Have atmospheric concentrations of ozone and ozone precursors significantly changed from the late 1990's to the present in Houston and DFW?

- Presented at the TEXAQS II Intensive Field Study Meeting, TCEQ Office, Austin, Texas, April 18, 2006

- Mark Sather, Environmental Scientist, U.S. EPA Region 6, Air Quality Analysis Section
- Email: sather.mark@epa.gov
- Phone: (214) 665-8353

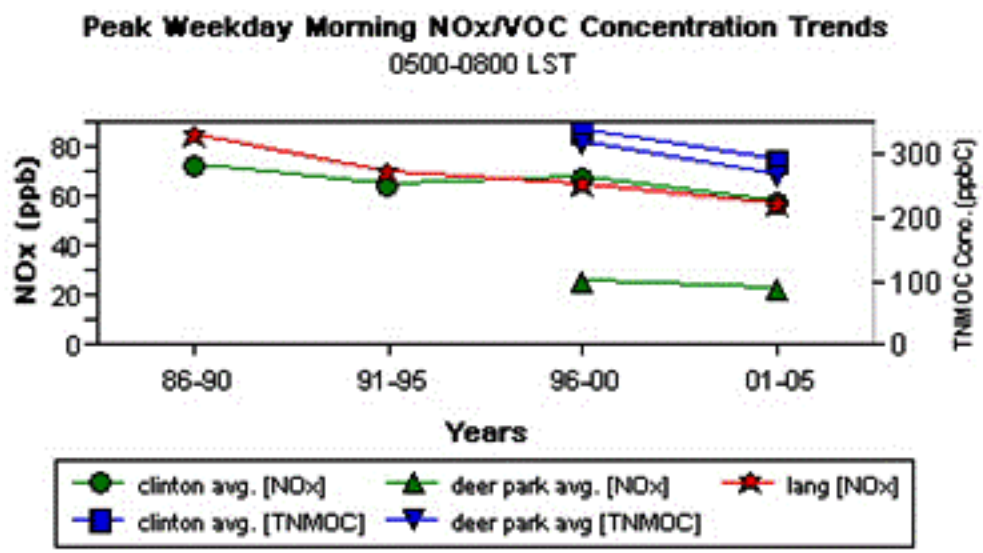
Analytical Methods

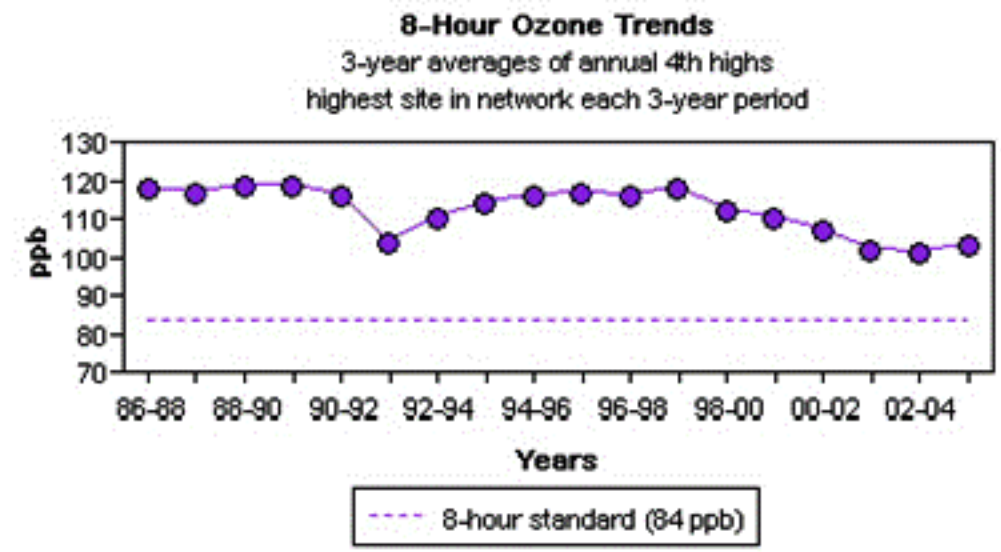
- Ozone, NO_x, VOC, Met. Data downloaded from U.S. EPA's AQS database, summary statistics run on data for morning peak hours during peak of summer season.

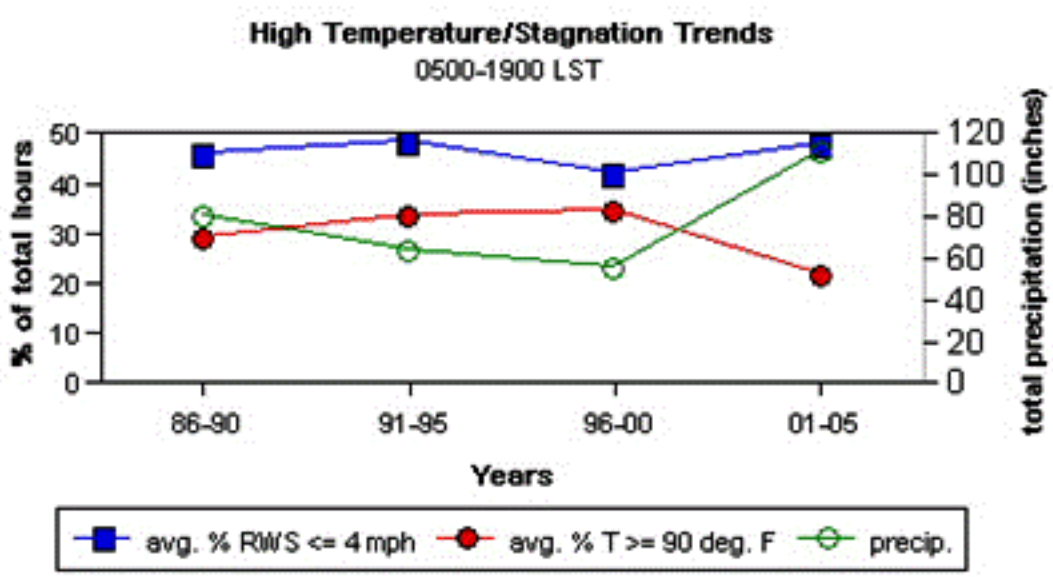
- Two ozone trend indicators: (1) 8-hour ozone design values time series; (2) Percentage of afternoon hours over the 8-hour ozone NAAQS.

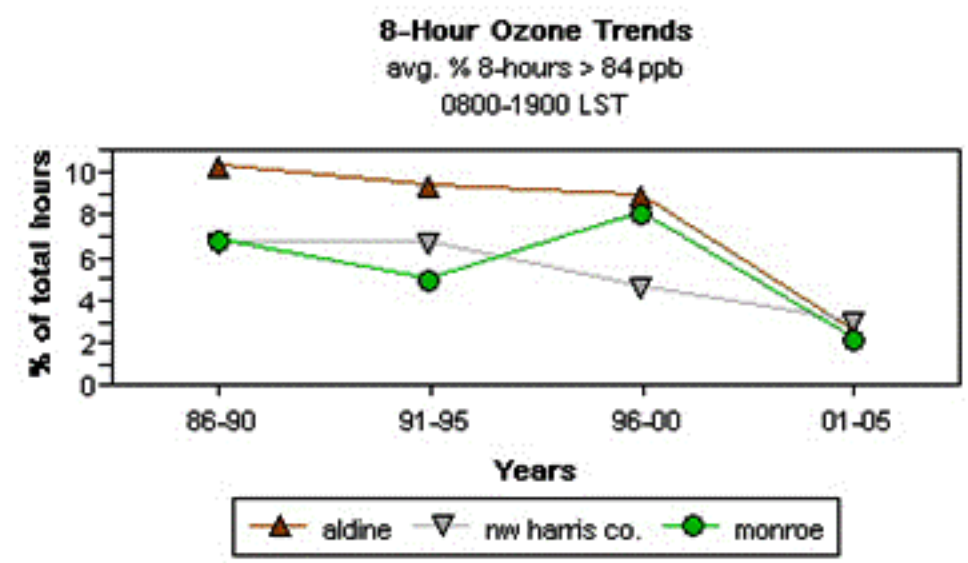
- One trends analysis compares the 5-year block periods 1986-1990, 1991-1995, 1996-2000, and 2001-2005 in order to smooth out the effects of annual meteorology, local emission source effects and variability in monitor precision and accuracy.

Houston Long-term Ozone/NOx/VOC/Meteorological Data Trends
June-August





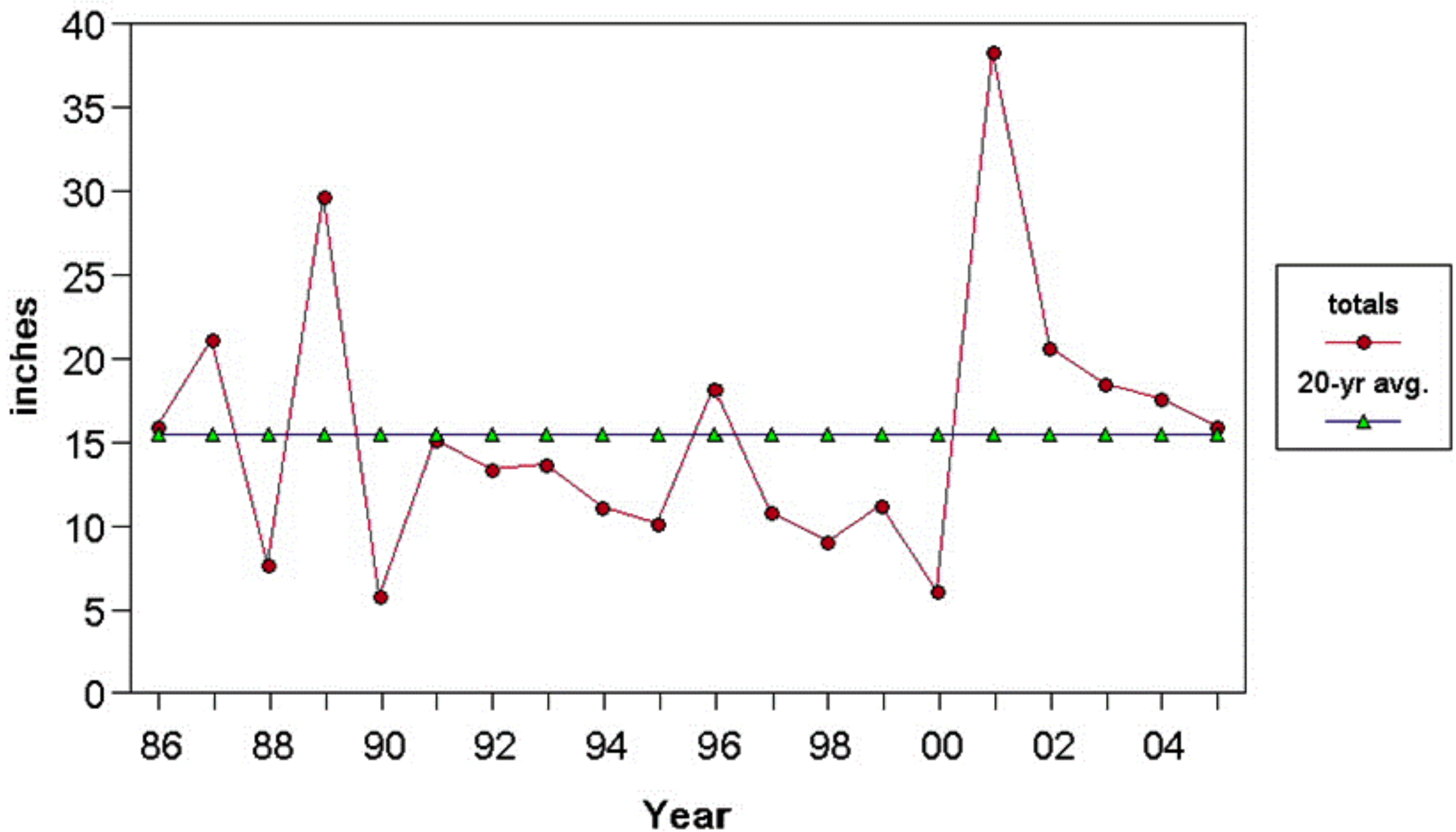


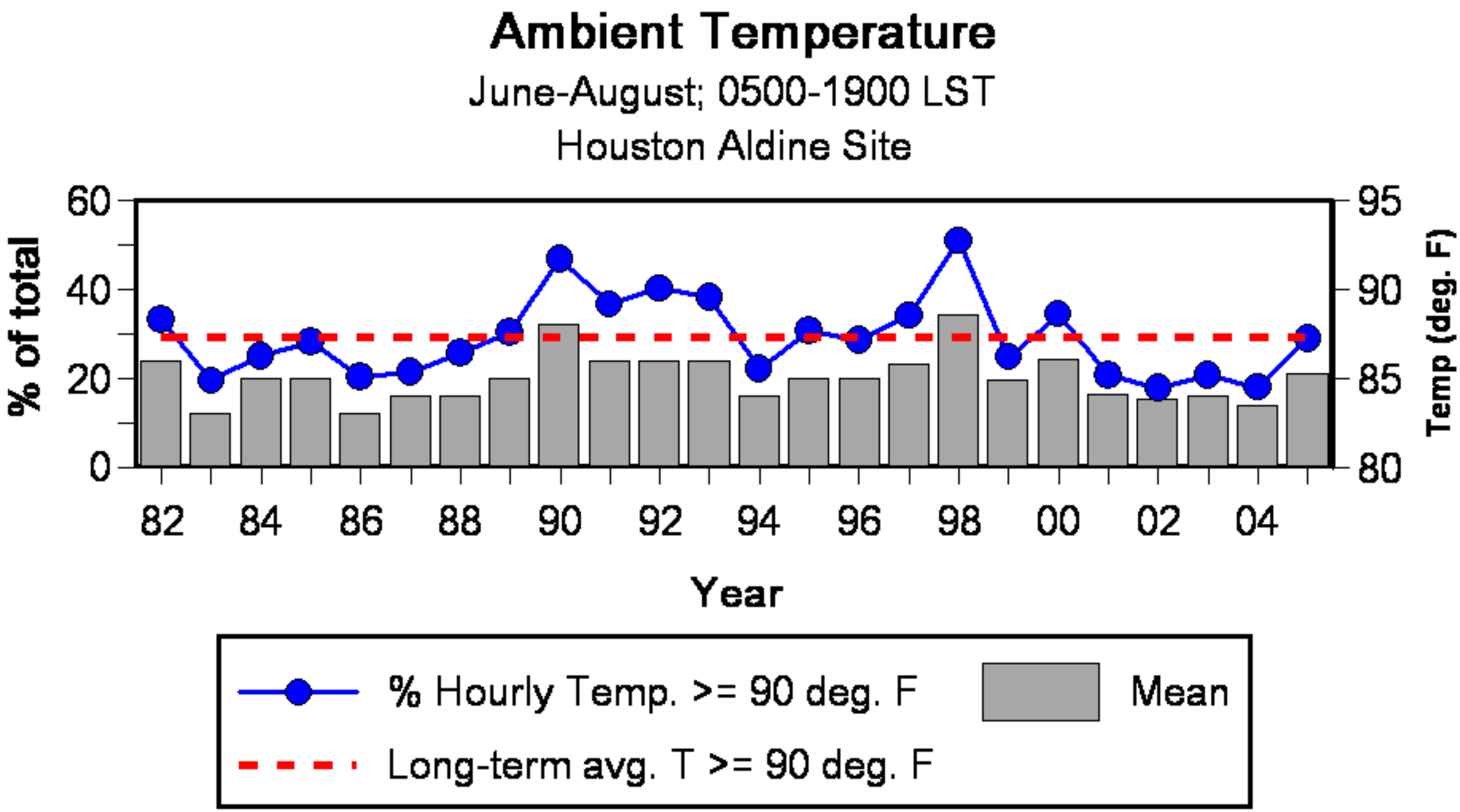


T and RWS data from aldine site; precip data from NCDC
T = temperature, RWS = resultant wind speed

Houston Precipitation Time Series

June-August totals from NCDC Data



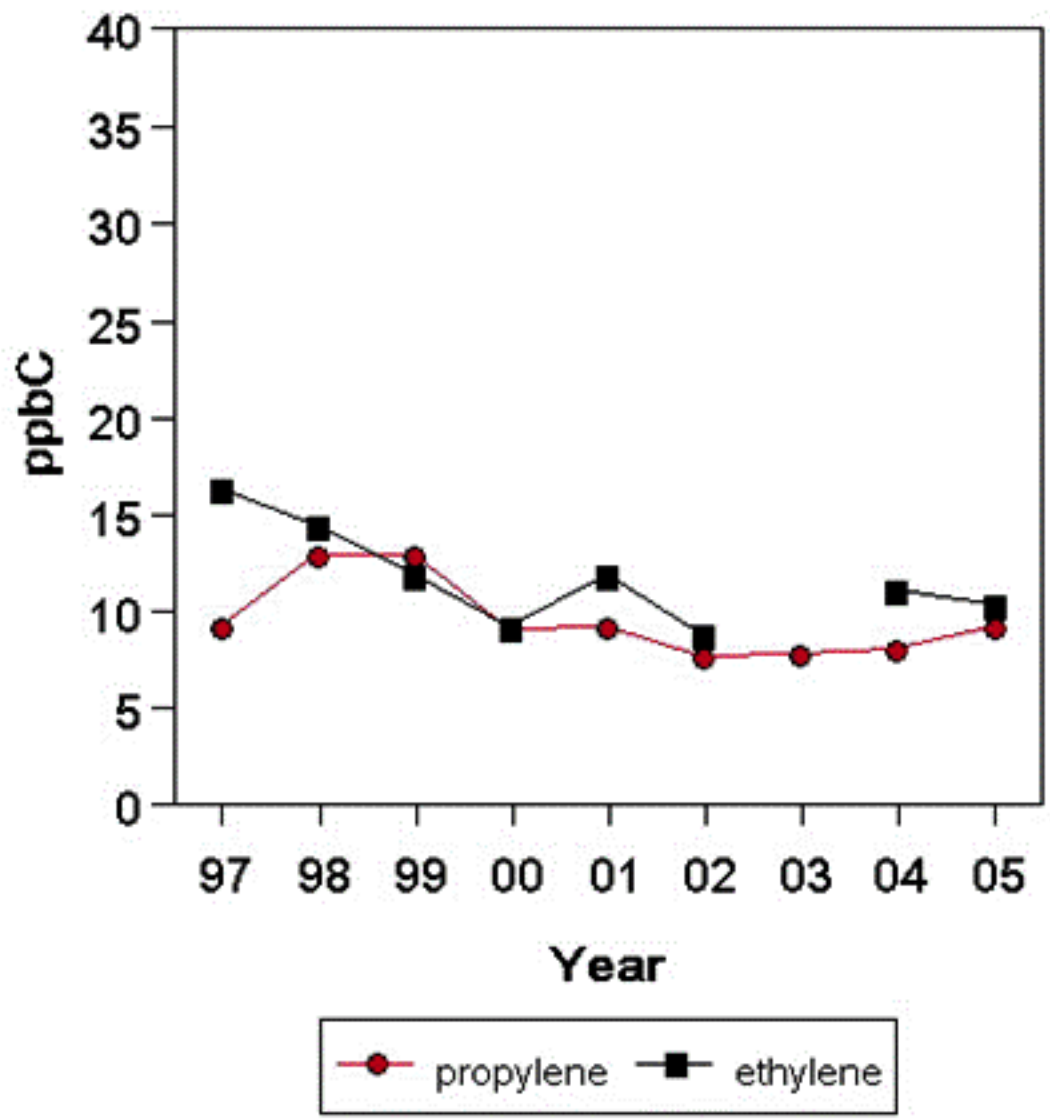

Ambient Temperature
June-August; 0500-1900 LST
Houston Aldine Site
% of total
Temp (deg. F)
Year
60
40
20
0
95
90
85
80
82
84
86
88
90
92
94
96
98
00
02
04
% Hourly Temp. >= 90 deg. F
Mean
Long-term avg. T >= 90 deg. F

Houston HRVOC Concentration Trends

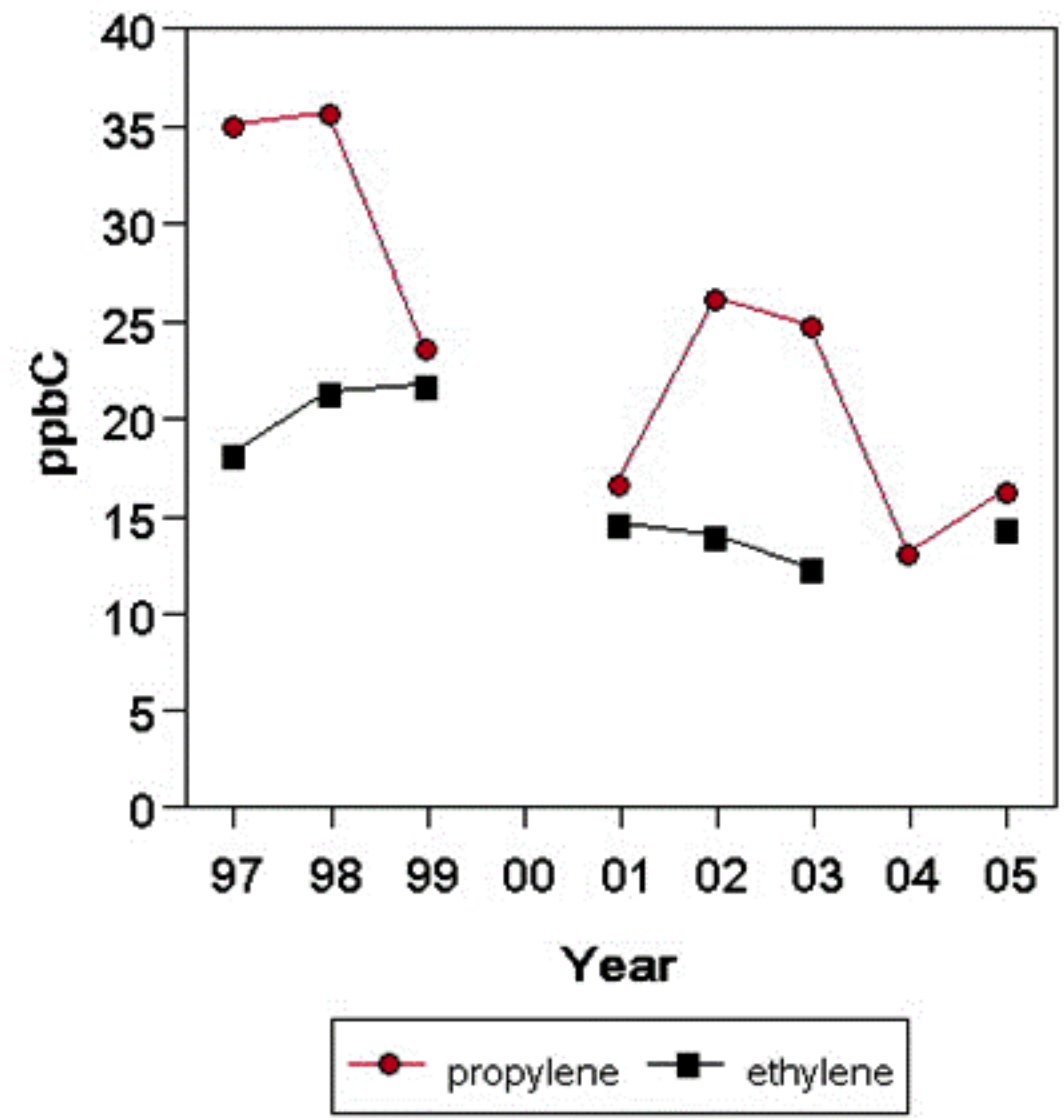
June-August Weekday 0500-0800 LST Arithmetic Means

70% minimum data capture for each year

Clinton Site

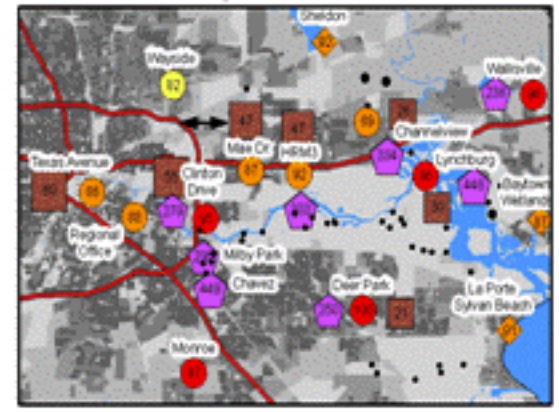


Deer Park Site

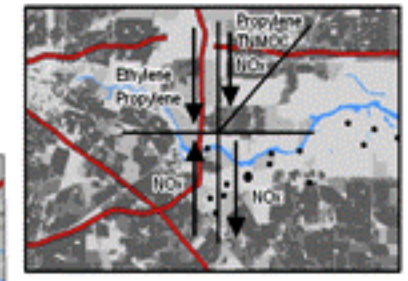


Houston Ozone and Ozone Precursor Monitoring Network

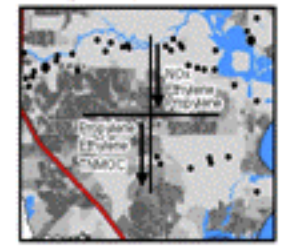
Ship Channel Inset



Clinton Drive Trend



Deer Park Trend



Montgomery

Waller

Harris

Liberty

Chambers

Fort Bend

Galveston

Brazoria

Conroe

NW Harris Co.

Mercer Arboretum

Kingwood Library

Meyer Park

Atascocita

Crosby Library

Aldine

Sheldon

Katy Park

West Houston

Lang

Wayside

Mae Dr.

Channelview

Wallisville

HRM3

Bunker Hill Village

Texas Avenue

Clinton Drive

Lynchburg

Westbrook

Baytown Wetlands

Bayland Park

Regional Office

Milby Park

Deer Park

Chavez

La Porte

Sylvan Beach

Crouget

Monroe

Tom Bass

Clear Lake

Seabrook

Clear Brook

Clear Creek

Smith Point

Manvel

Texas City

Mustang Bayou

Galveston Airport

Danciger

Lake Jackson

Legend

2003-2005 8-hr Ozone Design Value (ppb)*

- 65 - 74 ppb
- 75 - 84 ppb
- 85 - 94 ppb
- 95 - 104 ppb

2003-2005 Ozone Lite Design Value (ppb)*

- 65 - 74 ppb
- 75 - 84 ppb
- 85 - 94 ppb
- 95 - 104 ppb

Major NOx Stationary Emission Source (t/y)

- 100 - 5100 t/y
- 5101 - 10100 t/y
- 10101 - 15100 t/y
- 15101 - 20100 t/y
- 20101 - 25100 t/y
- 25101 - 30100 t/y
- 30101 - 35100 t/y

Population Density (per square mile)

- 0
- 1 - 500
- 501 - 1000
- 1001 - 5000
- > 5000

2003-2005 June-August 6-9 AM Weekday VOC (tnmoc) Concentration (ppbC)*

- 0 - 100 ppbC
- 101 - 200 ppbC
- 301 - 300 ppbC
- 301 - 400 ppbC
- 401 - 500 ppbC
- 501 - 600 ppbC

2003-2005 June-August 6-9 AM Weekday NOx Concentration (ppb)

- 0 - 10 ppb
- 11 - 20 ppb
- 21 - 30 ppb
- 31 - 40 ppb
- 41 - 50 ppb
- 51 - 60 ppb

Statistically Significant Long-Term Trend

Down | Up | No Change

Sources:
EPA Region 6, AQS Database
Census Bureau 2000 Data

0 2.5 5 10 15 20
Miles

*Notes:

Trend Years
1988-2005: Clinton Drive and Lang sites.
1996-2005: Mae Drive and Aldine sites.
1997-2005: Galveston, NW Harris, and Deer Park sites.
1998-2005: Bayland site.

Ozone data is from 2003-2005 except for the following sites:
2004-2005: Atascocita, Clear Creek, Katy Park, Kingwood Library, La Porte Sylvan Beach, Mercer Arboretum, Meyer Park, Tom Bass, and West Houston.
2005: Bunker Hill Village and Smith Point.

VOC data is from 2003-2005 except for the following sites:
2003-2004: Channelview.
2004-2005: Chavez, Lake Jackson, Mustang Bayou, and Wallisville.
2005: Milby Park.

Ozone Lite sites are non-regulatory ozone sites funded by the local area.

EPA Region 6
GIS Support Team
Dallas, TX
April 5, 2006

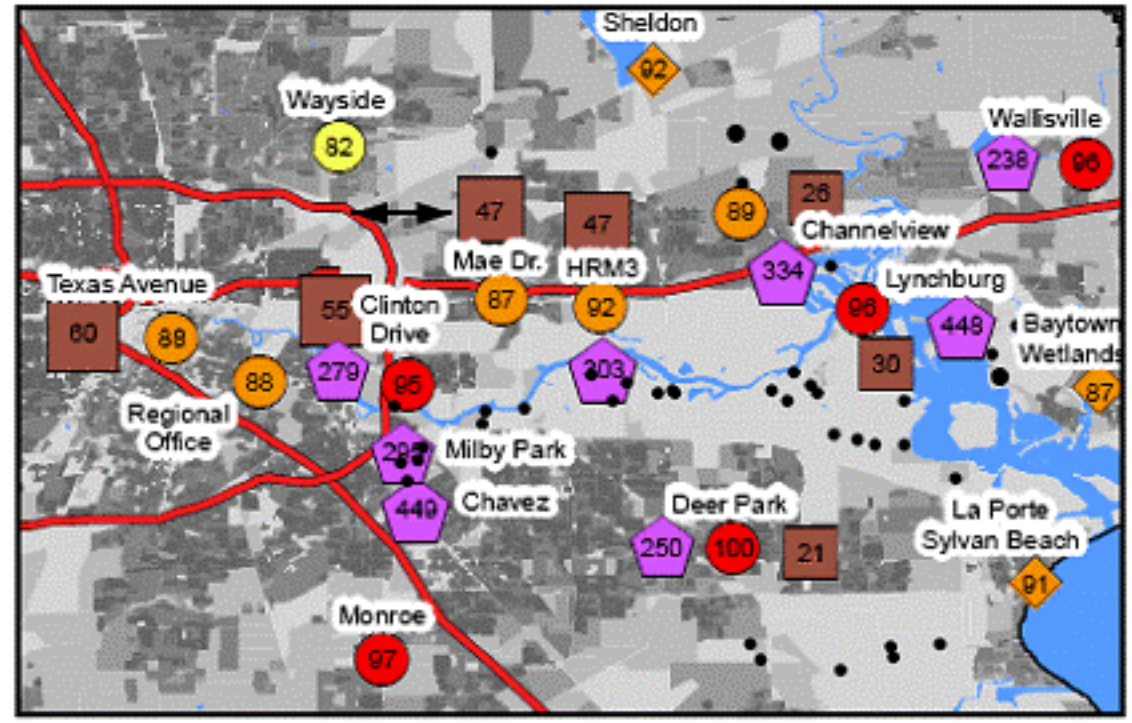
LOCKHEED MARTIN

20060405ML02

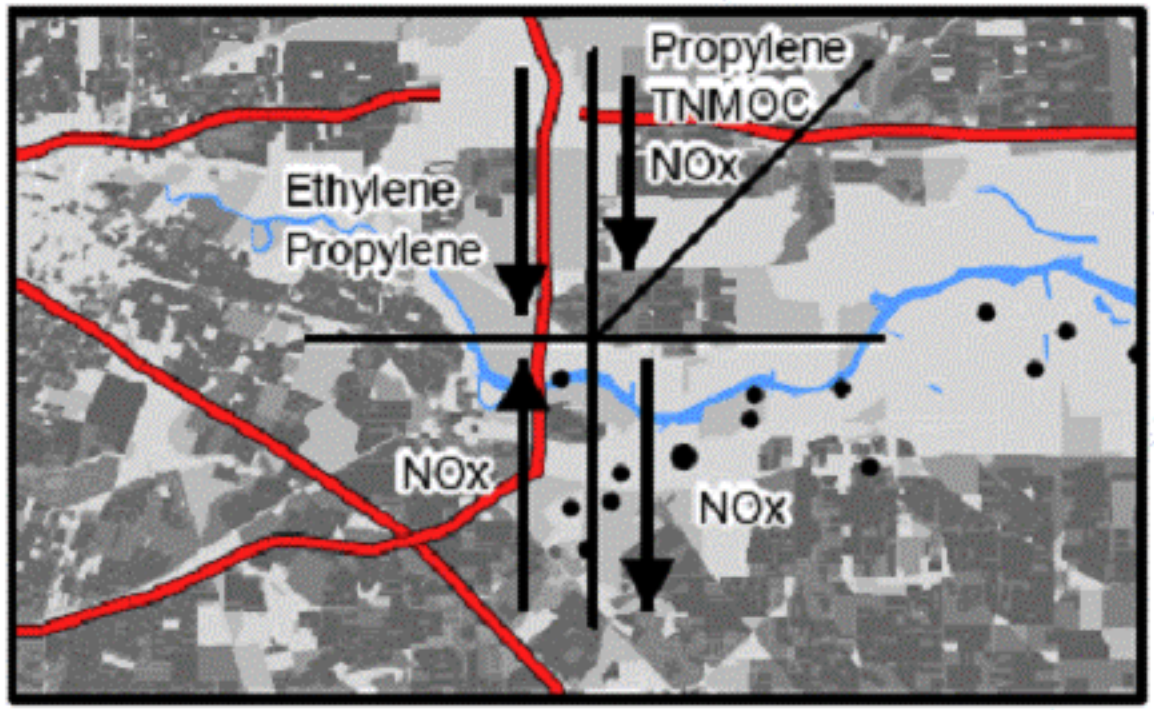
Wind Direction Sector Analysis

- Only looked at resultant wind speeds > 2.4 mph
- The measurement precision of wind speed/direction not reliable below this speed

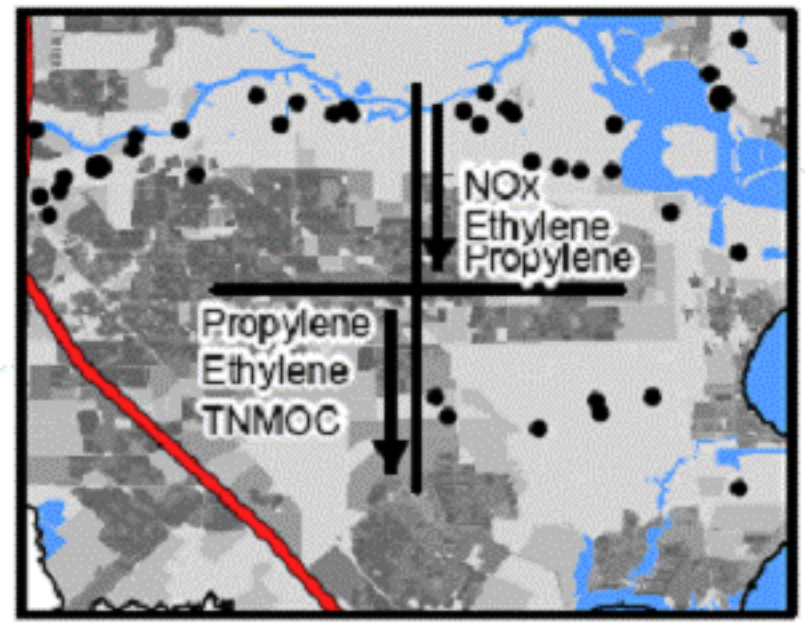
Ship Channel Inset



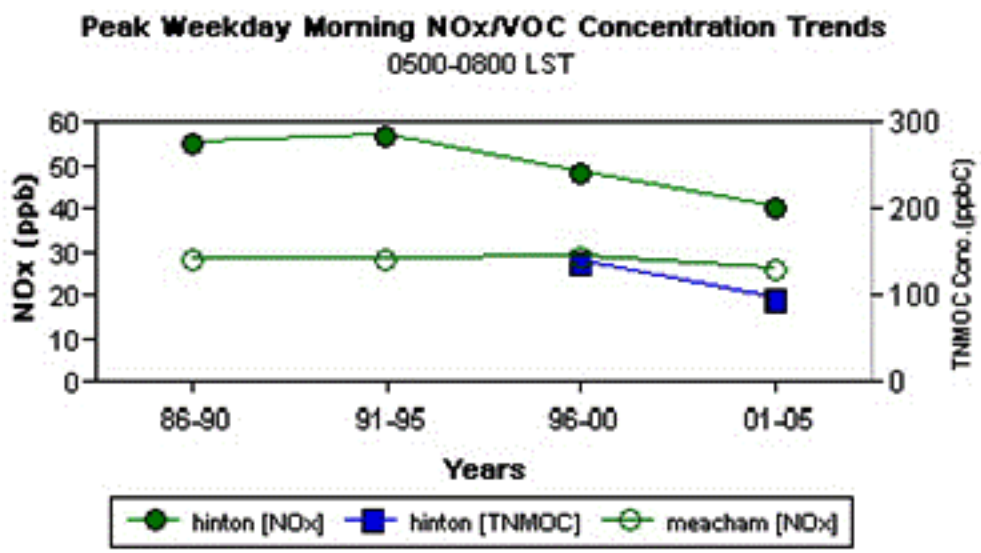
Clinton Drive Trend

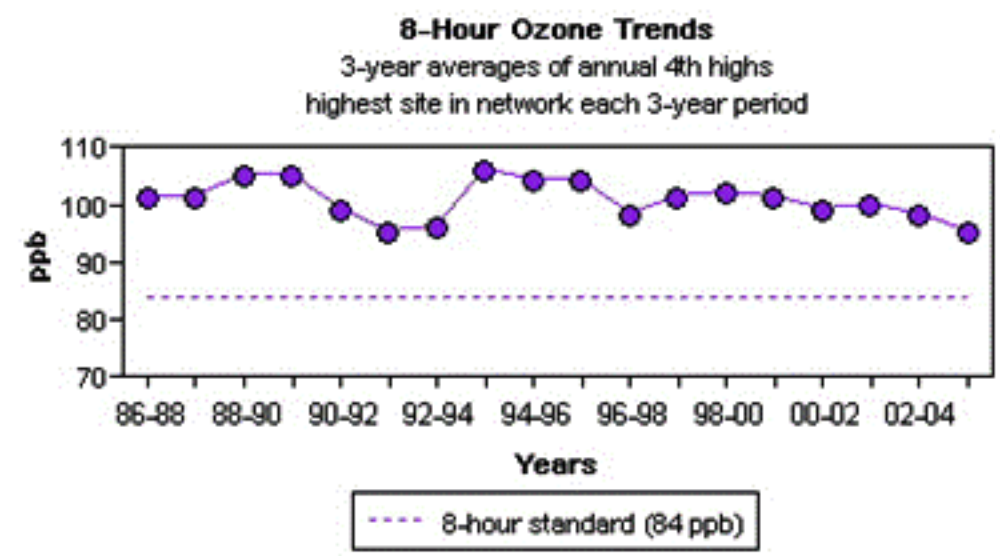


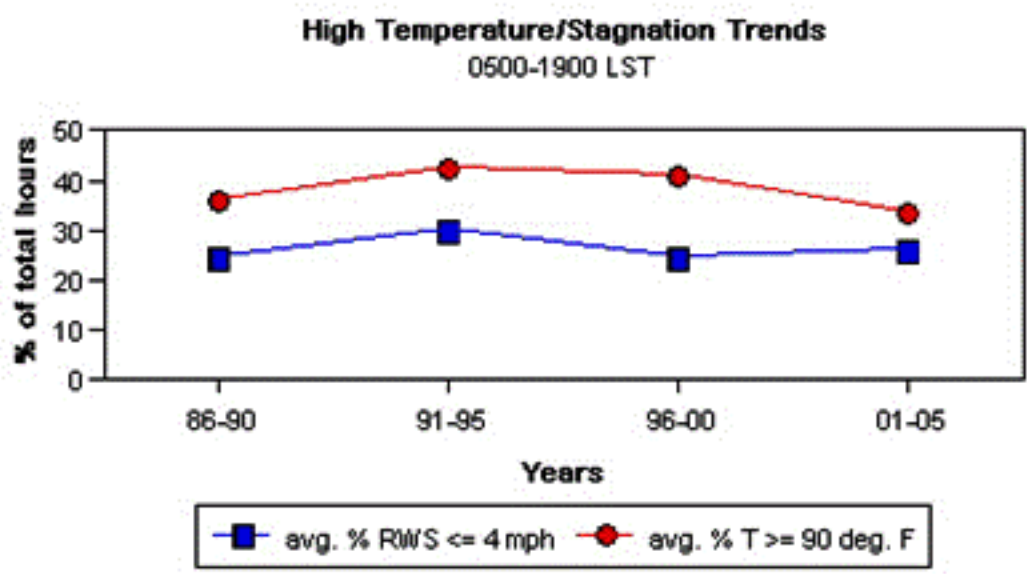
Deer Park Trend

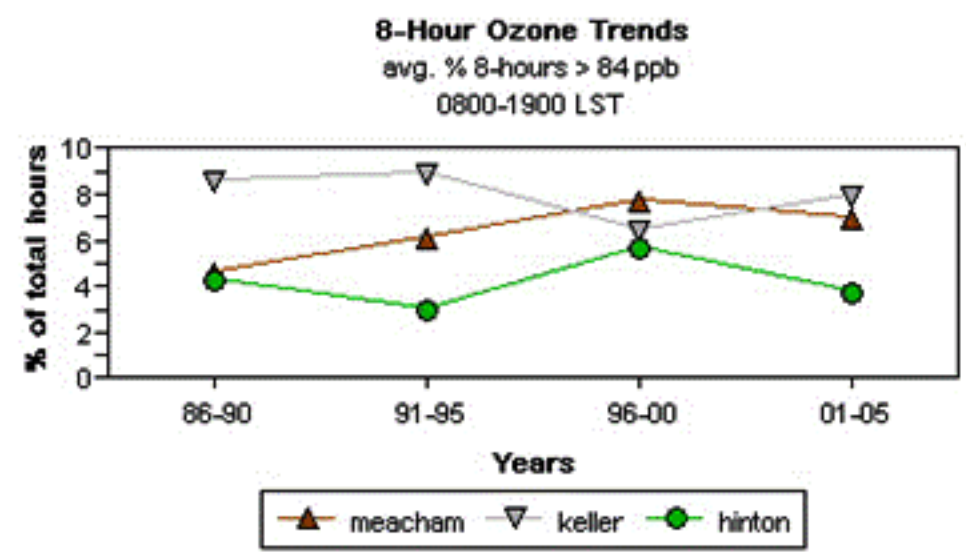


DFW Long-term Ozone/NOx/VOC/Meteorological Data Trends
June-August







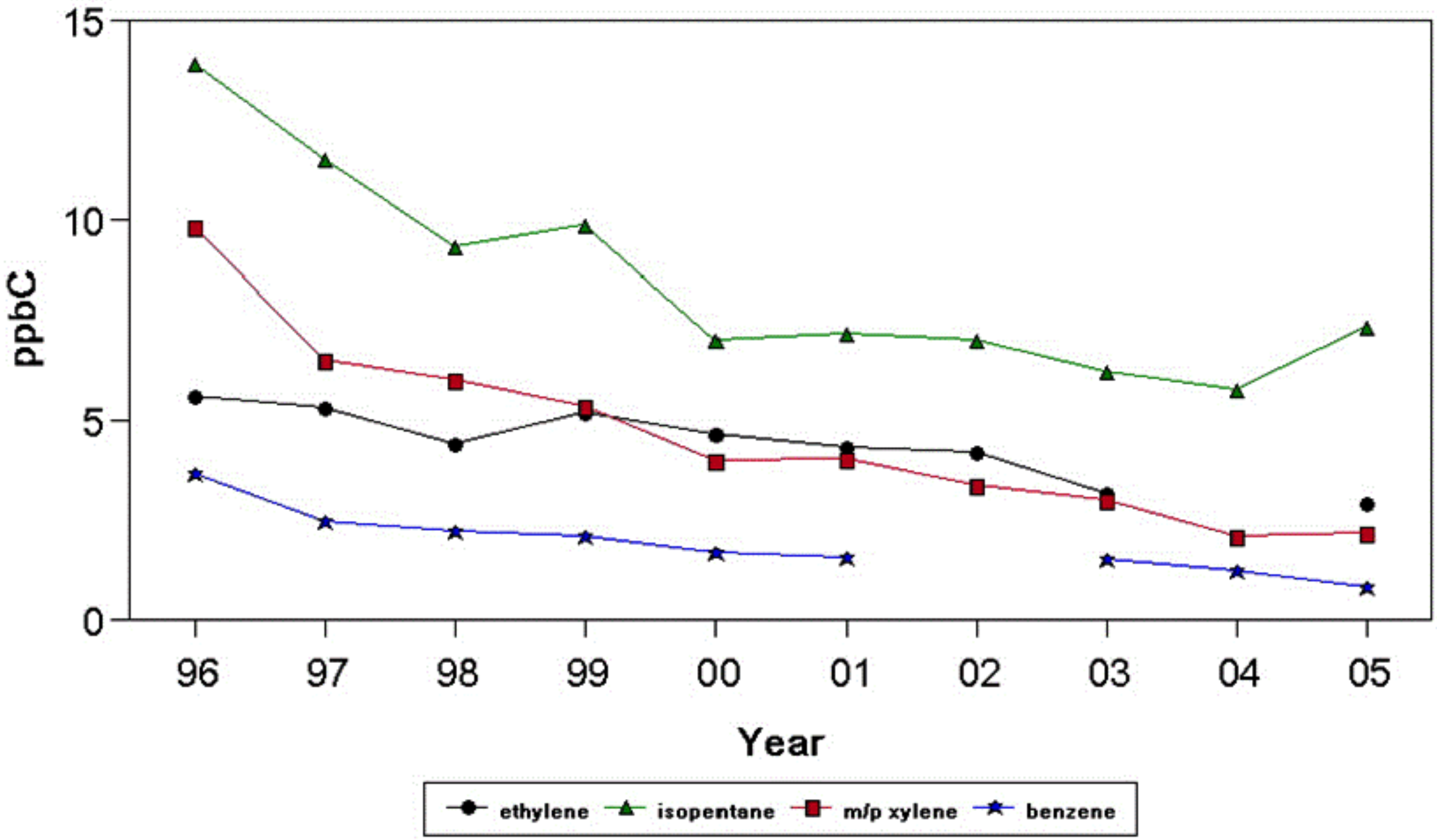


long-term met. data from meacham site
T = temperature, RWS = resultant wind speed

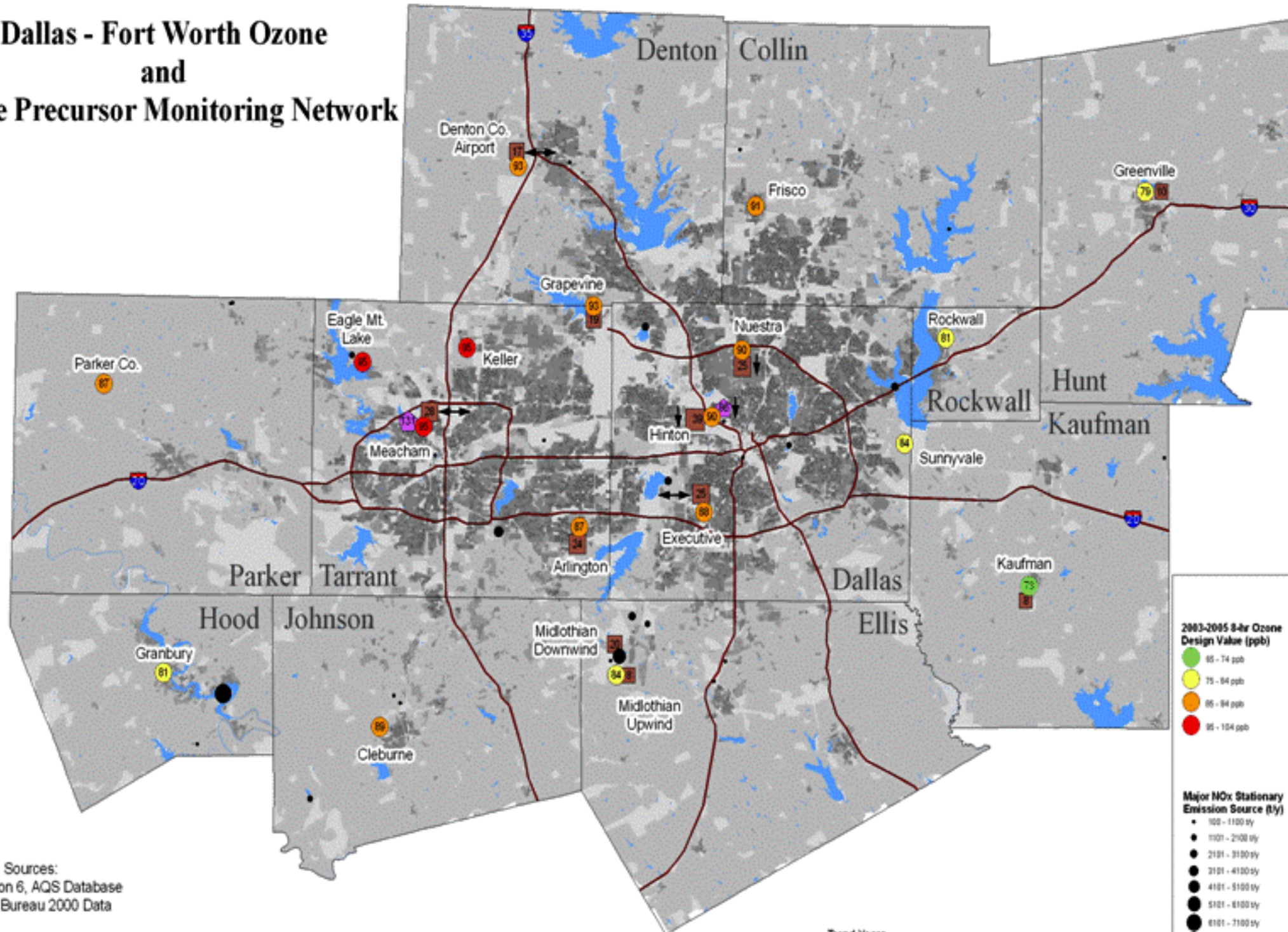
Dallas Hinton Site VOC Concentration Trends

June-August Weekday 0500-0800 LST Arithmetic Means

75% minimum data capture per year



Dallas - Fort Worth Ozone and Ozone Precursor Monitoring Network



Sources:
EPA Region 6, AQS Database
Census Bureau 2000 Data

EPA Region 6
GIS Support Team
Dallas, TX
April 5, 2006

LOCKHEED MARTIN

20060405ML03

Trend Years
1986-2005: Hinton and Meacham sites.
1996-2005: Nuestra and Executive sites.
1997-2005: Denton Co. Airport site.

0 2.5 5 10 15 20
Miles

Legend

2003-2005 8-hr Ozone Design Value (ppb)
- 65 - 74 ppb
- 75 - 84 ppb
- 85 - 94 ppb
- 95 - 104 ppb

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- 201 - 300 ppbC
- 301 - 400 ppbC

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- 2101 - 3100 t/y
- 3101 - 4100 t/y
- 4101 - 5100 t/y
- 5101 - 6100 t/y
- 6101 - 7100 t/y
- 7101 - 8100 t/y

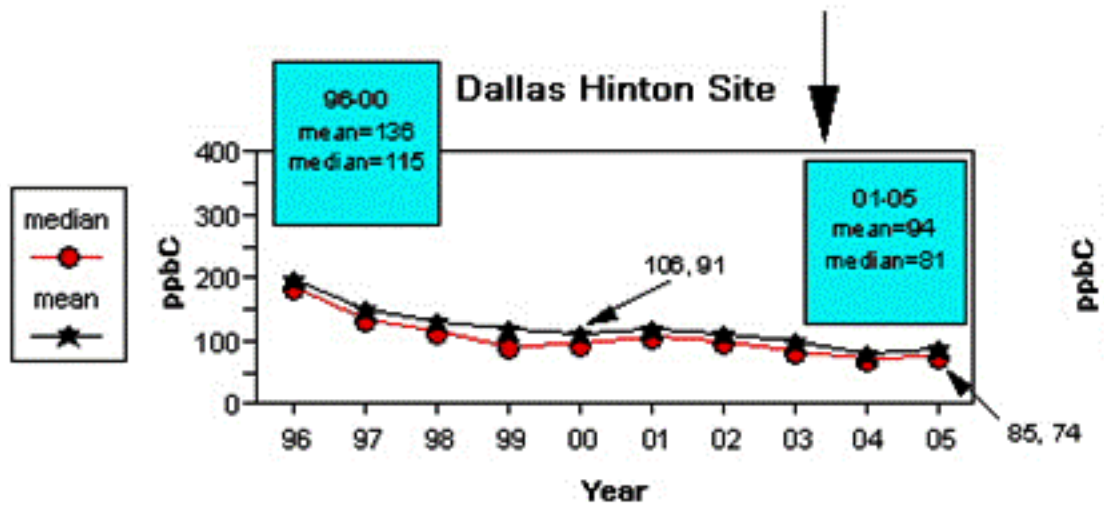
2003-2005 June-August 6-9 AM Weekday NOx Concentration (ppb)
- 0 - 10 ppb
- 11 - 20 ppb
- 21 - 30 ppb
- 31 - 40 ppb

Statistically Significant Long-Term Trend
- Down
- Up
- No Change

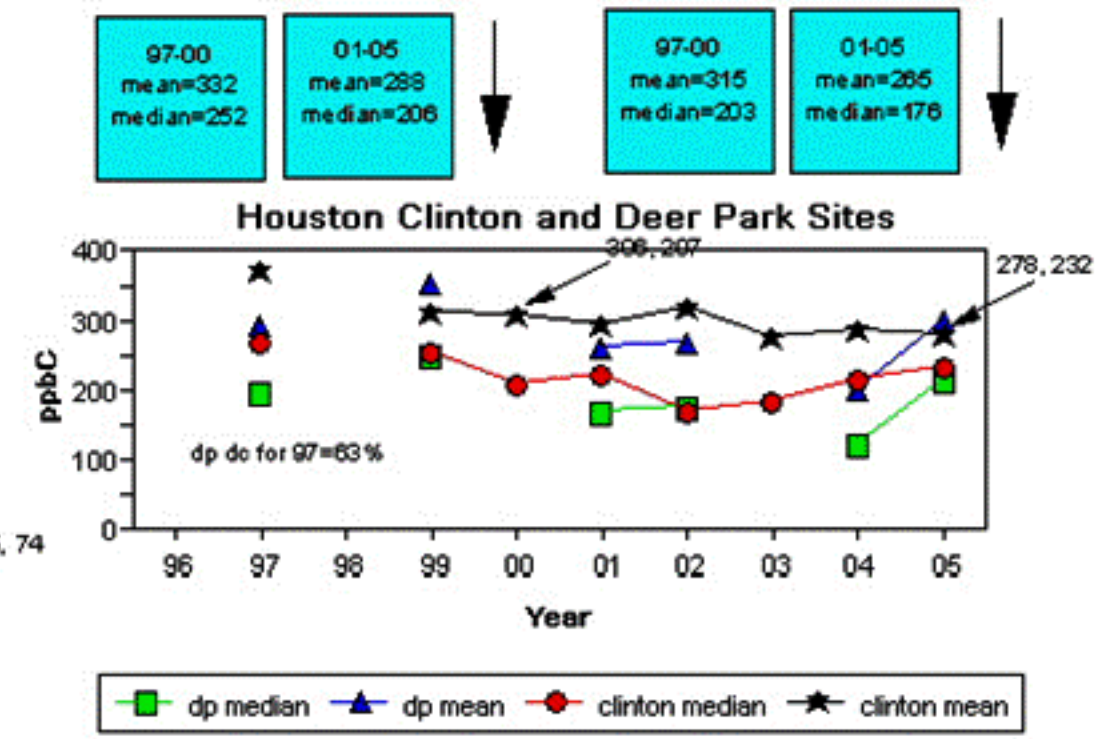
Population Density (per square mile)
- 0
- 1 - 500
- 501 - 1000
- 1001 - 5000
- > 5000

TNMOC Trends

June-August Weekday Morning (5-8 AM LST) Arithmetic Means and Medians; > 70% data capture

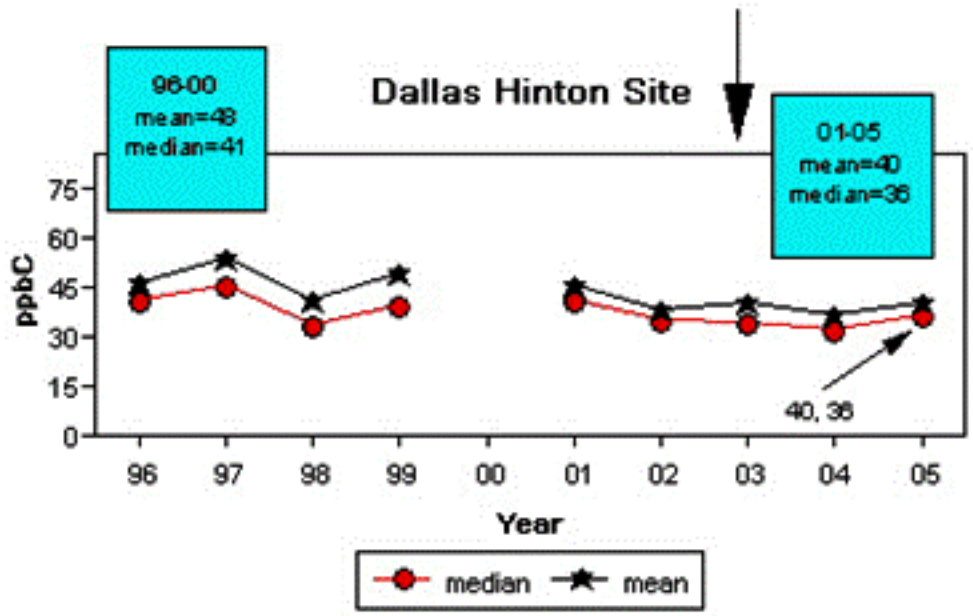


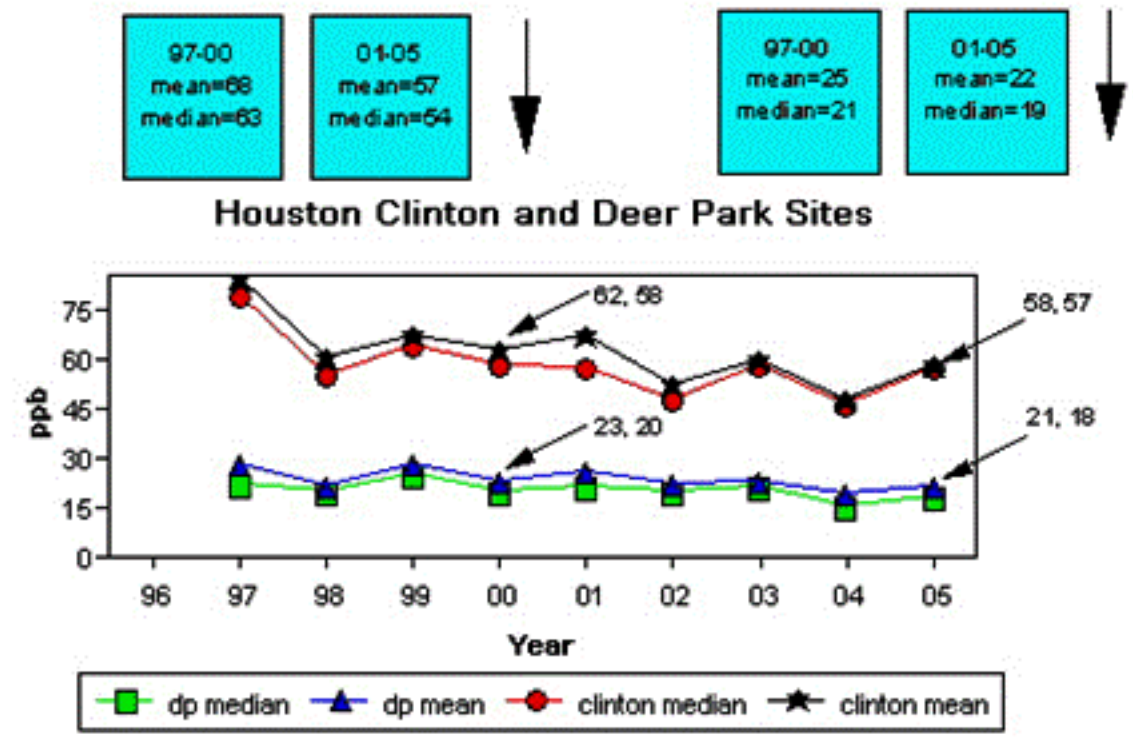
dc for 96 = 63%
dc for 97 = 67%



NOx Trends

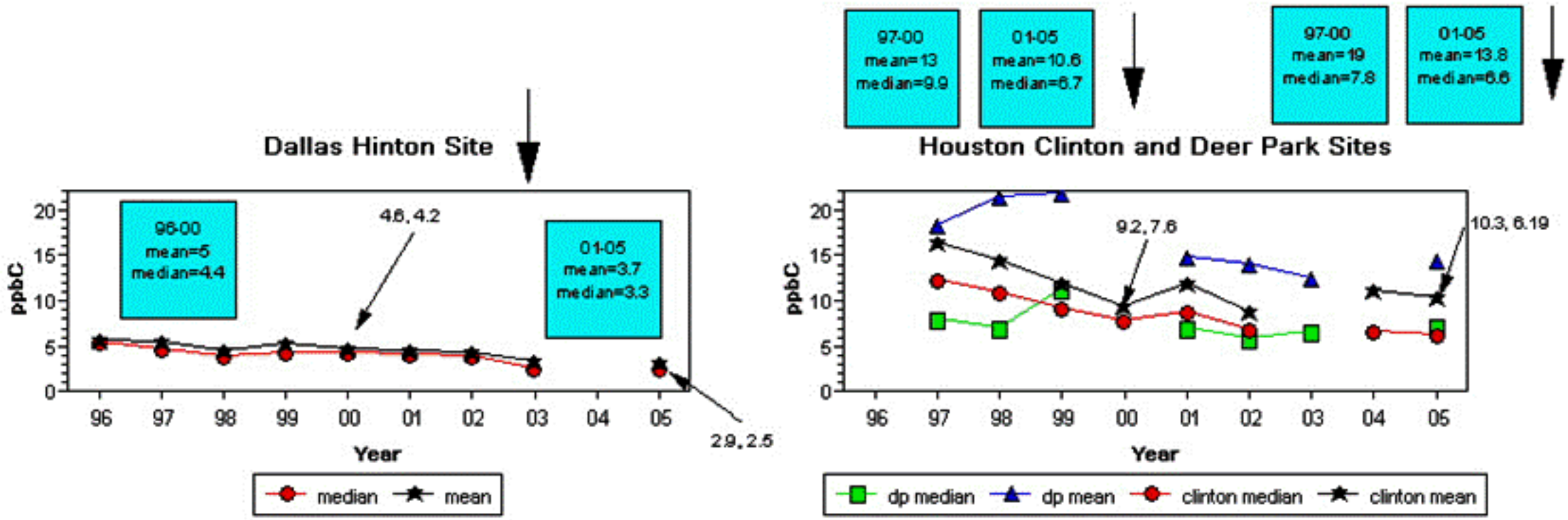
June-August Weekday Morning (5-8 AM LST) Arithmetic Means and Medians; >= 70% data capture





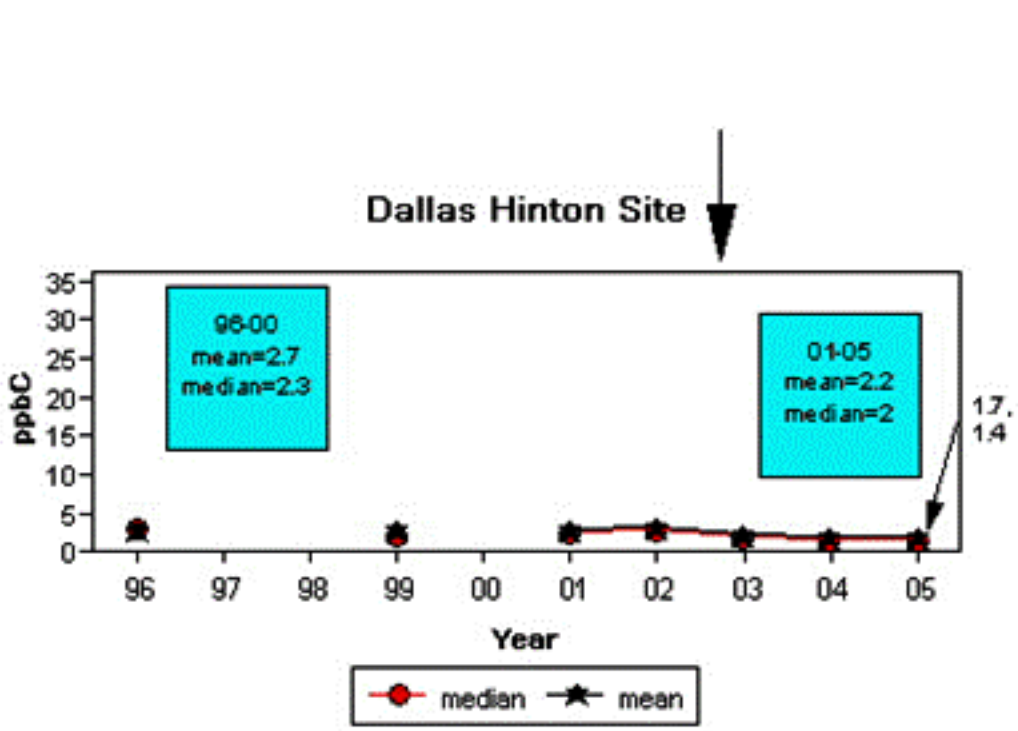
Ethylene Trends

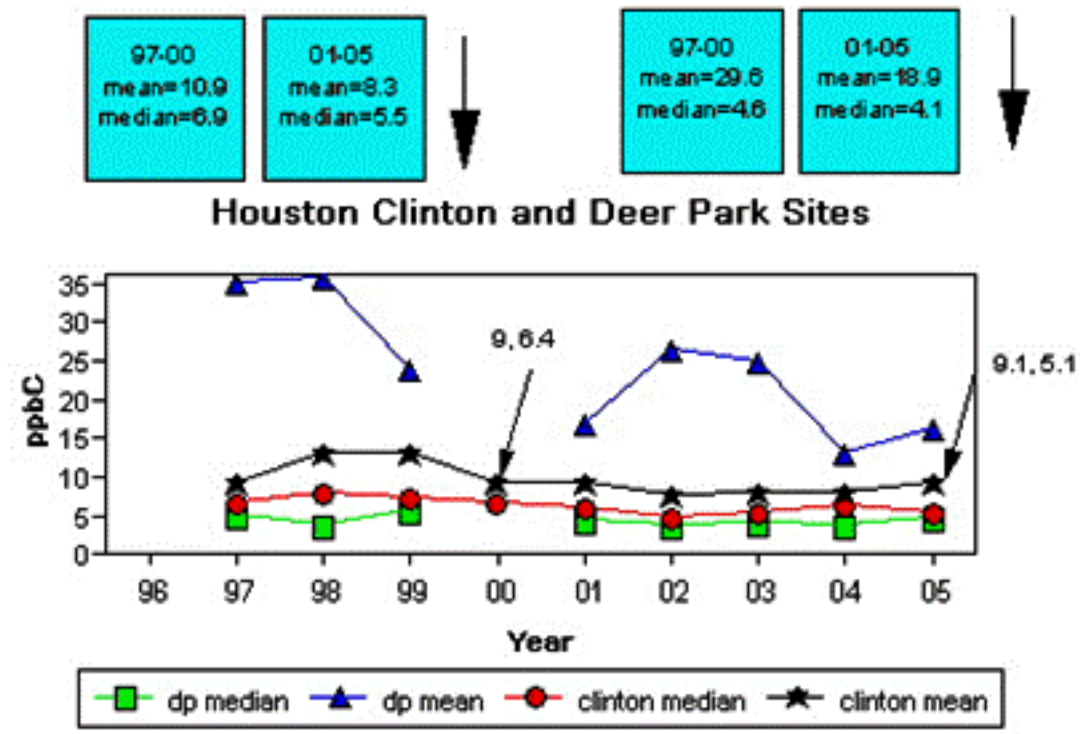
June-August Weekday Morning (5-8 AM LST) Arithmetic Means and Medians; >= 70% data capture



Propylene Trends

June-August Weekday Morning (5-8 AM LST) Arithmetic Means and Medians; >= 70% data capture





Conclusions

- The Good News: Both Houston and DFW have monitored decreases in ozone and NOx/VOC precursors over the past 20 years.
- The 2001-2005 precursor concentration means are statistically significantly lower at the 95% confidence level than the 1996-2000 means.
- 2005 precursor concentrations in Dallas have continued to slowly decline since 2000.
- 2005 precursor concentrations at the Houston Deer Park site are lower than 1999 concentrations; at the Houston Clinton Drive site 2005 precursor concentrations are similar to 2000 concentrations.

Conclusions (cont.)

- Continuing Challenges:
- (1) Ozone and precursor concentrations have dropped in Houston, but meteorology was also very favorable over past 5 years; Further reductions of VOC and NOx will be needed in Houston to combat future warmer and drier summers.

- (2) The DFW area similarly will need continued precursor reductions to counter the effects of substantial population growth in the area.