

## Appendix O

Report - Control Strategy Modeling for the Beaumont-Port Arthur Area

June 30, 1999

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# ***EVALUATION OF CONTROL STRATEGIES FOR THE BEAUMONT-PORT ARTHUR AREA***

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# 1. INTRODUCTION

The 1990 Federal Clean Air Act (FCAA) Amendments established five classifications for ozone nonattainment areas based on the magnitude of the monitored one-hour ozone design values, and established dates by which each classified area should attain the standard. For each nonattainment area, states must develop and submit to the U.S. Environmental Protection Agency (EPA) a State Implementation Plan (SIP) that demonstrates how the area will attain the standard by the attainment date. The EPA designated several ozone nonattainment areas in Texas and classified each.

The Houston/Galveston/Brazoria Consolidated Metropolitan Statistical Area (Brazoria, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties) and Chambers County were designated as a severe ozone nonattainment area, and these counties are included in the SIP for the Houston-Galveston (HG) area. The FCAA requires that photochemical grid models be used for SIP development in severe areas. The final SIP demonstrating attainment of the ozone National Ambient Air Quality Standard (NAAQS) in Houston-Galveston was initially due November 15, 1994. Severe areas must attain the one-hour ozone NAAQS by 2007. The Beaumont-Port Arthur (BPA) area was initially designated as a serious ozone nonattainment area, and was reclassified to moderate in April 1996.

To support the 1999 SIP revision, the Comprehensive Air quality Model with extensions (CAMx) was run for two episode periods with modified future year boundary conditions and emissions projected (growth and controls on record) to the year 2007 (MCNC, 1999a; MCNC, 1999b). The future year emissions were perturbed through the introduction of various control scenarios for the September 6-11, 1993 episode and for the August 31, 1993 – September 2, 1993 episode. The same air quality and meteorological inputs previously developed for the base case simulations (MCNC, 1999c; MCNC, 1999d) were used. The CAMx results were compared to the future year base case simulations and the NAAQS.

Throughout this report, we will refer to the August 31 – September 02, 1993 episode as the Beaumont-Port Arthur (BPA) episode. It will also be referred to as the September 1-2, 1993 episode as the majority of analyses excluded the first simulation day. The September 06-11, 1993 episode is referred to as the Houston-Galveston (HG) episode since it is used primarily for that area but the BPA area also experienced high ozone levels during this period. Hence this episode is also used to evaluate controls for the Beaumont-Port Arthur area. The HG episode is also referred to as the September 08-11, 1993 episode as the majority of analyses excluded the first two simulation days.

In the following sections we describe what these emission control scenarios consist of, how they were processed for CAMx, and the results obtained. Finally, we provide a discussion of the limitations of these model applications and make recommendations for future modeling studies.

## 2. METHODOLOGY

### 2.1 INTRODUCTION

In this study, control scenarios were evaluated by simulating the air quality under that scenario with the CAMx 1.13 air quality model, comparing the simulation results to previously simulated base cases, and assessing whether the predicted air quality is sufficiently improved to represent attainment of the National Ambient Air Quality Standards (NAAQS). To carry out such control scenario modeling requires preparation of gridded emission inventory files based on the control scenario within the domain modeled as well as initial and boundary condition files reflecting air quality and emission controls outside the modeling domain. Preparation of these files is discussed in the following sections.

### 2.2 CONTROL SCENARIO EMISSIONS PROCESSING

Control Scenarios are implemented in the emission inventory either by processing Control Packets with the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system (Coats and Houyoux, 1996; Houyoux and Vukovich, 1998) and applied to the base emission inputs or by applying factors to the gridded, model ready emission files. The latter approach is required for applying controls to mobile source emissions because they have not been provided as raw emission inputs.

To perform these scaling operations we use the program *geocuts*, which can be applied to each anthropogenic component of the inventory (Mobile, Area/Non-Road, Elevated Point, Low Point). The *geocuts* program allows not only the scaling of individual inventory species but may be used to limit the spatial extent of controls through the use of a "mask" file. For example, a number of the scenarios call for certain controls to be applied only in the 8-County HG area, so a mask file specifying that area is used when applying the control factors. Outside the masked area the emissions remain the same.

Once control factors are applied to the individual inventory components, either by SMOKE or *geocuts*, all non-elevated emissions are merged into a single gridded emission file. Finally, the emission inventory files for each control scenario are quality assured using statistical and graphical analysis techniques. These techniques are used to verify that the magnitude and locations of emission reductions are consistent with the description of the control scenario being processed.

## 2.3 INITIAL AND BOUNDARY CONDITIONS

To properly represent future year initial boundary conditions, a method that reflects emission reductions both inside and outside the modeling domain must be used. The TNRCC performed regional modeling for the year 2007 with CAMx on a much larger domain than used in this study, then extracted pollutant concentrations along this study's boundaries for use in the control scenario modeling. Two future year scenarios were modeled on the regional domain:

1. 2007\_tcas\_base3 – Base3 emissions in selected Central and East Texas counties (CETex).
2. 2007\_sip\_call – SIP call NOx reductions throughout the regional modeling domain.

Table 2-1 and 2-2 show the impact of these scenarios on boundary ozone for the September 1-2, 1993 and September 8-11, 1993 episode respectively.

**Table 2-1. Maximum Ozone Concentrations at Boundaries (ppb) for the September 1-2, 1993 Episode (all maxima at the Eastern edge of the COAST modeling domain)**

Scenario	930901	930902
2007_tcas_base3	120	100
2007_sip_call	116	100

**Table 2-2. Maximum Ozone Concentrations at Boundaries (ppb) for the September 8-11, 1993 Episode.**

Scenario	930908	930909	930910	930911
2007_tcas_base3	125	138	157	148
2007_sip_call	121	125	142	135

Only one set of initial and boundary conditions was used with each control scenario. Table 2-3 summarizes the association of each control scenario with the initial and boundary conditions used.

**Table 2-3. Summary of Initial and Boundary Conditions used with Control Scenarios.**

Scenario	Episode	Initial and Boundary Conditions
2007 Base	HG & BPA	2007_tcas_base3
5b	BPA	2007_sip_call
5b1	HG	2007_sip_call
5b2	HG	2007_sip_call
5b3	HG	2007_sip_call

### 3. EMISSION CONTROL SCENARIOS

#### 3.1 INTRODUCTION

The emissions control scenarios investigated in this study was applied to the **Future Year Base Case** for the appropriate ozone episode. While one control scenario was run for the September 1-2, 1993 (Beaumont-Port Arthur) episode, 3 control scenarios were run for the September 08-11, 1993 (Houston Galveston) episode. The future-year base-case includes the following Federal Measures (common to all scenarios). All apply nationally except as noted:

1. *On-road mobile sources:*
  - Heavy-duty diesel standards
  - Phase II reformulated gasoline (RFG) in H-G eight-county nonattainment area
  - Federal motor vehicle control program (FMVCP)
  - Texas motorists' choice inspection and maintenance (I/M) program in Harris county
  - National low emission vehicles (NLEV) standards
  - Federal low sulfur gasoline
  - Tier II vehicle emission standards
  
2. *Off-road mobile sources:*
  - Heavy duty diesel standards
  - Locomotive standards
  - Compression ignition standards for vehicles and equipment
  - Spark ignition standards for vehicles and equipment
  - Commercial marine vessel standards
  - Recreational marine standards

Section 3.2 and 3.3 describe scenarios with additional control measures (beyond the federal measures above) for the Beaumont-Port Arthur episode and Houston-Galveston episode respectively.

### 3.2 SCENARIOS FOR AUGUST 31 – SEPTEMBER 02

Additional control measures were applied to the future year base case to create one control scenario for the September 1-2, 1993 episode. This scenario is referred to as "Scenario 5b". The control measures applied in scenario 5b are summarized in Table 3-1.

**Table 3-1. Location and Type of Controls applied in Scenario 5b.**

<b>Point source Controls</b>				
<b>Geographical Area</b>	HG 8 county	BPA 3 county	Offshore	CETex <sup>1</sup>
<b>Controls</b>	TIER3	Lean Burn Engine	93basA	CETex point source controls <sup>2</sup>
<b>Mobile Source NOx Factors</b>				
<b>Geographical Area</b>	Harris County	HG 7 county	BPA	CETex
<b>Control Factor</b>	0.780	0.780	0.975	0.890
<b>Mobile VOC breakdown</b>				
<b>Geographical Area</b>	Harris County	HG 7 county	BPA	CETex
<b>Control Factor</b>	0.850	0.800	1.045	0.895
<b>Mobile Source Controls</b>				
<b>Geographical Area</b>	Harris County	HG 7 county	BPA	CETex
<b>Controls</b>	Calif RFG-Diesel; Clean Buses; TCMs; LowSulf; TIER2;I/M	Calif RFG-Diesel; Clean Buses; TCMs; LowSulf; TIER2	LowSulf; TIER2	Clean burning Gasoline; LowSulf; TIER2
<b>Nonroad and Area Source Controls</b>				
<b>Geographical Area</b>	HG 8 county	CETex	Offshore	
<b>Controls</b>	Calif-Diesel; 50% NOX cut	Clean burning Gasoline	93basA	

Emissions totals for the 2007 base case and this scenario are provided for September 1<sup>st</sup> in Table 3-2. Scenario 5b represents a 36.3 percent reduction of anthropogenic NOx and a 2.5 percent reduction in anthropogenic VOC emissions.

1 CETex: Selected Central and East Texas counties

2 CETex Point source controls = 50 % reduction to utility NOx and 30 % reduction to non-utility grandfathered sources

**Table 3-2. Comparison of the 2007 Base Case and Scenario 5b emissions.**

<b>NOX emissions totals (tons per day)</b>									
Scenario	TX elev pt	LA elev pt	OS elev pt	Area/Non-Road	Mobile	Low point	Biogenics	Total Anthropogenic	Percent Reduction
2007 Base	1090	118	32	492	429	162	124	2323	0.0%
5b	454	118	32	375	357	144	124	1480	36.3%
<b>VOC emissions totals (tons per day)</b>									
Scenario	TX elev pt	LA elev pt	OS elev pt	Area/Non-Road	Mobile	Low point	Biogenics	Total Anthropogenic	Percent Reduction
2007 Base	155	15	18	714	246	285	10566	1433	0.0%
5b	155	15	18	709	215	285	10566	1397	2.5%
<b>CO emissions totals (tons per day)</b>									
Scenario	TX elev pt	LA elev pt	OS elev pt	Area/Non-Road	Mobile	Low point	Biogenics	Total Anthropogenic	Percent Reduction
2007 Base	615	74	7	3091	2271	54	0	6112	0.0%
5b	615	74	7	3091	2271	54	0	6112	0.0%

### 3.3 SCENARIOS FOR SEPTEMBER 06 - 11

Additional control measures were applied to the future year base case to create three control scenarios for the September 8-11, 1993 episode. These scenarios are referred to as 5b1, 5b2 and 5b3. While the mobile, non-road and area source reductions are the same as those for Scenario 5b, the additional reductions here are only in emissions from point sources. The control measures applied here are summarized in Table 3-3 and 3-4.

**Table 3-3. Geographic Breakdown of Point Source control**

Point source Controls				
Control	HG 8 county	BPA 3 county	Offshore	CETex <sup>3</sup>
5b1	TIER3	Lean Burn Engine; TIER1	93basA	CETex point source controls <sup>4</sup>
5b2	TIER3	Lean Burn Engine; TIER2	93basA	CETex point source controls
5b3	TIER3	Lean Burn Engine; TIER3	93basA	CETex point source controls

**Table 3-4. Location and Type of Control for Mobile, Area and Non-road**

Mobile Source NOx Factors				
Geographical Area	Harris County	HG 7 county	BPA	CETex
Control Factor	0.780	0.780	0.975	0.890
Mobile VOC breakdown				
Geographical Area	Harris County	HG 7 county	BPA	CETex
Control Factor	0.850	0.800	1.045	0.895
Mobile Source Controls				
Geographical Area	Harris County	HG 7 county	BPA	CETex
Controls	Calif RFG-Diesel; Clean Buses; TCMS; LowSulf; TIER2;I/M	Calif RFG-Diesel; Clean Buses; TCMS; LowSulf; TIER2	LowSulf; TIER2	Clean burning Gasoline; LowSulf; TIER2
Nonroad and Area Source Controls				
Geographical Area	HG 8 county	CETex	Offshore	
Controls	Calif-Diesel; 50% NOX cut	Clean burning Gasoline	93basA	

3 CETex: Selected Central and East Texas counties

4 CETex Point source controls = 50 % reduction to utility NOx and 30 % reduction to non-utility grandfathered sources

None of the control scenarios investigated include reductions in Carbon Monoxide (CO) but the 2007 baseline emissions are provided in Table 3-5. The effect of each of the control scenarios on component and total emissions is shown in Table 3-6 (for NOx) and Table 3-7 (for VOC). These values were obtained from the model-ready gridded emission files for September 8 of the future year base case. While there are day-to-day fluctuations due to day specific environmental adjustments, these values are typical of weekday emissions during episodic conditions. The maximum reduction in NOx emissions was 39.9 % in the case of Scenario 5b3 and that in VOC emissions was 2.6% in all three scenarios for this episode.

**Table 3-5. CO Emissions (tons per day)**

Scenario	Texas Elevated Point	Louisiana Elevated Point	Offshore Elevated Point	Area & NonRoad	Mobile	Low Point	Biogenic	Total Anthropogenic	Anthropogenic Reduction	Total Emissions	Total Reduction
07basA	615	74	7	2971	2275	54	0	5996	0.0%	5996	0.0%

**Table 3-6. NOx Emissions (tons per day)**

Scenario	Texas Elevated Point	Louisiana Elevated Point	Offshore Elevated Point	Area & NonRoad	Mobile	Low Point	Biogenic	Total Anthropogenic	Anthropogenic Reduction	Total Emissions	Total Reduction
07basA	1078	118	32	491	458	162	118	2339	0.0%	2457	0.0%
5b1	412	118	32	374	383	144	118	1463	37.5%	1581	35.7%
5b2	361	118	32	374	383	143	118	1411	39.7%	1529	37.8%
5b3	356	118	32	374	383	143	118	1406	39.9%	1524	38.0%

**Table 3-7. VOC Emissions (tons per day)**

Scenario	Texas Elevated Point	Louisiana Elevated Point	Offshore Elevated Point	Area & NonRoad	Mobile	Low Point	Biogenic	Total Anthropogenic	Anthropogenic Reduction	Total Emissions	Total Reduction
07basA	153	15	18	699	267	285	10034	1437	0.0%	11471	0.0%
5b1	153	15	18	694	234	285	10034	1399	2.6%	11433	0.3%
5b2	153	15	18	694	234	285	10034	1399	2.6%	11433	0.3%
5b3	153	15	18	694	234	285	10034	1399	2.6%	11433	0.3%

## 4. RESULTS

### 4.1 INTRODUCTION

The CAMx simulations for these control scenarios were analyzed by statistical and graphical methods. We first calculate a series of metrics, which include the peak ozone concentration in the modeling domain for each day, the peak ozone concentration and the number of cells above the NAAQS for 1-hour ozone averages, by day, for the Houston-Galveston and Beaumont-Port Arthur non-attainment areas. The metrics are compared with the 2007 Base Case results to quantify the effectiveness of each control scenario. Finally, we generate color and gray-scale contour plots showing spatially the daily peak ozone concentrations by grid cell and the difference in daily peak ozone between the 2007 Base Case and each control scenario.

### 4.2 AUGUST 31 - SEPTEMBER 02, 1993 EPISODE

#### 4.2.1 Statistical Analyses

The full set of metrics calculated for scenario 5b are provided in the Appendix A. In this section key metrics are presented and discussed. The daily peak ozone concentrations anywhere in the modeling domain are summarized in Table 4-1. Each of the two days presented in this table had observed ozone exceeding the NAAQS. In the 1993 Base Case simulation these peaks were under-predicted by 2 to 6 ppb. The effects of growth to the year 2007 and the introduction of federal controls are shown in the 2007 Base Case. For control scenario 5b, this table shows the predicted impact on peak ozone concentrations. Under scenario 5b the domain peak ozone concentration is 132 ppb on September 1.

**Table 4-1. Domain Daily Maximum 1-hr Ozone Concentrations (ppb)**

Scenario	Date	
	09/01	09/02
Observed	164	139
1993 Base Case	162	133
2007 Base Case	136	121
5b	132	115

The daily peak ozone concentrations and the number of cells with concentrations above 124 ppb (areal exposure) for the three-county Beaumont-Port Arthur non-attainment area (BPA NAA) are

presented in Table 4-2. In this table we see that the BPA NAA is in attainment of the NAAQS on both days.

**Table 4-2. Area Specific Metrics for the 3-county Beaumont-Port Arthur non-attainment area**

		09/01	09/02
<b>Daily Peak Ozone (ppb)</b>	<b>2007 Base</b>	98	119
	<b>5b</b>	97	113
<b>Number of Cells above 124 ppb</b>	<b>2007 Base</b>	0	0
	<b>5b</b>	0	0

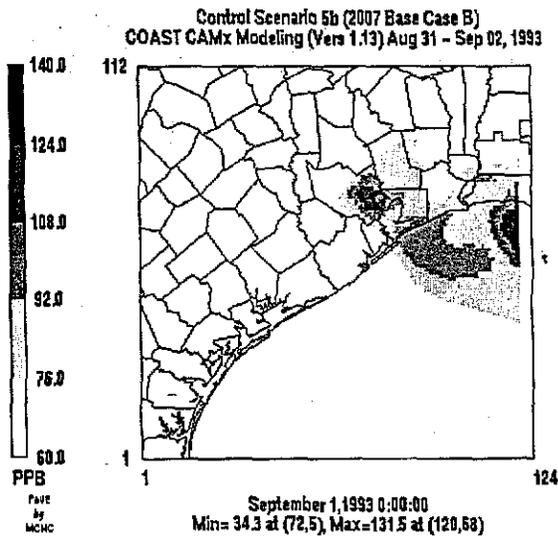
### 4.2.2 Graphical Analyses

Figure 4-1 has four plots on it with the daily maximum ground level ozone concentrations for scenario 5b presented on the left side and the corresponding difference plot showing the change in ozone from the 2007 base case. The upper half of the figure is for September 1<sup>st</sup> and the bottom half is for September 2<sup>nd</sup>. The daily maximum ozone plots show concentrations in five gray shades, with areas exceeding the NAAQS in black. On the difference plots the negative values represent decreases in ozone due to the control scenario and are separated into four gray shades:

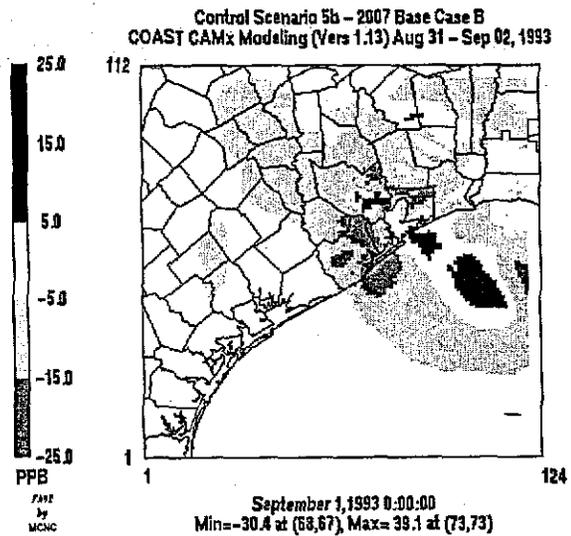
- White – Little or no change (within 5 ppb of the 2007 base case)
- Light Gray – 5 to 15 ppb decreases
- Medium Gray – Decreases in excess of 15 ppb
- Black – Increases of more than 5 ppb (“disbenefit” areas)

These figures are consistent with the preceding metrics and show that the BPA area shows attainment under this scenario. The only areas not attaining the NAAQS are 6 cells in the HG area and a group of cells along the eastern boundary. The latter is not unexpected since boundary ozone concentrations adjacent to this area range from 94 to 116 ppb to begin with. A large area of disbenefit extending from Houston to offshore on September 1<sup>st</sup> is evident in the difference plots. This is indicative of offshore flow carrying NOx from the HG area offshore where it titrates the ozone being advected from the eastern boundary. This phenomenon is seen to a lesser extent and also occurs downwind (offshore) of the BPA area on September 2<sup>nd</sup>.

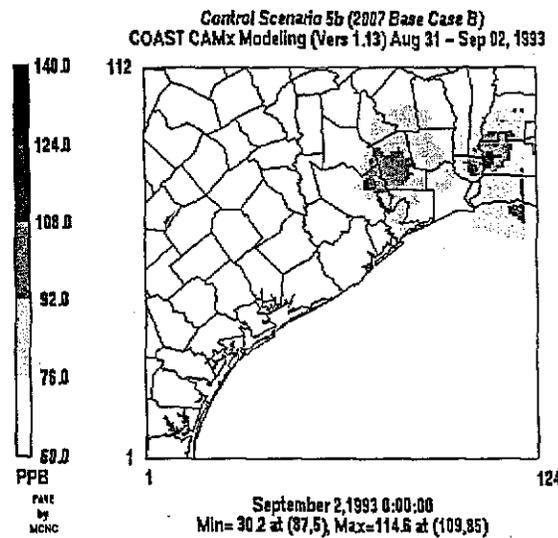
**Daily Max O3 Conc (ppb) : Layer 1**



**Daily Max O3 Difference : Layer 1**



**Daily Max O3 Conc (ppb) : Layer 1**



**Daily Max O3 Difference : Layer 1**

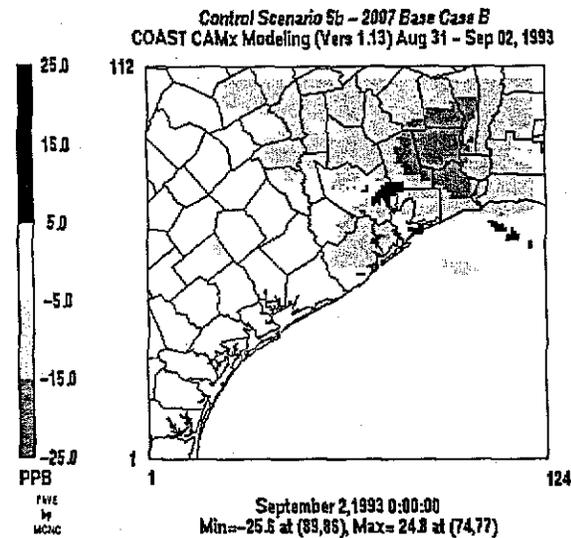


Figure 4-1. Daily Peak Ozone (left) and Difference from the 2007 Base Case (right) by day for Control Scenario 5b (September 1 and 2).

### 4.3 SEPTEMBER 06 -11, 1993 EPISODE

#### 4.3.1 Statistical Analyses

The full set of metrics that were calculated for each scenario are provided in Appendix B. In this section some of the key metrics are presented and discussed. The daily peak ozone concentrations anywhere in the modeling domain are summarized in Table 4-3. Each of the four days presented in this table had observed ozone exceeding the NAAQS. In the 1993 Base Case simulation these peaks were under-predicted on September 8, 9, and 11. The model over-predicts on September 10. The effects of growth to the year 2007 and the introduction of federal controls are shown in the 2007 Base Case. For each control scenario of state and local controls, this table shows the predicted impact on peak ozone concentrations. While all 3 scenarios show similar responses, scenario 5b3, which represents the largest emission reductions, generally has the lowest ozone concentrations. Though the controls in these simulations seem to reduce ozone concentrations in the 3-county Beaumont-Port Arthur area, the domain-wide peak does not seem to be decrease much from these controls.

**Table 4-3. Domain-wide Daily Maximum 1-hr Ozone Concentrations (ppb)**

SCENARIO	930908	930909	930910	930911
<b>OBSERVED</b>	214.0	195.0	162.0	189.0
1993 Base Case	181.9	179.7	177.8	185.7
2007 Base Case	171.1	166.0	164.9	170.6
5b1	159.9	147.9	153.1	146.2
5b2	159.8	147.9	153.1	146.0
5b3	159.8	147.9	153.1	146.0

The daily peak ozone concentrations and the number of cells with concentrations above 124 ppb (areal exposure) for the 3-county Beaumont-Port Arthur non-attainment area (BPA NAA) are provided in Tables 4-4 and 4-5.

**Table 4-4. Daily Peak Ozone (ppb) for the 3-county Beaumont-Port non-attainment area by date and control scenario.**

Scenario	Date (YYMMDD)			
	930908	930909	930910	930911
07basA	150	126	142	147
5b1	133	111	129	136
5b2	121	101	117	123
5b3	121	100	116	121

**Table 4-5. Number of Cells in the 3-county Beaumont-Port Arthur non-attainment area with concentrations greater than 124 ppb by date and control scenario.**

Scenario	Date (YYMMDD)			
	930908	930909	930910	930911
07basA	81	2	59	151
5b1	10	0	8	59
5b2	0	0	0	0
5b3	0	0	0	0

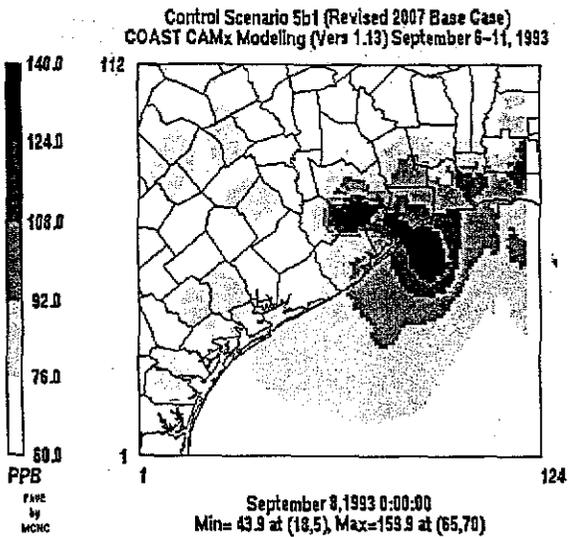
### 4.3.2 Graphical Analyses

The graphical analyses of the 3 control scenarios investigated for this episode are presented in Figures 4-2a, 4-2b, 4-3a, 4-3b, 4-4a and 4-4b with each figure representing a single scenario and covering two pages and presented in order beginning with scenario 5b1 and ending with scenario 5b3. The first page of each figure is the “a” part of the figure and covers September 8 and 9. The second page of each figure is the “b” part of the figure and covers September 10 and 11. Each page has four plots on it with the daily maximum ground level ozone concentrations for the scenario presented on the left side and the corresponding difference plot showing the change in ozone from the 2007 base case. The daily maximum ozone plots show concentrations in five gray shades, with areas exceeding the NAAQS in black. On the difference plots the negative values represent decreases in ozone due to the control scenario and are separated into four gray shades:

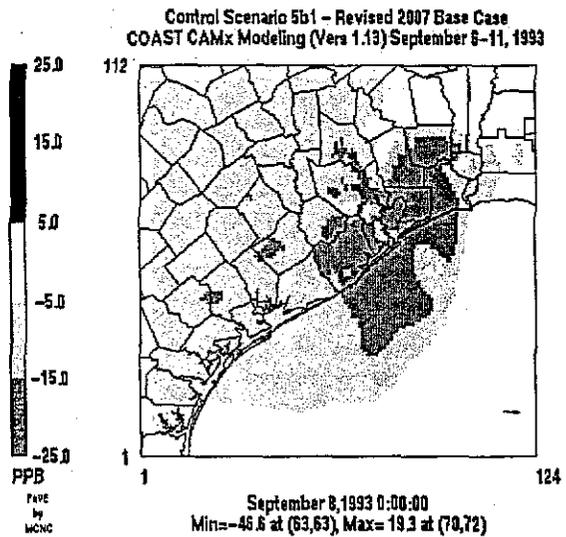
- White – Little or no change (within 5 ppb of the 2007 base case)
- Light Gray – 5 to 15 ppb decreases
- Medium Gray – Decreases in excess of 15 ppb
- Black – Increases of more than 5 ppb (“disbenefit” areas)

While there are obviously differences in the magnitudes of peak ozone, and some differences in the location where the peaks are and where benefits are seen between scenarios, there are many similarities that should be discussed. First, while Scenario 5b1 shows attainment for the BPA area only on the 9<sup>th</sup>, both 5b2 and 5b3 show attainment in the BPA area for all 4 days of the episode. Second, none of the scenarios run for this episode predict attainment of the NAAQS for the HG area. Third, there are several “features” in the ozone patterns that should be explored in the context of base case model performance and the meteorological inputs to CAMx.

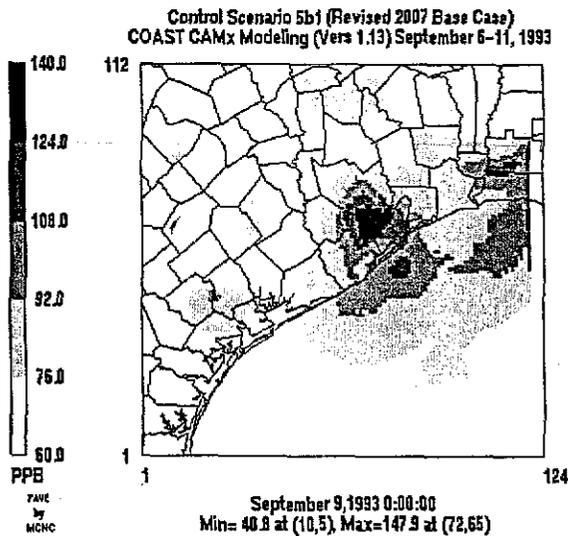
**Daily Max O3 Conc (ppb) : Layer 1**



**Daily Max O3 Difference : Layer 1**



**Daily Max O3 Conc (ppb) : Layer 1**



**Daily Max O3 Difference : Layer 1**

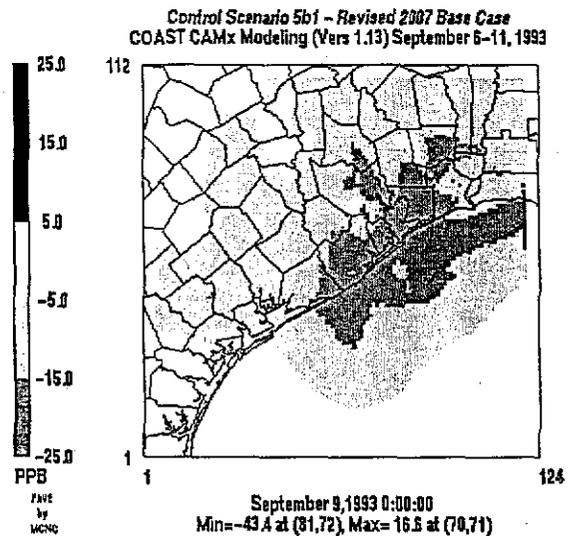


Figure 4-2a. Daily Peak Ozone (left) and Difference from the 2007 Base Case (right) by day for Control Scenario 5b1 (September 8 and 9).

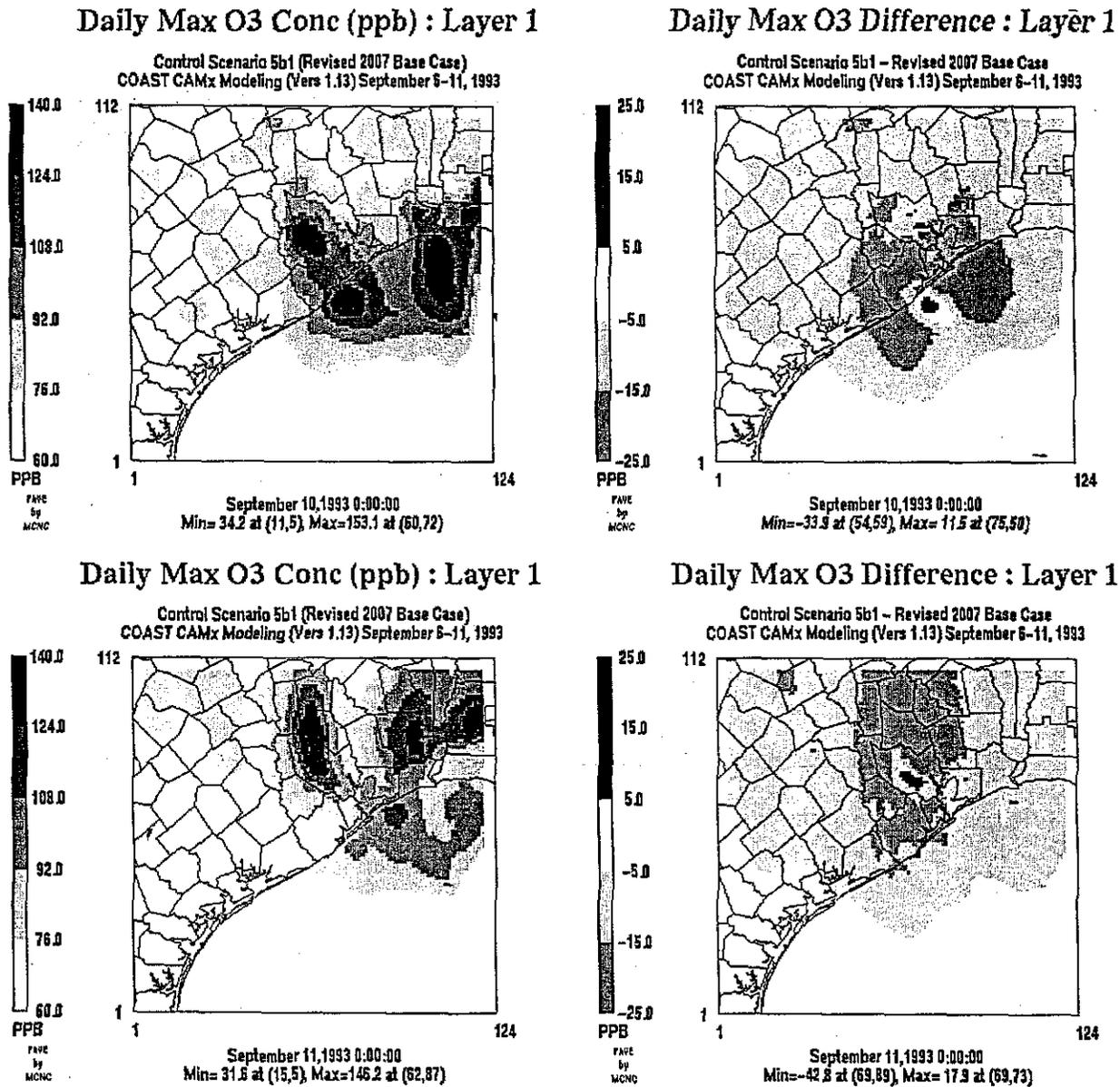


Figure 4-2b. Daily Peak Ozone (left) and Difference from the 2007 Base Case (right) by day for Control Scenario 5b1 (September 10 and 11).

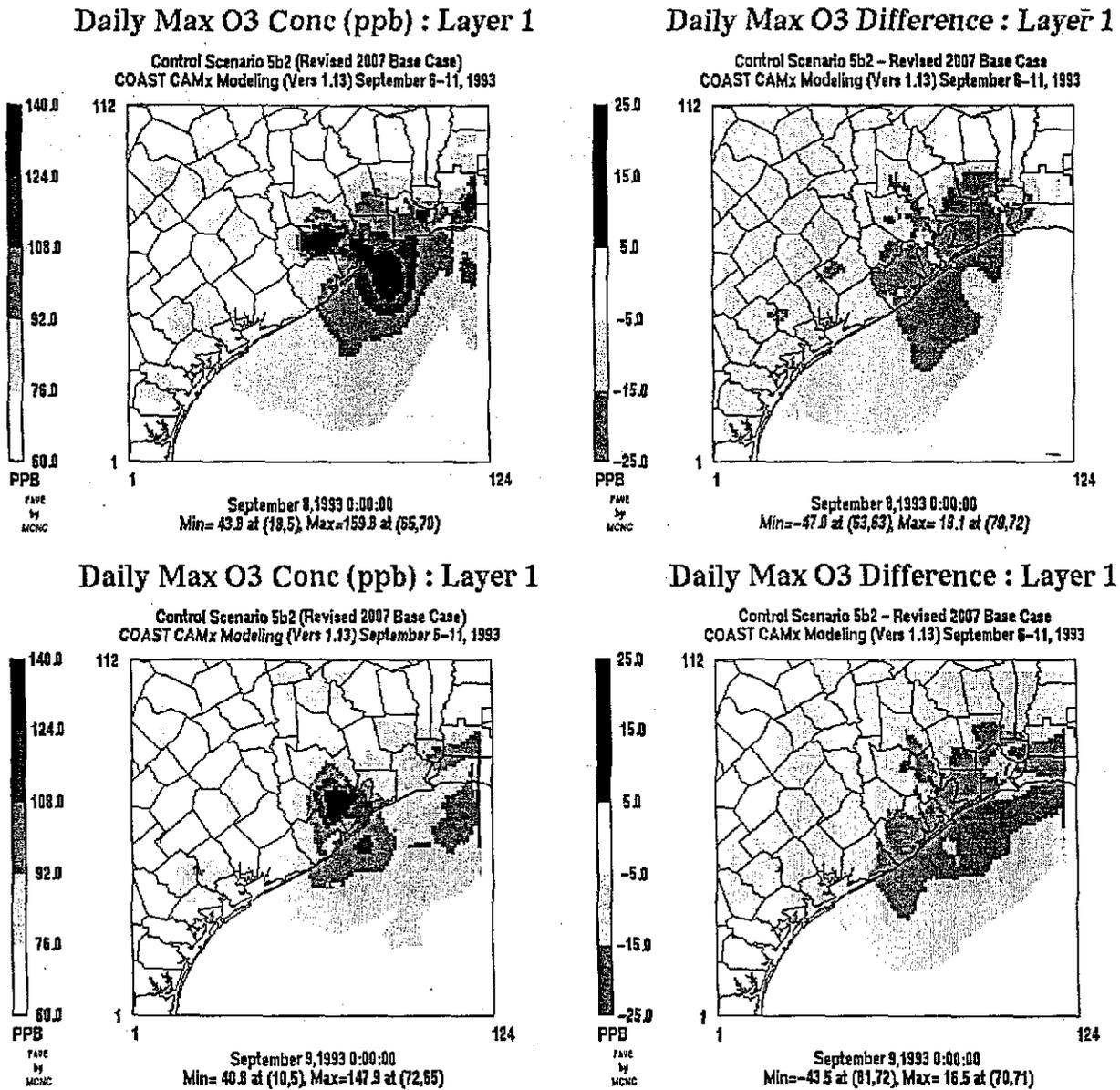


Figure 4-3a. Daily Peak Ozone (left) and Difference from the 2007 Base Case (right) by day for Control Scenario 5b2 (September 8 and 9).

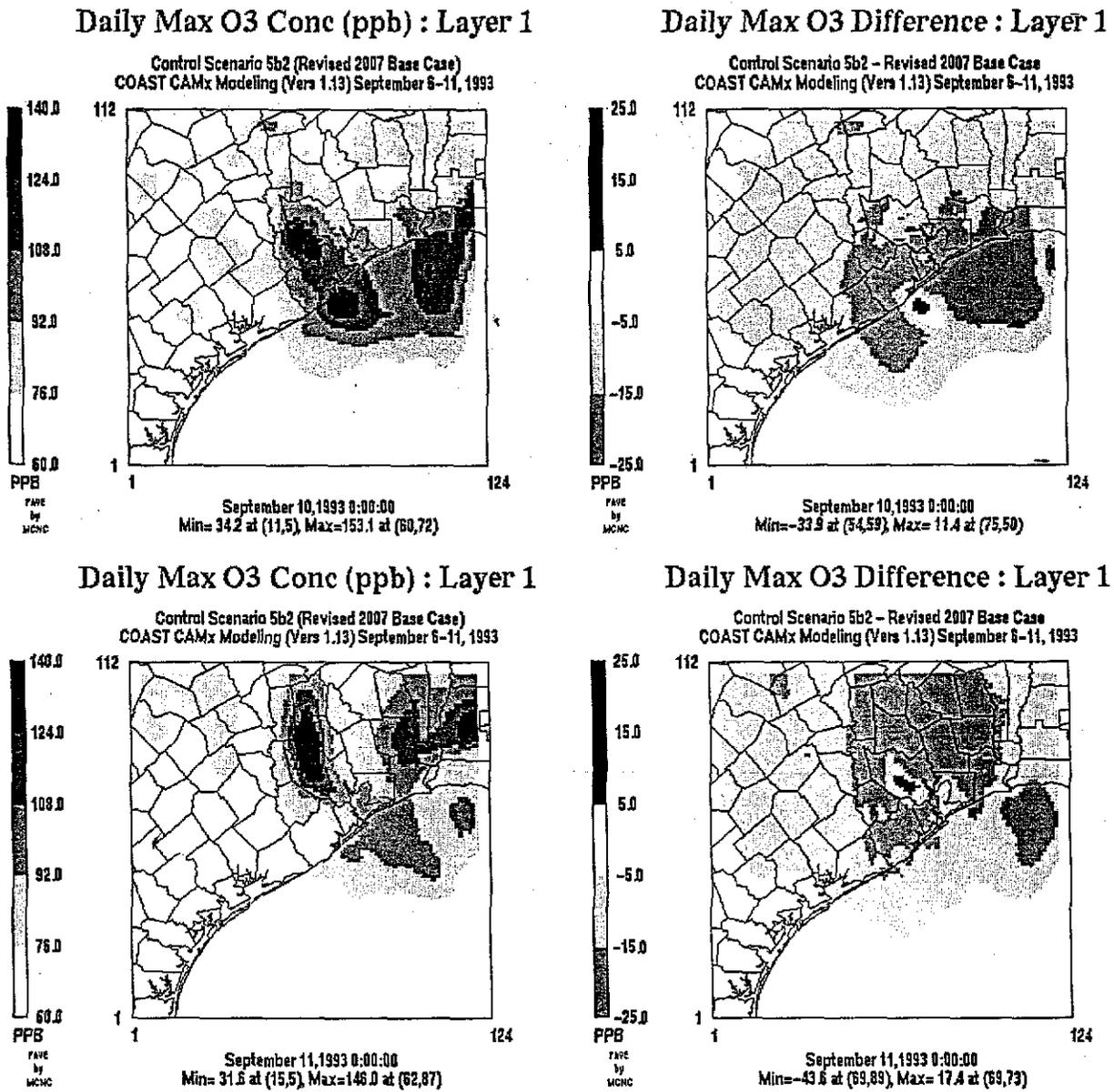
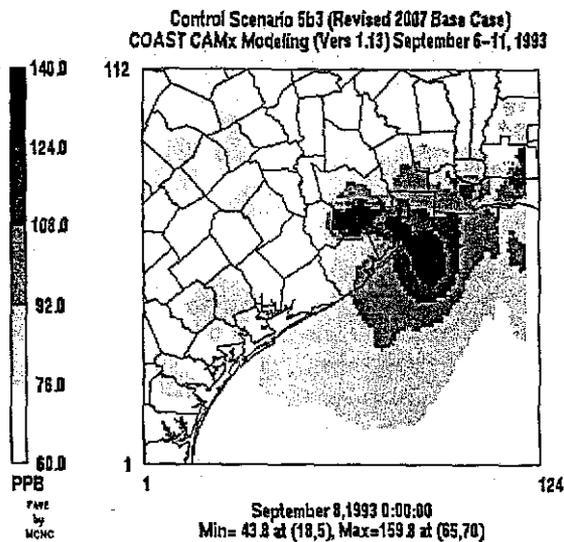
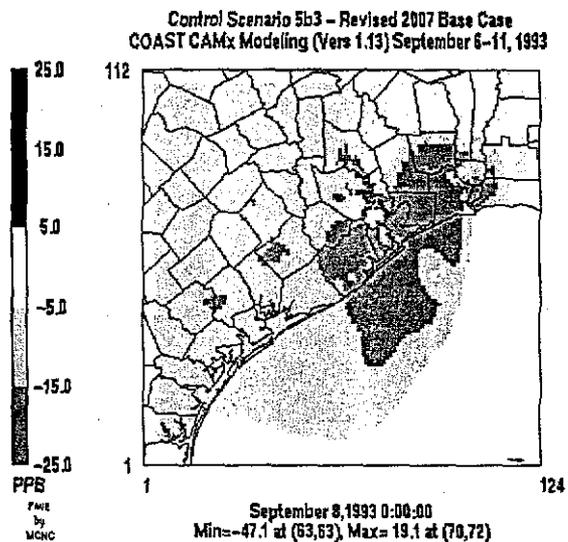


Figure 4-3b. Daily Peak Ozone (left) and Difference from the 2007 Base Case (right) by day for Control Scenario 5b2 (September 10 and 11).

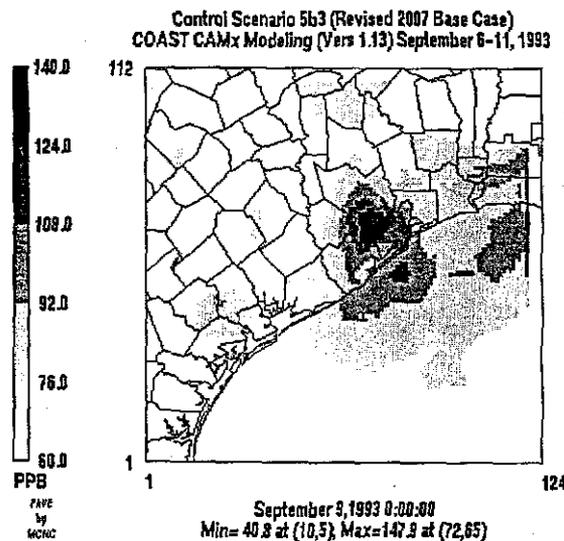
**Daily Max O3 Conc (ppb) : Layer 1**



**Daily Max O3 Difference : Layer 1**



**Daily Max O3 Conc (ppb) : Layer 1**



**Daily Max O3 Difference : Layer 1**

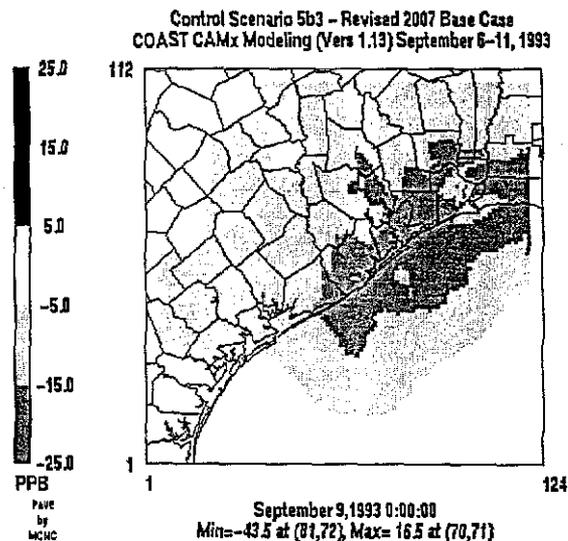
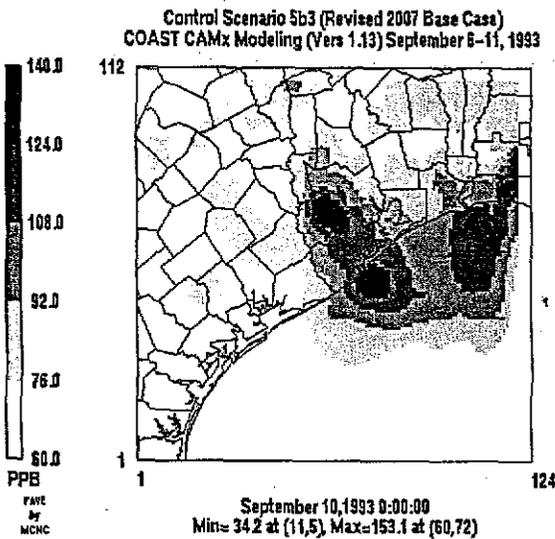
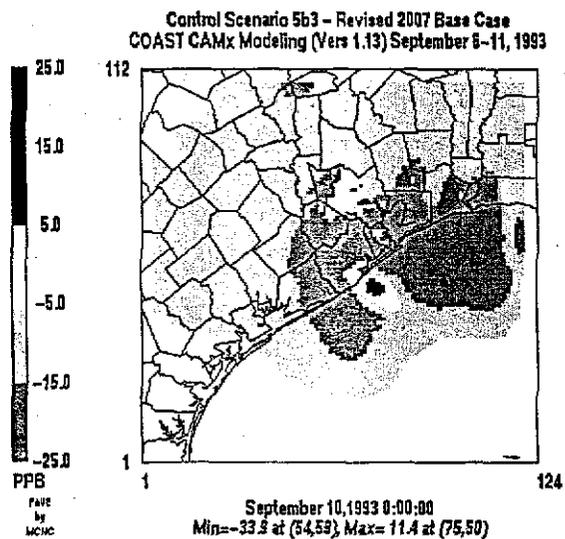


Figure 4-4a. Daily Peak Ozone (left) and Difference from the 2007 Base Case (right) by day for Control Scenario 5b3 (September 8 and 9).

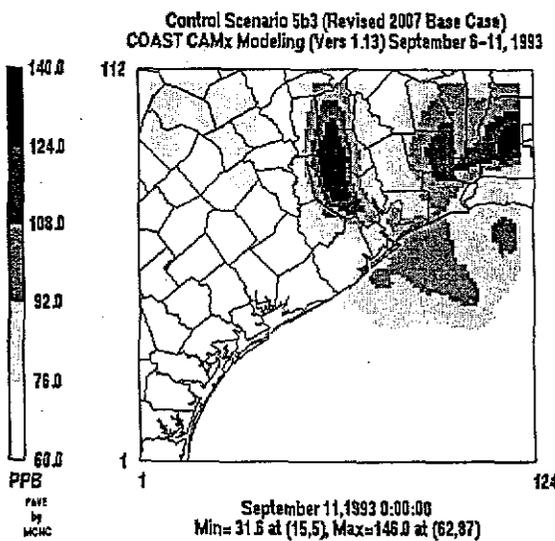
**Daily Max O3 Conc (ppb) : Layer 1**



**Daily Max O3 Difference : Layer 1**



**Daily Max O3 Conc (ppb) : Layer 1**



**Daily Max O3 Difference : Layer 1**

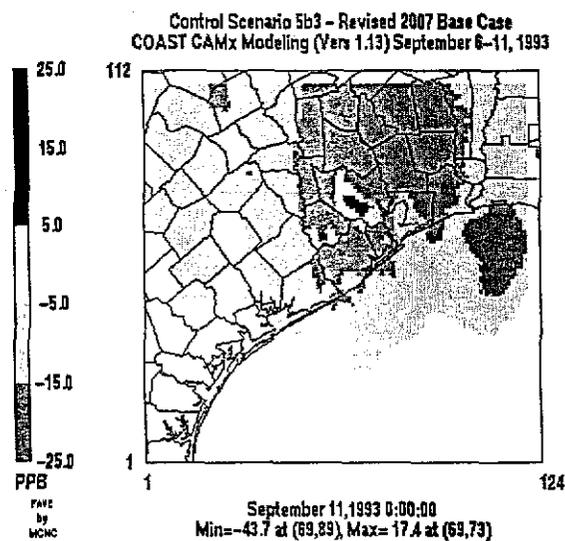


Figure 4-4b. Daily Peak Ozone (left) and Difference from the 2007 Base Case (right) by day for Control Scenario 5b3 (September 10 and 11).

## **5. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS**

One emission control scenario for the August 31 – September 02, 1993 and 3 emissions control scenarios for the September 06-11, 1993 COAST episode were processed and simulated. 3 out of 4 scenarios from the above demonstrated attainment in the Beaumont-Port Arthur area but not in the Houston-Galveston area. From an analysis of boundary conditions, model performance, and the meteorological inputs to CAMx, it appears that high ozone areas that are most resistant to emission control may be significantly, and possibly excessively, influenced by the boundary conditions derived from regional CAMx modeling and the meteorological inputs derived from SAIMM simulations. As a result, it may be easier to attain the NAAQS in reality than implied by this modeling study.

## 6. REFERENCES

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- MCNC, 1999d: Evaluation of CAMx Base Case Model Performance for the August 31 – September 2, 1993 COAST Episode, draft report to TNRCC, MCNC, RTP, NC, May 27, 1999.
- MCNC, 1999e: Modeling to Confirm the VOC/NOx Directional Guidance Established for the Houston-Galveston Area, draft report to TNRCC, MCNC, RTP, NC, May 19, 1999.

## **7. APPENDICES**

### **7.1 APPENDIX A: TABLES OF METRICS FOR THE AUGUST 31 – SEPTEMBER 02 EPISODE**

OBJECTIVE MEASURES: Beaumont-Port Arthur

DOMAIN NAME: 07Bscen5b\_vs\_07basB

BASE : 07basB

CONTROL : 07Bscen5b

O3	930831	930901	930902	Total
Peak 1 Hour (ppb)	91	97	113	113
Total # of Grid Cells				
> 80 (ppb)	24	88	155	267
>100 (ppb)	0	0	17	17
>124 (ppb)	0	0	0	0
>140 (ppb)	0	0	0	0
>160 (ppb)	0	0	0	0
Total hours over threshold				
> 80 (ppb)	41	235	371	647
>100 (ppb)	0	0	24	24
>124 (ppb)	0	0	0	0
>140 (ppb)	0	0	0	0
>160 (ppb)	0	0	0	0
Weighted Sum of Differences: $SUM(Diff*Base)/SUM(Base)$				
> 60 (ppb)	-16.4	-10.5	-23.8	-17.4
> 80 (ppb)	-18.4	-12.0	-25.2	-20.7
>100 (ppb)	0.0	0.0	-27.6	-27.6
>120 (ppb)	0.0	0.0	0.0	0.0
Average difference where Base is above				
> 80 (ppb)	-18.4	-12.1	-24.9	-20.3
>100 (ppb)	0.0	0.0	-27.6	-27.6
>120 (ppb)	0.0	0.0	0.0	0.0
Average difference where Control remains above				
> 80 (ppb)	-5.8	-7.9	-20.1	-14.0
>100 (ppb)	0.0	0.0	-16.9	-16.9
>120 (ppb)	0.0	0.0	0.0	0.0
Number of cells where Base is above and Control is below				
> 80 (ppb)	170	132	340	642
>100 (ppb)	0	0	125	125
>120 (ppb)	0	0	0	0
Mxdif (Cells in Subdomain)	440	440	440	1320
<= -4 (ppb)	366	424	307	1097
<= -12 (ppb)	242	139	401	782
<= -28 (ppb)	15	0	131	146
-12 to -6 (ppb)	116	248	36	400
-6 to -4 (ppb)	23	37	1	61
-4 to -2 (ppb)	39	14	2	55
-2 to 2 (ppb)	16	2	0	18
2 to 4 (ppb)	2	0	0	2
4 to 6 (ppb)	0	0	0	0
6 to 12 (ppb)	2	0	0	2
>= 12 (ppb)	0	0	0	0
>= 4 (ppb)	2	0	0	2
# Grid Cells w/ < -12 (ppb) Decr and Base is:				
>= 80 (ppb)	141	87	390	618
>= 100 (ppb)	0	0	126	126
>= 120 (ppb)	0	0	0	0
# Grid Cells w/ < -4 (ppb) Decr and Base is:				
>= 80 (ppb)	175	171	392	738
>= 100 (ppb)	0	0	127	127
>= 120 (ppb)	0	0	0	0
# Grid Cells w/ > 4 (ppb) Incr and Control is:				
>= 80 (ppb)	2	0	0	2
>= 100 (ppb)	0	0	0	0
>= 120 (ppb)	0	0	0	0
Peak 8 Hour (ppb)	75	78	84	84
Total # of Grid Cells				
> 60 (ppb)	157	158	438	753
> 84 (ppb)	0	0	1	1
>100 (ppb)	0	0	0	0
>120 (ppb)	0	0	0	0
>140 (ppb)	0	0	0	0

OBJECTIVE MEASURES: Houston-Galveston

DOMAIN NAME: 07Bscen5b\_vs\_07basB

BASE : 07basB

CONTROL : 07Bscen5b

O3	930831	930901	930902	Total
Peak 1 Hour (ppb)	100	128	106	128
Total # of Grid Cells				
> 80 (ppb)	223	431	284	938
>100 (ppb)	3	98	67	168
>124 (ppb)	0	6	0	6
>140 (ppb)	0	0	0	0
>160 (ppb)	0	0	0	0
Total hours over threshold				
> 80 (ppb)	882	1414	876	3172
>100 (ppb)	3	225	82	310
>124 (ppb)	0	6	0	6
>140 (ppb)	0	0	0	0
>160 (ppb)	0	0	0	0
Weighted Sum of Differences: $SUM(Diff*Base)/SUM(Base)$				
> 60 (ppb)	-1.3	-13.9	-13.0	-11.4
> 80 (ppb)	-2.0	-13.6	-16.4	-13.0
>100 (ppb)	0.0	-15.9	-21.7	-19.1
>120 (ppb)	0.0	-17.1	-28.3	-18.6
Average difference where Base is above				
> 80 (ppb)	-1.8	-13.5	-15.5	-12.5
>100 (ppb)	0.0	-15.9	-21.5	-19.0
>120 (ppb)	0.0	-17.1	-28.3	-18.6
Average difference where Control remains above				
> 80 (ppb)	6.2	-7.7	-13.9	-7.5
>100 (ppb)	0.0	-4.8	-2.5	-4.2
>120 (ppb)	0.0	0.0	0.0	0.0
Number of cells where Base is above and Control is below				
> 80 (ppb)	68	378	167	613
>100 (ppb)	0	102	167	269
>120 (ppb)	0	20	3	23
Mxdif (Cells in Subdomain)	1513	1513	1513	4539
<= -4 (ppb)	804	1356	1278	3438
<= -12 (ppb)	232	964	619	1815
<= -28 (ppb)	0	24	42	66
-12 to -6 (ppb)	357	369	569	1295
-6 to -4 (ppb)	215	47	132	394
-4 to -2 (ppb)	165	27	33	225
-2 to 2 (ppb)	207	49	72	328
2 to 4 (ppb)	31	14	14	59
4 to 6 (ppb)	28	8	22	58
6 to 12 (ppb)	89	17	33	139
>= 12 (ppb)	189	18	19	226
>= 4 (ppb)	306	43	74	423
# Grid Cells w/ <-12 (ppb) Decr and Base is:				
>= 80 (ppb)	49	413	257	719
>= 100 (ppb)	0	104	158	262
>= 120 (ppb)	0	14	3	17
# Grid Cells w/ < -4 (ppb) Decr and Base is:				
>= 80 (ppb)	90	563	317	970
>= 100 (ppb)	0	130	174	304
>= 120 (ppb)	0	20	3	23
# Grid Cells w/ > 4 (ppb) Incr and Control is:				
>= 80 (ppb)	144	40	42	226
>= 100 (ppb)	34	29	13	76
>= 120 (ppb)	0	7	0	7
Peak 8 Hour (ppb)	91	99	87	99
Total # of Grid Cells				
> 60 (ppb)	400	645	487	1532
> 84 (ppb)	42	92	24	158
>100 (ppb)	0	0	0	0
>120 (ppb)	0	0	0	0
>140 (ppb)	0	0	0	0

## **7.2 APPENDIX B: TABLES OF METRICS FOR THE SEPTEMBER 06 -11 EPISODE**

OBJECTIVE MEASURES: Beaumont-Port Arthur  
 DOMAIN NAME: 07scen5b1\_vs\_07basa

BASE : 07basa

CONTROL : 07scen5b1

O3	930906	930907	930908	930909	930910	930911	Total
Peak 1 Hour (ppb)	56	108	133	111	129	136	136
Total # of Grid Cells							
> 80 (ppb)	0	73	360	238	250	424	1345
>100 (ppb)	0	19	130	14	106	340	609
>124 (ppb)	0	0	10	0	8	59	77
>140 (ppb)	0	0	0	0	0	0	0
>160 (ppb)	0	0	0	0	0	0	0
Total hours over threshold							
> 80 (ppb)	0	552	2734	922	1663	3208	9079
>100 (ppb)	0	55	509	58	441	1256	2319
>124 (ppb)	0	0	19	0	16	81	116
>140 (ppb)	0	0	0	0	0	0	0
>160 (ppb)	0	0	0	0	0	0	0
Weighted Sum of Differences: SUM(Diff*Base)/SUM(Base)							
> 60 (ppb)	0.0	-3.6	-16.3	-13.6	-9.9	-9.8	-11.0
> 80 (ppb)	0.0	-3.8	-17.0	-14.3	-10.5	-9.8	-12.3
>100 (ppb)	0.0	-3.1	-18.4	-15.3	-12.0	-10.2	-13.5
>120 (ppb)	0.0	0.0	-21.7	-13.9	-12.6	-10.5	-14.0
Average difference where Base is above							
> 80 (ppb)	0.0	-3.8	-16.4	-14.2	-10.2	-9.7	-12.0
>100 (ppb)	0.0	-3.1	-18.1	-15.4	-11.9	-10.2	-13.4
>120 (ppb)	0.0	0.0	-21.5	-13.9	-12.6	-10.5	-13.9
Average difference where Control remains above							
> 80 (ppb)	0.0	-3.6	-16.6	-13.9	-10.2	-9.8	-12.1
>100 (ppb)	0.0	-2.7	-16.0	-13.0	-11.8	-10.1	-11.5
>120 (ppb)	0.0	0.0	-13.0	0.0	-12.7	-10.1	-10.8
Number of cells where Base is above and Control is below							
> 80 (ppb)	0	35	36	161	111	16	359
>100 (ppb)	0	5	182	107	57	43	394
>120 (ppb)	0	0	87	3	58	114	262
Mxdif (Cells in Subdomain)							
<= -4 (ppb)	440	440	440	440	440	440	2640
<= -12 (ppb)	0	155	381	418	405	433	1792
<= -28 (ppb)	0	0	262	307	149	74	792
<= -28 (ppb)	0	0	31	0	0	0	31
-12 to -6 (ppb)	0	14	99	102	222	321	758
-6 to -4 (ppb)	0	141	51	9	34	38	273
-4 to -2 (ppb)	374	256	25	8	26	4	693
-2 to 2 (ppb)	66	28	3	8	9	3	117
2 to 4 (ppb)	0	1	0	5	0	0	6
4 to 6 (ppb)	0	0	0	1	0	0	1
6 to 12 (ppb)	0	0	0	0	0	0	0
>= 12 (ppb)	0	0	0	0	0	0	0
>= 4 (ppb)	0	0	0	1	0	0	1
# Grid Cells w/ < -12 (ppb) Decr and Base is:							
>= 80 (ppb)	0	0	259	306	149	74	788
>= 100 (ppb)	0	0	225	102	94	71	492
>= 120 (ppb)	0	0	75	3	52	30	160
# Grid Cells w/ < -4 (ppb) Decr and Base is:							
>= 80 (ppb)	0	41	376	394	341	433	1585
>= 100 (ppb)	0	3	303	121	160	378	965
>= 120 (ppb)	0	0	103	3	73	201	380
# Grid Cells w/ > 4 (ppb) Incr and Control is:							
>= 80 (ppb)	0	0	0	0	0	0	0
>= 100 (ppb)	0	0	0	0	0	0	0
>= 120 (ppb)	0	0	0	0	0	0	0
Peak 8 Hour (ppb)	52	101	111	106	118	113	118
Total # of Grid Cells							
> 60 (ppb)	0	357	440	440	440	440	2117
> 84 (ppb)	0	40	212	54	137	367	810
>100 (ppb)	0	6	58	5	51	137	257
>120 (ppb)	0	0	0	0	0	0	0
>140 (ppb)	0	0	0	0	0	0	0

OBJECTIVE MEASURES: Houston-Galveston

DOMAIN NAME: 07scen5b1\_vs\_07basA

BASE : 07basA

CONTROL : 07scen5b1

O3	930906	930907	930908	930909	930910	930911	Total
Peak 1 Hour (ppb)	54	111	159	147	153	146	159
Total # of Grid Cells							
> 80 (ppb)	0	399	965	802	1183	1094	4443
>100 (ppb)	0	91	493	333	641	436	1994
>124 (ppb)	0	0	161	87	122	157	527
>140 (ppb)	0	0	44	18	26	29	117
>160 (ppb)	0	0	0	0	0	0	0
Total hours over threshold							
> 80 (ppb)	0	2140	6667	6096	8775	6868	30546
>100 (ppb)	0	247	2154	1640	2699	1586	8326
>124 (ppb)	0	0	342	236	271	348	1197
>140 (ppb)	0	0	77	27	39	36	179
>160 (ppb)	0	0	0	0	0	0	0
Weighted Sum of Differences: SUM(Diff*Base)/SUM(Base)							
> 60 (ppb)	-7.5	-10.9	-16.5	-16.2	-17.1	-19.0	-16.3
> 80 (ppb)	0.0	-15.5	-18.1	-18.2	-17.3	-19.1	-17.9
>100 (ppb)	0.0	-19.8	-19.9	-20.6	-19.1	-20.0	-19.8
>120 (ppb)	0.0	-21.7	-20.7	-21.1	-20.5	-25.6	-21.7
Average difference where Base is above							
> 80 (ppb)	0.0	-14.8	-17.4	-17.5	-16.5	-18.4	-17.2
>100 (ppb)	0.0	-19.6	-19.8	-20.4	-18.8	-19.3	-19.5
>120 (ppb)	0.0	-21.7	-20.9	-20.9	-20.5	-25.6	-21.7
Average difference where Control remains above							
> 80 (ppb)	0.0	-13.6	-18.5	-19.5	-18.0	-18.1	-18.0
>100 (ppb)	0.0	-15.6	-19.4	-17.3	-18.9	-17.7	-18.3
>120 (ppb)	0.0	0.0	-15.6	-13.4	-17.1	-20.2	-16.8
Number of cells where Base is above and Control is below							
> 80 (ppb)	0	205	258	370	295	386	1514
>100 (ppb)	0	191	356	404	395	612	1958
>120 (ppb)	0	78	303	241	465	196	1283
Mxdif (Cells in Subdomain)	1513	1513	1513	1513	1513	1513	9078
<= -4 (ppb)	121	1241	1384	1334	1415	1237	6732
<= -12 (ppb)	0	365	925	828	1079	1234	4431
<= -28 (ppb)	0	52	47	115	81	214	509
-12 to -6 (ppb)	31	411	446	517	392	202	1999
-6 to -4 (ppb)	90	517	60	104	25	15	811
-4 to -2 (ppb)	643	146	35	25	5	9	863
-2 to 2 (ppb)	749	68	35	24	7	12	895
2 to 4 (ppb)	0	3	4	6	3	7	23
4 to 6 (ppb)	0	2	2	2	2	5	13
6 to 12 (ppb)	0	1	3	5	0	14	23
>= 12 (ppb)	0	0	3	2	0	15	20
>= 4 (ppb)	0	3	8	9	2	34	56
# Grid Cells w/ < -12 (ppb) Decr and Base is:							
>= 80 (ppb)	0	349	919	827	1079	1209	4383
>= 100 (ppb)	0	225	736	626	901	809	3297
>= 120 (ppb)	0	78	438	289	579	344	1728
# Grid Cells w/ < -4 (ppb) Decr and Base is:							
>= 80 (ppb)	0	537	1176	1133	1461	1418	5725
>= 100 (ppb)	0	280	820	699	1021	986	3806
>= 120 (ppb)	0	78	489	334	637	363	1901
# Grid Cells w/ > 4 (ppb) Incr and Control is:							
>= 80 (ppb)	0	0	8	9	2	34	53
>= 100 (ppb)	0	0	8	9	2	34	53
>= 120 (ppb)	0	0	7	9	1	15	32
Peak 8 Hour (ppb)	49	102	125	125	120	118	125
Total # of Grid Cells							
> 60 (ppb)	0	818	1513	1513	1513	1488	6845
> 84 (ppb)	0	170	582	577	855	636	2820
>100 (ppb)	0	8	263	187	338	192	988
>120 (ppb)	0	0	23	29	4	0	56
>140 (ppb)	0	0	0	0	0	0	0

OBJECTIVE MEASURES: Beaumont-Port Arthur

DOMAIN NAME: 07scen5b2\_vs\_07basA

BASE : 07basA

CONTROL : 07scen5b2

O3	930906	930907	930908	930909	930910	930911	Total
Peak 1 Hour (ppb)	56	108	121	101	117	123	123
Total # of Grid Cells							
> 80 (ppb)	0	57	352	232	229	420	1290
>100 (ppb)	0	18	108	2	65	234	427
>124 (ppb)	0	0	0	0	0	0	0
>140 (ppb)	0	0	0	0	0	0	0
>160 (ppb)	0	0	0	0	0	0	0
Total hours over threshold							
> 80 (ppb)	0	413	2722	853	1498	2922	8408
>100 (ppb)	0	46	400	6	197	798	1447
>124 (ppb)	0	0	0	0	0	0	0
>140 (ppb)	0	0	0	0	0	0	0
>160 (ppb)	0	0	0	0	0	0	0
Weighted Sum of Differences: SUM(Diff*Base)/SUM(Base)							
> 60 (ppb)	0.0	-4.8	-18.3	-14.5	-13.9	-16.9	-14.3
> 80 (ppb)	0.0	-7.3	-19.0	-15.2	-15.3	-16.9	-16.2
>100 (ppb)	0.0	-4.1	-20.6	-17.5	-20.0	-18.0	-18.8
>120 (ppb)	0.0	0.0	-25.0	-23.2	-23.2	-19.5	-21.7
Average difference where Base is above							
> 80 (ppb)	0.0	-7.4	-18.3	-15.0	-14.3	-16.4	-15.5
>100 (ppb)	0.0	-4.1	-20.2	-17.5	-19.7	-17.7	-18.5
>120 (ppb)	0.0	0.0	-24.8	-23.1	-23.2	-19.5	-21.7
Average difference where Control remains above							
> 80 (ppb)	0.0	-5.5	-18.9	-15.1	-16.7	-16.8	-16.6
>100 (ppb)	0.0	-2.9	-21.8	-24.1	-23.0	-17.7	-19.0
>120 (ppb)	0.0	0.0	-25.7	0.0	0.0	-21.6	-22.8
Number of cells where Base is above and Control is below							
> 80 (ppb)	0	51	44	167	132	20	414
>100 (ppb)	0	6	204	119	98	149	576
>120 (ppb)	0	0	97	3	73	186	359
Mxdif (Cells in Subdomain)	440	440	440	440	440	440	2640
<= -4 (ppb)	0	218	393	421	425	435	1892
<= -12 (ppb)	0	18	325	336	216	331	1226
<= -28 (ppb)	0	0	33	0	0	0	33
-12 to -6 (ppb)	0	49	81	73	192	89	484
-6 to -4 (ppb)	0	151	20	12	17	15	215
-4 to -2 (ppb)	374	199	12	6	9	2	602
-2 to 2 (ppb)	66	22	2	7	6	2	105
2 to 4 (ppb)	0	1	0	5	0	1	7
4 to 6 (ppb)	0	0	0	1	0	0	1
6 to 12 (ppb)	0	0	0	0	0	0	0
>= 12 (ppb)	0	0	0	0	0	0	0
>= 4 (ppb)	0	0	0	1	0	0	1
# Grid Cells w/ < -12 (ppb) Decr and Base is:							
>= 80 (ppb)	0	18	321	335	216	331	1221
>= 100 (ppb)	0	2	283	119	151	329	883
>= 120 (ppb)	0	0	103	3	73	192	371
# Grid Cells w/ < -4 (ppb) Decr and Base is:							
>= 80 (ppb)	0	74	389	395	360	435	1653
>= 100 (ppb)	0	6	308	121	163	380	978
>= 120 (ppb)	0	0	103	3	73	201	380
# Grid Cells w/ > 4 (ppb) Incr and Control is:							
>= 80 (ppb)	0	0	0	0	0	0	0
>= 100 (ppb)	0	0	0	0	0	0	0
>= 120 (ppb)	0	0	0	0	0	0	0
Peak 8 Hour (ppb)	52	101	110	98	108	107	110
Total # of Grid Cells							
> 60 (ppb)	0	361	435	440	440	440	2116
> 84 (ppb)	0	29	200	48	120	332	729
>100 (ppb)	0	5	41	0	14	66	126
>120 (ppb)	0	0	0	0	0	0	0
>140 (ppb)	0	0	0	0	0	0	0

OBJECTIVE MEASURES: Houston-Galveston

DOMAIN NAME: 07scen5b2\_vs\_07basA

BASE : 07basA

CONTROL : 07scen5b2

O3	930906	930907	930908	930909	930910	930911	Total
Peak 1 Hour (ppb)	54	111	159	147	153	146	159
Total # of Grid Cells							
> 80 (ppb)	0	352	962	801	1183	1057	4355
>100 (ppb)	0	74	489	333	640	383	1919
>124 (ppb)	0	0	160	86	120	157	523
>140 (ppb)	0	0	44	18	26	27	115
>160 (ppb)	0	0	0	0	0	0	0
Total hours over threshold							
> 80 (ppb)	0	1867	6509	6051	8742	6245	29414
>100 (ppb)	0	183	2133	1628	2691	1432	8067
>124 (ppb)	0	0	336	234	269	345	1184
>140 (ppb)	0	0	77	27	39	33	176
>160 (ppb)	0	0	0	0	0	0	0
Weighted Sum of Differences: SUM(Diff*Base)/SUM(Base)							
> 60 (ppb)	-7.5	-12.0	-16.7	-16.3	-17.2	-20.3	-16.8
> 80 (ppb)	0.0	-17.1	-18.2	-18.3	-17.3	-20.4	-18.5
>100 (ppb)	0.0	-20.8	-20.1	-20.7	-19.1	-21.5	-20.4
>120 (ppb)	0.0	-21.7	-20.9	-21.2	-20.6	-26.0	-21.9
Average difference where Base is above							
> 80 (ppb)	0.0	-16.5	-17.6	-17.6	-16.6	-19.8	-17.8
>100 (ppb)	0.0	-20.7	-20.0	-20.5	-18.9	-21.0	-20.1
>120 (ppb)	0.0	-21.7	-21.0	-21.0	-20.5	-26.0	-21.8
Average difference where Control remains above							
> 80 (ppb)	0.0	-16.7	-18.7	-19.6	-18.0	-19.6	-18.7
>100 (ppb)	0.0	-18.3	-19.6	-17.4	-18.9	-19.0	-18.8
>120 (ppb)	0.0	0.0	-15.7	-13.3	-17.2	-20.4	-16.9
Number of cells where Base is above and Control is below							
> 80 (ppb)	0	251	261	371	295	423	1601
>100 (ppb)	0	208	360	404	396	665	2033
>120 (ppb)	0	78	305	242	466	199	1290
Mxdif (Cells in Subdomain)							
<= -4 (ppb)	1513	1513	1513	1513	1513	1513	9078
<= -12 (ppb)	121	1359	1381	1336	1413	1223	6833
<= -28 (ppb)	0	394	931	832	1084	1336	4577
-12 to -6 (ppb)	0	52	53	116	83	229	533
-6 to -4 (ppb)	31	527	446	513	387	105	2009
-4 to -2 (ppb)	90	490	57	107	25	11	780
-2 to 2 (ppb)	643	75	35	22	5	8	788
2 to 4 (ppb)	749	23	33	24	7	14	850
4 to 6 (ppb)	0	2	3	6	3	6	20
6 to 12 (ppb)	0	1	2	2	2	4	11
>= 12 (ppb)	0	1	4	5	0	15	25
>= 4 (ppb)	0	0	2	2	0	14	18
>= 4 (ppb)	0	2	8	9	2	33	54
# Grid Cells w/ < -12 (ppb) Decr and Base is:							
>= 80 (ppb)	0	378	924	831	1084	1311	4528
>= 100 (ppb)	0	242	736	627	901	898	3404
>= 120 (ppb)	0	78	438	290	579	344	1729
# Grid Cells w/ < -4 (ppb) Decr and Base is:							
>= 80 (ppb)	0	603	1177	1133	1461	1419	5793
>= 100 (ppb)	0	282	820	699	1021	987	3809
>= 120 (ppb)	0	78	489	334	637	364	1902
# Grid Cells w/ > 4 (ppb) Incr and Control is:							
>= 80 (ppb)	0	0	8	9	2	33	52
>= 100 (ppb)	0	0	8	9	2	33	52
>= 120 (ppb)	0	0	7	9	1	14	31
Peak 8 Hour (ppb)	49	99	125	125	120	118	125
Total # of Grid Cells							
> 60 (ppb)	0	808	1513	1513	1513	1485	6832
> 84 (ppb)	0	146	573	576	852	555	2702
>100 (ppb)	0	0	262	187	338	182	969
>120 (ppb)	0	0	20	28	4	0	52
>140 (ppb)	0	0	0	0	0	0	0

OBJECTIVE MEASURES: Beaumont-Port Arthur

DOMAIN NAME: 07scen5b3\_vs\_07basA

BASE : 07basA

CONTROL : 07scen5b3

03	930906	930907	930908	930909	930910	930911	Total
Peak 1 Hour (ppb)	56	108	121	100	116	121	121
Total # of Grid Cells							
> 80 (ppb)	0	54	352	227	228	420	1281
>100 (ppb)	0	18	102	1	52	230	413
>124 (ppb)	0	0	0	0	0	0	0
>140 (ppb)	0	0	0	0	0	0	0
>160 (ppb)	0	0	0	0	0	0	0
Total hours over threshold							
> 80 (ppb)	0	382	2733	843	1474	2896	8328
>100 (ppb)	0	45	383	2	171	751	1352
>124 (ppb)	0	0	0	0	0	0	0
>140 (ppb)	0	0	0	0	0	0	0
>160 (ppb)	0	0	0	0	0	0	0
Weighted Sum of Differences: SUM(Diff*Base)/SUM(Base)							
> 60 (ppb)	0.0	-5.0	-18.5	-14.6	-14.4	-17.8	-14.7
> 80 (ppb)	0.0	-7.7	-19.3	-15.3	-15.8	-17.8	-16.7
>100 (ppb)	0.0	-4.2	-20.9	-17.8	-20.9	-18.9	-19.4
>120 (ppb)	0.0	0.0	-25.4	-24.0	-24.5	-20.6	-22.7
Average difference where Base is above							
> 80 (ppb)	0.0	-7.8	-18.6	-15.1	-14.8	-17.2	-15.9
>100 (ppb)	0.0	-4.2	-20.5	-17.7	-20.6	-18.7	-19.1
>120 (ppb)	0.0	0.0	-25.2	-24.0	-24.5	-20.5	-22.6
Average difference where Control remains above							
> 80 (ppb)	0.0	-5.5	-19.2	-15.3	-17.4	-17.7	-17.1
>100 (ppb)	0.0	-3.0	-22.8	-25.7	-24.3	-18.6	-19.8
>120 (ppb)	0.0	0.0	-29.6	0.0	0.0	-23.5	-25.3
Number of cells where Base is above and Control is below							
> 80 (ppb)	0	54	44	172	133	20	423
>100 (ppb)	0	6	210	120	101	153	590
>120 (ppb)	0	0	100	3	73	194	370
Mxdif (Cells in Subdomain)	440	440	440	440	440	440	2640
<= -4 (ppb)	0	220	393	421	423	435	1892
<= -12 (ppb)	0	19	329	338	219	336	1241
<= -28 (ppb)	0	0	34	0	2	0	36
-12 to -6 (ppb)	0	50	77	71	194	84	476
-6 to -4 (ppb)	0	151	21	12	12	15	211
-4 to -2 (ppb)	374	196	11	6	9	3	599
-2 to 2 (ppb)	66	23	2	7	6	1	105
2 to 4 (ppb)	0	1	0	5	0	1	7
4 to 6 (ppb)	0	0	0	1	0	0	1
6 to 12 (ppb)	0	0	0	0	0	0	0
>= 12 (ppb)	0	0	0	0	0	0	0
>= 4 (ppb)	0	0	0	1	0	0	1
# Grid Cells w/ < -12 (ppb) Decr and Base is:							
>= 80 (ppb)	0	19	325	337	219	336	1236
>= 100 (ppb)	0	2	285	120	154	331	892
>= 120 (ppb)	0	0	103	3	73	192	371
# Grid Cells w/ < -4 (ppb) Decr and Base is:							
>= 80 (ppb)	0	75	390	395	360	435	1655
>= 100 (ppb)	0	6	309	121	163	380	979
>= 120 (ppb)	0	0	103	3	73	201	380
# Grid Cells w/ > 4 (ppb) Incr and Control is:							
>= 80 (ppb)	0	0	0	0	0	0	0
>= 100 (ppb)	0	0	0	0	0	0	0
>= 120 (ppb)	0	0	0	0	0	0	0
Peak 8 Hour (ppb)	52	101	110	97	107	106	110
Total # of Grid Cells							
> 60 (ppb)	0	360	433	440	440	440	2113
> 84 (ppb)	0	28	199	48	118	329	722
>100 (ppb)	0	5	39	0	13	59	116
>120 (ppb)	0	0	0	0	0	0	0
>140 (ppb)	0	0	0	0	0	0	0

OBJECTIVE MEASURES: Houston-Galveston

DOMAIN NAME: 07scen5b3\_vs\_07basA

BASE : 07basA

CONTROL : 07scen5b3

O3	930906	930907	930908	930909	930910	930911	Total
Peak 1 Hour (ppb)	54	111	159	147	153	145	159
Total # of Grid Cells							
> 80 (ppb)	0	348	962	800	1183	1046	4339
>100 (ppb)	0	71	489	333	640	380	1913
>124 (ppb)	0	0	160	86	120	157	523
>140 (ppb)	0	0	44	18	26	27	115
>160 (ppb)	0	0	0	0	0	0	0
Total hours over threshold							
> 80 (ppb)	0	1831	6492	6045	8739	6145	29252
>100 (ppb)	0	180	2132	1625	2690	1425	8052
>124 (ppb)	0	0	336	234	269	344	1183
>140 (ppb)	0	0	77	27	39	32	175
>160 (ppb)	0	0	0	0	0	0	0
Weighted Sum of Differences: SUM(Diff*Base)/SUM(Base)							
> 60 (ppb)	-7.5	-12.1	-16.7	-16.3	-17.2	-20.4	-16.8
> 80 (ppb)	0.0	-17.3	-18.3	-18.3	-17.3	-20.5	-18.5
>100 (ppb)	0.0	-20.9	-20.1	-20.7	-19.1	-21.7	-20.4
>120 (ppb)	0.0	-21.7	-20.9	-21.2	-20.6	-26.1	-21.9
Average difference where Base is above							
> 80 (ppb)	0.0	-16.7	-17.6	-17.6	-16.6	-19.9	-17.8
>100 (ppb)	0.0	-20.8	-20.1	-20.5	-18.9	-21.2	-20.2
>120 (ppb)	0.0	-21.7	-21.0	-21.0	-20.5	-26.1	-21.9
Average difference where Control remains above							
> 80 (ppb)	0.0	-17.1	-18.8	-19.6	-18.0	-19.7	-18.8
>100 (ppb)	0.0	-18.6	-19.6	-17.4	-18.9	-19.1	-18.8
>120 (ppb)	0.0	0.0	-15.8	-13.3	-17.2	-20.4	-17.0
Number of cells where Base is above and Control is below							
> 80 (ppb)	0	255	261	372	295	434	1617
>100 (ppb)	0	211	360	404	396	668	2039
>120 (ppb)	0	78	305	242	466	199	1290
Mxdif (Cells in Subdomain)	1513	1513	1513	1513	1513	1513	9078
<= -4 (ppb)	121	1362	1381	1336	1413	1222	6835
<= -12 (ppb)	0	436	931	832	1084	1346	4629
<= -28 (ppb)	0	52	54	116	83	230	535
-12 to -6 (ppb)	31	495	446	513	387	96	1968
-6 to -4 (ppb)	90	483	58	107	25	10	773
-4 to -2 (ppb)	643	72	34	22	6	8	785
-2 to 2 (ppb)	749	23	33	24	6	14	849
2 to 4 (ppb)	0	2	3	6	3	6	20
4 to 6 (ppb)	0	1	2	2	2	4	11
6 to 12 (ppb)	0	1	4	5	0	15	25
>= 12 (ppb)	0	0	2	2	0	14	18
>= 4 (ppb)	0	2	8	9	2	33	54
# Grid Cells w/ < -12 (ppb) Decr and Base is:							
>= 80 (ppb)	0	420	924	831	1084	1320	4579
>= 100 (ppb)	0	266	736	627	901	907	3437
>= 120 (ppb)	0	78	438	290	579	344	1729
# Grid Cells w/ < -4 (ppb) Decr and Base is:							
>= 80 (ppb)	0	603	1178	1133	1461	1419	5794
>= 100 (ppb)	0	282	820	699	1021	987	3809
>= 120 (ppb)	0	78	489	334	637	364	1902
# Grid Cells w/ > 4 (ppb) Incr and Control is:							
>= 80 (ppb)	0	0	8	9	2	33	52
>= 100 (ppb)	0	0	8	9	2	33	52
>= 120 (ppb)	0	0	7	9	1	13	30
Peak 8 Hour (ppb)	49	99	125	125	120	118	125
Total # of Grid Cells							
> 60 (ppb)	0	807	1513	1513	1513	1485	6831
> 84 (ppb)	0	144	572	576	851	547	2690
>100 (ppb)	0	0	262	187	338	182	969
>120 (ppb)	0	0	20	28	4	0	52
>140 (ppb)	0	0	0	0	0	0	0