Assessing the Air Quality Impacts in the Austin Area Associated with Seven Proposed Central Texas Coal-Fired Power Plants

Prepared for

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Executive Summary

Six photochemical modeling runs were performed using the 2007 Future Case for the September 13-20, 1999 photochemical modeling episode to evaluate the air quality impacts associated with the proposed construction of six coal-fired power plants in the Central Texas area. The facilities modeled were the Sandow 5 plant in Milam county, the Sandy Creek plant in McLennan county, the Twin Oaks and Oak Grove plants in Robertson county, the J K Spruce plant in Bexar county, and the Formosa and Joslin plants in Calhoun county. All emissions and modeling data specific to these facilities were obtained from the Texas Commission on Environmental Quality (TCEQ).

Results of the studies demonstrated that the addition of all power plants to the 2007 Future Case scenario resulted in a daily maximum 8-hour ozone increase within the 4-km CAMx domain of 1.23 ppb or greater for each day during the September 15th through 20thperiod, with a maximum increase of 7.00 ppb on the 20th. During the 15th through 18th period, the Oak Grove and Twin Oaks facilities had the largest impact in the 5-county Austin area. These facilities are located approximately 150 km to the northeast of Austin, and winds in the lower atmosphere transported a portion of the power plant plumes into Central Texas. Winds became more southerly on the 19th and 20th, and maximum impacts of 0.29 ppb and 0.13 ppb, respectively, in the Austin area were primarily associated with emissions from the J K Spruce facility.

Comparison of the results of these simulations with those of the final set of control strategies recommended in Austin's Early Action Compact (EAC) indicated that the increased ozone impacts associated with the new power plants were greater than the ozone reductions obtained by the EAC controls on all days in the 4-km CAMx domain except the 19th. In the 5-county Austin area, maximum impacts due to emissions from the power plants were 3.14 ppb, 2.03 ppb, and 1.51 ppb on the 15th, 16th, and 18th, respectively. These values compare to EAC control strategy reductions of 1.21 ppb, 1.36 ppb, and 2.58 ppb on the 15th, 16th, and 18th, respectively. The results demonstrate that the ozone increases associated with the construction of the proposed coal-fired power plants in Central Texas could more than offset the reduction in ozone impacts associated with the recommended EAC emission control strategies on specific days. This suggests that the proposed facilities should be carefully considered if the Austin area is to maintain attainment with the 8-hour NAAQS and reduce population exposure to ozone in the future.

TABLE OF CONTENTS

Page

TABLES

Page

FIGURES

Page

1. Introduction

This report documents the development and results of six photochemical modeling runs designed to evaluate the impact on future air quality in the Austin area due to the construction of seven new coal-fired power plants in Central Texas. These air quality studies were performed using the 2007 Future Case for the September 13-20, 1999 CAMx episode.

2. Model Preparation

Six CAMx runs were developed for this study. For all runs, the model configuration, meteorological fields, boundary and initial conditions, dry deposition algorithms, chemical mechanisms, and biogenic emission inventories are the same as those developed for the September 13-20, 2007 Future Case. Complete documentation of the 2007 Future Case model is provided in *Photochemical Modeling for Austin's Early Action Compact: Development of the September 13-20, 1999 Photochemical Model with 2007 Projected Emissions and Analysis of Future 8-Hour Ozone Design Values,* submitted by The Capital Area Planning Council to the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency in March 2004. The only differences between the photochemical modeling simulations discussed in this report and the 2007 Future Case model are the projected changes in emissions at the Alcoa facility and the addition of emissions from each of the seven new power plants as described below:

Figure 1 provides the locations of the seven new coal-fired power plants modeled in this study. The facility-wide emissions are provided in Table 1. The locations, stack parameters, and emissions characteristics for each of the new power plants were modeled as provided by TCEQ in the file "afs.newEGUs_Oct2005_SolidFuel30day_2009_sensitivity.lcp". This file was emailed by Bill Gill to Cyril Durrenberger on December 19, 2005.

The first model scenario simulates the construction of the Sandow 5 power plant in Milam county and the dismantling of the three boilers currently operating at Alcoa. Otherwise, emissions for the first scenario are the same as the original 2007 Future Case. A comparison of the facility-wide Alcoa emissions between the original Future Case and the updated Future Case is shown in Table 2. Note that the removal of the three Alcoa boilers decreased the facility-wide NOx emissions from 26.66 tpd to 1.06 tpd. For the updated 2007 Future Case run, the removal of the three Alcoa boilers combined with the addition of the Sandow 5 facility results in total Milam County Nox emissions of 8.16 tpd, compared to total Milam county Nox emissions of 26.66 tpd for the original Future Case. Note that this updated Future Case scenario becomes the base case for the additional simulations summarized in this report. **For the remainder of this report, the updated Future Case scenario is simply referred to as the 2007 Future Case.**

The second model scenario (Sandy Creek) simulates the construction of the LS Power coal-fired power plant in McLennan county, as shown in Figure 1. The ton per day emissions for the proposed coal-fired power plant are provided in Table 1. Note that this simulation is exactly the same as the 2007 Future Case scenario except that the Sandy Creek facility has been added to the run.

The third model scenario (Twin Oaks) simulates the construction of the Sempra coal-fired power plant in Robertson county, as shown in Figure 1. The ton per day emissions for the proposed coal-fired power plant are provided in Table 1. Note that this simulation is exactly the same as the 2007 Future Case scenario except that the Twin Oaks facility has been added to the run.

The fourth model scenario (Oak Grove) simulates the construction of the Texas Utilities (TXU) coal-fired power plant in Robertson county, as shown in Figure 1. The ton per day emissions for the proposed coal-fired power plant are provided in Table 1. Note that this simulation is exactly the same as the 2007 Future Case scenario except that the Oak Grove facility has been added to the run.

The fifth model scenario simulates the construction of the Sandy Creek, Twin Oaks, and Oak Grove coal-fired power plants, as shown in Figure 1. The ton per day emissions for the three coal-fired power plants are provided in Table 1. Note that this simulation is exactly the same as the 2007 Future Case scenario except that the Sandy Creek, Twin Oaks, and Oak Grove facilities have been added to the run.

The sixth model scenario simulates the construction of all six proposed coal-fired power plants (in addition to the Sandow facility, which has also been included in the 2007 Future Case), as shown in Figure 1. The ton per day emissions for the coal-fired power plants are provided in Table 1. Note that this simulation is exactly the same as the 2007 Future Case scenario except that the Sandy Creek, Twin Oaks, and Oak Grove, Spruce, Formosa, and Joslin facilities have been added to the run.

Figure 1. Map showing the modeled locations of the seven proposed coal-fired power plants in Central Texas.

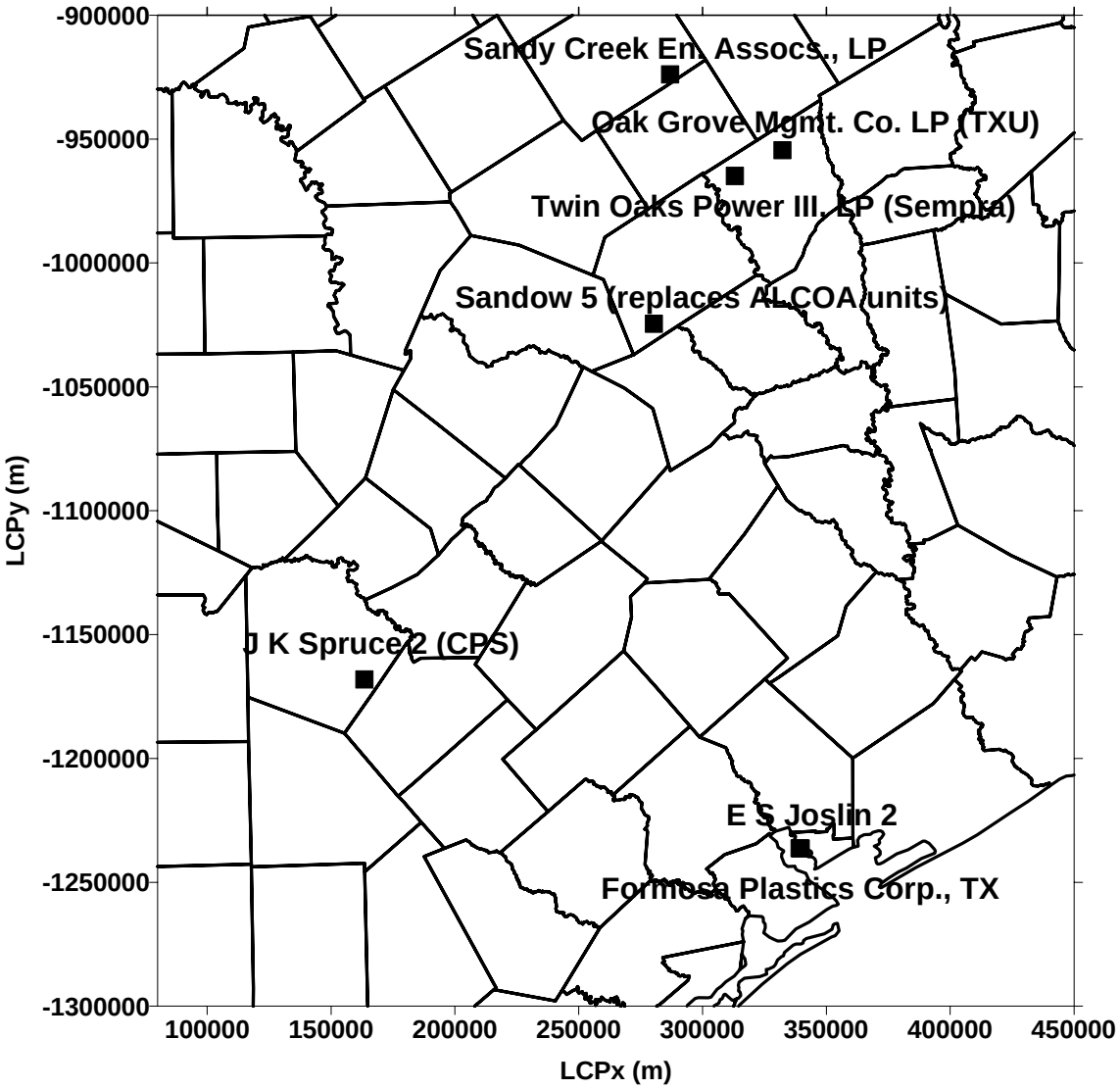


Table 1. Total point source emissions associated with the seven proposed coal-fired power plants in Central Texas.

Facility	Pollutant	Emis (TPD)
E S Joslin 2 ("Joslin" run)	CO	4.78
	NOx	2.23
	VOC	0.18
Formosa Plastics Corp.,TX ("Formosa" run)	CO	10.80
	NOx	4.03
	VOC	0.36
J K Spruce 2 (CPS) ("Spruce" run)	CO	53.76
	NOx	6.62
	VOC	0.35
Oak Grove Mgmt. Co. LP (TXU) ("Oak Grove" run)	CO	120.55
	NOx	20.64
	VOC	1.13
Sandow 5 (replaces ALCOA units)	CO	7.10
	NOx	7.10
	VOC	0.36
Sandy Creek En. Assocs., LP ("Sandy Creek" run)	CO	29.47
	NOx	6.88
	VOC	0.35
Twin Oaks Power III, LP (Sempra) ("Twin Oaks" run)	CO	44.64
	NOx	8.16
	VOC	0.36

Table 2. A comparison of facility-wide Alcoa emissions for the original 2007 Future Case and the updated 2007 Future Case (Future Case with Sandow 5). For the updated 2007 Future Case simulation, the three Alcoa boilers were removed. Only Alcoa emissions are reported in Table 2; the emissions associated with the Sandow facility are presented in Table 1.

	Pollutant	Original 2007 FC	Updated 2007 FC
Facility-Wide Alcoa Emissions	CO	44.35	43.82
	NOx	26.66	1.06
	VOC	3.06	2.98

3. Air Quality Impacts

The objective of the six modeling studies described in this report is to examine the impact on future ozone air quality due to emissions from the construction of the proposed coal-fired power plants in Central Texas. Air quality impacts are evaluated using statistical and graphical metrics for 8-hour averaged ozone concentrations.

The differences in the daily maximum 8-hour averaged ozone concentrations between the 2007 Future Case and each of the modeling scenarios were generated for both the 4-km and 12-km domains. Due to the number of figures, the daily ozone difference maps for each scenario have been provided as Appendix A. The ozone difference maps clearly demonstrate the spatial extent of air quality impacts associated with emissions from the new sources. Ozone difference maps have been generated for each day during the September 15-20, 2007 period as follows:

12-km Ozone Difference Maps

1.) 2007 Future Case with Sandy Creek minus 2007 Future Case: Figures A1-A6 present the differences in daily maximum 8-hour averaged ozone concentrations for each day during September 15-20, 2007.
2.) 2007 Future Case with Twin Oaks minus 2007 Future Case: Figures A7-A12 present the differences in daily maximum 8-hour averaged ozone concentrations for each day during September 15-20, 2007.
3.) 2007 Future Case with Oak Grove minus 2007 Future Case: Figures A13-A18 present the differences in daily maximum 8-hour averaged ozone concentrations for each day during September 15-20, 2007.
4.) 2007 Future Case with Sandy Creek, Twin Oaks, and Oak Grove minus 2007 Future Case: Figures A19-A24 present the differences in daily maximum 8-hour averaged ozone concentrations for each day during September 15-20, 2007.
5.) 2007 Future Case with Sandy Creek, Twin Oaks, Oak Grove, Spruce, Formosa, and Joslin minus 2007 Future Case: Figures A25-A30 present the differences in daily maximum 8-hour averaged ozone concentrations for each day during September 15-20, 2007.

4-km Ozone Difference Maps

6.) 2007 Future Case with Sandy Creek minus 2007 Future Case: Figures A31-A36 present the differences in daily maximum 8-hour averaged ozone concentrations for each day during September 15-20, 2007.
7.) 2007 Future Case with Twin Oaks minus 2007 Future Case: Figures A37-A42 present the differences in daily maximum 8-hour averaged ozone concentrations for each day during September 15-20, 2007.
8.) 2007 Future Case with Oak Grove minus 2007 Future Case: Figures A43-A48 present the differences in daily maximum 8-hour averaged ozone concentrations for each day during September 15-20, 2007.

9.) 2007 Future Case with Sandy Creek, Twin Oaks, and Oak Grove minus 2007 Future Case: Figures A49-A54 present the differences in daily maximum 8-hour averaged ozone concentrations for each day during September 15-20, 2007.

10.) 2007 Future Case with Sandy Creek, Twin Oaks, Oak Grove, Spruce, Formosa, and Joslin minus 2007 Future Case: Figures A55-A60 present the differences in daily maximum 8-hour averaged ozone concentrations for each day during September 15-20, 2007.

Table 3 provides the maximum ozone increases within the 12-km CAMx domain for each scenario for each day. The values presented in Table 3 correspond to the maximum values displayed in the ozone difference maps shown in Figures A1-A30. The NOx emission rates for the Sandy Creek, Twin Oaks, and Oak Grove facilities are 6.88, 8.16, and 20.64 tons per day, respectively. Not surprisingly, emissions from the Oak Grove facility, which has the highest NOx emission rate, are associated with the highest ozone impacts on all days. The maximum Oak Grove daily impacts range from a low of 2.95 ppb on the 15th to a high of 9.08 ppb on the 19th. Maximum impacts associated with the Twin Oaks facility range from a minimum of 1.01 ppb on the 15th to a maximum of 3.33 ppb on the 20th. Note that the ozone impacts associated with the Sandy Creek facility are much lower and range from a minimum of 0.37 ppb on the 15th to a maximum of 0.80 ppb on the 17th.

Table 4 provides the maximum ozone increases within the 4-km CAMx domain for each scenario for each day. The values presented in Table 4 correspond to the maximum values displayed in the ozone difference maps shown in Figures A31-A60. The Sandy Creek facility is located approximately 150 km to the north-northeast of the Austin area and approximately 50 km to the northwest of the Oak Grove and Twin Oaks facilities. Northerly winds in the lower atmosphere on the 15th transported a portion of the Sandy Creek plume into the 4-km domain resulting in a maximum Sandy Creek impact of 0.24 ppb on the 15th. Winds became more easterly after the 15th, and impacts due to emissions from the Sandy Creek facility decreased to 0.05 ppb or less on subsequent days. A general northerly and easterly flow in the boundary layer during the 15th through 19th period transported portions of both the Twin Oaks and Oak Grove plumes into the northern portion of the 4-km domain on these days. The daily maximum impacts due to the Twin Oaks facility ranged from a minimum of 1.10 ppb on the 15th to a maximum of 1.82 ppb on the 18th. Oak Grove impacts ranged from a minimum of 2.16 ppb on the 17th to a maximum of 3.99 ppb on the 18th. By the 19th, winds in the boundary layer were characterized by a more southeasterly component, and maximum impacts from the Twin Oaks and Oak Grove facilities decreased to 0.04 ppb and 0.05 ppb, respectively. On the 20th, a slight northerly flow returned ahead of a southward moving cold front, and impacts from the Twin Oaks and Oak Grove facilities increased to 2.35 ppb and 5.48 ppb, respectively. As shown in Figures A42 and A48, these impacts were limited to the far northeastern portion of the 4-km domain and did not directly impact the Austin area.

Table 5 presents the maximum daily ozone increases within the 5-county Austin area for each scenario. Refer to the previous paragraph for a discussion of the prevailing winds in

the lower atmosphere on each day. The maximum daily impact associated with the Sandy Creek facility was 0.15 ppb on the 15th. Ozone impacts in the Austin area through the 18th were dominated by the Oak Grove and Twin Oaks facilities. Impacts due to emissions from Oak Grove ranged from a minimum of 0.23 ppb on the 17th to a maximum of 2.26 ppb on the 15th. The area of maximum impacts was generally limited to the far northern portions of the Austin area (i.e., Williamson County). Maximum impacts on the 19th and 20th in the Austin area were dominated by emissions from the J K Spruce power plant. For example, refer to the ozone difference map for the 19th shown in Figure A59 that clearly demonstrates the movement of the Spruce plume northward from Bexar county into the Austin area.

Table 3. Maximum daily ozone increases in the 12-km CAMx domain after new sources were added to the 2007 Future Case.

Scenario	9/15	9/16	9/17	9/18	9/19	9/20
Sandy Creek	0.37	0.42	0.80	0.55	0.63	0.79
Twin Oaks	1.01	1.73	2.59	2.44	3.15	3.33
Oak Grove	2.95	4.11	6.11	5.87	9.08	8.82
Sandy+Twin+Oak	3.66	5.40	6.58	6.88	10.10	9.95
All Power Plants	3.66	5.40	6.58	6.88	10.10	9.95

Table 4. Maximum daily ozone increases in the 4-km CAMx domain after new sources were added to the 2007 Future Case.

Scenario	9/15	9/16	9/17	9/18	9/19	9/20
Sandy Creek	0.24	0.03	0.01	0.01	0.00	0.05
Twin Oaks	1.10	1.45	1.12	1.82	0.02	2.35
Oak Grove	2.96	3.22	2.16	3.99	0.04	5.48
Sandy+Twin+Oak	3.98	4.39	3.09	5.65	0.05	6.97
All Power Plants	3.98	4.39	3.09	5.65	1.23	7.00

Table 5. Maximum daily ozone increases in the 5-county Austin area after new sources were added to the 2007 Future Case.

Scenario	9/15	9/16	9/17	9/18	9/19	9/20
Sandy Creek	0.15	0.00	0.00	0.00	0.00	0.01
Twin Oaks	0.91	0.55	0.16	0.47	0.01	0.02
Oak Grove	2.26	1.52	0.23	1.11	0.02	0.04
Sandy+Twin+Oak	3.14	2.03	0.37	1.51	0.04	0.06
All Power Plants	3.14	2.03	0.37	1.51	0.29	0.13

In support of Austin's Early Action Compact (EAC), relative reduction factors and future 8-hour ozone design values for the Murchison and Audubon monitoring stations were calculated for the 2007 Future Case and 2007 Future Case with control scenarios in accordance with the U.S. EPA's *Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS (1999) and the U.S. EPA's Protocol for Early Action Compacts (2003).* Although emissions from the proposed power plants do not significantly impact the design values at the Austin monitoring stations, there is a significant reduction in air quality within the five-county Austin area. The daily maximum ozone reductions within the 4-km CAMx domain for each EAC control strategy evaluated by the Austin Area are presented in Table 6. These maximum ozone reductions are provided for comparison to the maximum ozone increases shown in Table 4. Note that the increased ozone impacts associated with the new power plants are greater than the ozone reductions obtained by the EAC controls on all days except the 19th. In the 5-county Austin area, maximum impacts due to emissions from the power plants were 3.14 ppb, 2.03 ppb, and 1.51 ppb on the 15th, 16th, and 18th, respectively, as shown in Table 5. These values compare to EAC control strategy reductions of 1.21 ppb, 1.36 ppb, and 2.58 ppb on the 15th, 16th, and 18th, respectively. This comparison demonstrates that the ozone increases associated with the construction of the proposed coal-fired power plants in Central Texas could more than offset the reduction in ozone impacts associated with the recommended EAC emission control strategies on some days.

Table 6. Maximum daily ozone reductions in the 4-km CAMx Domain for the EAC control measures applied to the 2007 Future Case.

Control Case	9/15	9/16	9/17	9/18	9/19	9/20	Murchison (average over all days)	Audubon (average over all days)
I&M only – no Hays IM	0.27	0.26	0.47	0.53	0.53	0.48	0.35	0.35
Point Source – voluntary	1.19	1.33	2.11	2.55	3.20	3.24	0.44	0.35
TERP	0.17	0.15	0.20	0.17	0.14	0.23	0.09	0.18
Area VOC	0.20	0.20	0.38	0.57	0.21	0.69	0.26	0.18
All Controls – Final	1.21	1.36	2.13	2.57	3.24	3.54	1.22	0.98
All Controls – no IM, no RVP	1.21	1.36	2.13	2.58	3.24	3.43	0.87	0.71

4. Summary and Recommendations

The results of the 2007 Future Case simulations conducted in support of Austin's EAC predict that Austin will be on the cusp of attainment or non-attainment with the 8-hour ozone National Ambient Air Quality Standard (NAAQS). In recognition of these results, the Austin area focused on the evaluation and implementation of numerous local emission control strategies to provide the area with a margin of safety to ensure that the NAAQS is maintained. Based on the results of these control strategy simulations, the Austin area recommended a specific set of local control strategies in support of the EAC.

Although emissions from the proposed power plants do not significantly impact the design values at the Austin monitoring stations, there is a significant reduction in air quality within the five-county Austin area. The six sensitivity runs summarized in this report demonstrate that the air quality impacts associated with the construction of the new power plants could more than offset the reduction in ozone impacts associated with the recommended set of emission control strategies on some days. These results highlight the need to carefully assess the air quality impacts associated with emissions from any new coal-fired power plants that may be constructed in Central Texas. This evaluation is crucial if the Austin area is to maintain attainment with the 8-hour NAAQS and reduce population exposure to ozone in the future.

5. References

United States Environmental Protection Agency. 2003. “Protocol for Early Action Compacts Designed to Achieve and Maintain the 8-Hour Ozone Standard.” U.S. Environmental Protection Agency, Research Triangle Park, NC.

United States Environmental Protection Agency. 1999. “Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS”, EPA 454/R-99-004, U.S. Environmental Protection Agency, Research Triangle Park, NC. May 1999.

University of Texas at Austin. 2004. “Development of the September 13-20, 1999 Base Case Photochemical Model for Austin’s Early Action Compact”, submitted by The Capital Area Planning Council to the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency, March 2004 (original submission to the U.S. EPA, November 2003).

University of Texas at Austin. 2004. “Photochemical Modeling for Austin’s Early Action Compact: Development of the September 13-20, 1999 Photochemical Model with 2007 Projected Emissions and Analysis of Future 8-Hour Ozone Design Values”, submitted by The Capital Area Planning Council to the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency, March 2004 (original submission to the U.S. EPA December 2003).

University of Texas at Austin. 2004. “Photochemical Modeling for Austin’s Early Action Compact: Analysis of Emission Control Strategies for Ozone Precursors”, submitted by The Capital Area Planning Council to the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency, March 2004.

Appendix A
Ozone Difference Maps

Figure A1. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 15 between the 2007 Future Case and 2007 Future Case with Sandy Creek.

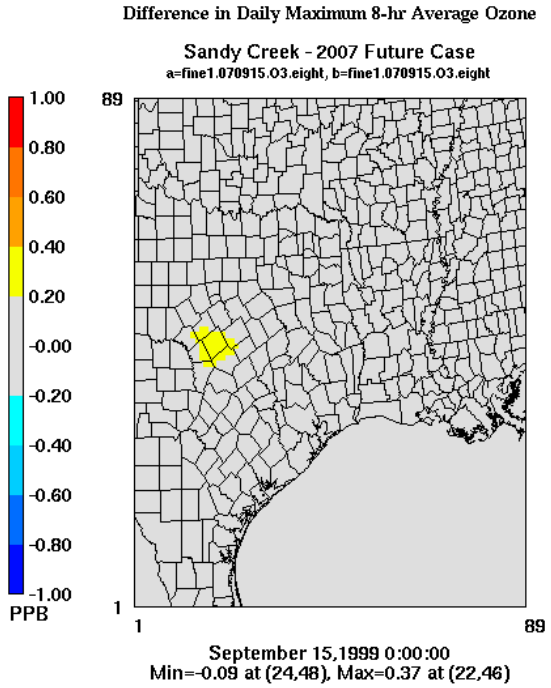


Figure A2. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 16 between the 2007 Future Case and 2007 Future Case with Sandy Creek.

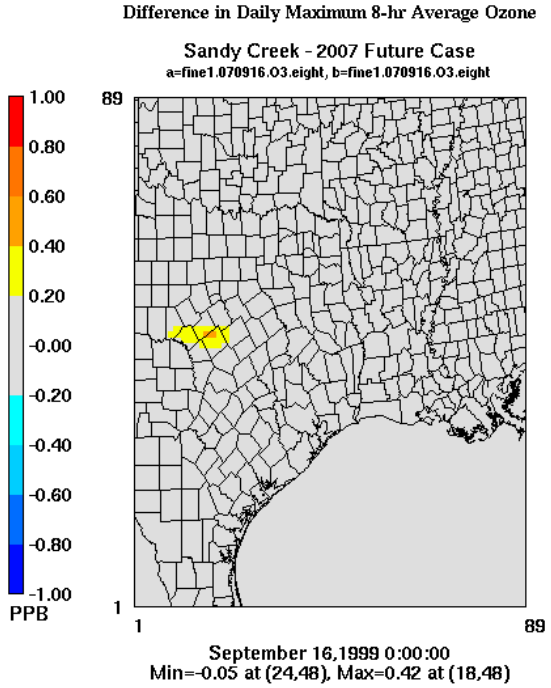


Figure A3. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 17 between the 2007 Future Case and 2007 Future Case with Sandy Creek.

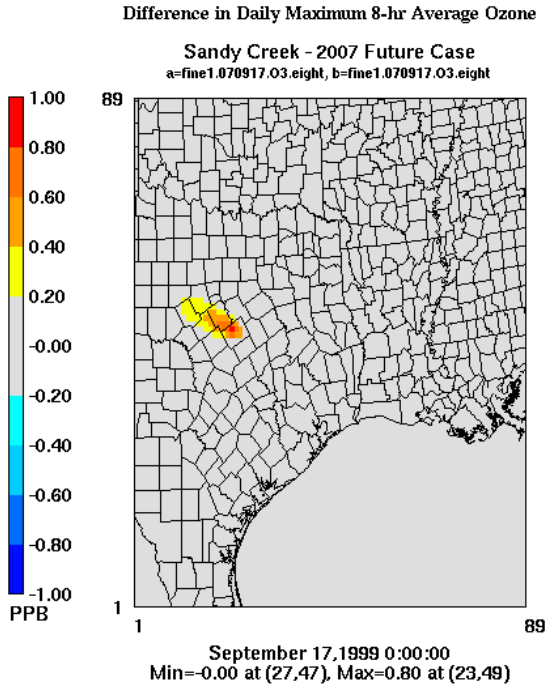


Figure A4. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 18 between the 2007 Future Case and 2007 Future Case with Sandy Creek.

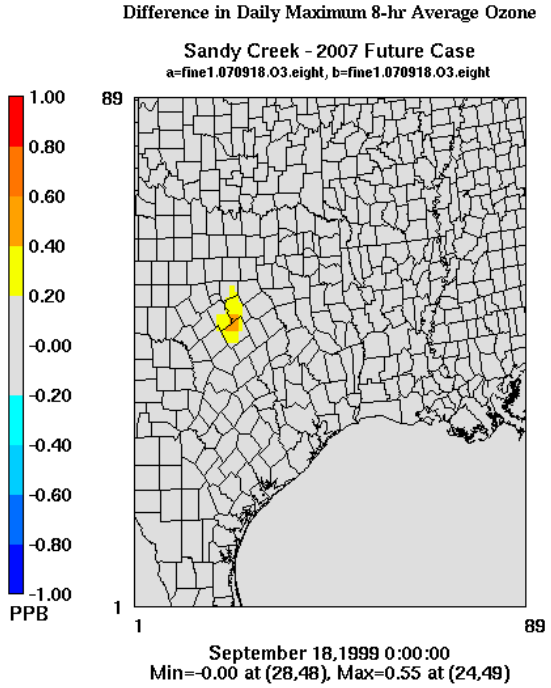


Figure A5. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 19 between the 2007 Future Case and 2007 Future Case with Sandy Creek.

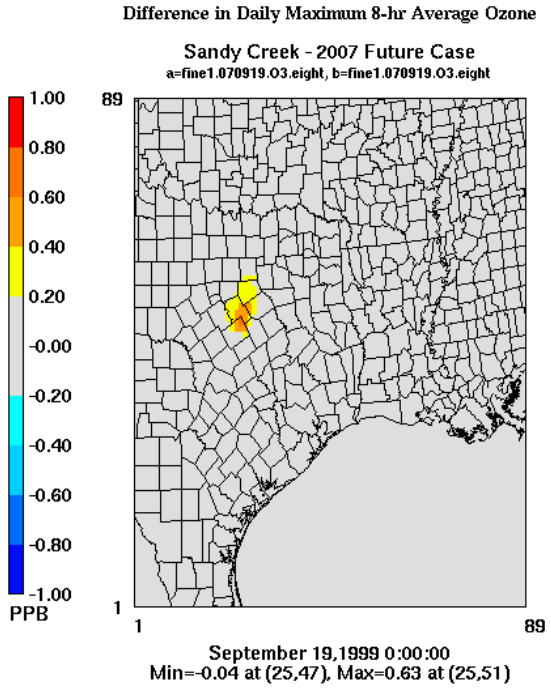


Figure A6. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 20 between the 2007 Future Case and 2007 Future Case with Sandy Creek.

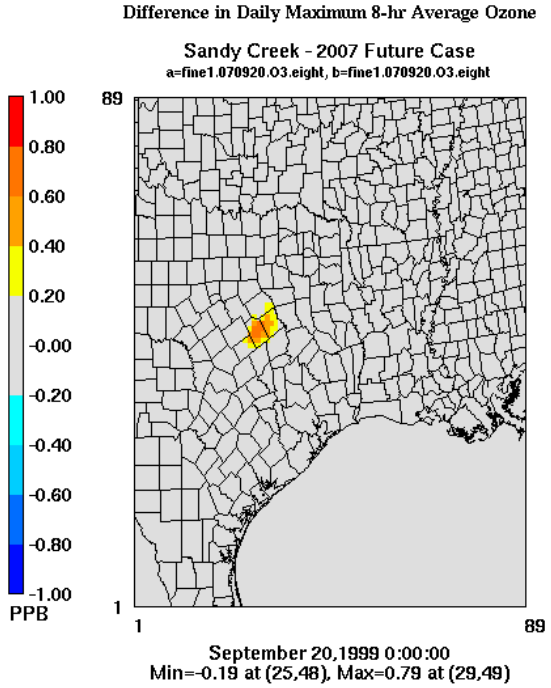


Figure A7. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 15 between the 2007 Future Case and 2007 Future Case with Twin Oaks.

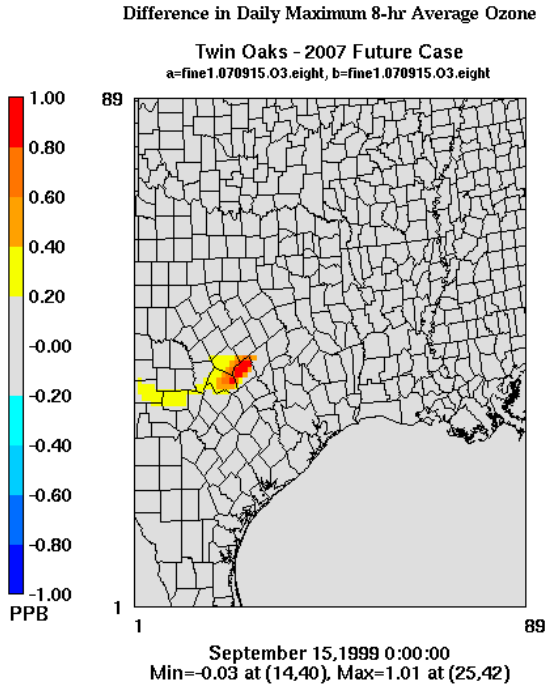


Figure A8. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 16 between the 2007 Future Case and 2007 Future Case with Twin Oaks.

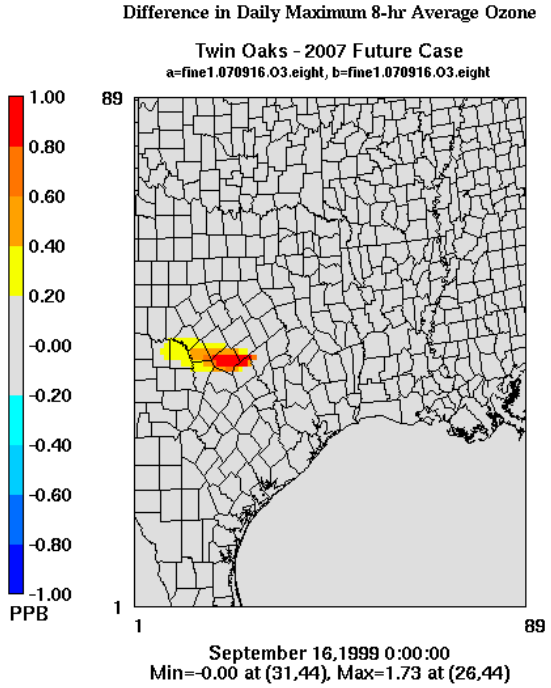


Figure A9. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 17 between the 2007 Future Case and 2007 Future Case with Twin Oaks.

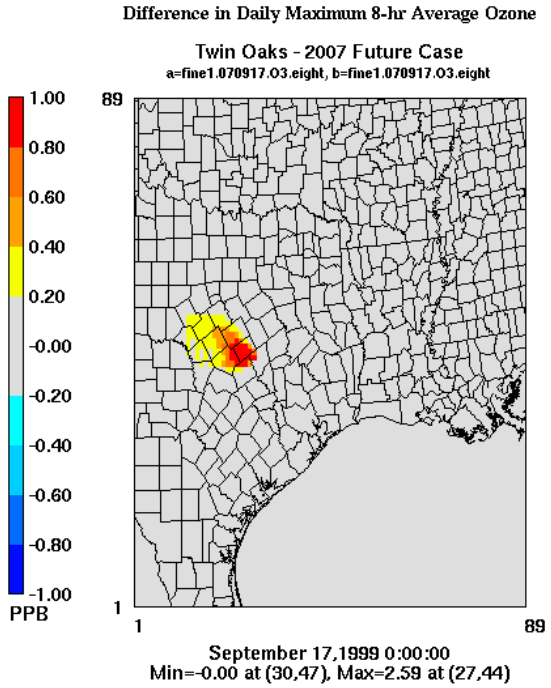


Figure A10. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 18 between the 2007 Future Case and 2007 Future Case with Twin Oaks.

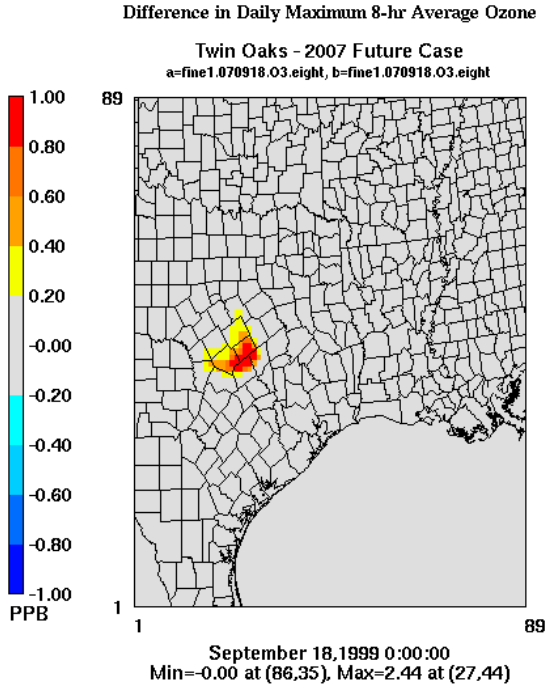


Figure A11. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 19 between the 2007 Future Case and 2007 Future Case with Twin Oaks.

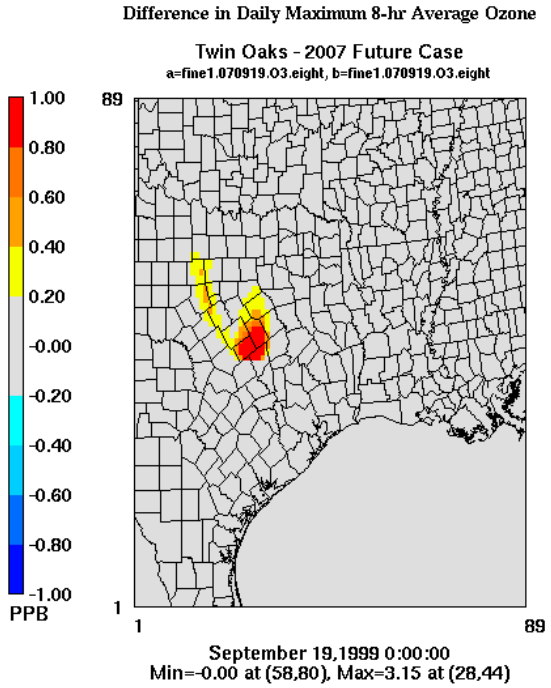


Figure A12. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 20 between the 2007 Future Case and 2007 Future Case with Twin Oaks

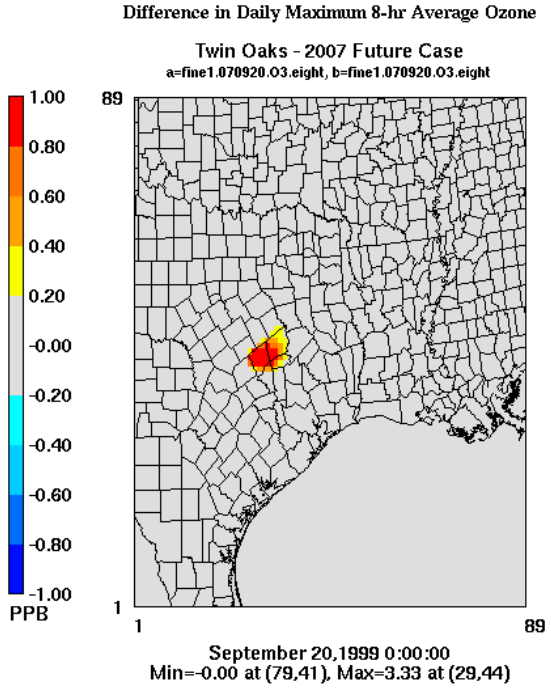


Figure A13. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 15 between the 2007 Future Case and 2007 Future Case with Oak Grove.

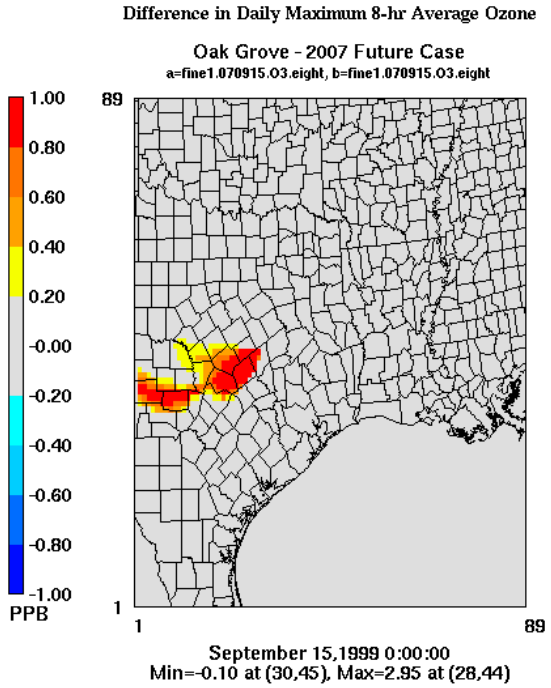


Figure A14. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 16 between the 2007 Future Case and 2007 Future Case with Oak Grove.

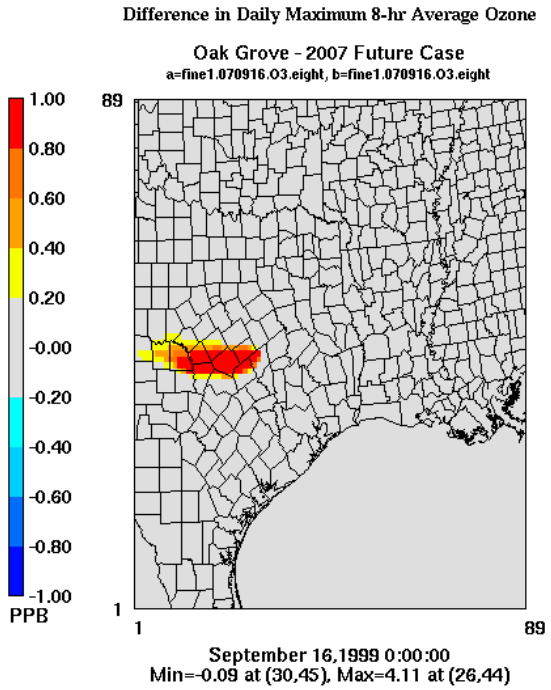


Figure A15. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 17 between the 2007 Future Case and 2007 Future Case with Oak Grove.

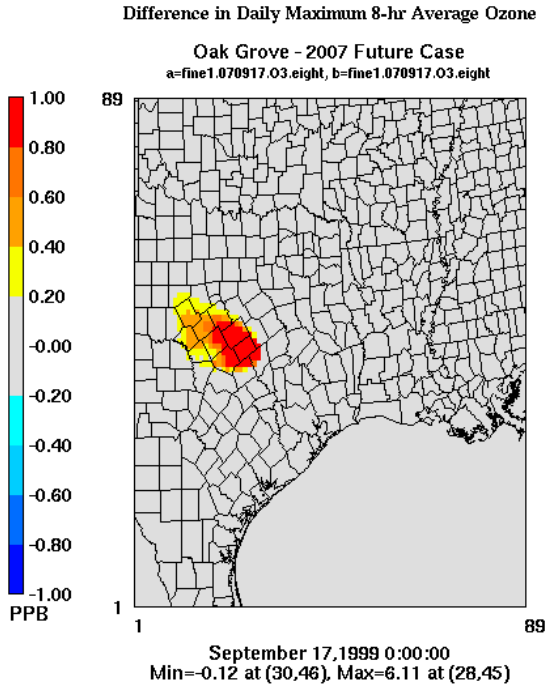


Figure A16. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 18 between the 2007 Future Case and 2007 Future Case with Oak Grove.

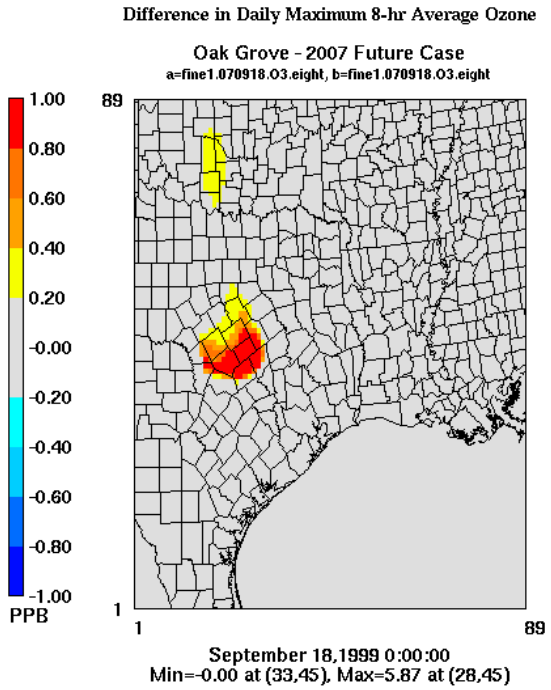


Figure A17. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 19 between the 2007 Future Case and 2007 Future Case with Oak Grove.

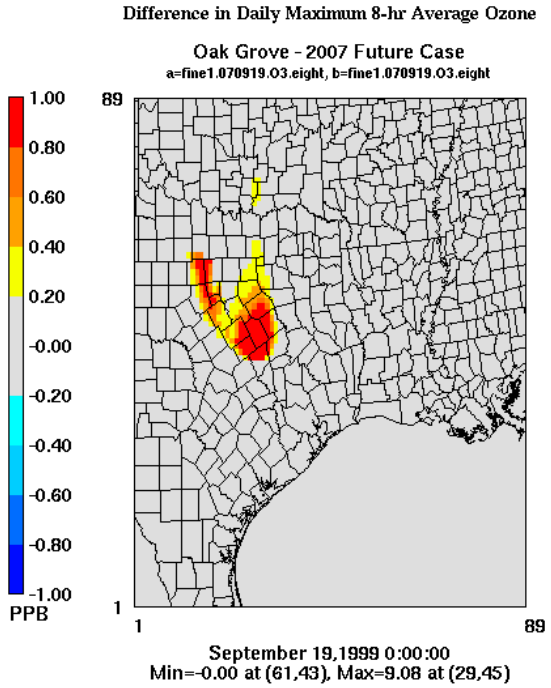


Figure A18. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 20 between the 2007 Future Case and 2007 Future Case with Oak Grove.

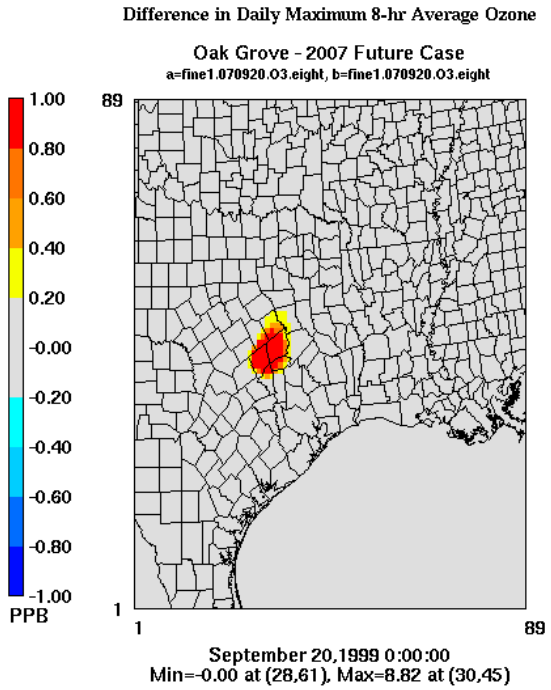


Figure A19. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 15 between the 2007 Future and 2007 Future Case with Sandy Creek + Twin Oaks + Oak Grove.

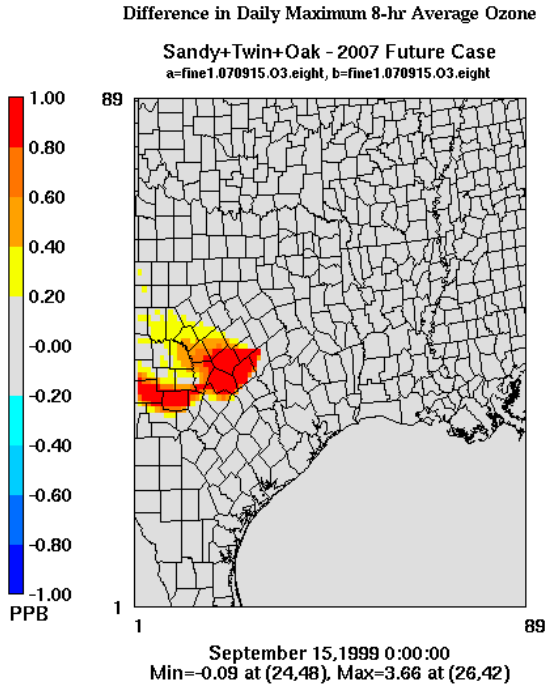


Figure A20. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 16 between the 2007 Future and 2007 Future Case with Sandy Creek + Twin Oaks + Oak Grove.

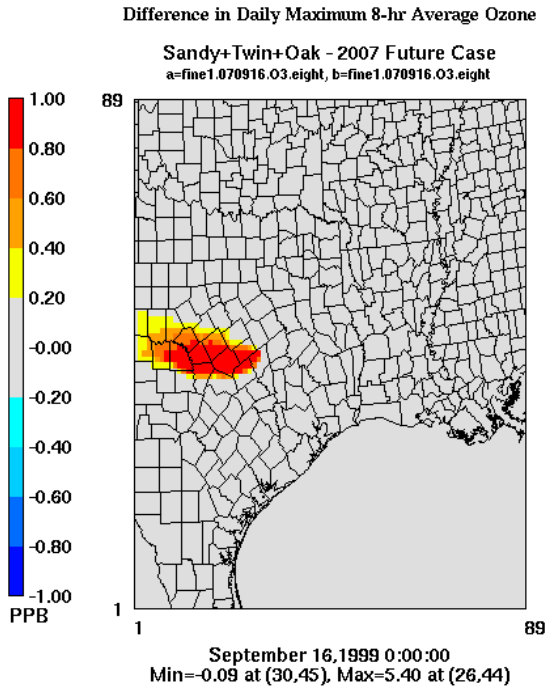


Figure A21. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 17 between the 2007 Future and 2007 Future Case with Sandy Creek + Twin Oaks + Oak Grove.

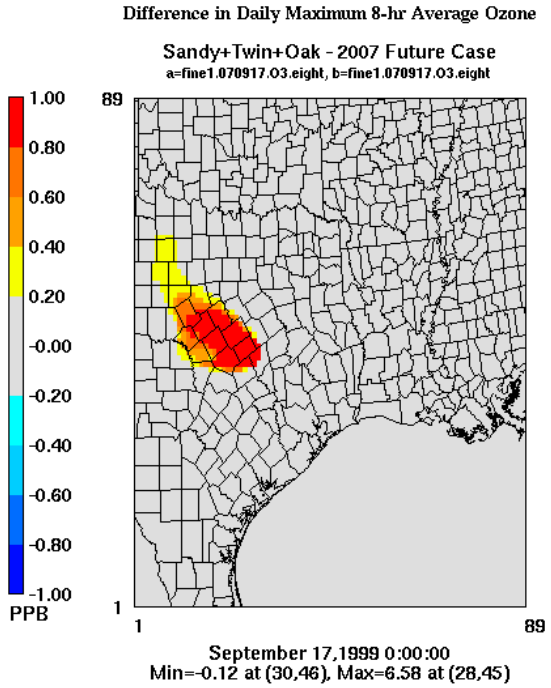


Figure A22. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 18 between the 2007 Future and 2007 Future Case with Sandy Creek + Twin Oaks + Oak Grove.

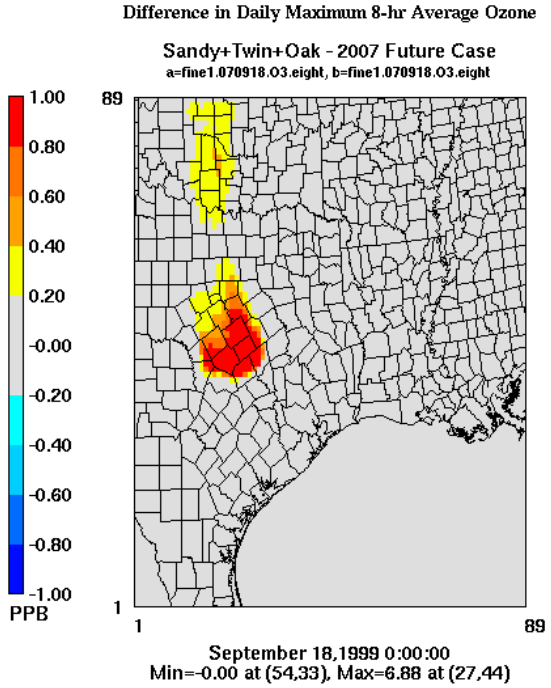


Figure A23. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 19 between the 2007 Future and 2007 Future Case with Sandy Creek + Twin Oaks + Oak Grove.

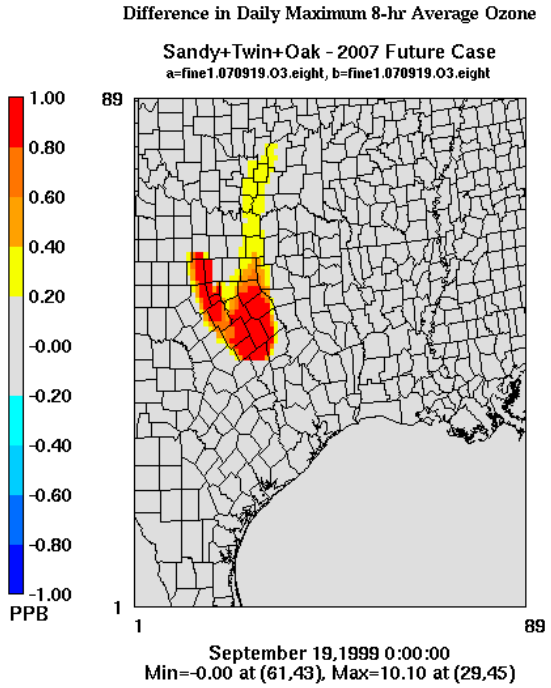


Figure A24. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 20 between the 2007 Future and 2007 Future Case with Sandy Creek + Twin Oaks + Oak Grove.

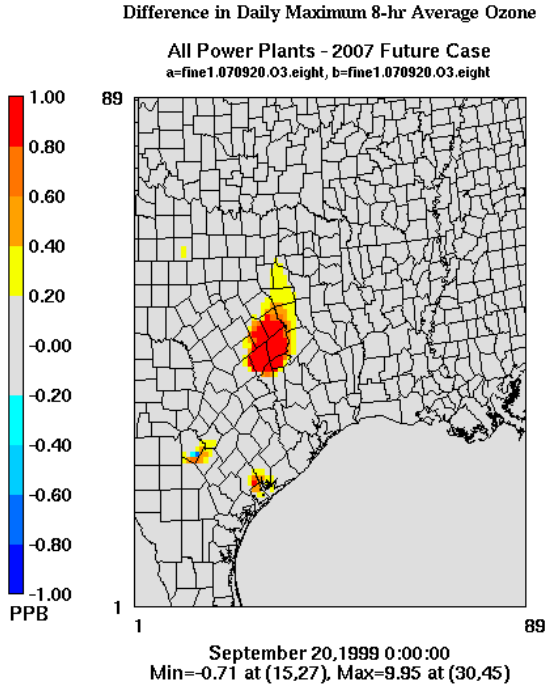


Figure A25. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 15 between the 2007 Future and 2007 Future Case with All Power Plants.

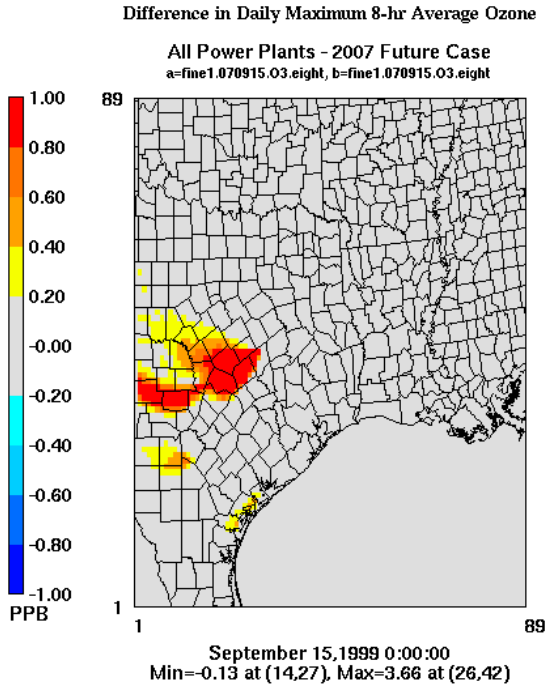


Figure A26. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 16 between the 2007 Future and 2007 Future Case with All Power Plants.

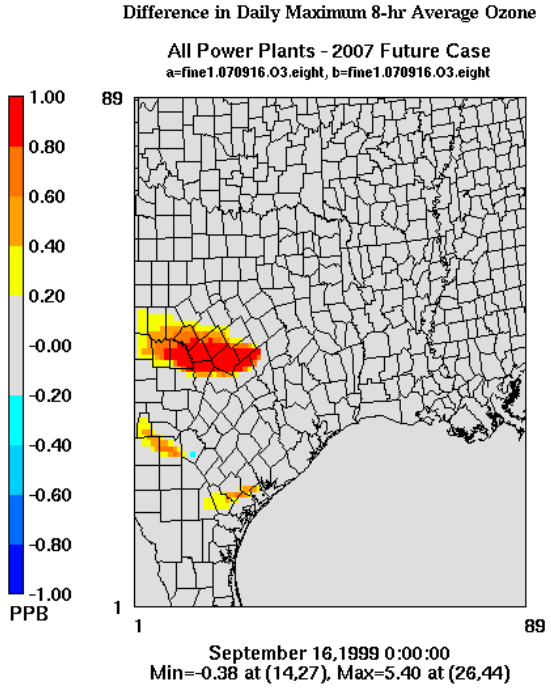


Figure A27. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 17 between the 2007 Future and 2007 Future Case with All Power Plants.

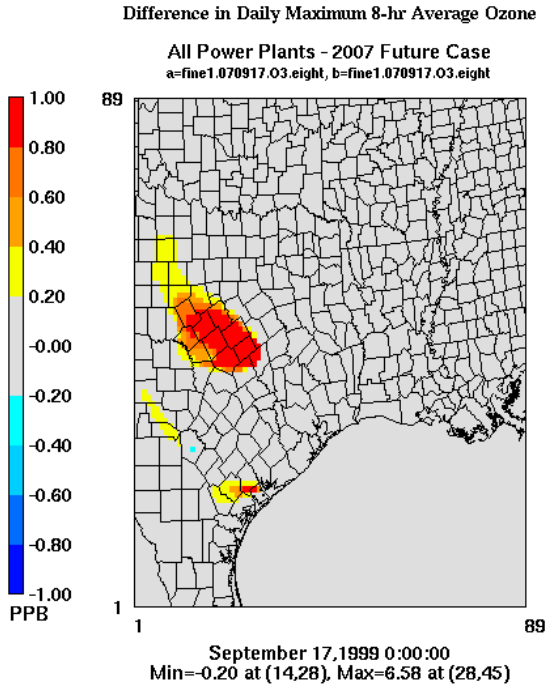


Figure A28. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 18 between the 2007 Future and 2007 Future Case with All Power Plants.

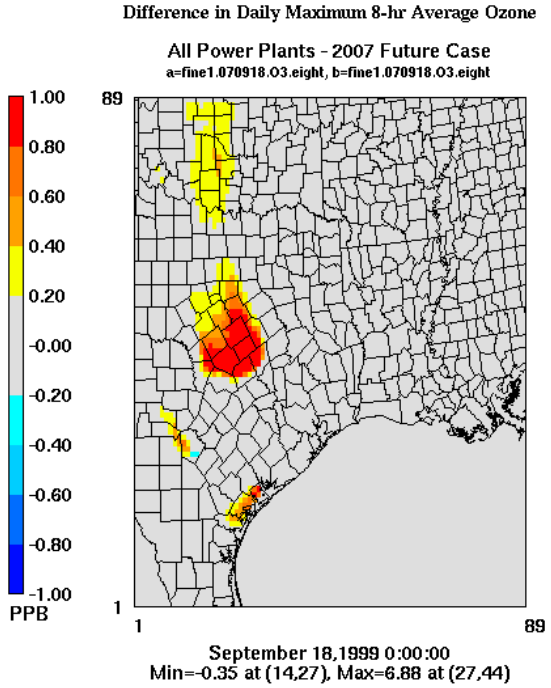


Figure A29. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 19 between the 2007 Future and 2007 Future Case with All Power Plants.

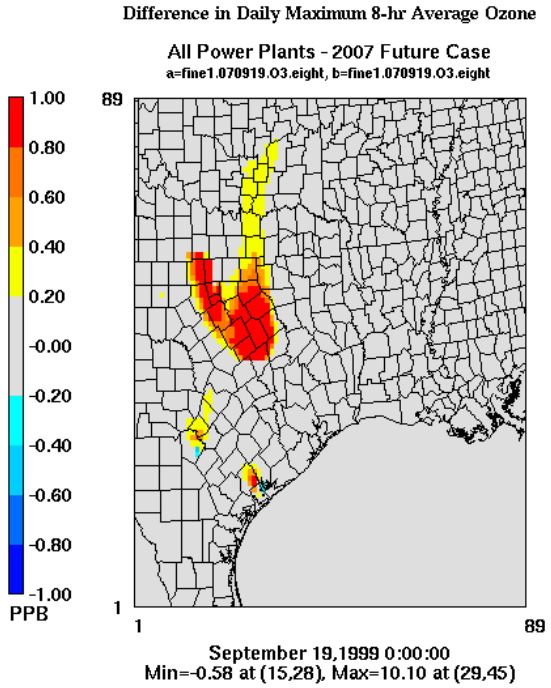


Figure A30. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 12-km CAMx domain on September 20 between the 2007 Future and 2007 Future Case with All Power Plants.

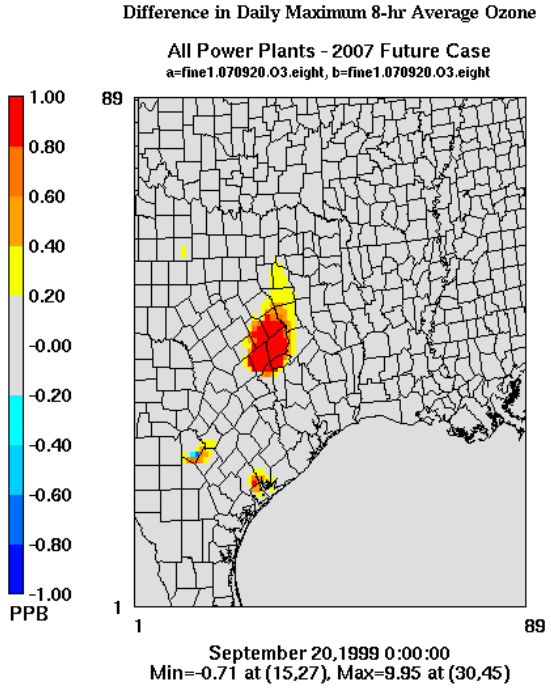


Figure A31. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 15 between the 2007 Future Case and 2007 Future Case with Sandy Creek.

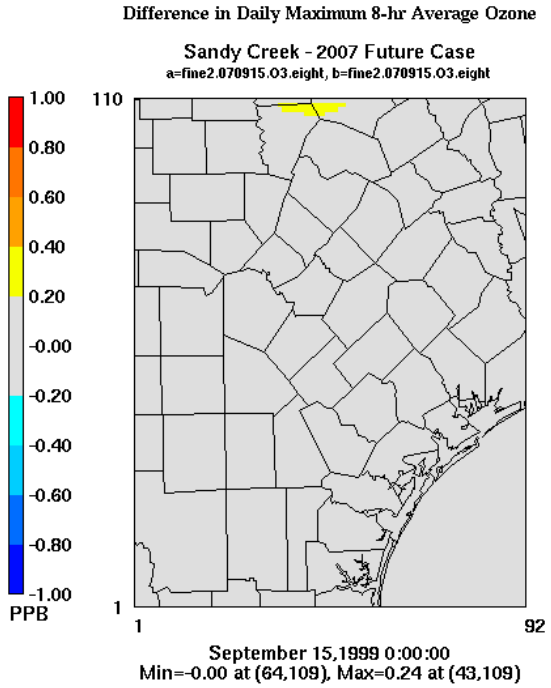


Figure A32. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 16 between the 2007 Future Case and 2007 Future Case with Sandy Creek.

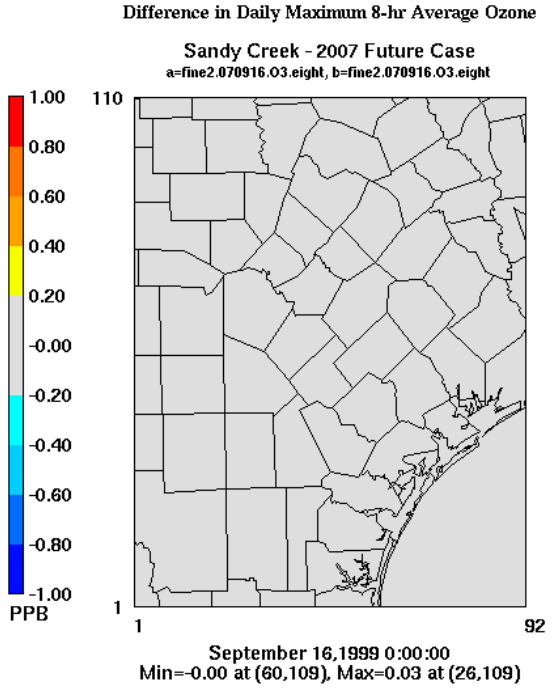


Figure A33. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 17 between the 2007 Future Case and 2007 Future Case with Sandy Creek.

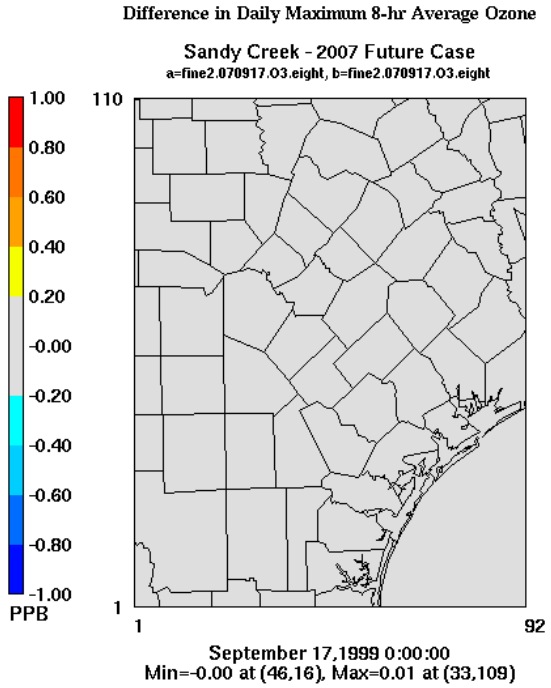


Figure A34. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 18 between the 2007 Future Case and 2007 Future Case with Sandy Creek.

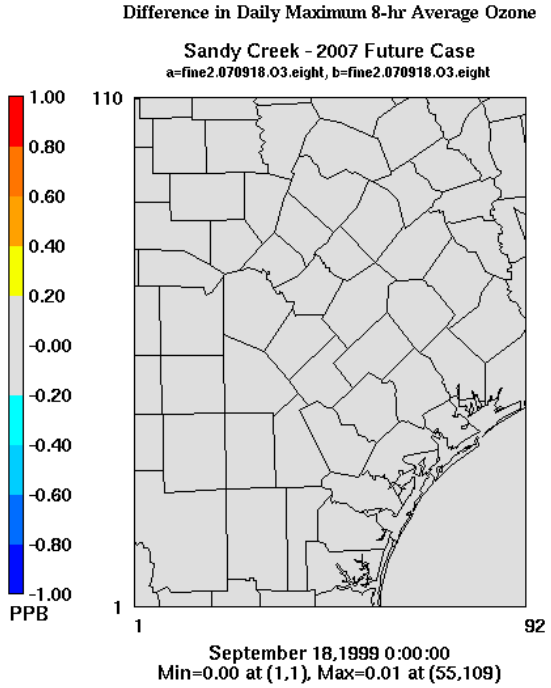


Figure A35. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 19 between the 2007 Future Case and 2007 Future Case with Sandy Creek.

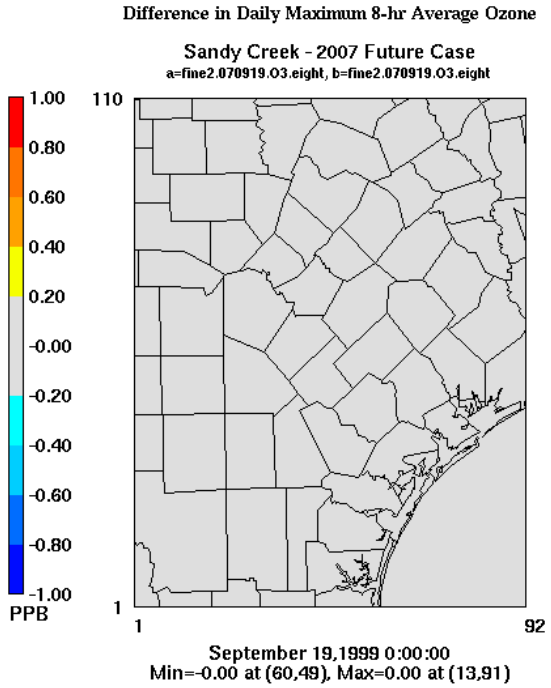


Figure A36. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 20 between the 2007 Future Case and 2007 Future Case with Sandy Creek.

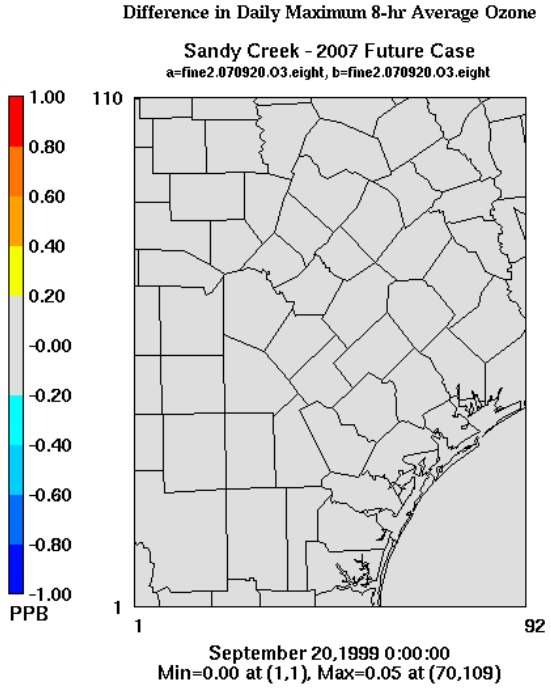


Figure A37. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 15 between the 2007 Future Case and 2007 Future Case with Twin Oaks.

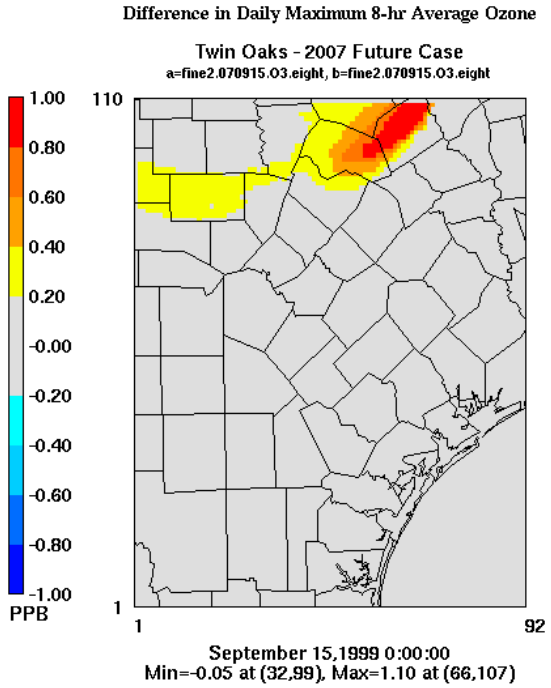


Figure A38. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 16 between the 2007 Future Case and 2007 Future Case with Twin Oaks.

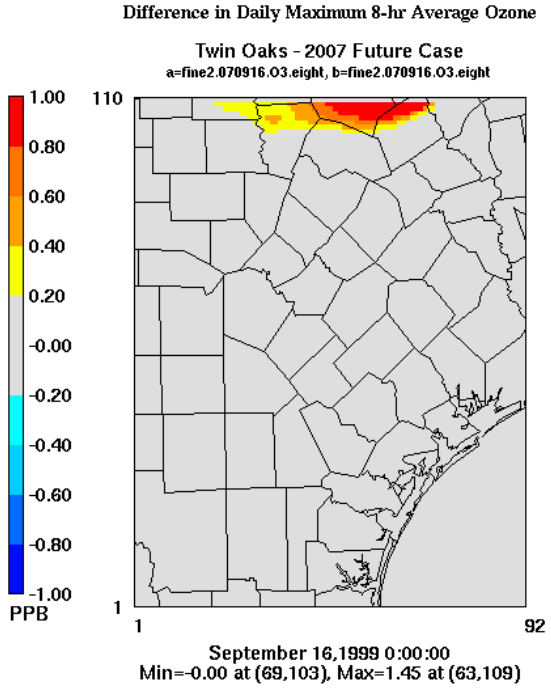


Figure A39. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 17 between the 2007 Future Case and 2007 Future Case with Twin Oaks.

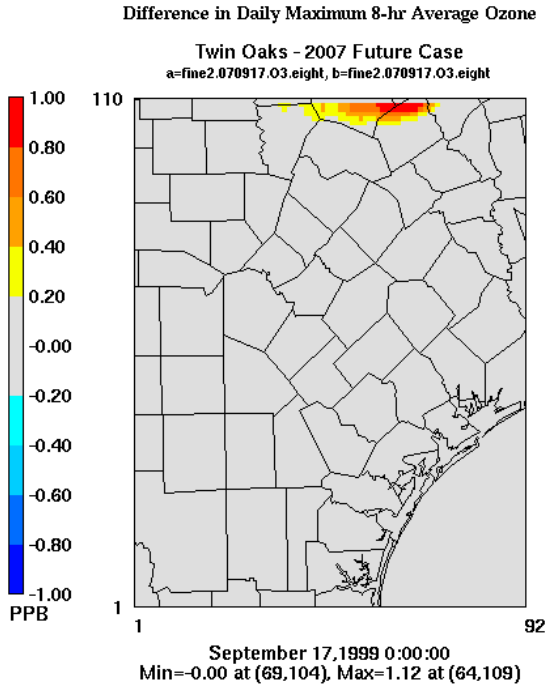


Figure A40. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 18 between the 2007 Future Case and 2007 Future Case with Twin Oaks.

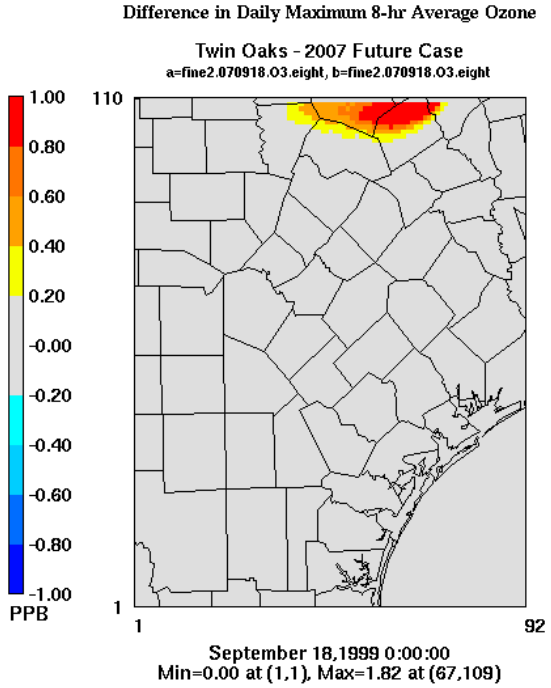


Figure A41. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 19 between the 2007 Future Case and 2007 Future Case with Twin Oaks.

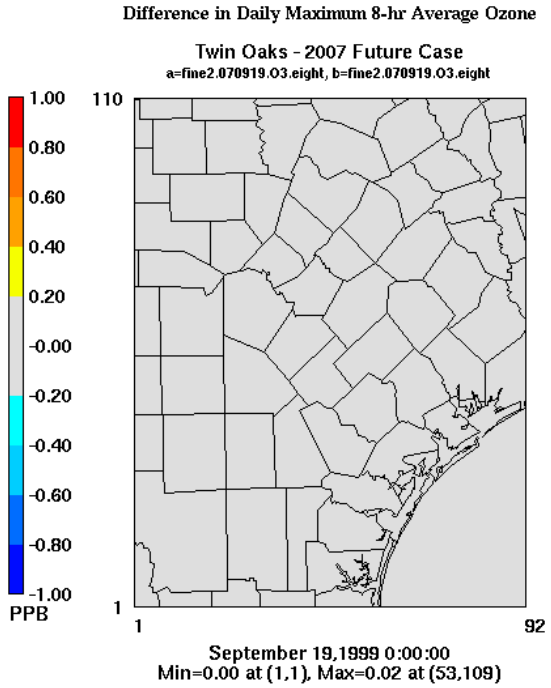


Figure A42. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 20 between the 2007 Future Case and 2007 Future Case with Twin Oaks

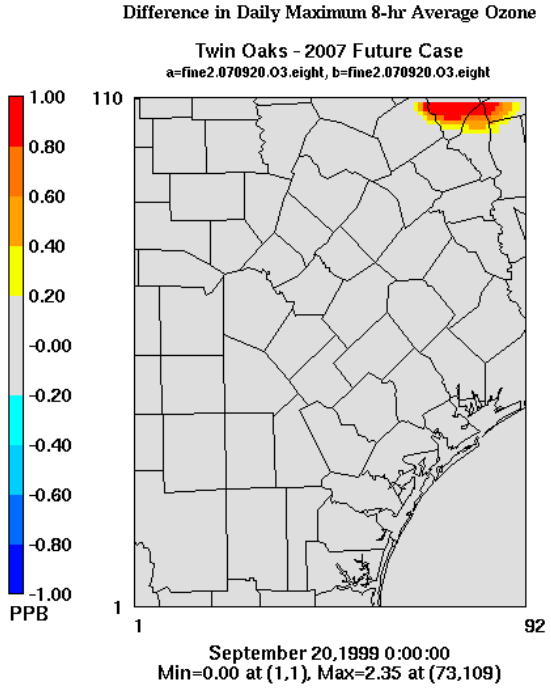


Figure A43. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 15 between the 2007 Future Case and 2007 Future Case with Oak Grove.

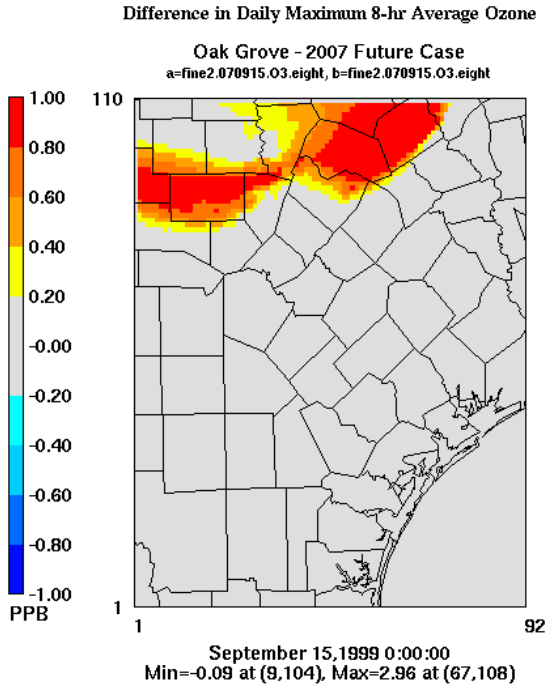


Figure A44. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 16 between the 2007 Future Case and 2007 Future Case with Oak Grove.

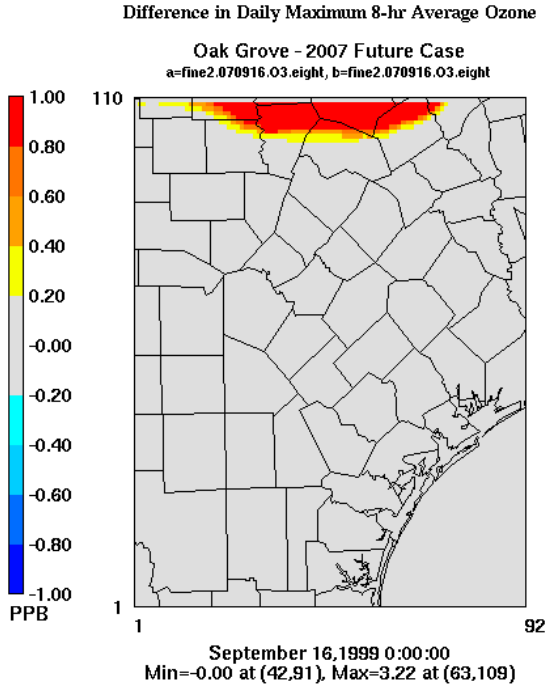


Figure A45. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 17 between the 2007 Future Case and 2007 Future Case with Oak Grove.

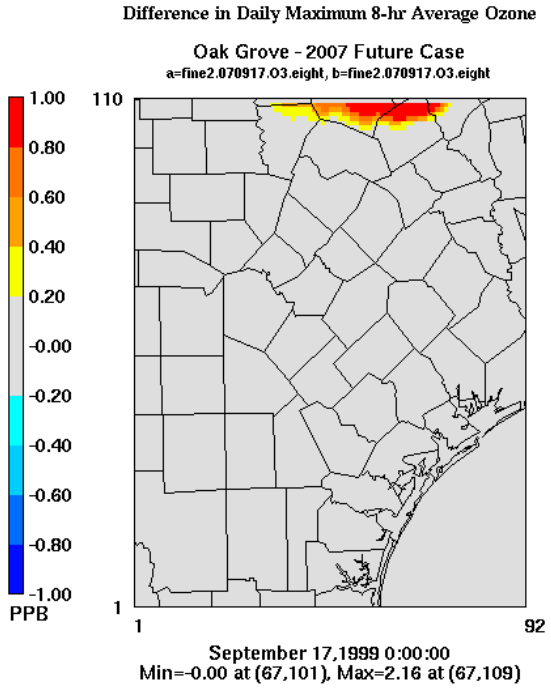


Figure A46. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 18 between the 2007 Future Case and 2007 Future Case with Oak Grove.

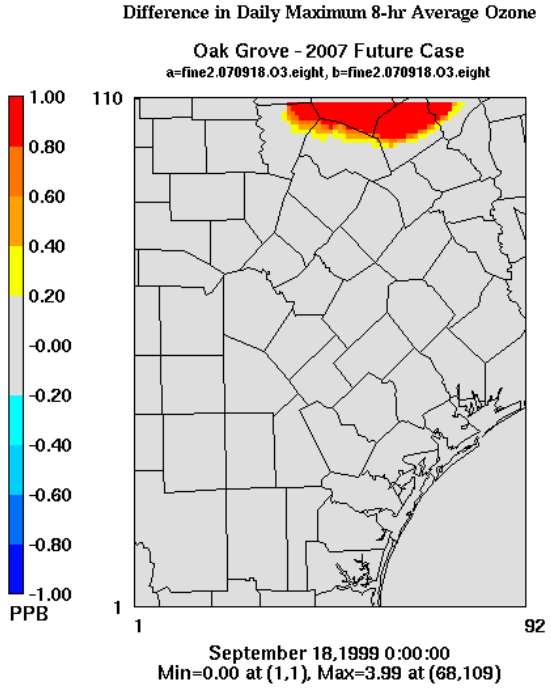


Figure A47. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 19 between the 2007 Future Case and 2007 Future Case with Oak Grove.

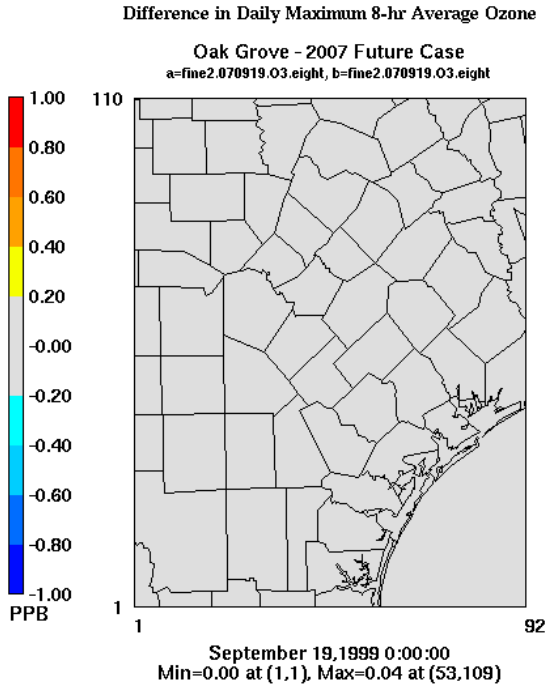


Figure A48. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 20 between the 2007 Future Case and 2007 Future Case with Oak Grove.

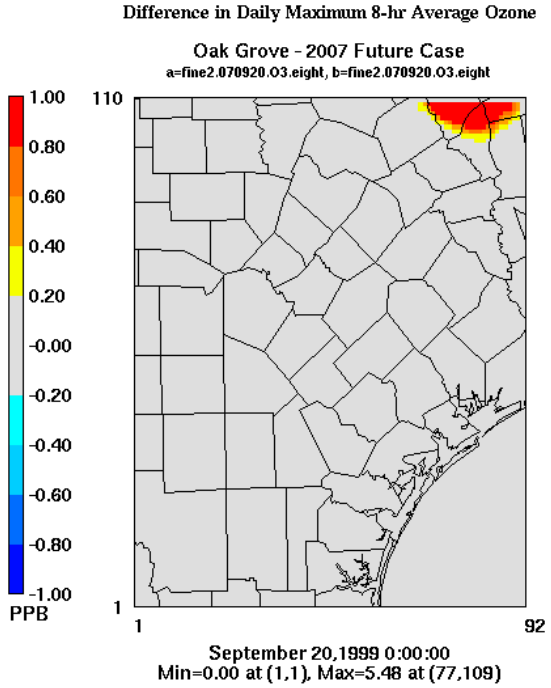


Figure A49. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 15 between the 2007 Future and 2007 Future Case with Sandy Creek + Twin Oaks + Oak Grove.

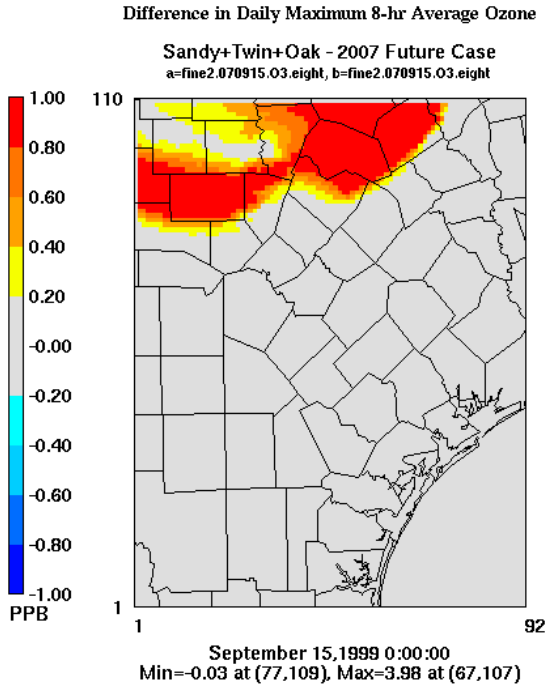


Figure A50. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 16 between the 2007 Future and 2007 Future Case with Sandy Creek + Twin Oaks + Oak Grove.

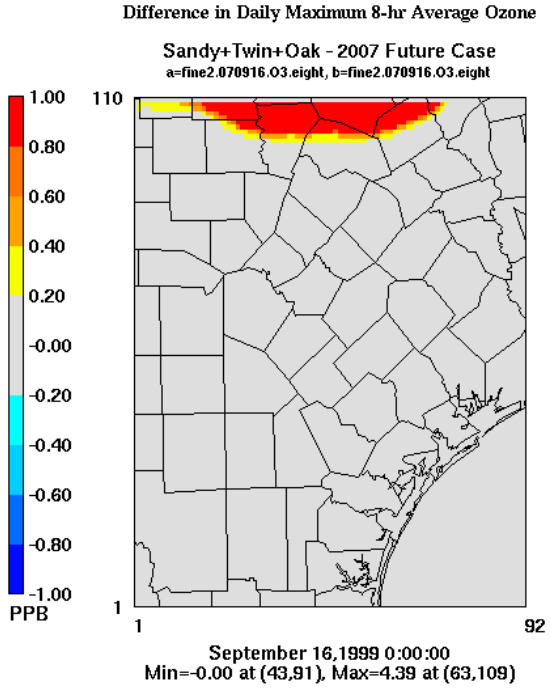


Figure A51. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 17 between the 2007 Future and 2007 Future Case with Sandy Creek + Twin Oaks + Oak Grove.

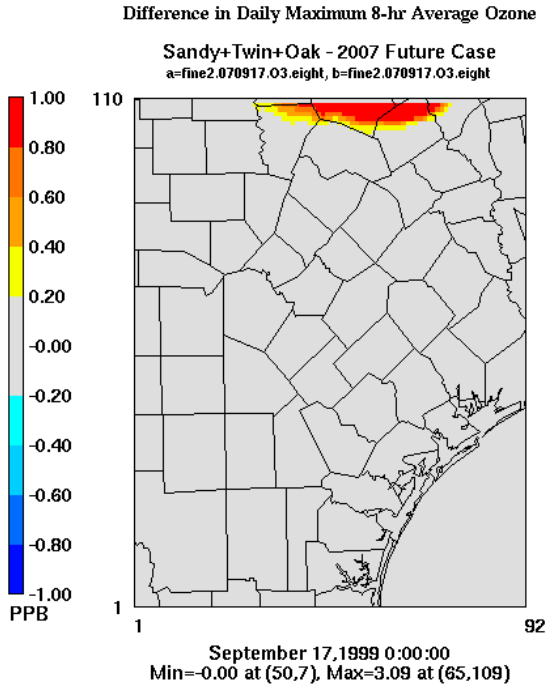


Figure A52. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 18 between the 2007 Future and 2007 Future Case with Sandy Creek + Twin Oaks + Oak Grove.

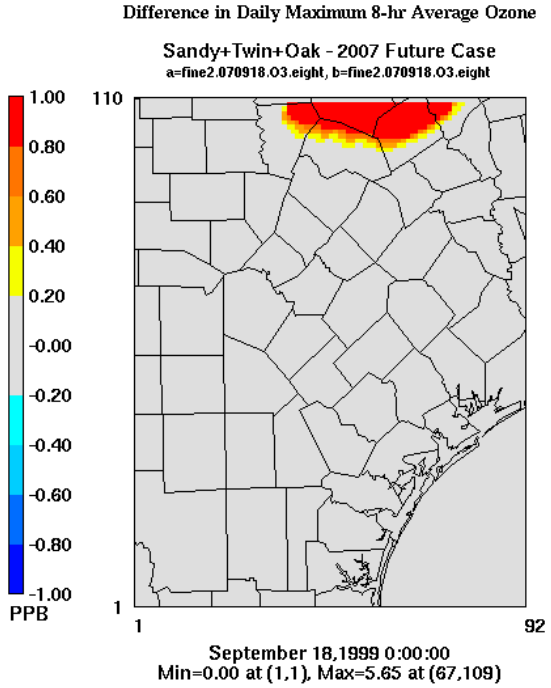


Figure A53. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 19 between the 2007 Future and 2007 Future Case with Sandy Creek + Twin Oaks + Oak Grove.

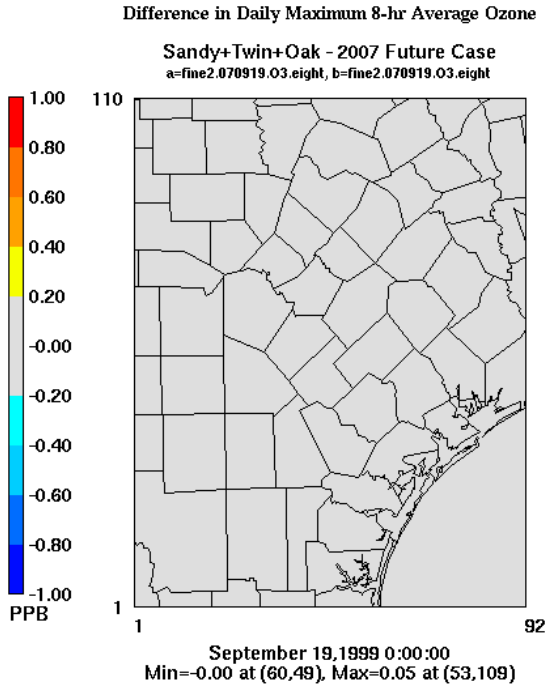


Figure A54. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 20 between the 2007 Future and 2007 Future Case with Sandy Creek + Twin Oaks + Oak Grove.

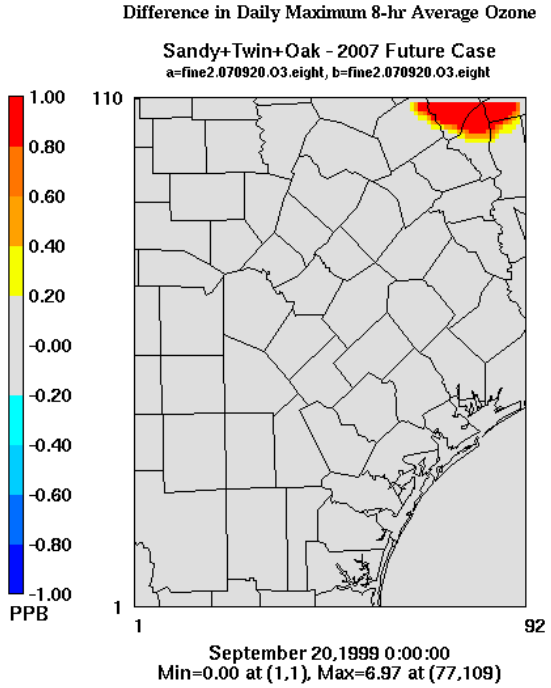


Figure A55. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 15 between the 2007 Future and 2007 Future Case with All Power Plants.

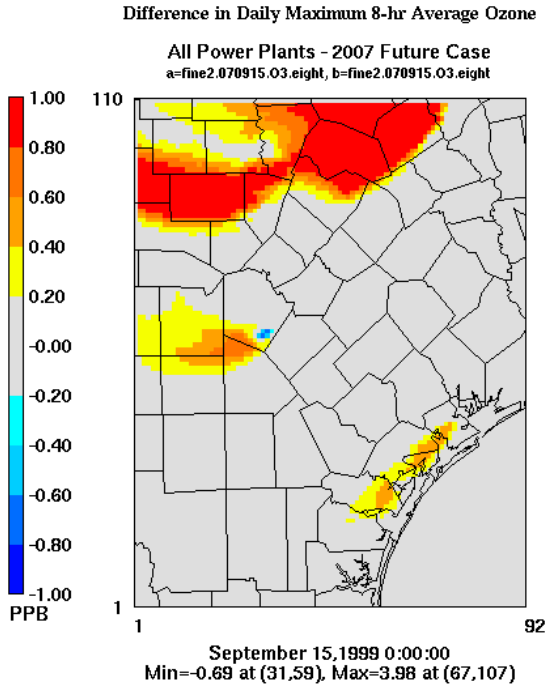


Figure A56. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 16 between the 2007 Future and 2007 Future Case with All Power Plants.

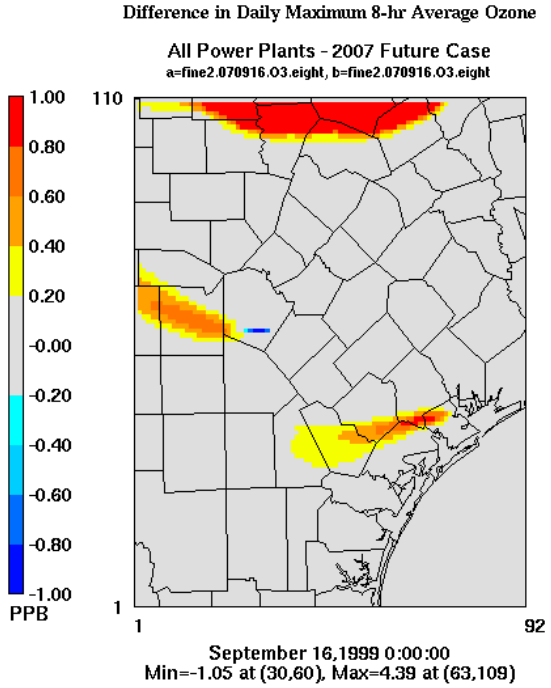
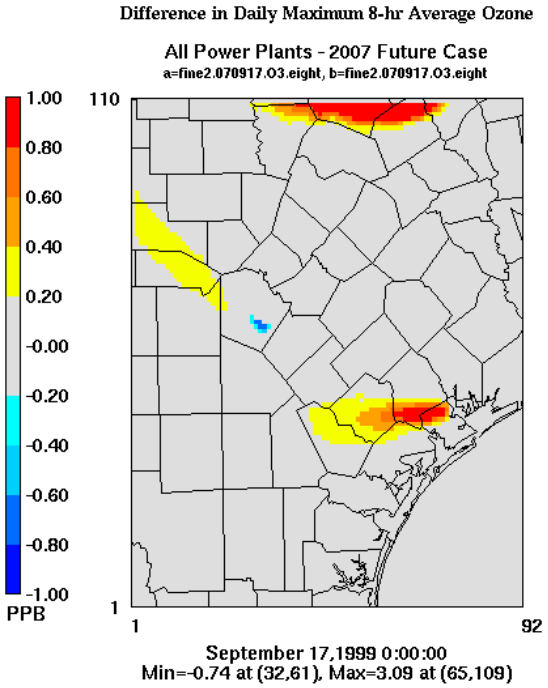


Figure A57. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 17 between the 2007 Future and 2007 Future Case with All Power Plants.



A58. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 18 between the 2007 Future and 2007 Future Case with All Power Plants.

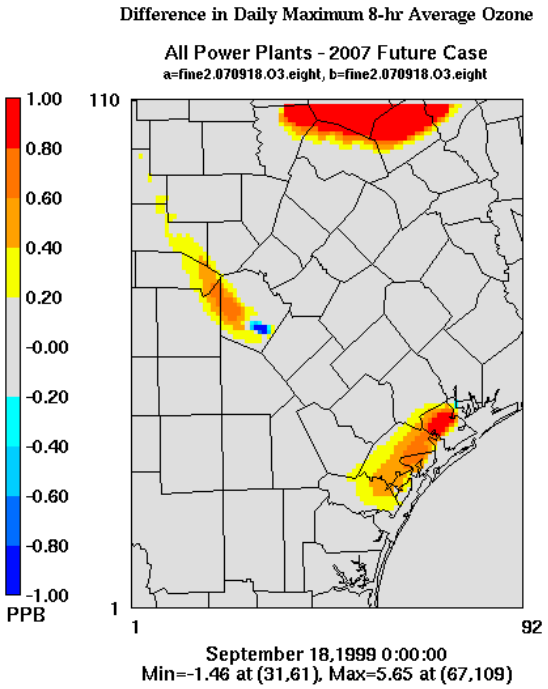


Figure A59. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 19 between the 2007 Future and 2007 Future Case with All Power Plants.

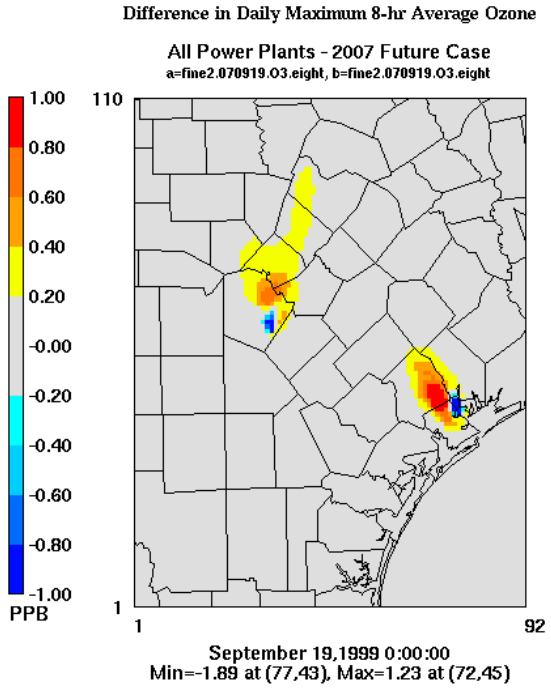


Figure A60. Difference in predicted daily maximum 8-hour averaged ozone concentrations on the 4-km CAMx domain on September 20 between the 2007 Future and 2007 Future Case with All Power Plants.