



Texas Commission on Environmental Quality

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# Weekday/Weekend Effect Analysis, Part Two

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June 8, 2006

DRAFT



# 8-Hour Guidance on MPE

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- In addition to evaluating the model's ability to reproduce base case ozone & precursors, new 8-hour guidance includes evaluation of model response to emission changes.
- Four approaches are recommended:
  - Observation-based models
  - Probing tools
  - Alternative base cases
  - Retrospective analysis



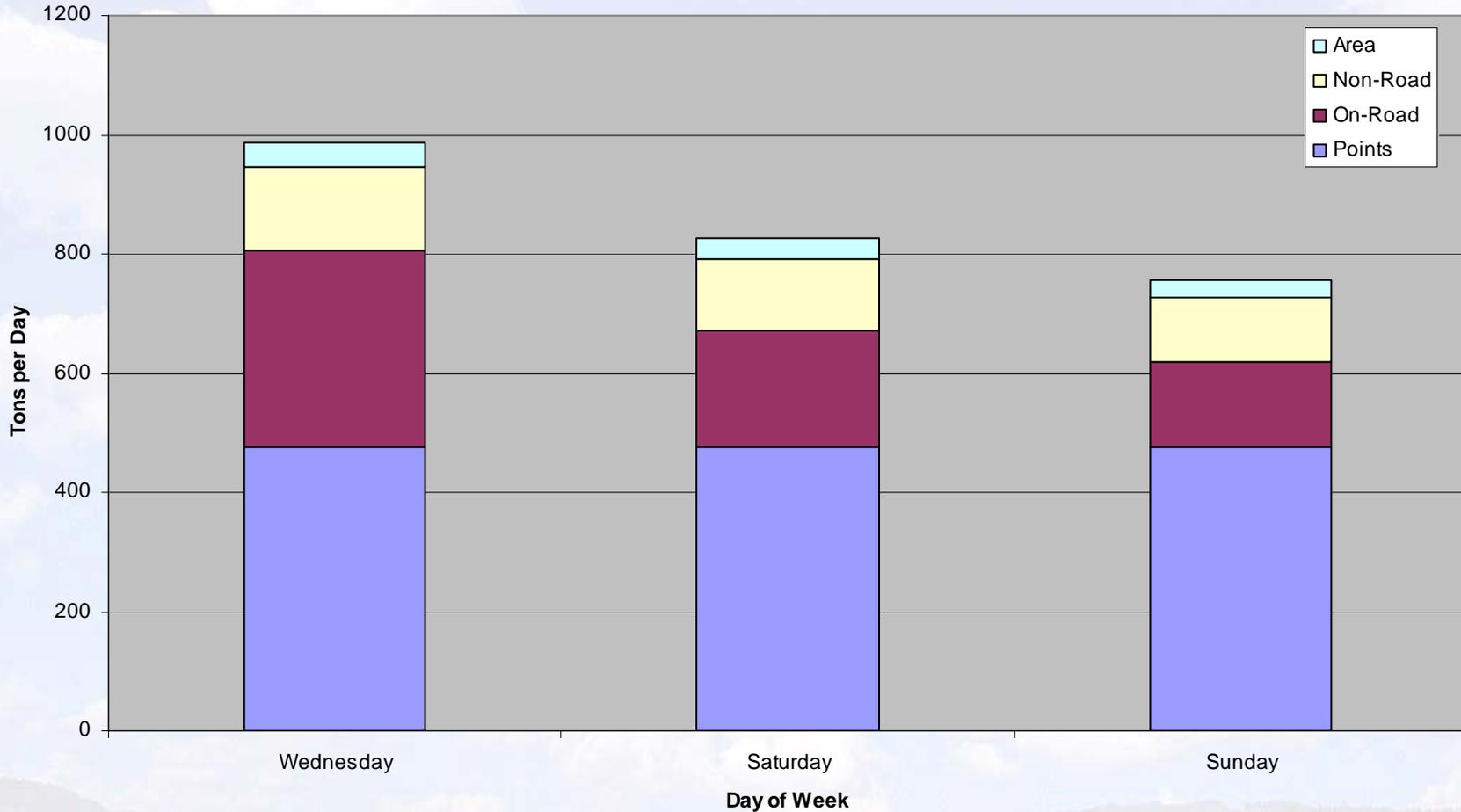
# Weekday-Weekend analysis

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- Weekday/weekend analysis forms a natural observation-based model for testing the model's response to emission changes.
- At most locations, NO<sub>x</sub> emissions decrease from weekdays to Saturday through Sunday, while VOC emissions are highest on Saturday, lowest on Sunday.

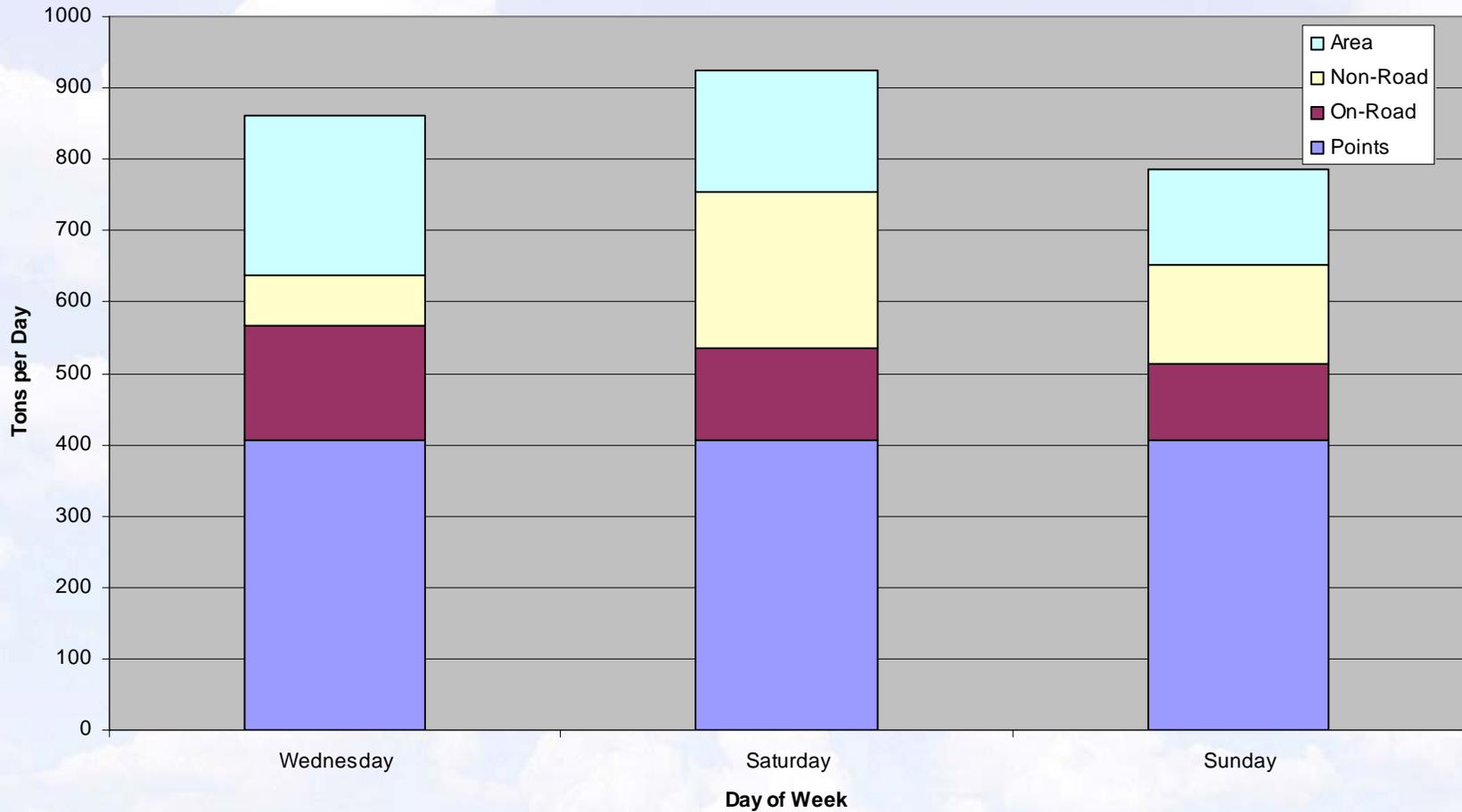


## Weekday vs. Weekend NO<sub>x</sub> Emissions in the HGB 8-County Area August-September, 2000





# Weekday vs. Weekend VOC Emissions in the HGB 8-County Area August-September, 2000





# Ambient NO<sub>x</sub>

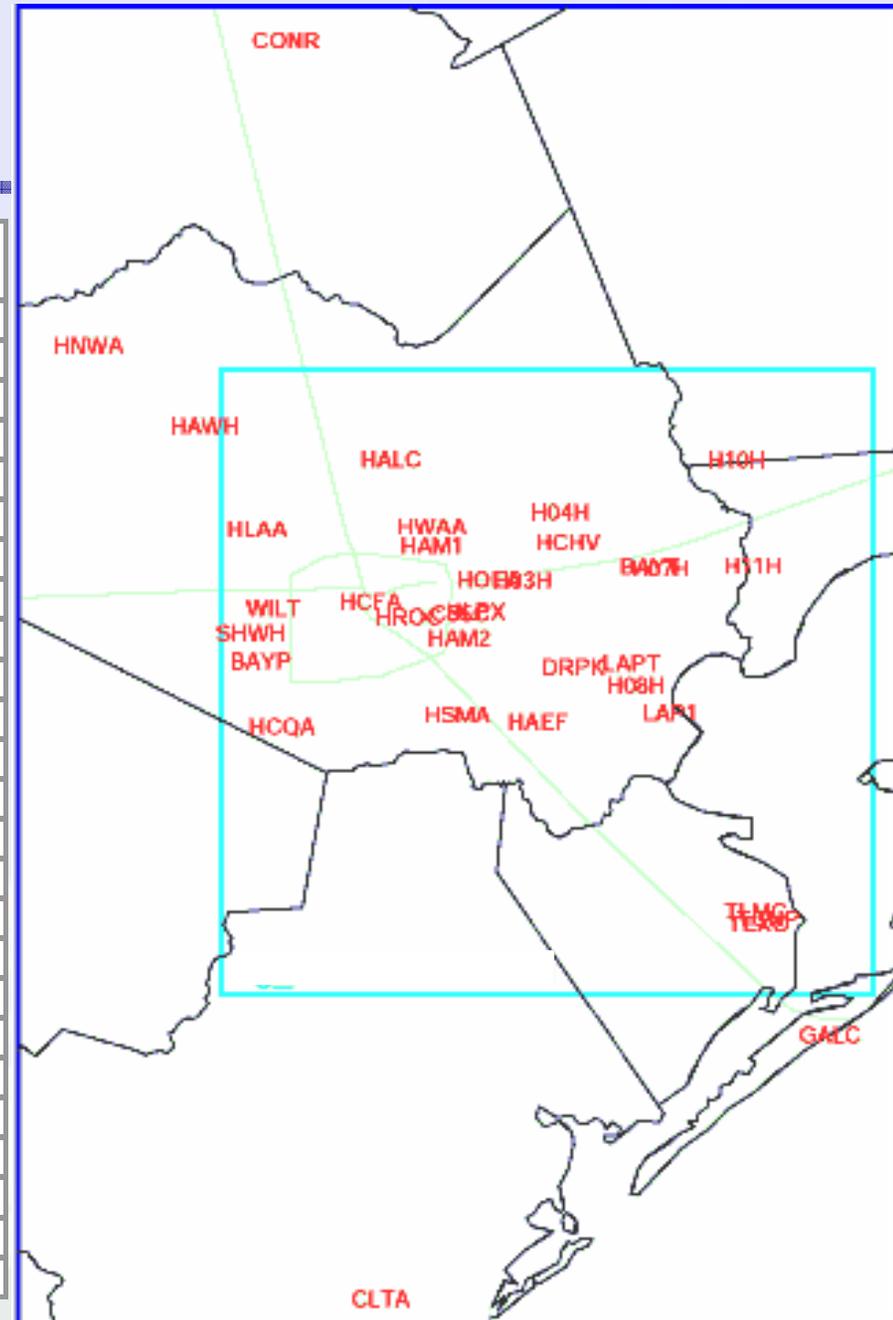
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- Based on the emissions inventory, we would expect ambient NO<sub>x</sub> concentrations to decrease on weekends, especially in mobile source-dominated areas.
- Blanchard (2005) looked at average NO<sub>x</sub> concentrations by day-of-week as a % of Wednesday concentrations:
  - March-October, 1998 through 2003
  - 6:00 AM and Noon



# Monitor Site Codes and Locations

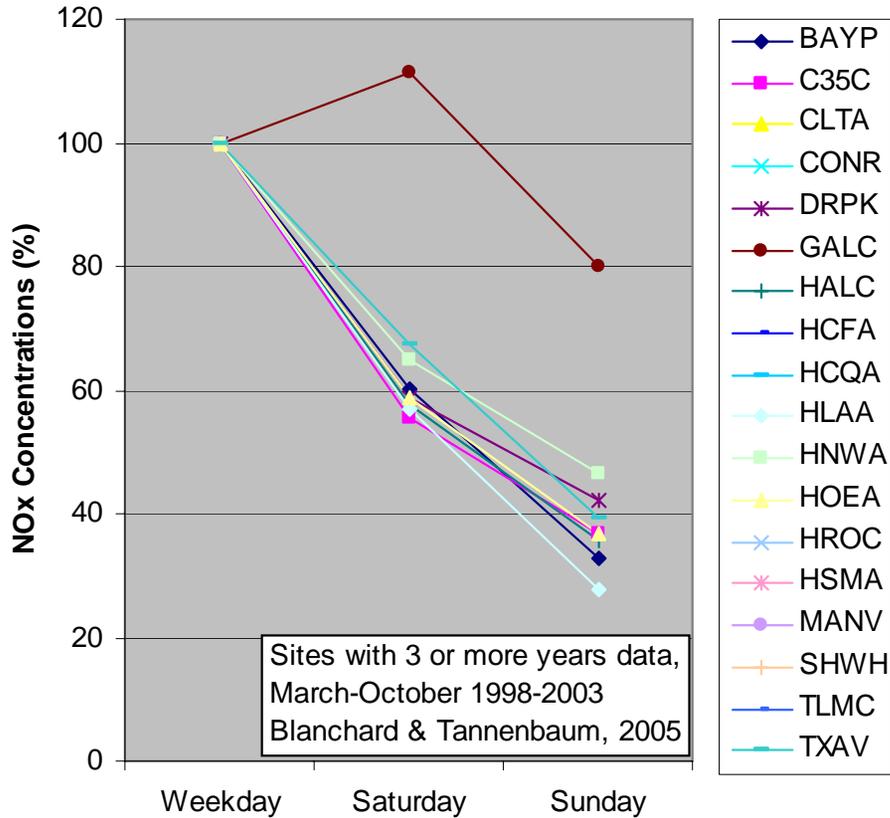
Site Code	Site Info
BAYP	Bayland Park, Harris Co., TX
C35C	Clinton, Harris Co., TX
CLTA	Clute, Brazoria Co., TX
CONR	Conroe, Montgomery Co., TX
DRPK	Deer Park, Harris Co., TX
GALC	Galveston, Galveston Co., TX
H03H	HRM Site 3, Houston, Harris Co., TX
H04H	HRM Site 4, Houston, Harris Co., TX
H07H	HRM Site 7, West Baytown, Harris Co., TX
H08H	HRM Site 8, Houston, Harris Co., TX
H10H	HRM Site 10, Mont Belvieu, Chambers Co., TX
H11H	HRM Site 11, Chambers Co., TX
HALC	Aldine, Houston, Harris Co., TX
HCFA	Crawford, Houston, Harris Co., TX
HCQA	Croquet, Houston, Harris Co., TX
HLAA	Lang, Houston, Harris Co., TX
HNWA	NW Harris, Tomball, Harris Co., TX
HOEA	Houston East, Houston, Harris Co., TX
HROC	TCEQ Houston Regional Office, Harris Co., TX
HSMA	Swiss & Monroe, Houston, Harris Co., TX
HWAA	North Wayside, Houston, Harris Co., TX
SHWH	Westhollow, Houston, Harris Co., TX
TLMC	Texas City, Galveston Co., TX
LAPT	La Porte, Harris Co., TX
WILT	Top of Williams Tower (254m AGL), Harris Co., TX



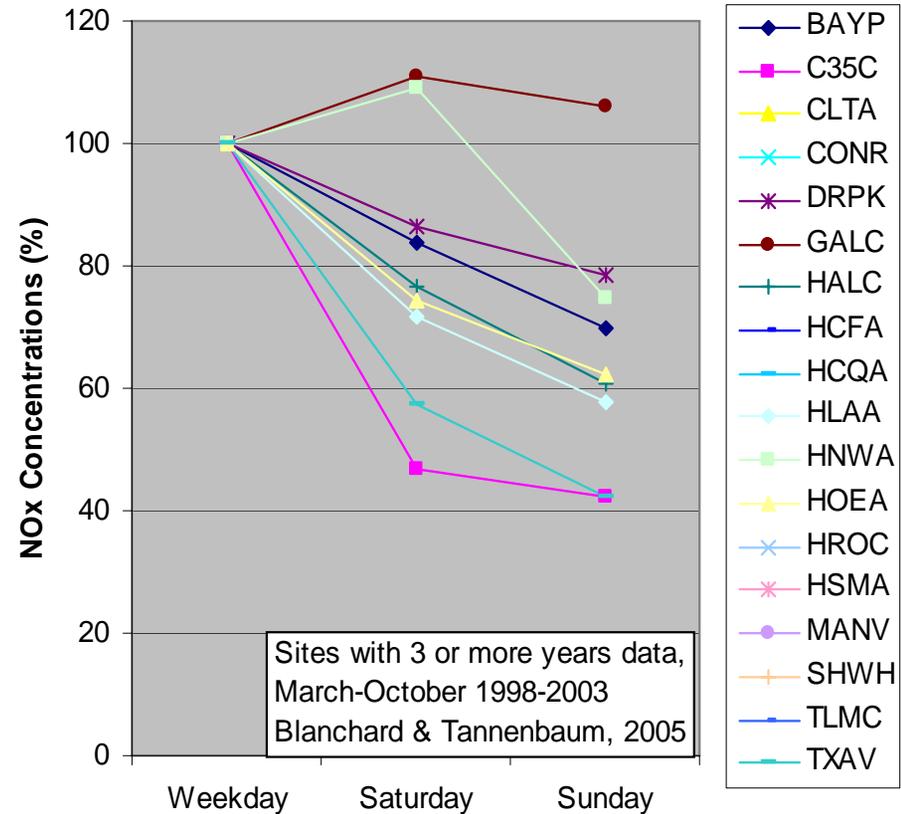


# Ambient NOx (cont.)

### 6 AM Observed NOx Concentrations as a % of Weekday (Blanchard)



### Noon Observed NOx Concentrations as a % of Weekday (Blanchard)



Note: List of monitoring sites is the same for all graphics to facilitate comparison. Not all sites are represented in every plot.



## Ambient NO<sub>x</sub> (cont.)

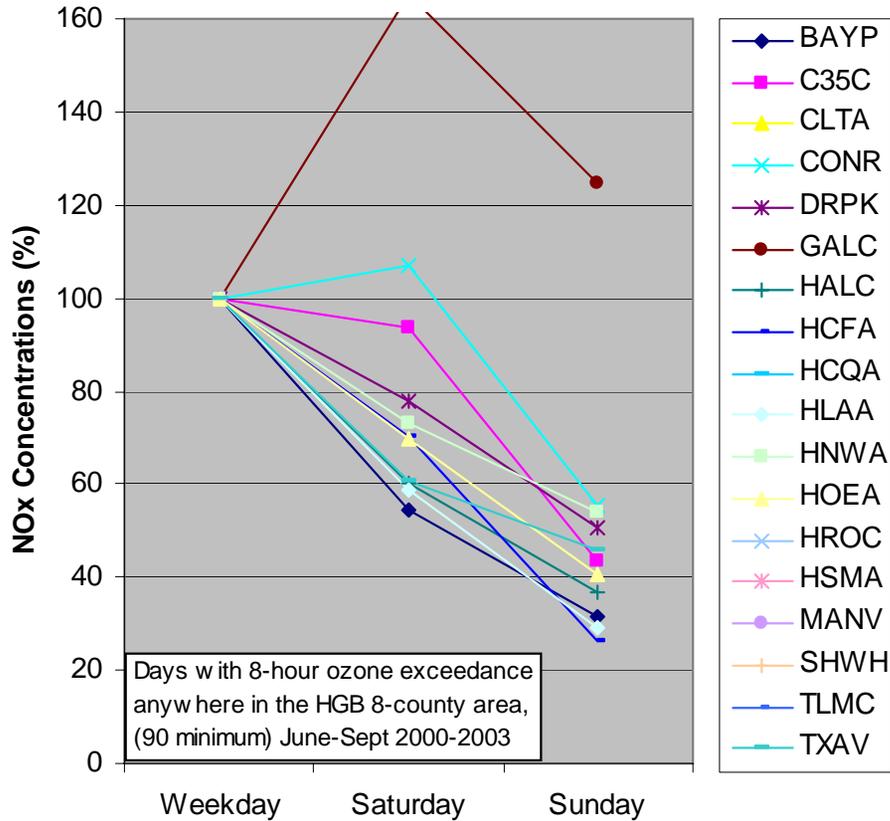
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- We looked at the same set of monitors as Blanchard, & found similar patterns
  - June-September, 2000 through 2004
  - 6:00 AM and Noon
  - Only days experiencing an 8-hour ozone exceedance at a monitor in the 8-county area.

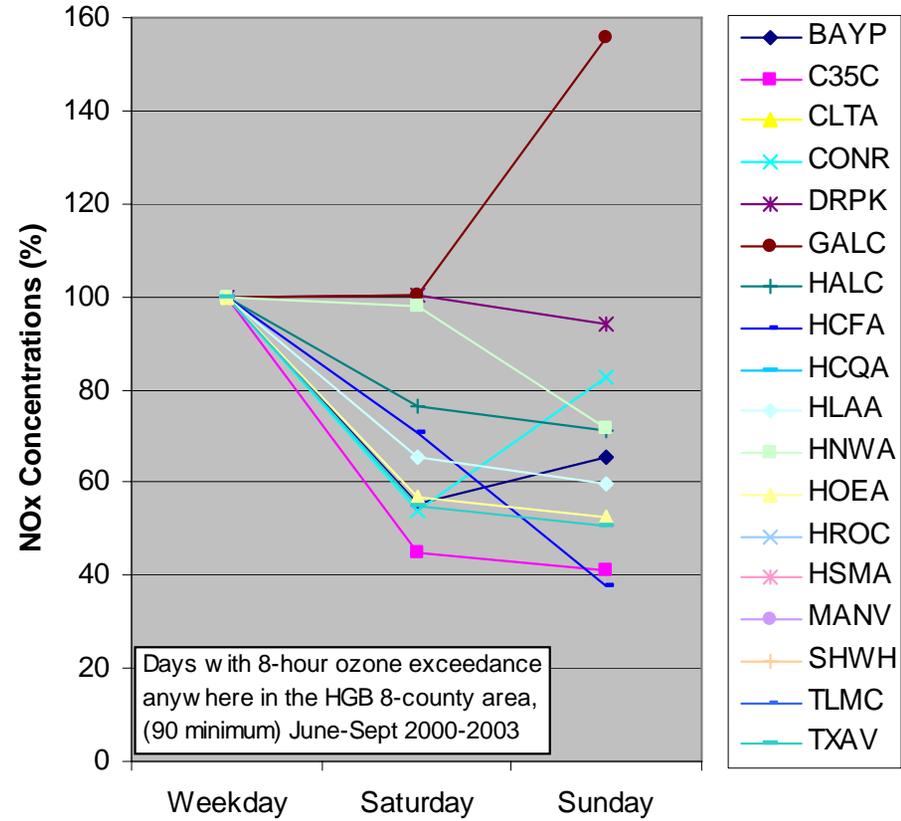


# Ambient NOx (cont.)

### 6 AM Observed NOx Concentrations as a % of Weekday (TCEQ)



### Noon Observed NOx Concentrations as a % of Weekday (TCEQ)





# Modeled NO<sub>x</sub>

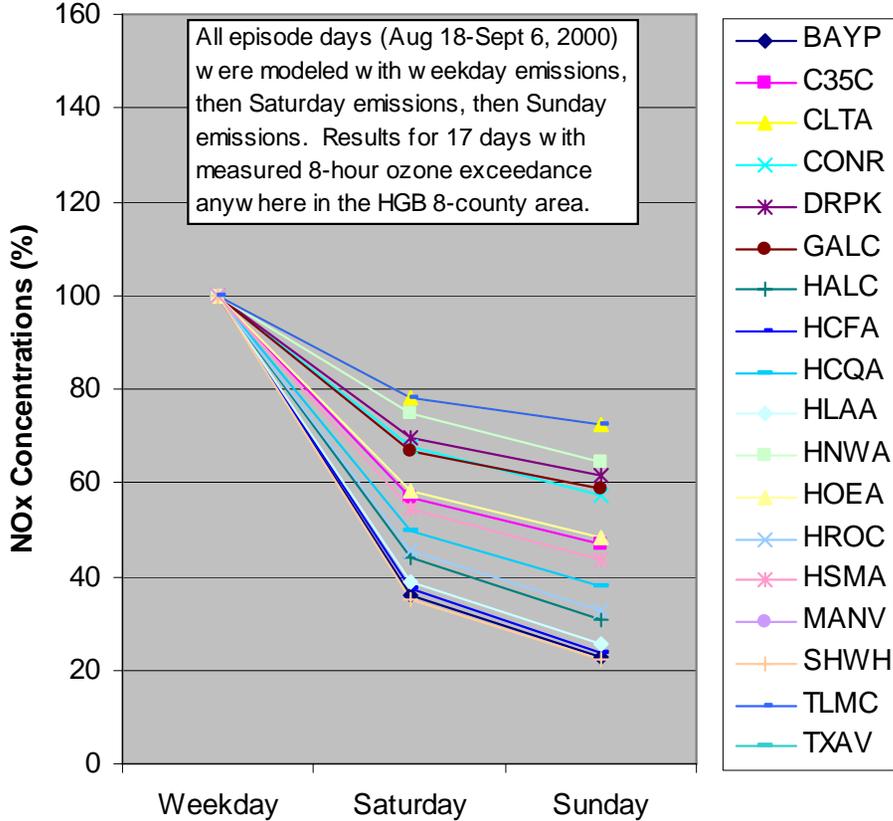
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- We devised a set of diagnostic runs to test the response of CAMx to the weekday/ weekend effect.
- We ran the entire August 18-September 6 baseline using the same anthropogenic emissions for each day:
  - Representative weekday
  - Representative Saturday
  - Representative Sunday
- Following are depictions of 6 AM and Noon modeled NO<sub>x</sub> concentrations as a % of weekday.

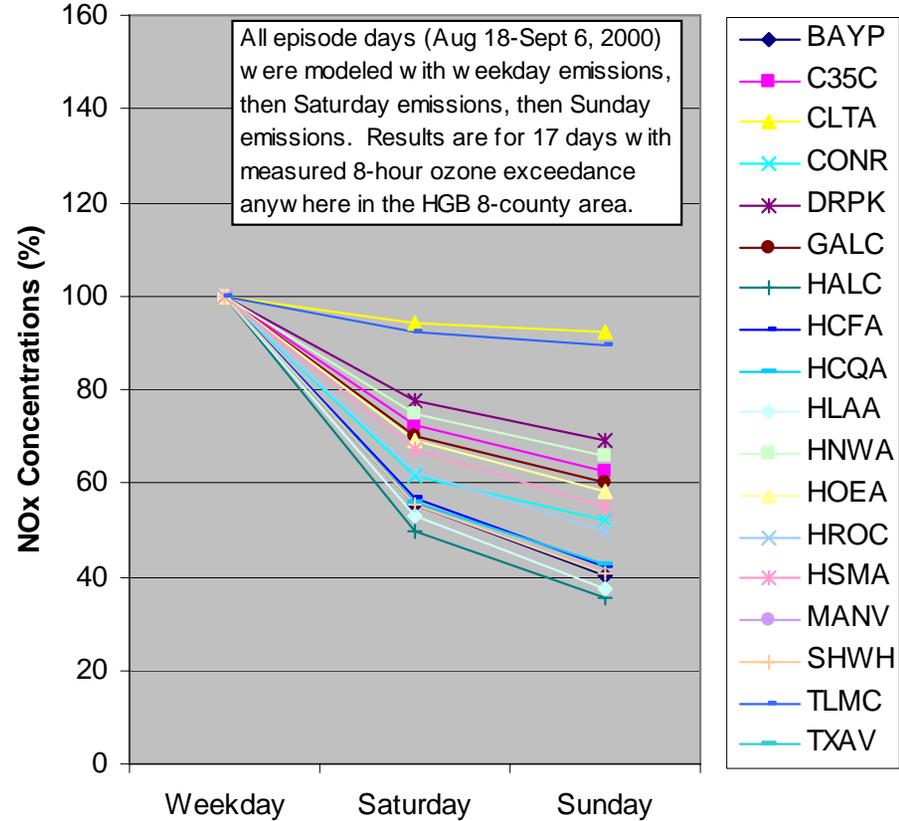


# Modeled NOx

**6 AM Modeled NOx Concentrations as a % of Weekday (Aug 18 - Sept 6, 2000, Weekday/Weekend Test)**



**Noon Modeled NOx Concentrations as a % of Weekday (Aug 18 - Sept 6, 2000, Weekday/Weekend Test)**





# NO<sub>x</sub> Analysis

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- Model generally represents weekday-Saturday-Sunday decline in NO<sub>x</sub> concentrations.
- Modeled 6AM Saturday concentrations (as a % of weekday) appear to be too low.
- Model did not replicate observed patterns at coastal sites (CLTA, GALC) or at Conroe (CONR).



# Ambient CO

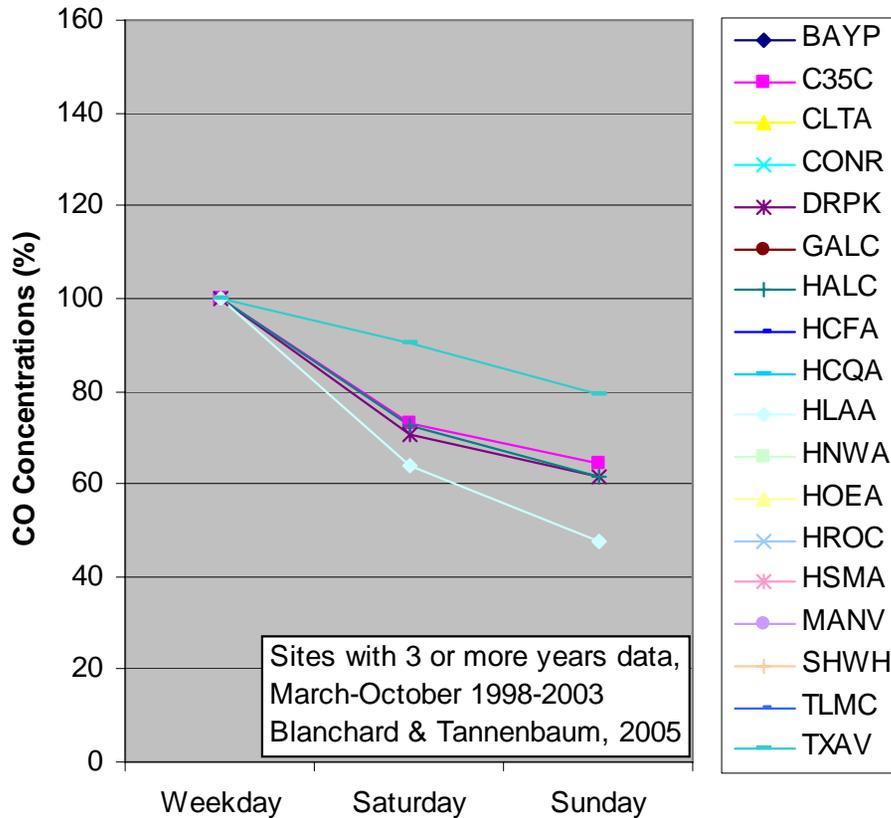
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- Like NO<sub>x</sub>, CO emissions are expected to decline from weekdays to Saturday to Sunday.
- Similar analyses were conducted for ambient and modeled CO concentrations.

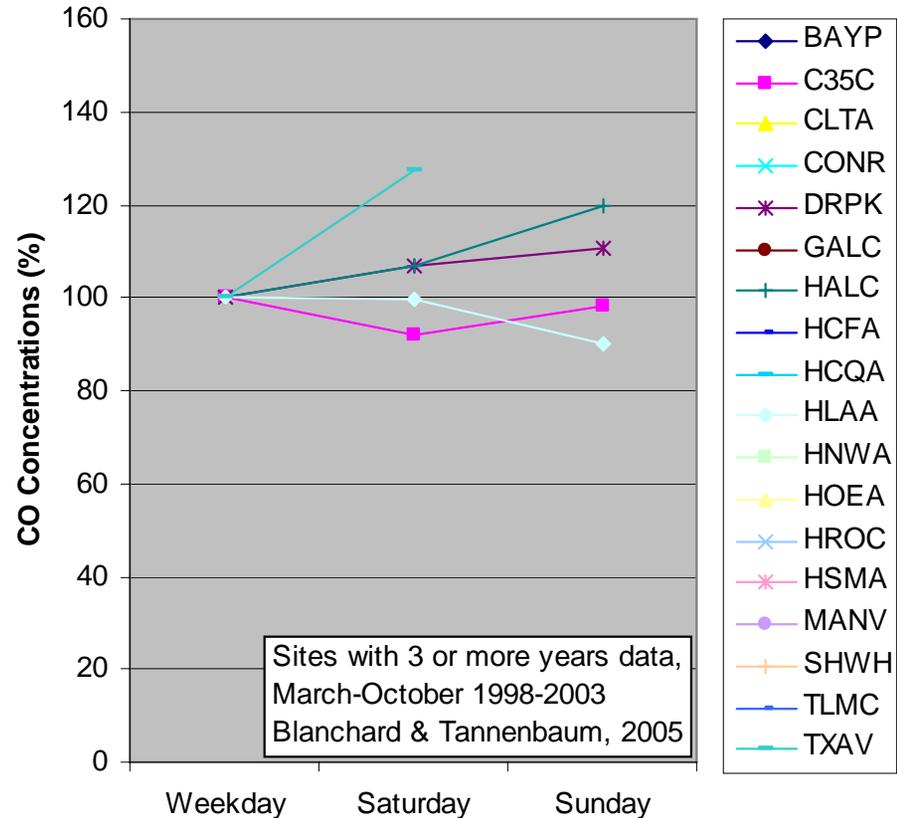


# Ambient CO (Cont.)

### 6 AM Observed CO Concentrations as a % of Weekday (Blanchard)



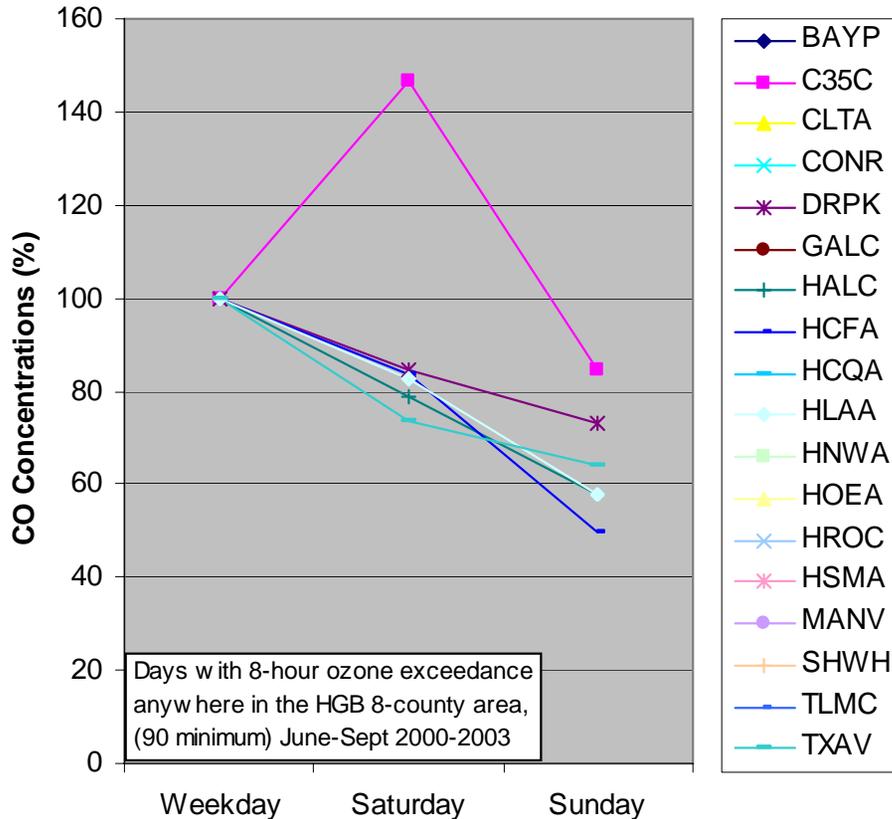
### Noon Observed CO Concentrations as a % of Weekday (Blanchard)



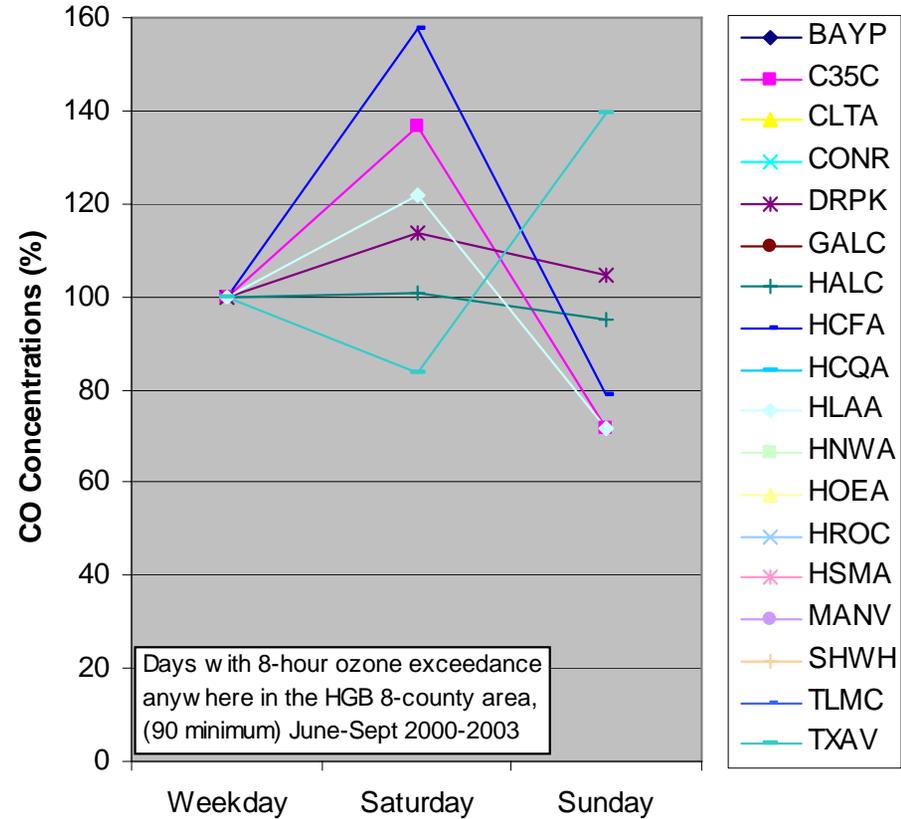


# Ambient CO (Cont.)

### 6 AM Observed CO Concentrations as a % of Weekday (TCEQ)



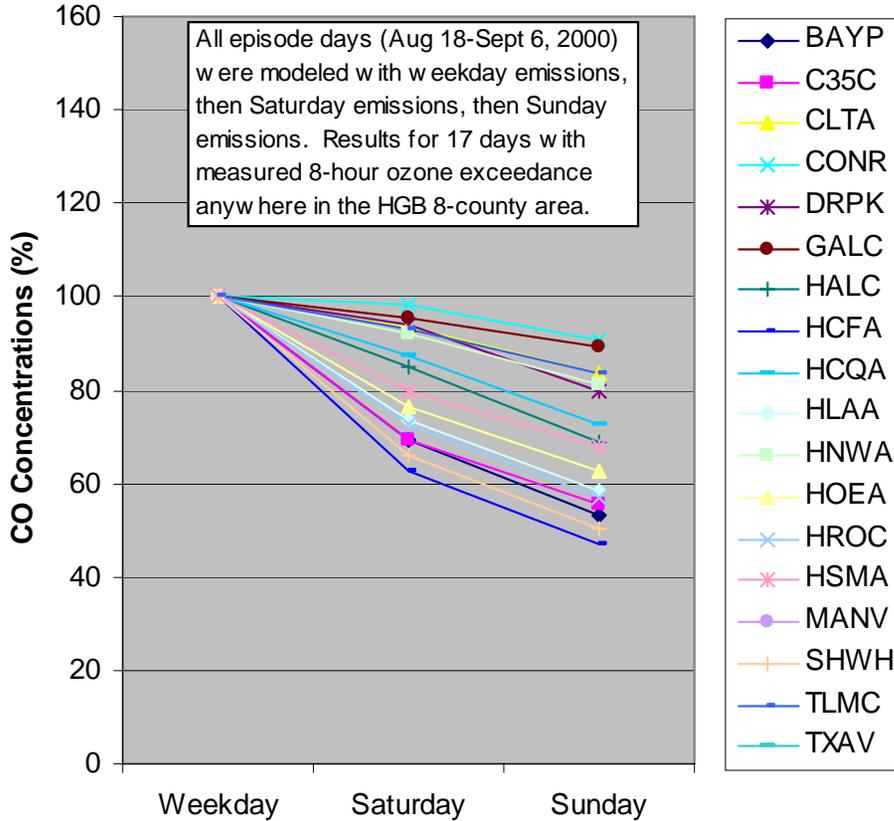
### Noon Observed CO Concentrations as a % of Weekday (TCEQ)



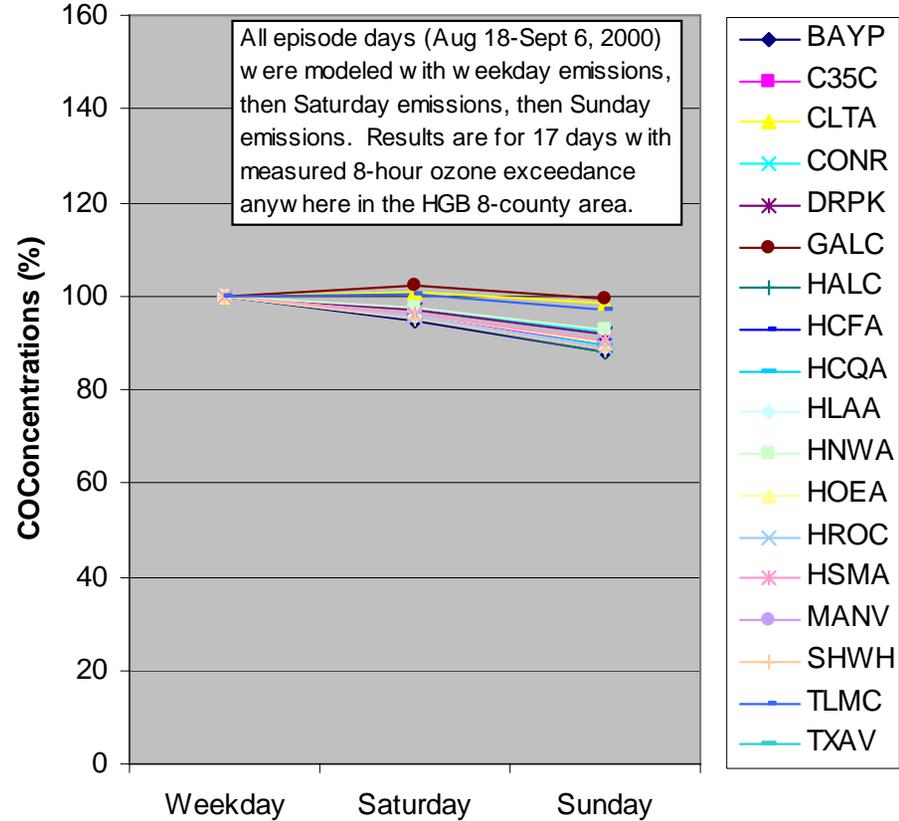


# Modeled CO

**6 AM Modeled CO Concentrations as a % of Weekday (Aug 18 - Sept 6, 2000, Weekday/Weekend Test)**



**Noon Modeled CO Concentrations as a % of Weekday (Aug 18 - Sept 6, 2000, Weekday/Weekend Test)**





# CO Analysis

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- Model generally represents weekday-Saturday-Sunday decline in CO concentrations.
- Differences between Blanchard data and TCEQ data might be due to differences between periods represented (March-Oct. vs. June-Sept.) or may be simply due to relatively small sample sizes.



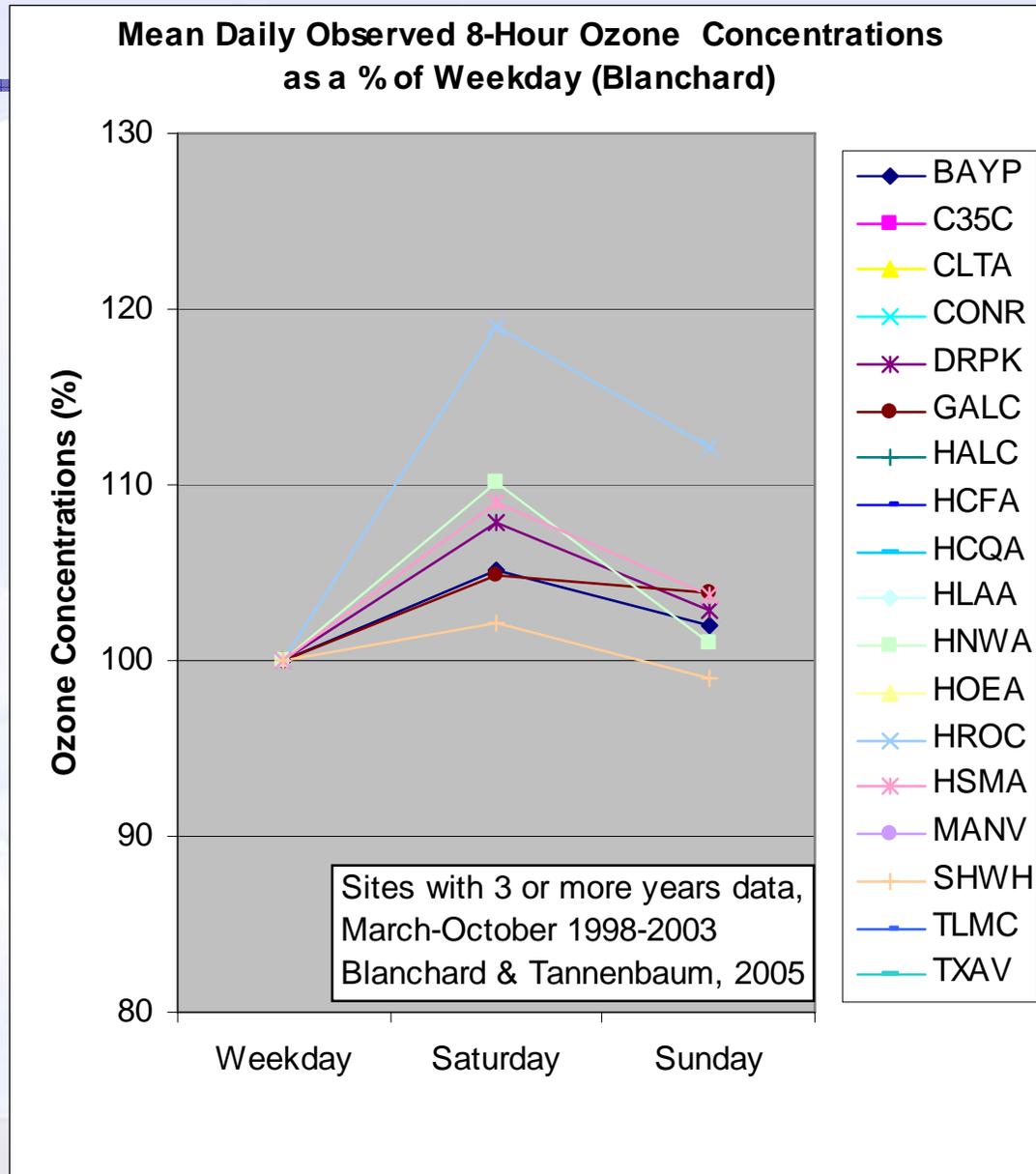
# Ambient Ozone

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- In many areas, Blanchard and others have noted an increase in ambient ozone concentrations on weekends in many areas.
- We compared modeled peak daily 8-hour ozone concentrations (as a % of weekday) with measured concentrations to see if model reproduces observed trends.

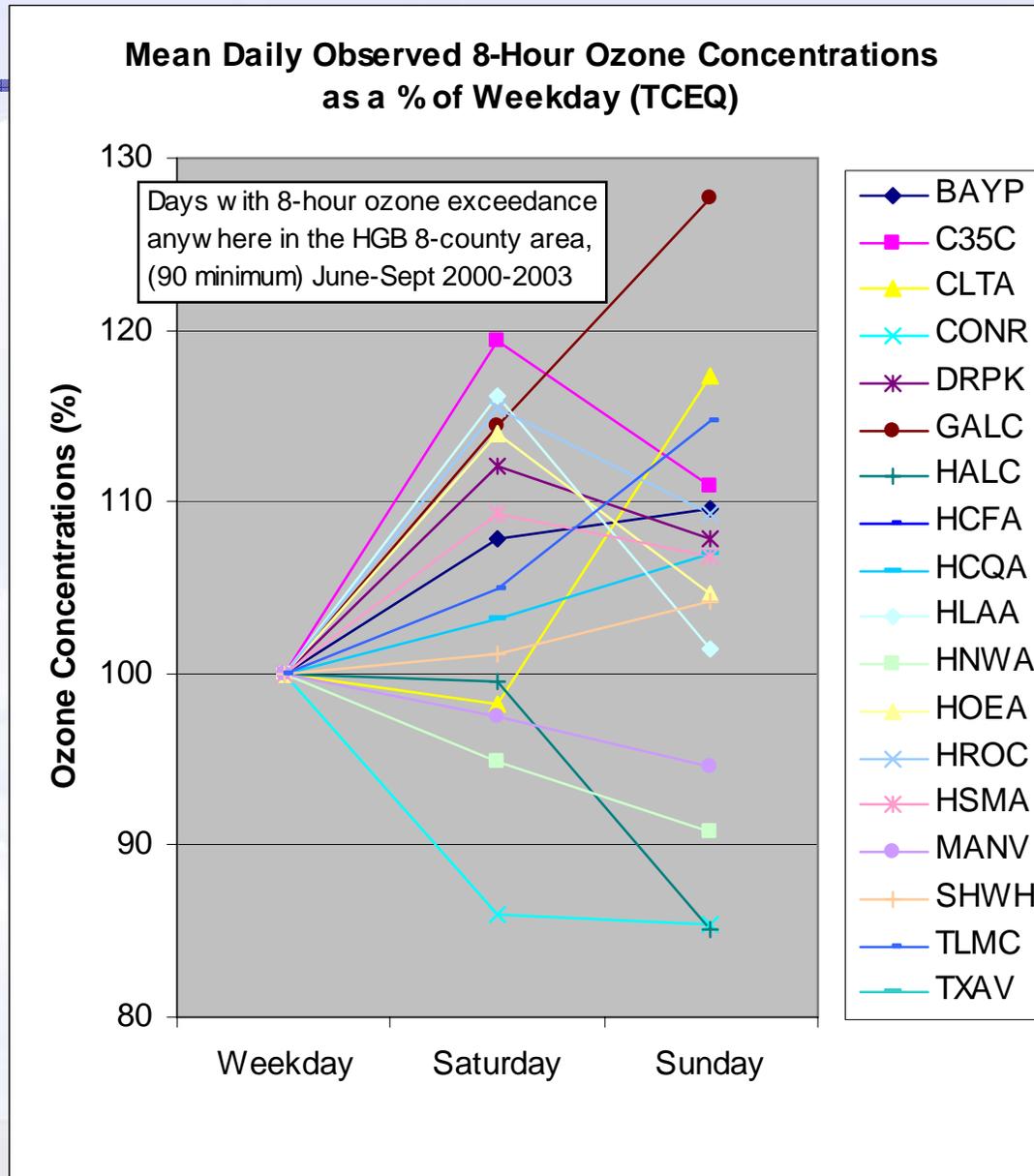


# Ambient Ozone (cont.)





# Ambient Ozone (cont.)

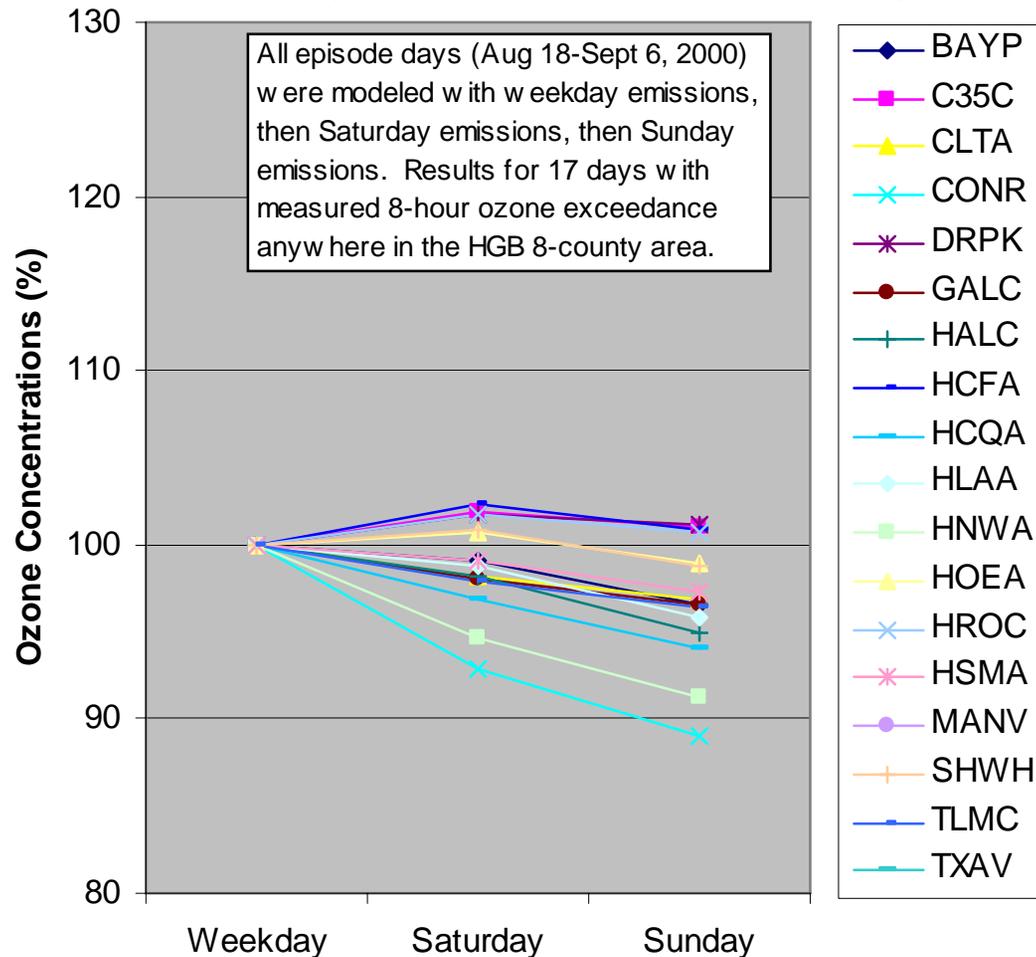




# Modeled Ozone

## Mean Daily Modeled 8-Hour Ozone Concentrations as a % of Weekday

(Aug 18 - Sept 6, 2000, Weekday/Weekend Test)





# Ozone Analysis

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- Blanchard shows distinctive Saturday peak, with Sunday concentrations slightly higher than weekday.
- TCEQ ambient data show similar trend at many urban/industrial sites, but some of these sites show an increase on Sunday.
  - Coastal sites tend to increase from weekday through Saturday to Sunday
  - Other more rural sites tend to decrease from weekday through Saturday to Sunday



## Ozone Analysis (cont.)

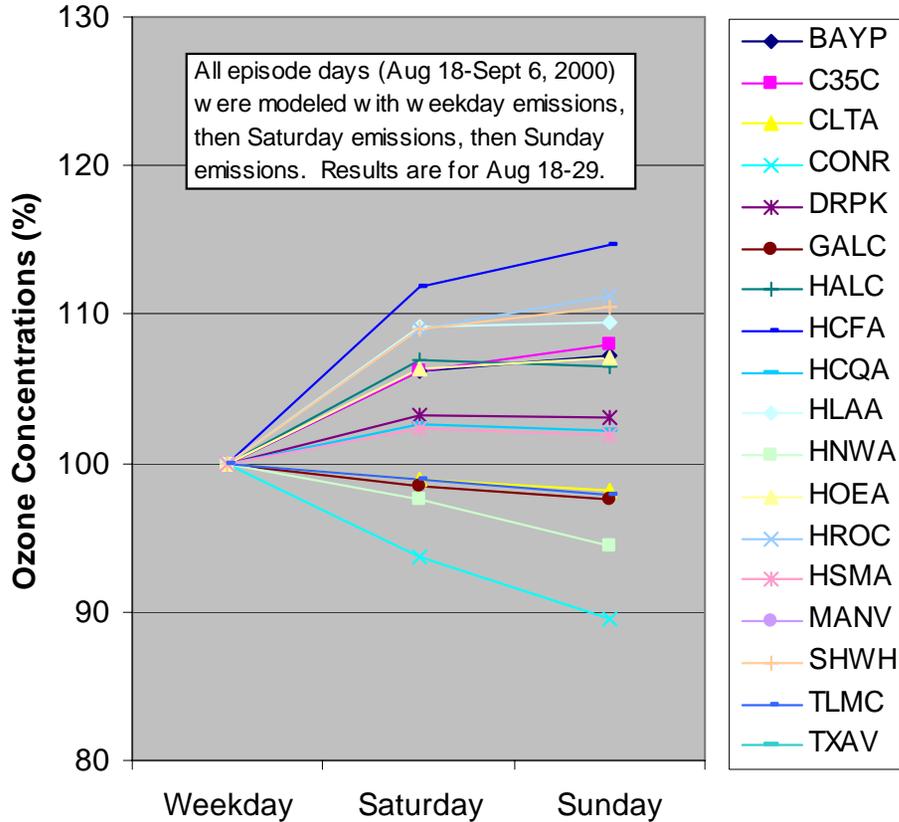
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- Model shows either no change or a slight decline from weekday through Saturday to Sunday.
- To further understand what's going on, we split the episode into two parts:
  - Aug 18 – 29: Typical ozone season meteorology
  - Aug 30 – Sept 6: Extremely hot, with atypical wind regimes

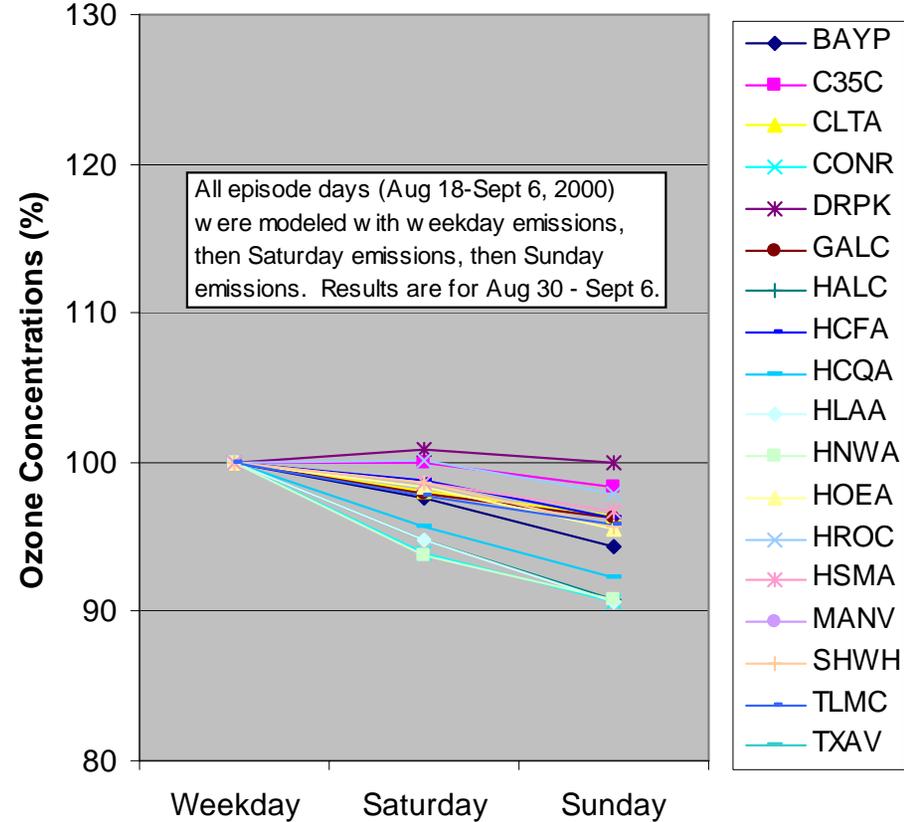


# Ozone Analysis (cont.)

**Mean Daily Modeled 8-Hour Ozone Concentrations as a % of Weekday (Aug 18 - 29, 2000, Weekday/Weekend Test)**



**Mean Daily Modeled 8-Hour Ozone Concentrations as a % of Weekday (Aug 30 - Sept 6, 2000, Weekday/Weekend Test)**





## Ozone Analysis (cont.)

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- In Aug 18-29 period, model behavior is somewhat consistent with observations, but:
  - There is no Saturday peak evident at urban/industrial sites
  - Coastal sites do not show an increasing trend.
- In August 30-Sept 6 period, model shows little response to weekday/weekend effects. Since these days tend to have the highest modeled ozone concentrations, they dominate modeled response in RRF calculations.



## Important note

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- Because of limited sample sizes, trends in the TCEQ data were not tested for statistical significance. The analysis presented here relies on visual identification of patterns in the data and is therefore subjective. Blanchard noted several instances where the weekday trends for NO<sub>x</sub> and CO were significant, but did not see significant trends in the ozone data in most cases.



# Tenative Conclusions

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- Overall model response to weekday/weekend effect is reasonably consistent with observations, at least in the first part of the episode.
- Lack of a Saturday peak in modeled ozone at urban/industrial sites may indicate that model has too much surface-level NO<sub>x</sub>, and may be less responsive to NO<sub>x</sub> reductions than the real atmosphere.
- Deviation between modeled and measured behavior at coastal sites is likely due to local mobile source emission patterns not accurately reflected in the inventory.



# Tenative Conclusions

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- Latter part of the episode shows little response to weekday/weekend emission changes, which probably dampens overall model response.
  - Note that while the modeled behavior during this period is not consistent with long-term measured trends, there is no reason to believe the model is not correctly characterizing the response to emission changes for these types of days.