8-Hour Guidance on MPE

• 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

- Weekday/weekend analysis forms a natural observation-based model for testing the model’s response to emission changes.

- At most locations, NOx emissions decrease from weekdays to Saturday through Sunday, while VOC emissions are highest on Saturday, lowest on Sunday.
Weekday vs. Weekend NO\textsubscript{x} Emissions in the HGB 8-County Area
August-September, 2000
Weekday vs. Weekend VOC Emissions in the HGB 8-County Area
August-September, 2000

Tons per Day

- Area
- Non-Road
- On-Road
- Points

Day of Week

- Wednesday
- Saturday
- Sunday
Ambient NOx

• Based on the emissions inventory, we would expect ambient NOx concentrations to decrease on weekends, especially in mobile source-dominated areas.

• Blanchard (2005) looked at average NOx 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

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

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

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

Sites with 3 or more years data, March-October 1998-2003
Blanchard & Tannenbaum, 2005

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

• 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.
Modeled NOx

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

All episode days (Aug 18-Sept 6, 2000) were modeled with weekday emissions, then Saturday emissions, then Sunday emissions. Results for 17 days with measured 8-hour ozone exceedance anywhere in the HGB 8-county area.

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

All episode days (Aug 18-Sept 6, 2000) were modeled with weekday emissions, then Saturday emissions, then Sunday emissions. Results are for 17 days with measured 8-hour ozone exceedance anywhere in the HGB 8-county area.
NOx Analysis

- Model generally represents weekday-Saturday-Sunday decline in NOx 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

• Like NOx, CO emissions are expected to decline from weekdays to Saturday to Sunday.

• Similar analyses were conducted for ambient and modeled CO concentrations.
6 AM Observed CO Concentrations as a % of Weekday (Blanchard)

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

Sites with 3 or more years data, March-October 1998-2003
Blanchard & Tannenbaum, 2005
Ambient CO (Cont.)

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

Weekday Saturday Sunday

CO Concentrations (%)

BAYP C35C CLTA CONR DRPK GALC HANC HALC HCQA HLAA HNWA HOEA HROA HROC HSMA MANV SHWH TLMC TXAV

Days with 8-hour ozone exceedance anywhere in the HGB 8-county area, (90 minimum) June-Sept 2000-2003

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

Weekday Saturday Sunday

CO Concentrations (%)

BAYP C35C CLTA CONR DRPK GALC HANC HALC HCQA HLAA HNWA HOEA HROA HROC HSMA MANV SHWH TLMC TXAV

Days with 8-hour ozone exceedance anywhere in the HGB 8-county area, (90 minimum) June-Sept 2000-2003
Modeled CO

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

All episode days (Aug 18-Sept 6, 2000) were modeled with weekday emissions, then Saturday emissions, then Sunday emissions. Results for 17 days with measured 8-hour ozone exceedance anywhere in the HGB 8-county area.

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

All episode days (Aug 18-Sept 6, 2000) were modeled with weekday emissions, then Saturday emissions, then Sunday emissions. Results are for 17 days with measured 8-hour ozone exceedance anywhere in the HGB 8-county area.
CO Analysis

- 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

• 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.)

Mean Daily Observed 8-Hour Ozone Concentrations as a % of Weekday (Blanchard)

Sites with 3 or more years data, March-October 1998-2003
Blanchard & Tannenbaum, 2005

- BAYP
- C35C
- CLTA
- CONR
- DRPK
- GALC
- HALC
- HCFA
- HCQA
- HLAA
- HNWA
- HNWA
- HOEA
- HROA
- HSMA
- MANV
- SHWH
- TLMC
- TXAV

Ozone Concentrations (%)
Weekday Saturday Sunday
Ambient Ozone (cont.)

Mean Daily Observed 8-Hour Ozone Concentrations as a % of Weekday (TCEQ)

Days with 8-hour ozone exceedance anywhere in the HGB 8-county area, (90 minimum) June-Sept 2000-2003

- BAYP
- C35C
- CLTA
- CONR
- DRPK
- GALC
- HALC
- HCFA
- HCQA
- HLAA
- HNWA
- HOEA
- HOEA
- HROC
- HSMA
- HSMA
- MANV
- MANV
- SHWH
- SHWH
- TLMC
- TLMC
- TXAV
- TXAV

- Ozone Concentrations (%)
- Weekday
- Saturday
- Sunday
Models Ozone

Mean Daily Modeled 8-Hour Ozone Concentrations
as a % of Weekday
(Aug 18 - Sept 6, 2000, Weekday/Weekend Test)

All episode days (Aug 18-Sept 6, 2000) were modeled with weekday emissions, then Saturday emissions, then Sunday emissions. Results for 17 days with measured 8-hour ozone exceedance anywhere in the HGB 8-county area.
Ozone Analysis

- 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.)

- 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)

- All episode days (Aug 18-Sept 6, 2000) were modeled with weekday emissions, then Saturday emissions, then Sunday emissions. Results are for Aug 18-29.

---

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

- All episode days (Aug 18-Sept 6, 2000) were modeled with weekday emissions, then Saturday emissions, then Sunday emissions. Results are for Aug 30 - Sept 6.
Ozone Analysis (cont.)

- 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

- 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 NOx and CO were significant, but did not see significant trends in the ozone data in most cases.
Tenative Conclusions

- 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 NOx, and may be less responsive to NOx 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

• 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.