TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Update on DFW Photochemical Modeling

Technical Analysis Division
Brian Foster

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27 Pages

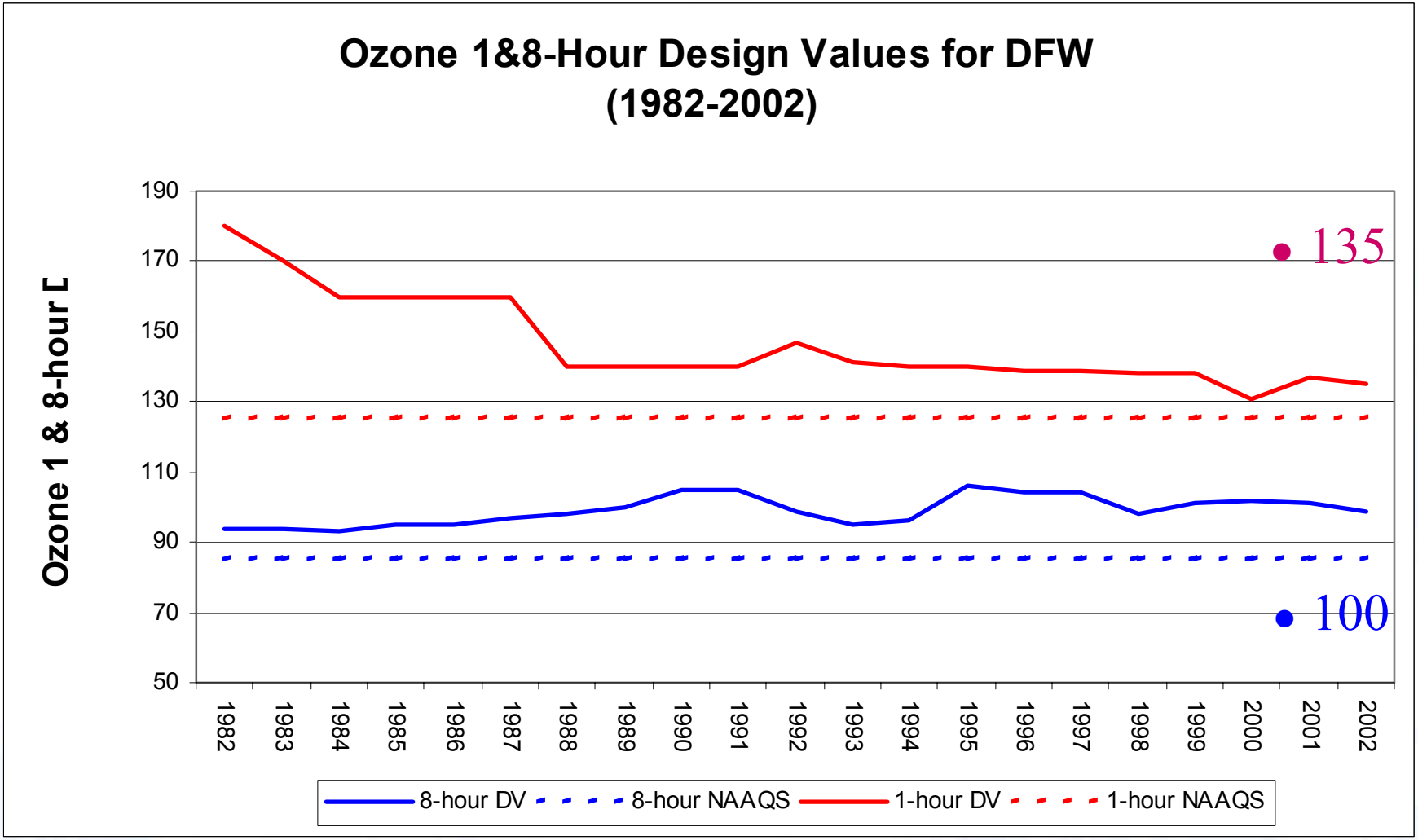
Update on DFW Photochemical Modeling

- 1999 Base Case Modeling
- Base Case Source Apportionment
- Base Case Modeling Conclusions
- Status of Future Modeling

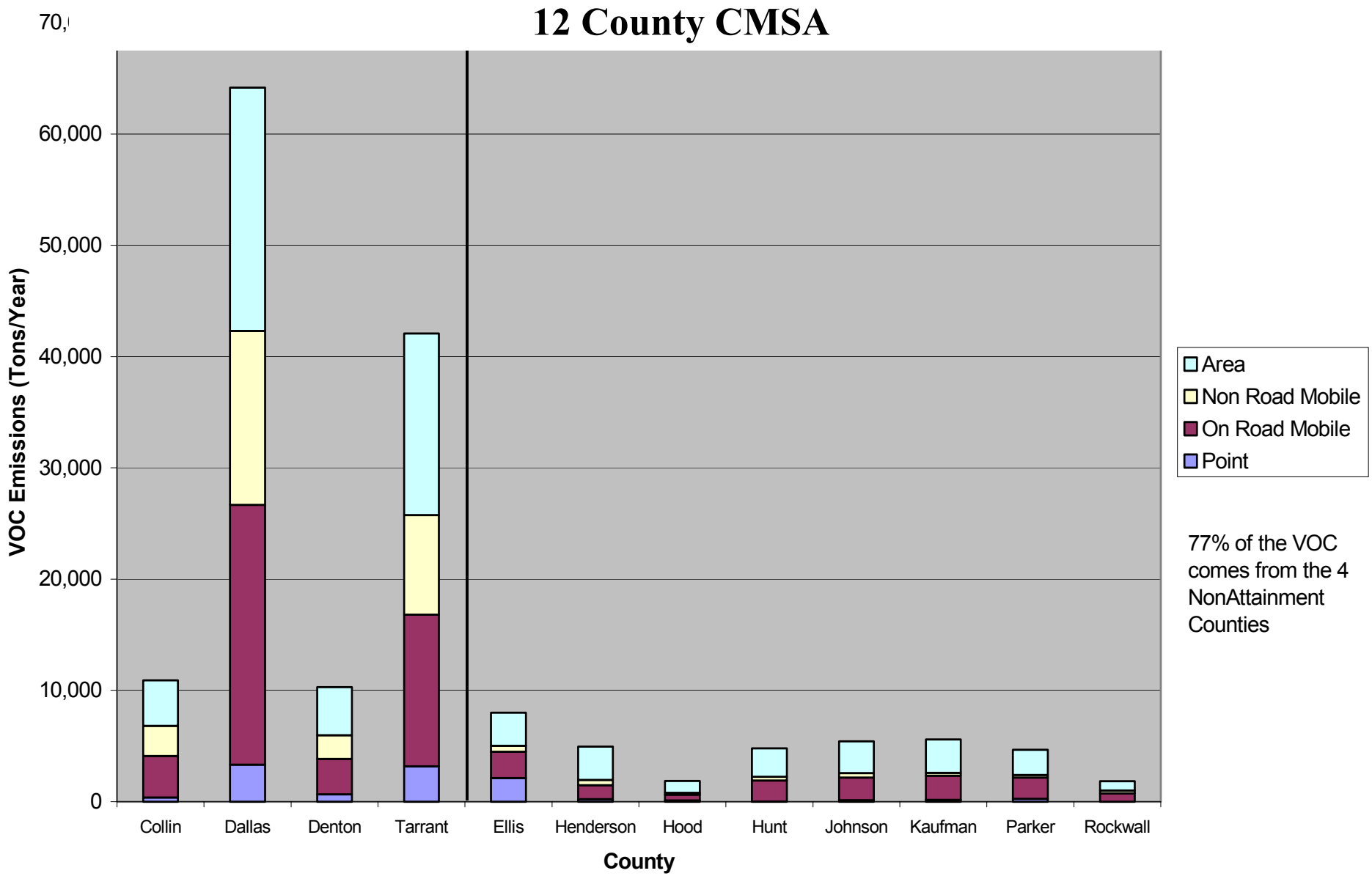
DFW Modeling Overview

- Environ has been contracted to do DFW modeling
- Base Case
  - ✓ Select Ozone Episode
  - ✓ Build Base Emissions Inventory
  - ✓ Develop Meteorology for Episode
  - ✓ Allocate Emissions in Space and Time
  - ✓ Test the Model: Compare with Observed Values
- Future Case
  - ✓ Select Future Year
  - – Grow Base Emissions to Future Year
  - – Account for State/Federal Measures
  - – Run Control Strategies

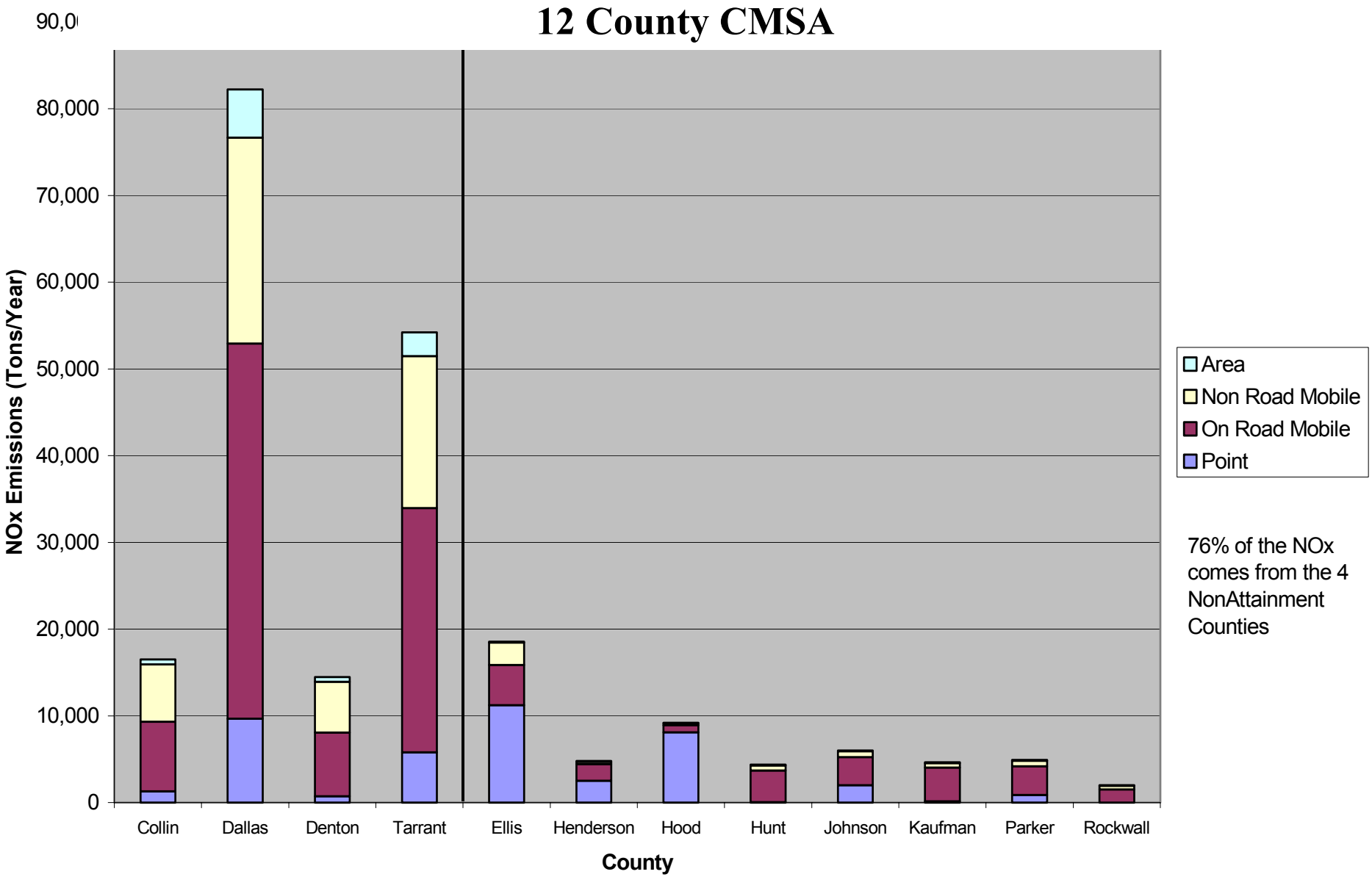
DFW 1-hr & 8-hr Ozone DV Trends



1999 VOC Emissions in DFW Area



1999 NOx Emissions in DFW Area



August 13-22, 1999 Ozone Episode

- Recent, Multi-Day 1-Hour Episode
- Representative Wind Patterns
- Exceedances Close to Design Value
- Representative Meteorological Conditions
- Multi-Day 8-Hour Episode
- Same Episode As Tyler/Longview EAC Modeling

DFW 1-Hour Episode Data

- August 13 - August 22, 1999 Episode

Day	Date	Max O3	Site Name	# Sites	Remarks
F	Aug 13	88	Frisco	0	Ramp Up Day
Sa	Aug 14	115	Arlington	0	
Sun	Aug 15	107	Keller	0	
M	Aug 16	127	Keller	1	
T	Aug 17	**150**	Frisco	4	
W	Aug 18	131	Frisco	2	
Th	Aug 19	128	Midlothian	1	
Fri	Aug 20	108	Midlothian	0	
Sa	Aug 21	111	Fort Worth	0	
Sun	Aug 22	101	Colony	0	
Mon	Aug 23	68	Denton	0	

DFW 8-Hour Episode Data

- August 13 - August 22, 1999 Episode

Day	Date	Max O3	Site Name	# Sites	Remarks
F	Aug 13	67	Frisco	0	Ramp Up Day
Sa	Aug 14	103	Arlington	4	
Sun	Aug 15	97	Keller	6	
M	Aug 16	107	Keller	6	
T	Aug 17	**126**	Frisco, Denton	7	
W	Aug 18	116	Frisco	4	
Th	Aug 19	108	Midlothian	2	
Fri	Aug 20	98	Midlothian	1	
Sa	Aug 21	98	Arlington	5	
Sun	Aug 22	108	Denton	2	
Mon	Aug 23	59	Denton	0	

CAMx Daily Peak Ozone (ppb)

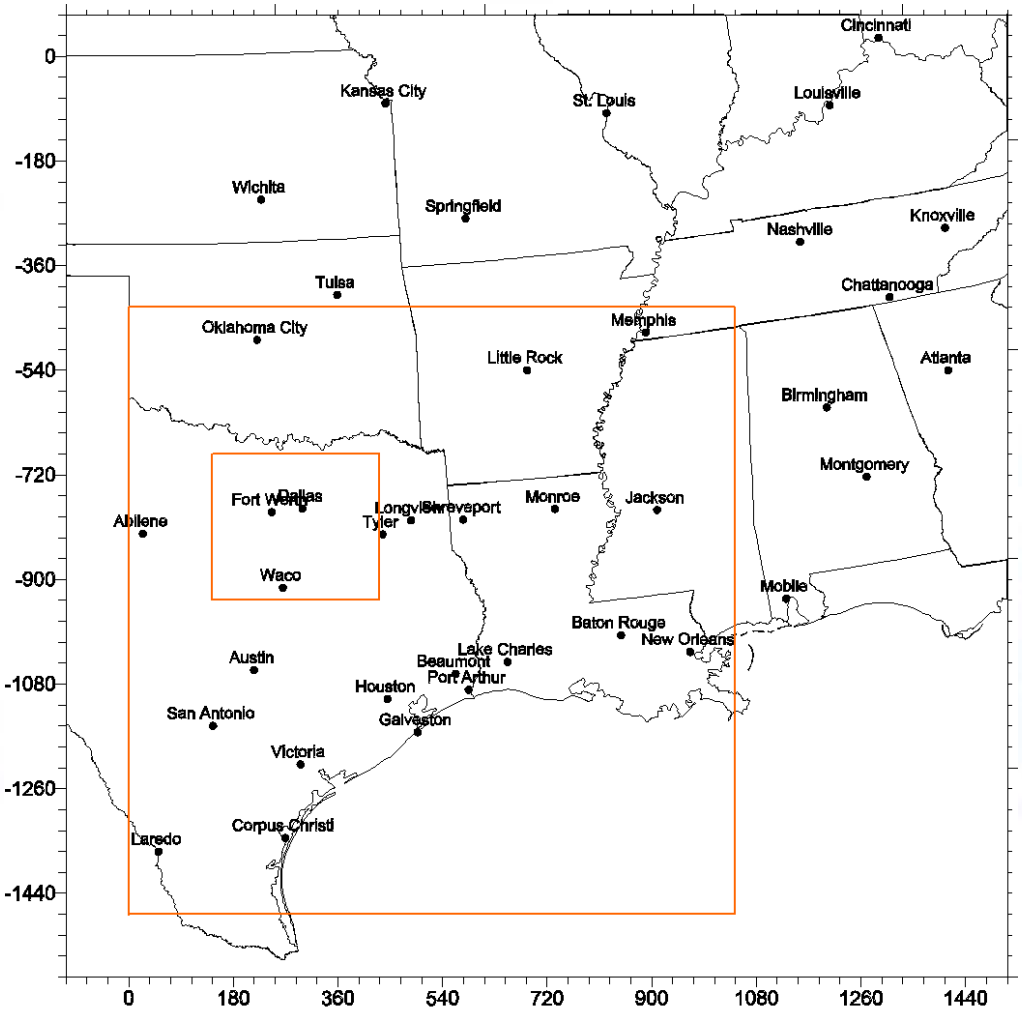
Observed Peak	88.0	115.0	107.0	127.0	150.0	131.0	128.0	108.0	111.0	100.0
Predicted Value										
Run	08/13/99	08/14/99	08/15/99	08/16/99	08/17/99	08/18/99	08/19/99	08/20/99	08/21/99	08/22/99
run1	83.7	117.9	112.4	111.8	137.1	154.0	137.2	101.6	109.4	120.3
run1a	83.0	125.3	123.8	113.9	140.9	154.0	137.9	103.7	120.4	124.9
run2	81.7	110.3	107.2	103.7	124.1	142.3	122.6	96.1	104.6	104.6
run3	82.1	119.1	120.1	109.8	134.3	146.1	132.8	100.8	116.6	120.0
run4	84.3	120.0	113.0	112.4	137.8	154.7	137.6	102.4	109.9	120.9
run6	82.1	119.0	120.0	109.9	134.9	146.3	132.7	100.8	116.6	120.3
run7a	108.6	139.0	138.4	136.9	159.0	164.3	150.0	114.7	134.1	128.4
run7b	119.6	144.8	143.9	144.8	164.6	167.4	153.8	122.2	139.6	131.6
run7c	85.1	125.7	128.8	119.1	143.5	151.1	137.5	109.1	126.1	124.0
run7e	85.1	126.9	129.4	119.2	143.9	151.1	137.6	110.8	127.1	124.3
run8	82.8	115.0	117.6	107.7	132.3	142.6	131.0	98.2	116.2	115.4
run8a	86.7	122.7	126.2	116.5	140.6	147.5	135.8	106.2	125.6	119.3
run9	82.1	118.9	120.0	109.9	134.9	146.4	132.8	100.8	116.6	119.3
run9a	85.1	125.7	128.8	119.1	143.5	151.2	137.6	109.1	126.1	123.1
run10	85.4	124.9	128.6	119.0	143.0	150.6	137.0	109.5	126.0	123.8
run12	89.5	133.1	127.2	124.8	149.9	157.9	142.6	110.0	130.4	128.8

Base Case Modeling Runs

- Run7B
  - Increases initial condition (IC) and boundary condition (BC) ozone levels from 40 to 60 ppb
  - Uses Southern Oxidant Study precursor concentrations
  - Considered a “diagnostic run” because increased IC/BC ozone levels cannot be verified by ground monitors

- Run7C
  - Modeling run being used for episode
  - Retains EPA default IC/BC ozone levels of 40 ppb
  - Uses Southern Oxidant Study precursor concentrations

DFW Ozone Modeling Domain



CAMx GRID DIMENSIONS
LCP Grid with reference origin at (40 N, 100 W)

EPA Standard Boundary Conditions
Ozone 40 ppb, Low NOx, Low VOC

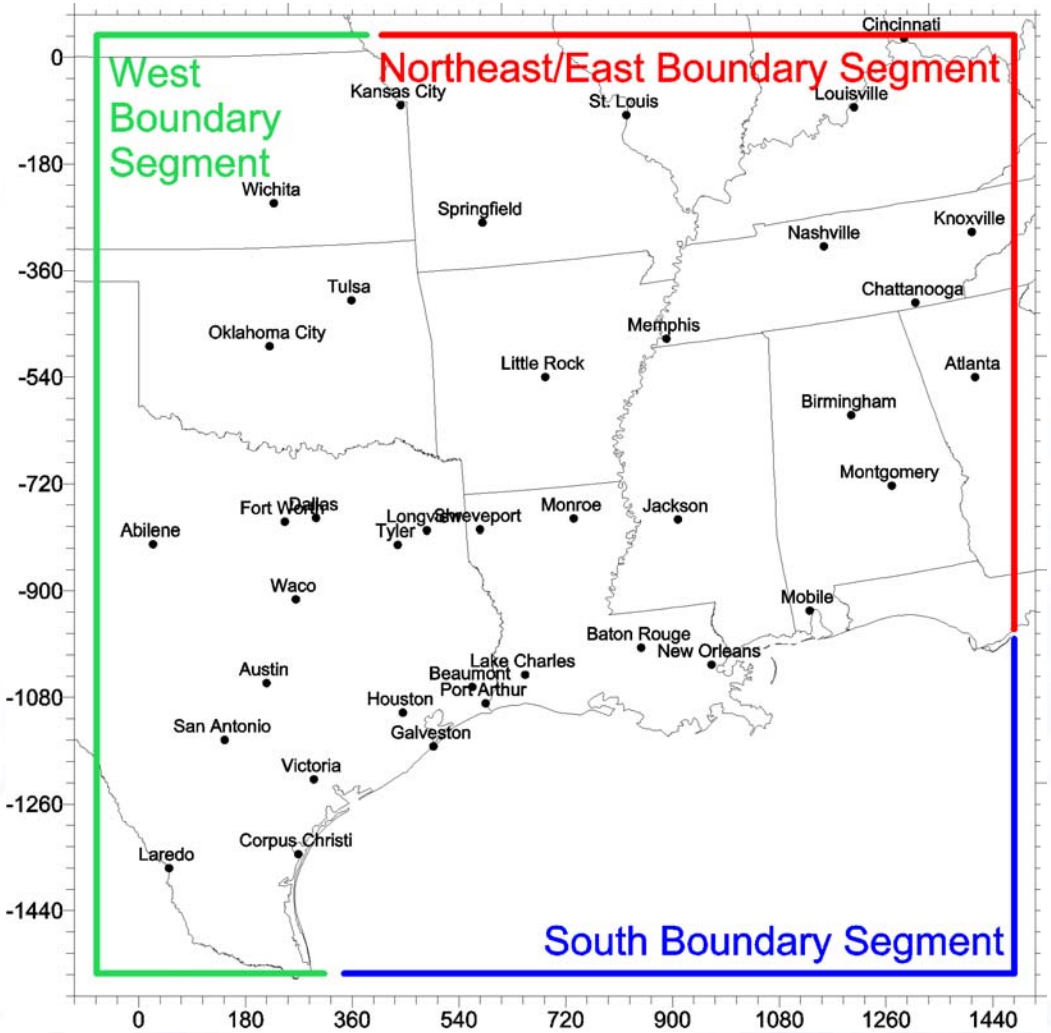
Species	Concentration (ppb)
O3	40.0
NO	0.000049
NO2	0.08555
CO	100.0
PAR	3.078
HCHO	1.068
ETH	0.005315
ALD2	0.1051
TOL	0.006043
PAN	0.03834
HNO2	0.000728
HNO3	1.525
H2O2	2.263
Total NOx	0.086
Total VOC (ppbC)	4.4

SOS Derived Boundary Conditions

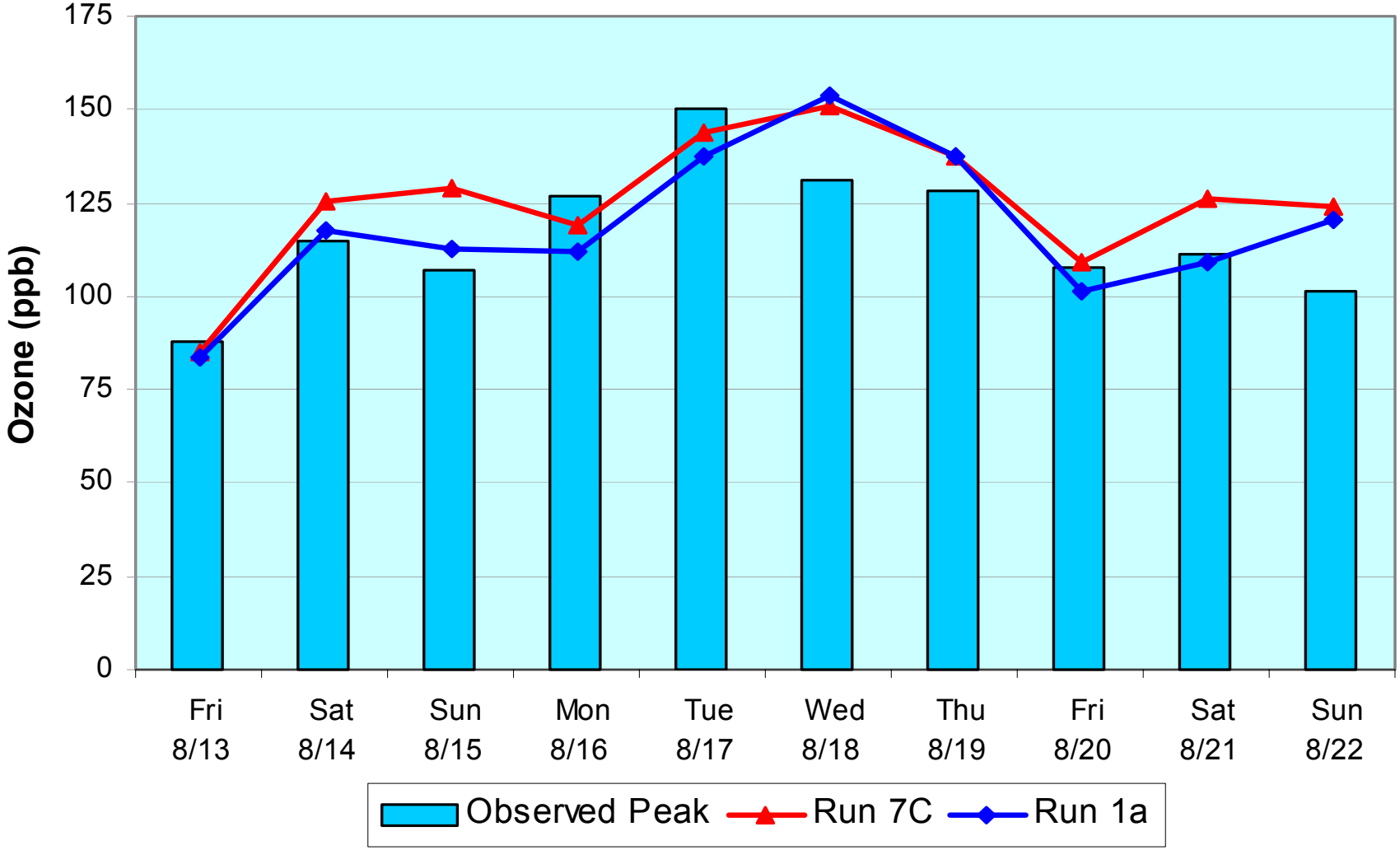
Applied to August 1999 DFW Ozone Episode

SOS Boundary Concentrations for September 1999			
TXNNA 36-km CAMx Domain			
Species	**NorthEast**	**West**	**Maritime**
O3	40	40	40
CO	200	200	100
NO	0.1	0.1	0.1
NO2	1	1	1
HNO3	3	3	1
HNO2	0.001	0.001	0.001
ALD2	0.555	0.555	0.05
ETH	0.51	0.51	0.15
HCHO	2.1	2.1	0.05
OLE	0.3	0.3	0.05
PAR	14.9	14.9	7.6
TOL	0.18	0.18	0.0786
XYL	0.0975	0.0975	0.0688
ISOP	3.6	0.1	0.001
PAN	0.1	0.1	0.1
H2O2	3	3	1
MEOH	8.5	0.001	0.001
ETOH	1.1	0.001	0.001
Total NOx	**1.1**	**1.1**	**1.1**
Total VOC (ppbC)	**50.5**	**22.3**	**9.3**

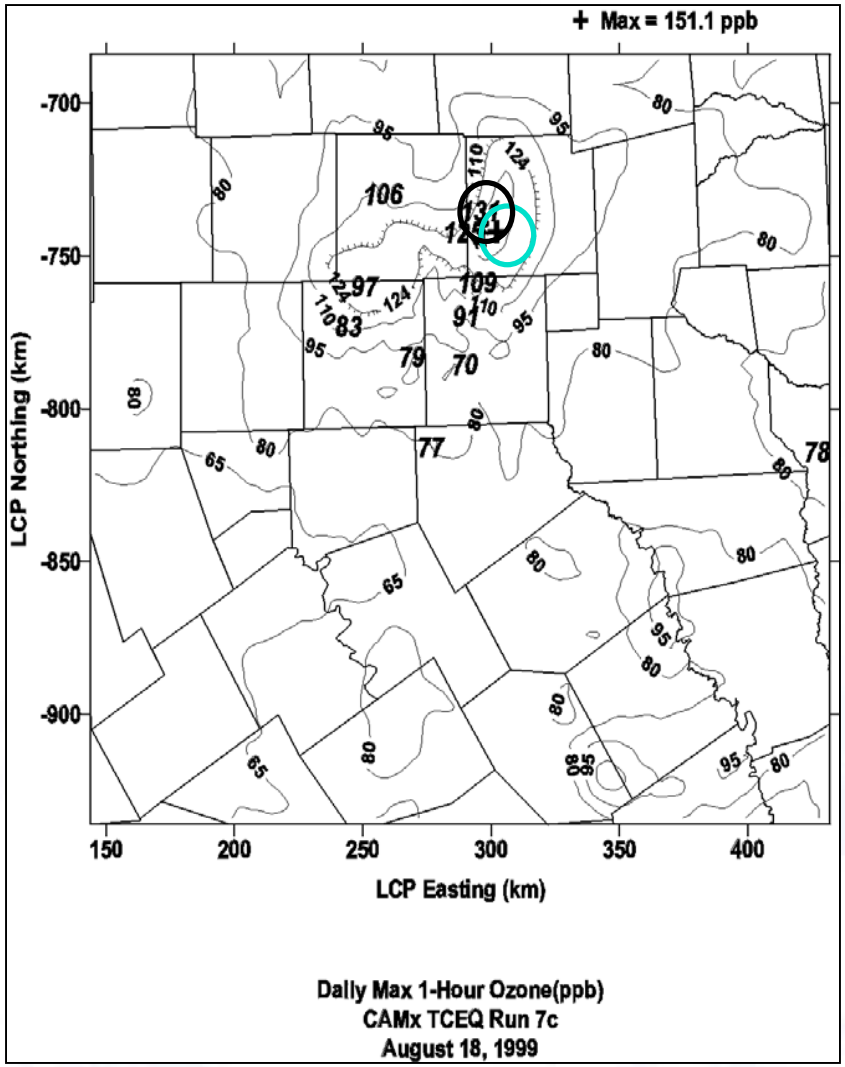
DFW Boundary Conditions Tests (Runs 7c, 7e)



DFW Performance Statistics
(Modeled vs Observed Peak)



Wednesday, August 18, 1999
Run 7C



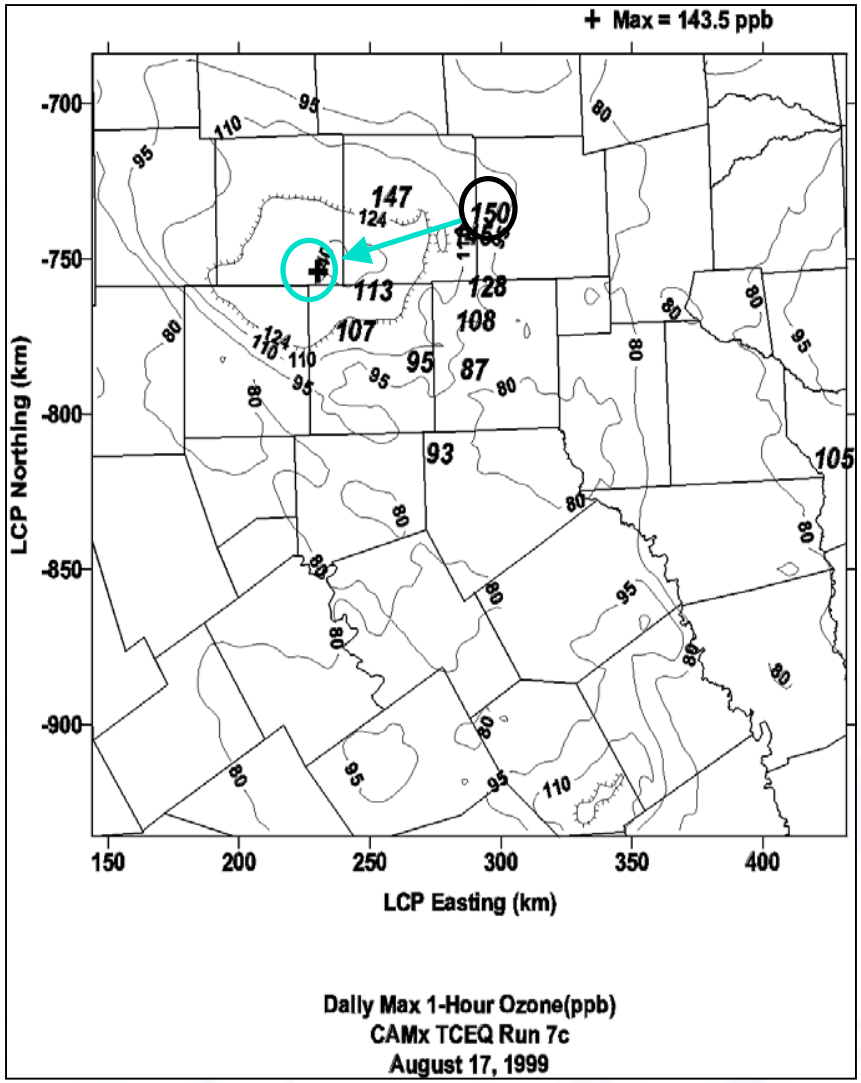
- Peak

+ 15.3% OK
Location OK

- Bias

+2.1% OK
Modeling
High OK

Tuesday, August 17, 1999
Run 7C



- Peak

-4.3% OK
Displaced

- Bias

-24.2% OK
Modeling
Low Overall

APCA Ozone Concentrations for 1999 Base Case

- Anthropogenic Precursor Culpability Assessment (APCA)
  - APCA differs from source apportionment testing in recognizing that certain emissions groups are not controllable (i.e., biogenics)
  - Apportioning ozone production to these emissions does not provide control strategy relevant information
  - APCA was developed by Environ during the development of the Ozone Transport Assessment Group (OTAG)

1-Hour Ozone APCA Analysis for August 15-22, 1999

4-County DFW Nonattainment Area
Averages of All Grid Cell Hours Above 85 ppb Ozone
Ozone Contribution by Region & Source Type

County	Biogenics	Elevated Points	Onroad	Other Anthropogenic	Total
4 "Core" Counties	0.68	3.81	19.89	13.02	37.40
12 "Perimeter" Counties	0.57	1.46	2.04	1.22	5.29
Central Texas	0.77	1.70	0.65	0.95	4.07
East Texas	0.29	2.08	0.65	1.21	4.23
South Texas	0.10	0.13	0.05	0.14	0.42
Houston/Beaumont	0.10	1.12	0.50	0.71	2.43
West Texas	0.03	0.03	0.02	0.05	0.13
Arkansas	0.25	0.77	0.60	0.85	2.47
Louisiana	0.23	2.00	0.68	1.51	4.42
Oklahoma	0.07	0.18	0.21	0.23	0.69
Other States	0.35	1.85	0.77	1.23	4.20
Boundary Conditions					32.74
Initial Conditions					0.70
Total	3.44	15.13	26.06	21.12	99.19

1999 APCA Results for DFW

- Relative contributions for 8-hr ozone are very similar to the 1-hr

- Ozone source apportionment results will differ for 2007 and 2010 analyses:
  - Meteorological and biogenic inputs consistent with 1999 episode
  - Absolute totals and relative contribution of 2007/2010 emissions from area, nonroad, onroad, & point will be different from 1999

1999 Base Case Results

- 1999 Base Case Results are Consistent with 1995/96 Modeling
- DFW area is still NOx limited, so NOx controls are the most effective way to reduce ground-level ozone
- Local emissions are the largest contributor to local ozone
  - Sources in the 4-county nonattainment area contribute more NOx and VOCs than the sources in the 12 surrounding counties

1999 Base Case Results (cont.)

- Satisfactory Model Performance:
  - 3 out of 4 days of the 1-hour episode
  - 5 out of 8 days of the 8-hour episode

- EPA Statistical Tests
  - Peak accuracy meets standard
  - Gross error meets standard
  - Negative Bias on some days
  - Usable for directional guidance

Future Case Modeling

- Future Case Will Determine:
  - What specific controls will be most effective
  - Amount of emissions reductions needed

- Additional analysis will be required to assess 8-hour performance upon finalization of EPA's 8-hour implementation guidance

Status of Environ Modeling

- 1999 Base Case - Completed
- Phase I 2007/2010 Future Case - Underway
  - Re-run 1999 base case with updated factors
  - Develop and process 2007 and 2010 emission inventories
  - Perform CAMx future case modeling for 2007 and 2010

Status of Environ Modeling (cont.)

- Phase II Work for 2007/ 2010 Future Case
  - Perform directional guidance runs
  - Perform ozone source apportionment analyses
  - Quantify the magnitude of specified control strategies
  - Model combinations of specified control strategies
  - Full documentation of work provided in a final report

- Modeling Report Available on TCEQ's Web Site
  - http://www.tnrcc.state.tx.us/air/aqp/sipmod/dfwaq_techcom.html
  - Final Modeling Report link at bottom of web page
  - APCA Results - Appendix A

Contributors

- ENVIRON Modeling Staff
  - Thuyen Dinh
  - Michele Jimenez
  - Gerard Mansell
  - Greg Yarwood
- TCEQ Modeling Staff
  - Pete Breitenbach
  - Chris Kite