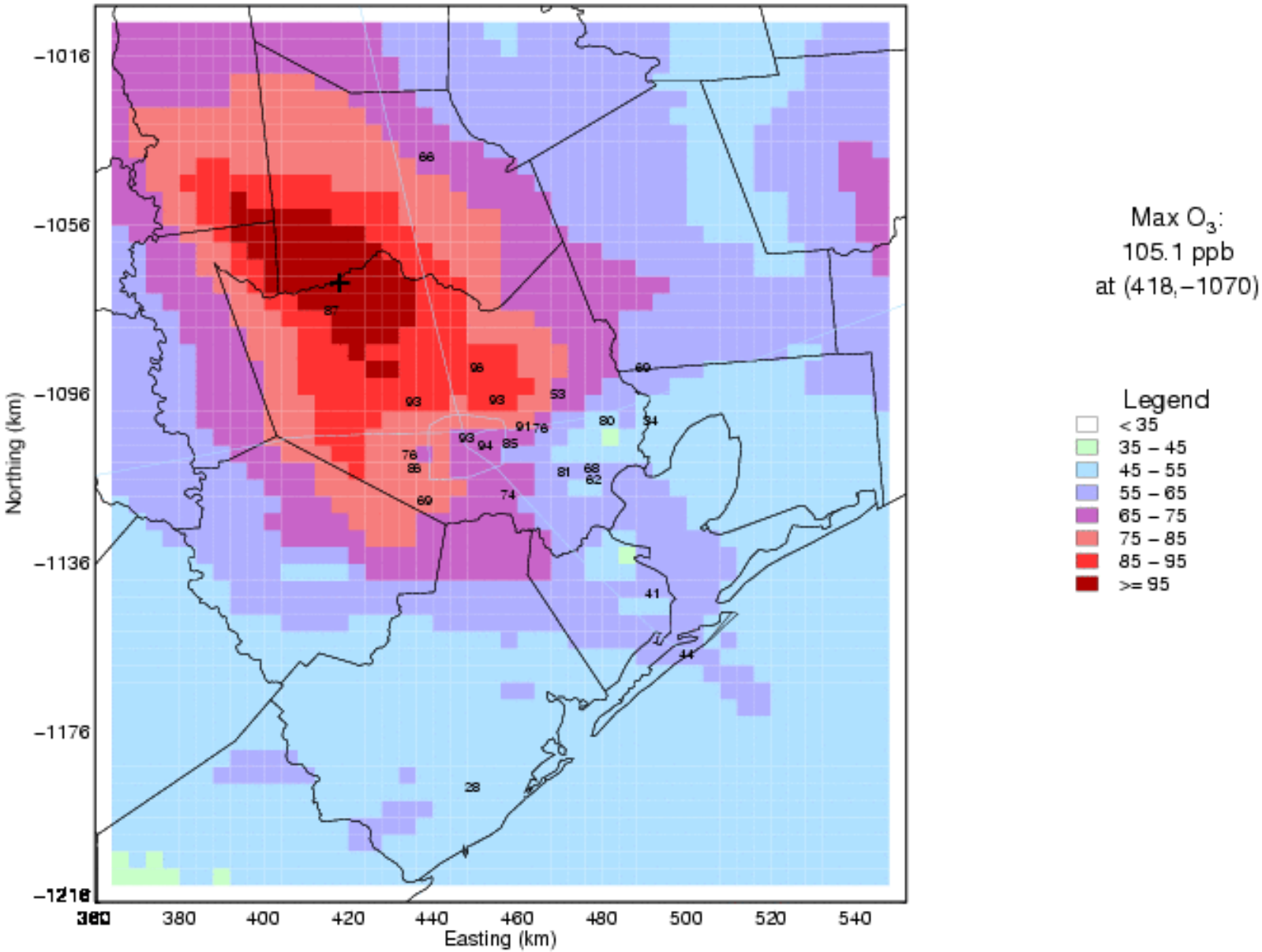

La Porte Supersite Ozone Concentrations
Parts/Billion
210
180
150
120
90
60
30
0
A16
A17
A18
A19
A20
A21
A22
A23
A24
A25
A26
A27
A28
A29
A30
A31
S1
S2
S3
S4
S5
S6
PSITO2N2, uh1-Eta-TKE
2004 SIP
Observed


Williams Tower Supersite Ozone Concentrations
Parts/Billion
210
180
150
120
90
60
30
0
A16
A17
A18
A19
A20
A21
A22
A23
A24
A25
A26
A27
A28
A29
A30
A31
S1
S2
S3
S4
S5
S6
PSITO2N2, uh1-Eta-TKE
2004 SIP
Observed

Daily Maximum 8–Hour Moving Average O_3 Concentrations (ppb) for 08/25/2000

camx420_cb4.hgb8h.base1c.psito2n2.TCEQuh1_eta_tke

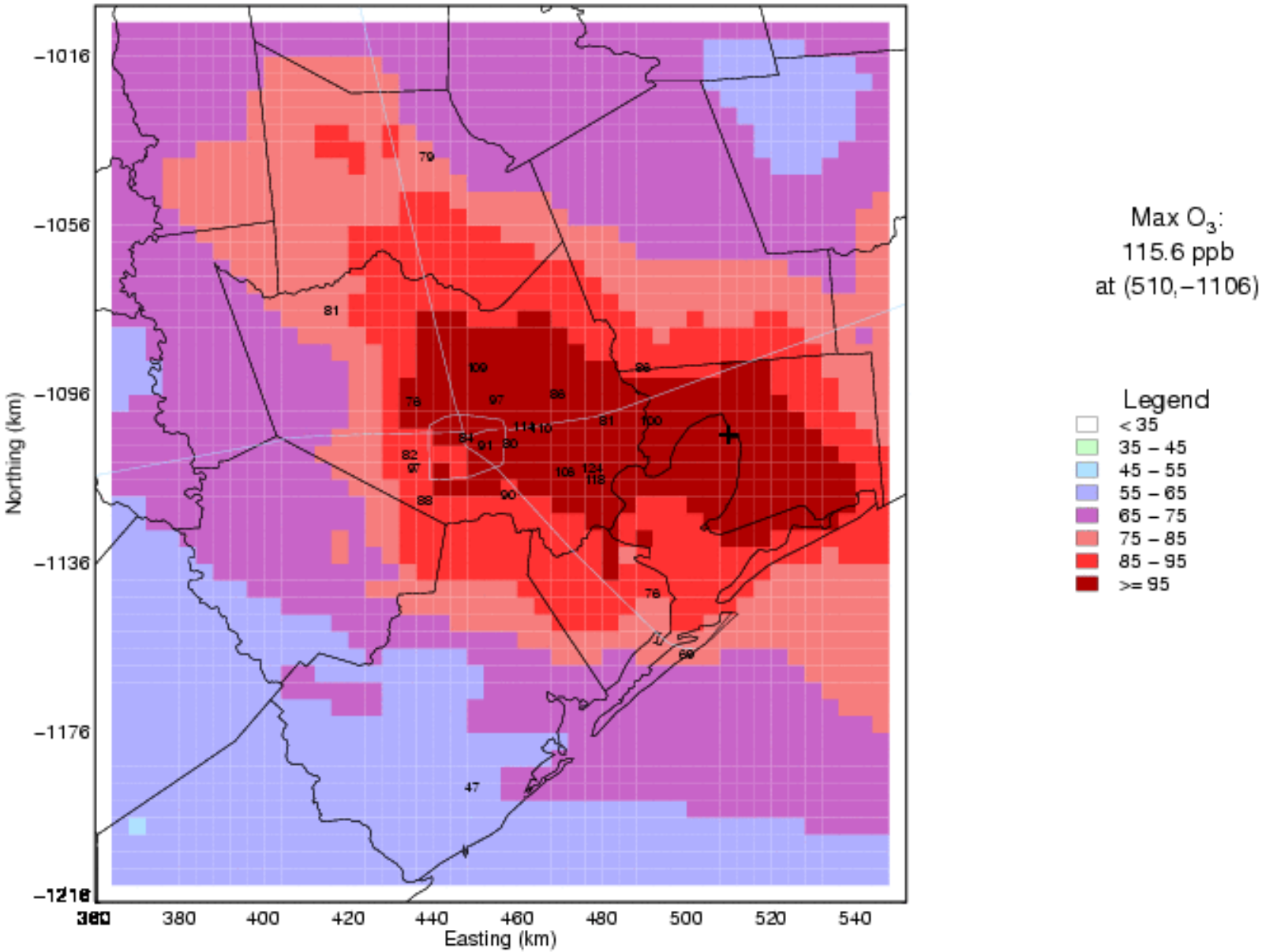
Layer 1



Daily Maximum 8–Hour Moving Average O_3 Concentrations (ppb) for 08/31/2000

camx420_cb4.hgb8h.base1c.psito2n2.TCEQuh1_eta_tke

Layer 1

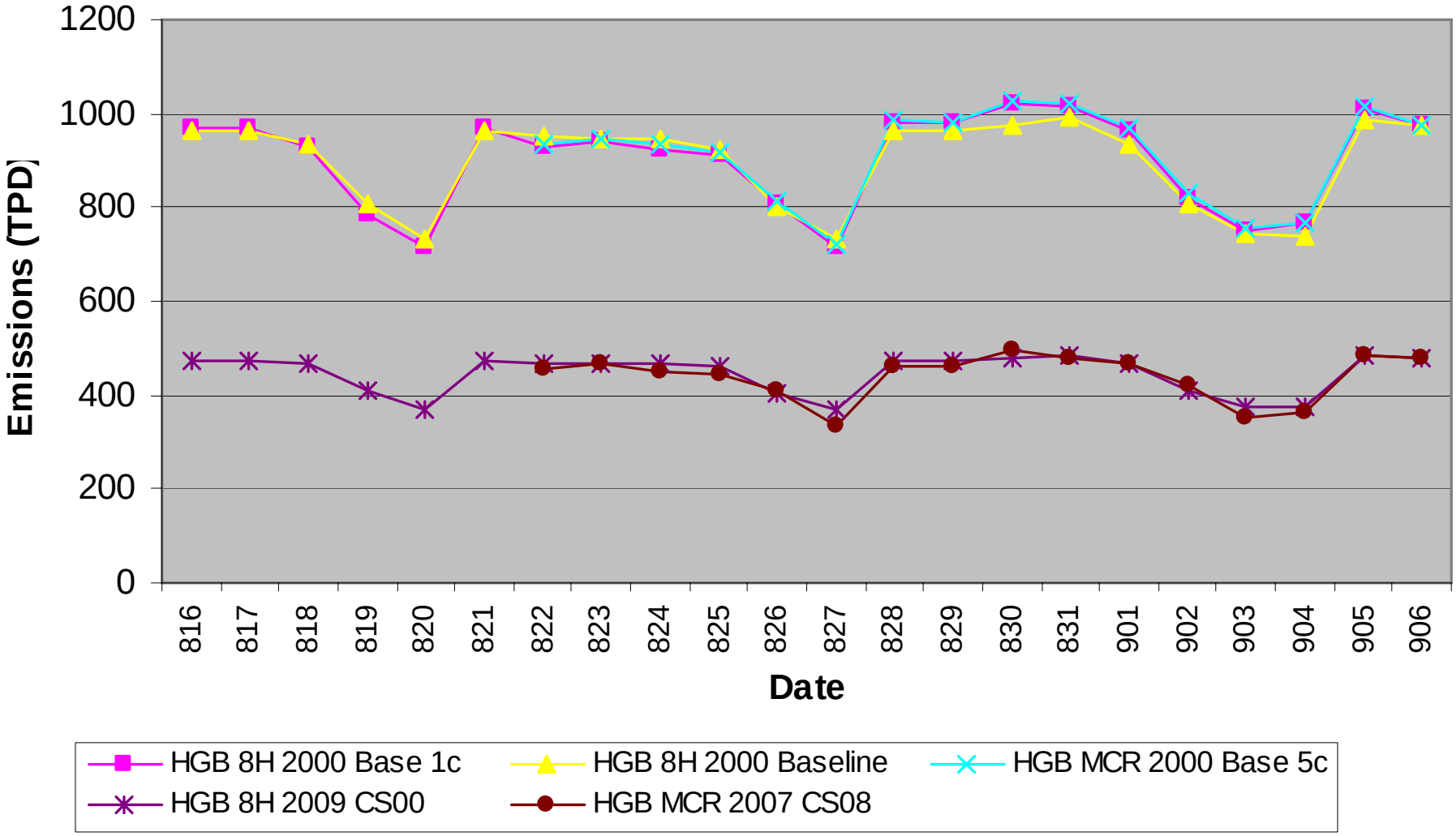


Emissions for the Year 2000 Baseline and 2009 Attainment Year

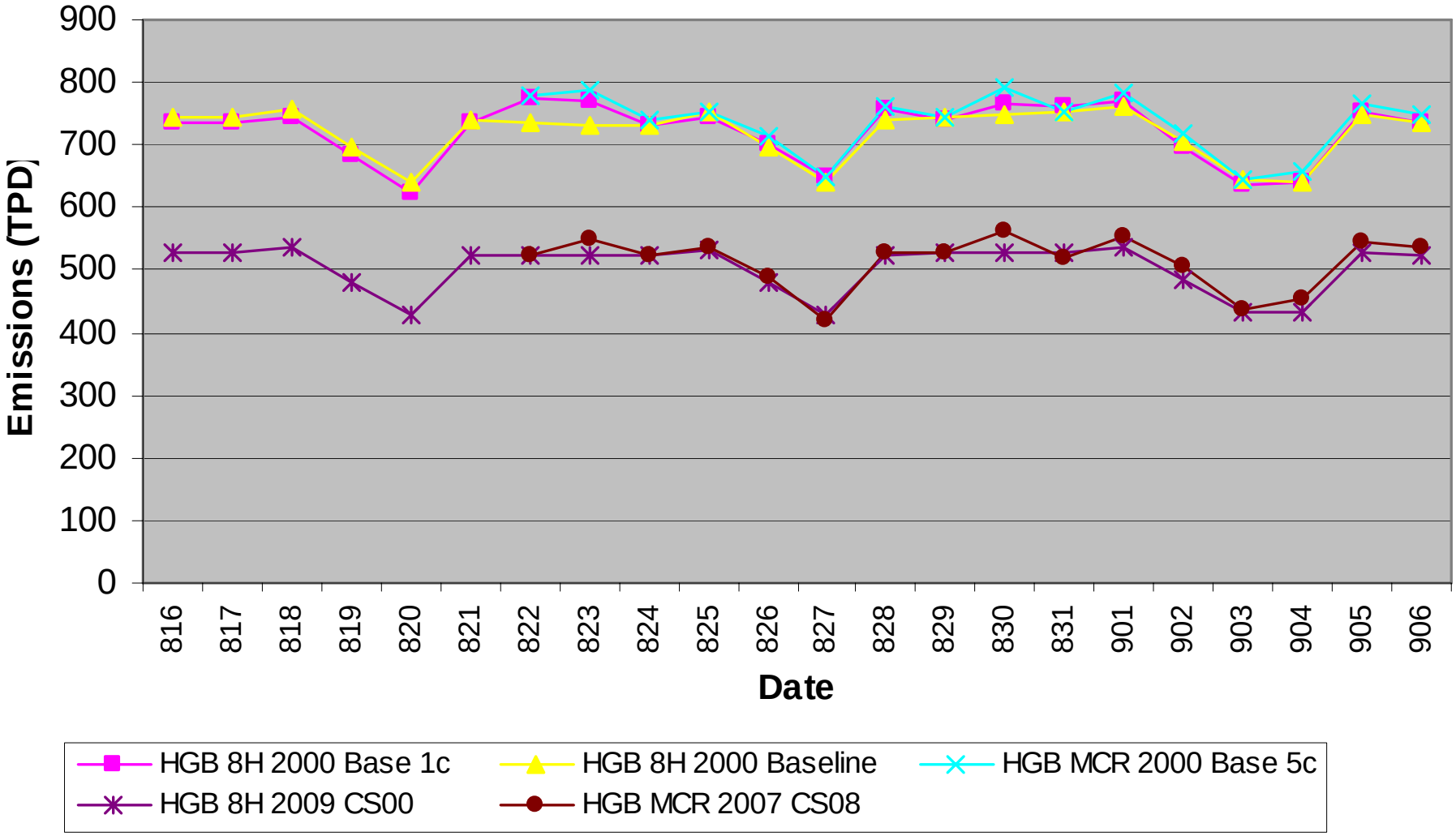
Year 2000 Baseline – Ozone Season Day (OSD) Emissions Replace Episode Specific Emissions

2009 Attainment Year – OSD Emissions Adjusted for Growth & Scheduled Controls

HGB Anthropogenic NOx Emissions



HGB Anthropogenic VOC Emissions



Summary

New model configuration is much more responsive to emission reductions than modeling used in earlier 2010 sensitivity runs.

Modeled 2009 future design value for HGB is 97 ppb (at Deer Park), before any additional control measures.

Summary (Cont.)

Modeling estimates that attainment could be reached with ~60% reduction in each NO_X & VOC emissions, or ~65% reduction in NO_X emissions only.

Model shows response to VOC emission reductions, but not as much as to NO_X.

Contributors

- Steve Davis
- Zarena Post
- Jim Smith
- Mark Estes
- Weining Zhao
- Jim MacKay
- Ron Thomas
- Marvin Jones
- Chris Kite