ENVIRON

MEMORANDUM

To: Pete Breitenbach

From: Edward Tai and Greg Yarwood

Date: June 22, 2006

Subject: Task 17: Revised DFW minor source controls

Introduction

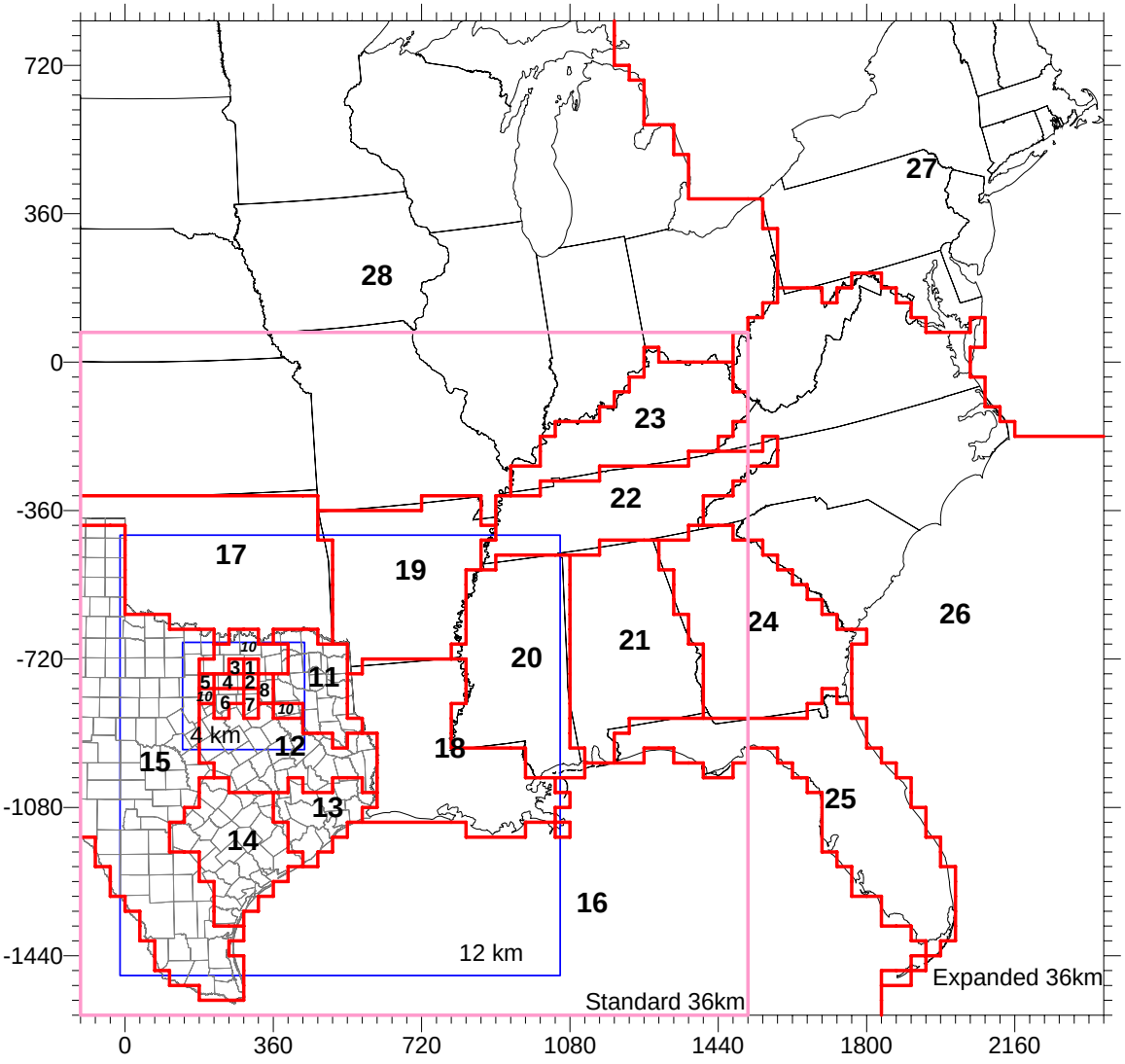
A CAMx sensitivity run (run44.fy2009.a1.dfw_minor2) examined the impact to 8-hour ozone in the DFW 9-county NAA during the August 13-22, 1999 episode for the 2009 future year when applying revised NOx controls on DFW minor sources to Houston ESAD levels.

The run was based on the Run 44 baseline configuration, with the modeling domain covering the expanded 36 km domain with 14 km model top. Inputs included meteorology from MM5 Run 6, which was based on the ETA PBL scheme coupled with the Noah land surface model, with the kv100 patch applied to the vertical diffusivity. The boundary conditions assigned moderate conditions in the mixed layer over land, and clean conditions over the Gulf, Atlantic and all areas aloft. A modified version of CAMx 4.03 was used in which several NOx recycling reactions were added to the CB4 mechanism (CB4xi).

Emissions

The controls were applied to the 2009 "a1" baseline emissions, which incorporated 2005 acid rain data for the Texas EGUs. NOx emissions from the DFW minor sources were reduced 4.6 tpd to achieve the same level as the Houston ESADs (down from 17.4 tpd in the original DFW minor source control in Task 12). Four counties accounted for 90 % of the NOx reduction – Denton, Dallas, Parker, and Tarrant Counties. VOCs were unchanged from the 2009 baseline.

A summary of the 2009 weekday NOx emissions is shown in Table 1 by source region, as defined in Figure 1, and by emission group (biogenics, elevated points, Texas mobile, low points, area, and off-road, and non-Texas low-level anthropogenics). The rightmost column shows the change in emissions from the 2009 baseline. The area with the largest NOx decrease from the 2009 baseline was in western Denton County, as can be seen in the tile plot in Figure 2.



DFW Source Regions. 36 km Expanded Domain

1. Collin Co.
2. Dallas Co.
3. Denton Co.
4. Tarrant Co.
5. Parker Co.
6. Johnson Co.
7. Ellis Co.
8. Kaufman Co.
9. Rockwall Co.
10. DFW 16-County
11. NE Texas
12. Central Texas
13. Houston
14. South Texas
15. West Texas
16. Gulf of Mexico + Mexico
17. Oklahoma
18. Louisiana
19. Arkansas
20. Mississippi
21. Alabama
22. Tennessee
23. Kentucky
24. Georgia
25. Florida
26. Mid Atlantic States
27. Northeast US
28. Northern Plains

Figure 1. Map of source regions in the 36 km expanded domain.

Table 1. Weekday NOx emissions in 2009 with revised DFW minor source controls.

NOx [tpd]	Bio	TX Mobile	Elev Points	TX Low Points	TX Area	TX Offroad	Non-TX Low Anthro	All Anthro	Anthro Change from 2009 baseline
Collin Co	10	15	1	0	2	8	0	26	-0.1
Dallas Co	4	77	6	2	17	45	0	148	-0.9
Denton Co	8	17	1	0	11	9	0	38	-1.6
Tarrant Co	3	46	2	2	9	28	0	88	-0.6
Parker Co	1	6	1	0	1	2	0	9	-0.9
Johnson Co	5	5	6	0	0	5	0	16	-0.2
Ellis Co	15	9	35	1	0	6	0	51	-0.1
Kaufman Co	5	6	4	0	0	2	0	13	0.0
Rockwall Co	2	3	0	0	0	1	0	5	0.0
DFW 9-County	**52**	**184**	**55**	**6**	**40**	**107**	**0**	**392**	**-4.4**
DFW 16 County	**83**	**212**	**80**	**10**	**62**	**123**	**0**	**487**	**-4.5**
NE Texas	16	79	189	16	71	42	1	397	0.0
Central TX	113	88	138	2	56	69	0	353	0.0
Houston	21	175	282	12	53	63	0	585	0.0
South TX	229	189	267	22	75	100	0	653	0.0
West TX	524	160	154	21	212	105	1	653	0.0
Texas	**986**	**904**	**1109**	**83**	**529**	**501**	**2**	**3128**	**-4.6**
Gulf + Mexico	79	5	437	0	4	2	444	892	0.0
Oklahoma	227	1	256	0	2	3	661	924	0.0
Louisiana	106	1	715	2	2	1	1183	1905	0.0
Arkansas	125	2	220	0	0	2	468	692	0.0
Mississippi	121	0	353	0	0	0	455	808	0.0
Alabama	75	0	442	0	0	0	491	932	0.0
Tennessee	118	0	244	0	0	0	662	906	0.0
Kentucky	145	0	289	0	0	0	770	1060	0.0
Georgia	110	0	408	0	0	0	823	1230	0.0
Florida	56	0	367	0	0	0	1206	1573	0.0
Mid Atlantic (SC, NC, VA, WV)	293	0	977	0	0	0	2332	3310	0.0
NE US	314	0	1302	0	0	0	5748	7051	0.0
Northern Plains	5238	0	3269	0	0	0	8623	11892	0.0
Total	**7992**	**913**	**10389**	**85**	**538**	**509**	**23869**	**36303**	**-4.6**
Total change from baseline	**0.0**	**0.0**	**0.0**	**0.0**	**-4.6**	**0.0**	**0.0**	**-4.6**	

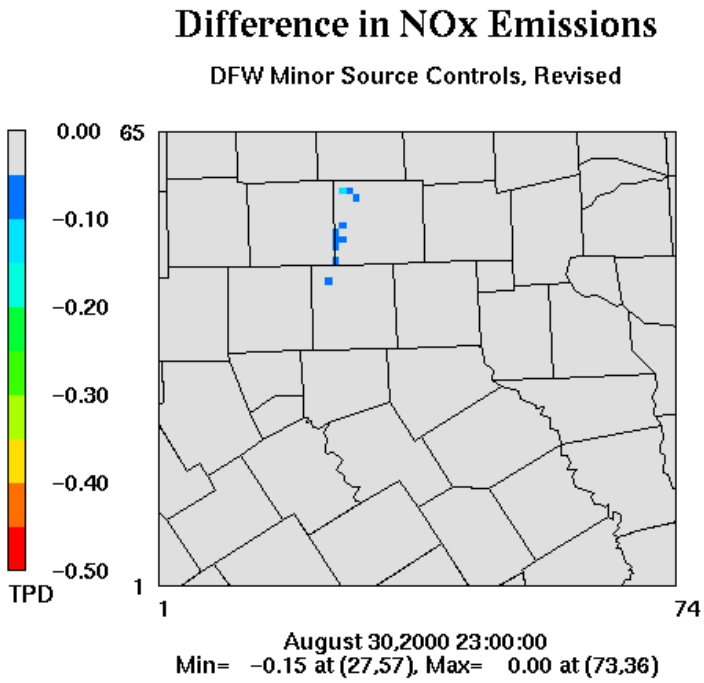


Figure 2. Tile plot of differences in NOx emissions from the revised DFW minor source controls.

Modeling Results

Spatial plots of the daily maximum 8-hour ozone and differences from the 2009 baseline are shown in Figure 3 for each episode date in the DFW 4 km domain. From August 18 to 20, the revised DFW minor source controls reduced 8-hour ozone between 0.25 to 0.4 ppb in parts of Parker County, and western Denton and Tarrant Counties. On all other episode dates, ozone was reduced less than 0.25 ppb throughout the DFW 9-county NAA.

The 8-hour ozone design value calculation is shown in Table 2 for all DFW monitoring sites using the 1999 baseline design value, and is compared to the 2009 baseline design values in Table 3. Fort Worth C13, which was the western-most monitoring site, had the largest future design value reduction of 0.11 ppb. Denton and Frisco were reduced 0.10 and 0.05 ppb, respectively.

Tables 4 to 6 examine the 4-km grid cells in the DFW 9-county NAA in which the daily maximum 8-hour ozone exceeded 85 ppb. Table 4 lists the number of unique grid cells in DFW that exceed 85 ppb for each date in both the 2009 baseline and control scenario. The rightmost column shows the percent change in exceedance area. The revised DFW minor source controls only dropped 10 (1 %) of the 1199 exceedance cells below 85 ppb, all occurring between August 17 and 19. Table 5 shows that no 8-hour ozone exceedance cells were reduced more than 1 ppb from the controls during the episode.

Table 6 sums the number of ppb's in the daily maximum 8-hour ozone that exceed 85 ppb. For example, if the daily maximum ozone in a grid cell is 90 ppb, the grid cell adds 5 ppb (90 – 85 ppb) to the sum of ozone exceedances. The episode averaged a 1.2 % reduction.

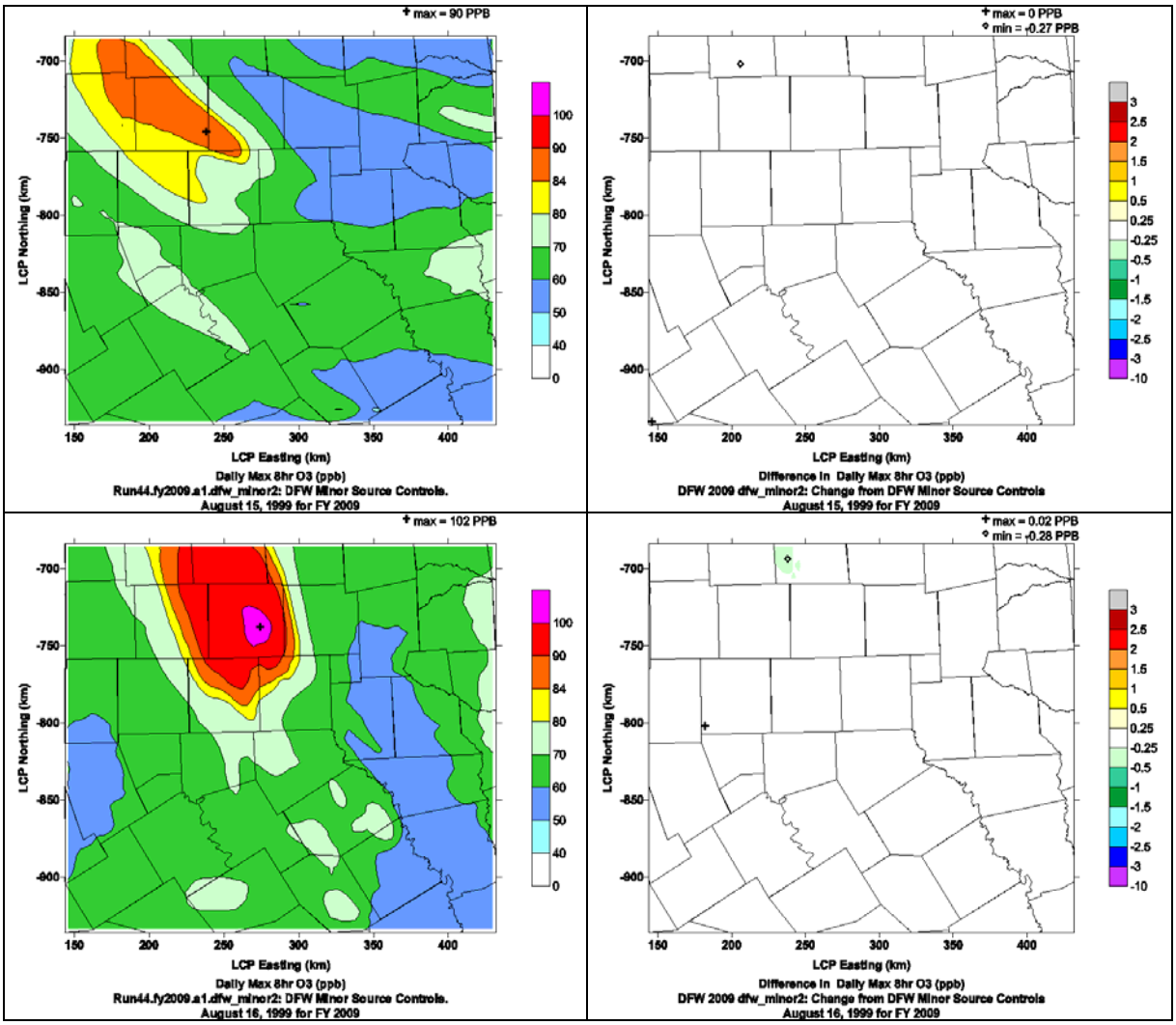


Figure 3. Spatial plots of the daily maximum 8-hour ozone with the revised DFW minor source controls (left) and differences from the 2009 baseline (right).

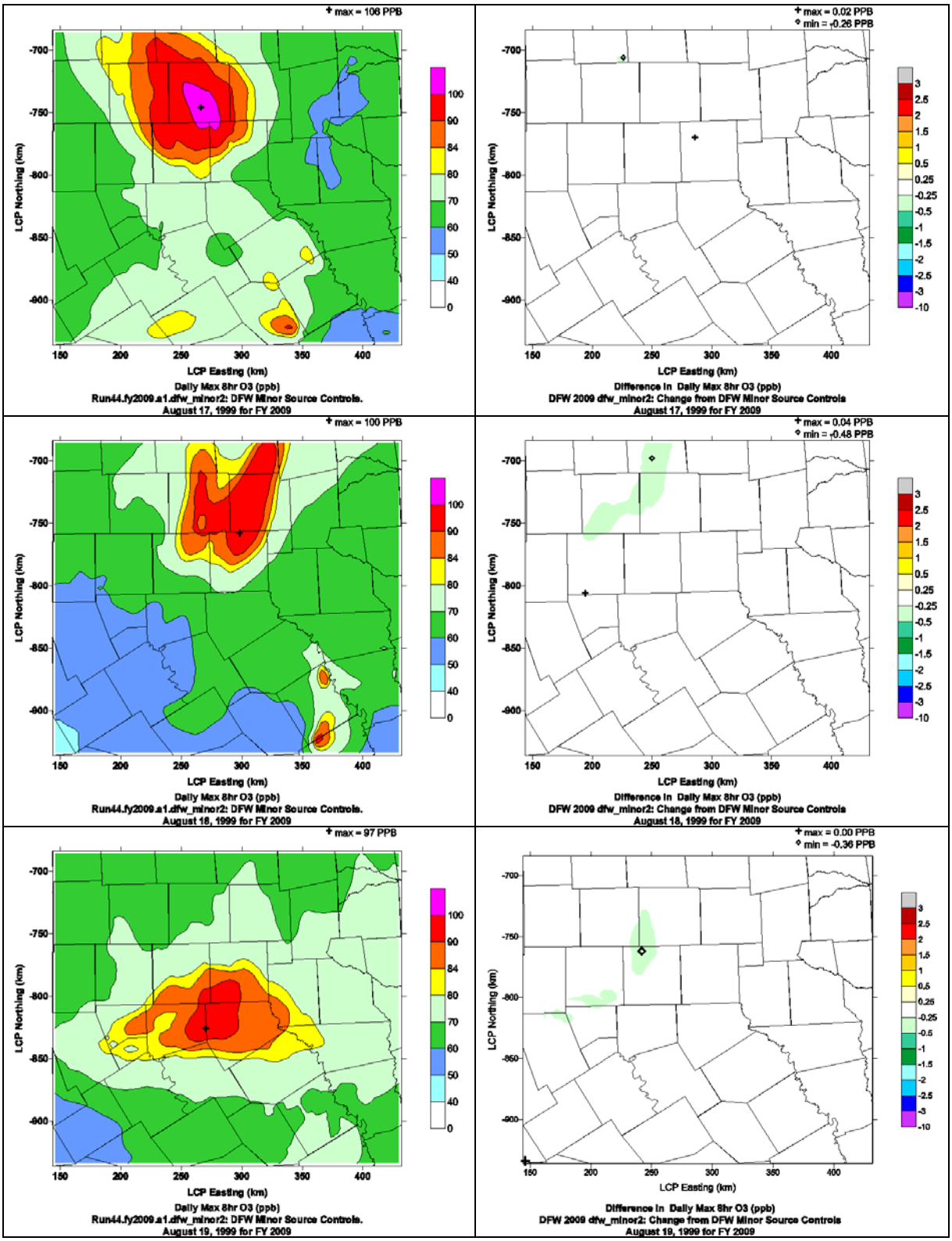


Figure 3. (Continued) Spatial plots of the daily maximum 8-hour ozone with the revised DFW minor source controls (left) and differences from the 2009 baseline (right).

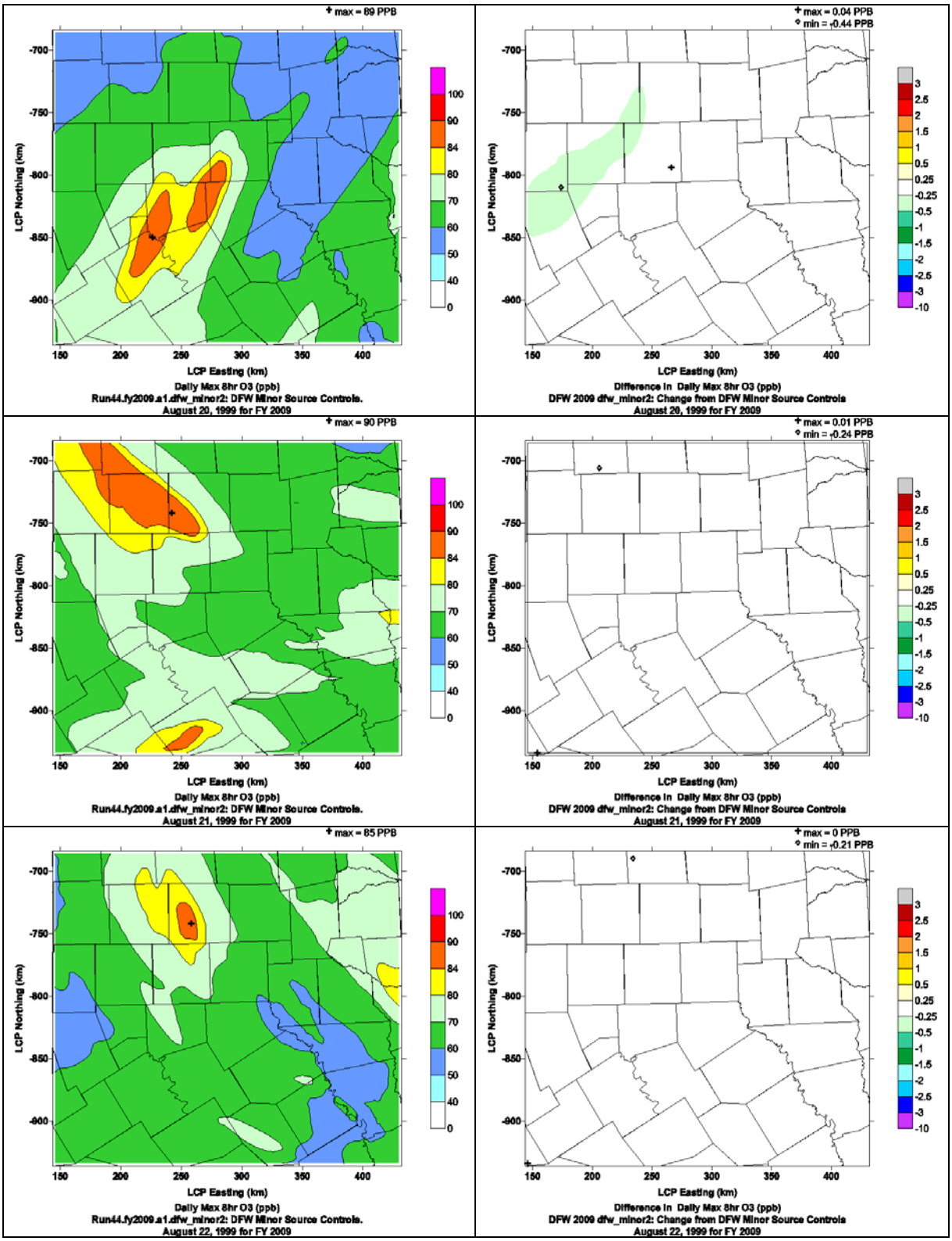


Figure 3. (Concluded) Spatial plots of the daily maximum 8-hour ozone with the revised DFW minor source controls (left) and differences from the 2009 baseline (right).

Table 2. Design value calculation for the revised DFW minor source control scenario.

Base Case: run44												
Site	**990815**	**990816**	**990817**	**990818**	**990819**	**990820**	**990821**	**990822**	**Average**	**#Days>70**		
Frisco	80.7	105.6	99.0	104.9	85.6	70.0	85.9	89.4	90.1	8		
Dallas C60	83.2	98.1	100.6	102.8	96.7	77.4	86.0	85.1	91.2	8		
North Dallas C63	82.8	99.6	99.0	104.7	94.0	76.0	86.0	87.5	91.2	8		
Dallas C402	78.3	92.9	98.0	98.3	104.7	84.7	80.5	80.6	89.7	8		
Denton	102.4	110.5	108.5	113.0	83.9	72.4	101.6	100.1	99.0	8		
Midlothian	75.5	85.0	86.2	78.0	111.8	89.6	75.0	74.9	84.5	8		
Arlington	86.3	98.3	99.6	94.5	104.5	84.2	81.8	86.6	92.0	8		
Fort Worth C13	94.2	105.4	102.6	104.2	94.9	79.9	90.9	91.9	95.5	8		
Fort Worth C17	100.4	110.1	107.6	106.8	92.3	77.9	95.1	97.3	98.4	8		
Future Year: run44.fy2009.a1.dfw_minor2												
Site	**990815**	**990816**	**990817**	**990818**	**990819**	**990820**	**990821**	**990822**	**Average**	**RRF[1]**	**BaseDV**	**FutureDV[2]**
Frisco	68.3	100.1	100.4	98.3	73.1	64.9	75.1	75.3	81.9	0.909	100.3	91.2
Dallas C60	73.7	93.0	102.1	99.5	89.3	82.6	79.2	75.0	86.8	0.951	92.0	87.5
North Dallas C63	71.6	95.7	100.4	99.9	83.9	78.8	77.8	74.2	85.3	0.935	93.0	87.0
Dallas C402	68.4	82.5	90.3	88.1	95.6	87.6	72.2	70.2	81.9	0.912	87.3	79.6
Denton	88.5	102.3	106.5	92.0	70.9	63.9	89.5	85.1	87.3	0.882	101.5	89.5
Midlothian	70.6	76.1	78.3	70.5	97.3	87.0	69.2	68.4	77.2	0.913	92.5	84.5
Arlington	74.3	90.3	91.5	83.5	94.3	87.6	74.1	79.5	84.4	0.918	95.0	87.2
Fort Worth C13	81.5	94.8	93.7	88.1	83.5	76.4	80.4	81.6	85.0	0.890	98.3	87.5
Fort Worth C17	88.8	97.6	102.5	90.5	79.6	71.0	87.8	84.5	87.8	0.892	96.3	85.9
Daily RRFs[3]												
Site	**990815**	**990816**	**990817**	**990818**	**990819**	**990820**	**990821**	**990822**				
Frisco	0.846	0.947	1.014	0.937	0.854	0.926	0.874	0.843				
Dallas C60	0.887	0.947	1.014	0.968	0.924	1.067	0.920	0.881				
North Dallas C63	0.866	0.960	1.014	0.954	0.893	1.038	0.904	0.848				
Dallas C402	0.874	0.889	0.921	0.897	0.913	1.034	0.897	0.871				
Denton	0.865	0.925	0.982	0.815	0.845	0.882	0.881	0.850				
Midlothian	0.934	0.895	0.908	0.904	0.871	0.972	0.923	0.913				
Arlington	0.861	0.918	0.919	0.884	0.902	1.041	0.906	0.917				
Fort Worth C13	0.865	0.900	0.913	0.846	0.880	0.957	0.885	0.888				
Fort Worth C17	0.884	0.886	0.952	0.848	0.862	0.912	0.924	0.868				

1. RRF = Future year average / base year average
2. Future DV = Baseline DV * RRF
3. Daily RRFs are for information only and are not used to calculate the future DVs.

Table 3. 2009 design value summary [ppb].

Run	run44.fy2009.a1	run44.fy2009.a1.dfw_minor2	
Scenario	2009 baseline	DFW minor sources at HGB ESADs, revised	Difference from 2009 baseline [ppb]
Frisco	91.2	91.2	-0.05
Dallas C60	87.6	87.5	-0.07
Dallas C63	87.0	87.0	-0.05
Dallas C402	79.7	79.6	-0.06
Denton	89.6	89.5	-0.10
Midlothian	84.5	84.5	-0.08
Arlington	87.2	87.2	-0.02
Fort Worth C13	87.6	87.5	-0.11
Fort Worth C17	86.0	85.9	-0.06

Table 4. Exceedance Area (Number of 4-km grid cells in DFW with daily maximum 8-hour ozone > 85 ppb).

Run	run44.fy2009.a1	run44.fy2009.a1.dfw_minor2	Difference [%}
Scenario	2009 baseline	DFW minor sources at HGB ESADs, revised	
990815	19	19	0%
990816	223	223	0%
990817	296	295	0%
990818	253	250	-1%
990819	304	298	-2%
990820	70	70	0%
990821	29	29	0%
990822	5	5	0%
Total	1199	1189	-1%

Table 5. Number of exceedance 4-km grid cells reduced at least 1 ppb.

Run	run44.fy2009.a1.dfw_minor2
Scenario	DFW minor sources at HGB ESADs, revised
990815	0
990816	0
990817	0
990818	0
990819	0
990820	0
990821	0
990822	0
Total	0

Table 6. Number of ppb's from 4-km grid cells in the daily maximum 8-hour ozone in excess of 85 ppb[1].

Run	run44.fy2009.a1	run44.fy2009.a1.dfw_minor2
Scenario	2009 baseline	DFW minor sources at HGB ESADs, revised
990815	50	48
990816	2184	2166
990817	2594	2577
990818	1660	1641
990819	1201	1169
990820	84	80
990821	74	72
990822	1	0
Total	7846	7753
% Difference		-1.2 %

[1] Σ(max(O3-85, 0.0))

Summary

A CAMx sensitivity test examined the 8-hour ozone impacts from revised DFW minor source controls to reduce NOx emissions to the same level as the Houston ESADs. The controls lowered NOx emissions by 4.6 tpd, of which a third were found in western Denton County.

Ozone benefits between 0.25 and 0.40 ppb were found in parts of Parker County and western Denton and Tarrant Counties from August 18 to 20. On all other dates, 8-hour ozone was reduced less than 0.25 ppb throughout the DFW 9-county NAA. Future design values were reduced 0.02 ppb to 0.11 ppb among all monitoring sites; Denton and Frisco were 0.10 and 0.05 ppb lower, respectively. The 8-hour ozone benefits were less than other sensitivity tests due to two factors: (1) the change in NOx emissions was relatively small, and (2) a majority of the emission reductions was downwind of the monitoring sites on most dates.