Observational Modeling: Weekday vs. Weekend

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Background

- *Evaluation of the model's ability to suitably replicate the relationship between levels of ozone and the emissions of NO_X and VOC is necessary to have confidence in the model's prediction of the response of ozone to various control measures.*

- *As recommended in the EPA modeling guidance, the TCEQ conducted two types of performance evaluations, operational and diagnostic.*

Background

- *Operational Evaluations, which have been the principal gauge of performance in the past, assess how accurately the model predicts (replicates) measured (observed) concentrations of ozone and ozone precursors. These types of evaluations are typically comprised of statistical assessments.*

- *Diagnostic Evaluations, which have recently been given more prominence in gauging performance, assess how accurately the model replicates the responses of ozone and ozone precursors to changes in the modeled inputs (e.g., emissions, meteorology).*

Background

EPA recommends four types of Diagnostic Evaluations:

- *Observation-based models (e.g., Weekday versus Weekend)*
- *Probing tools (e.g., Chemical Process Analysis)*
- *Alternative base cases (e.g., with and with out emissions reconciliation)*
- *Retrospective analysis (e.g., Back cast modeling to 2000)*

Background

- *Weekday-Weekend Analysis is a form of observation-based modeling.*
  - *Differences between weekday and weekend emissions form a "natural laboratory" for studying the airshed's response to emission changes.*
  - *Weekday/weekend analysis can indicate whether the airshed is VOC- or NO_X-limited.*
  - *The airshed's response to these emission changes provides a benchmark against which the model's response can be evaluated.*

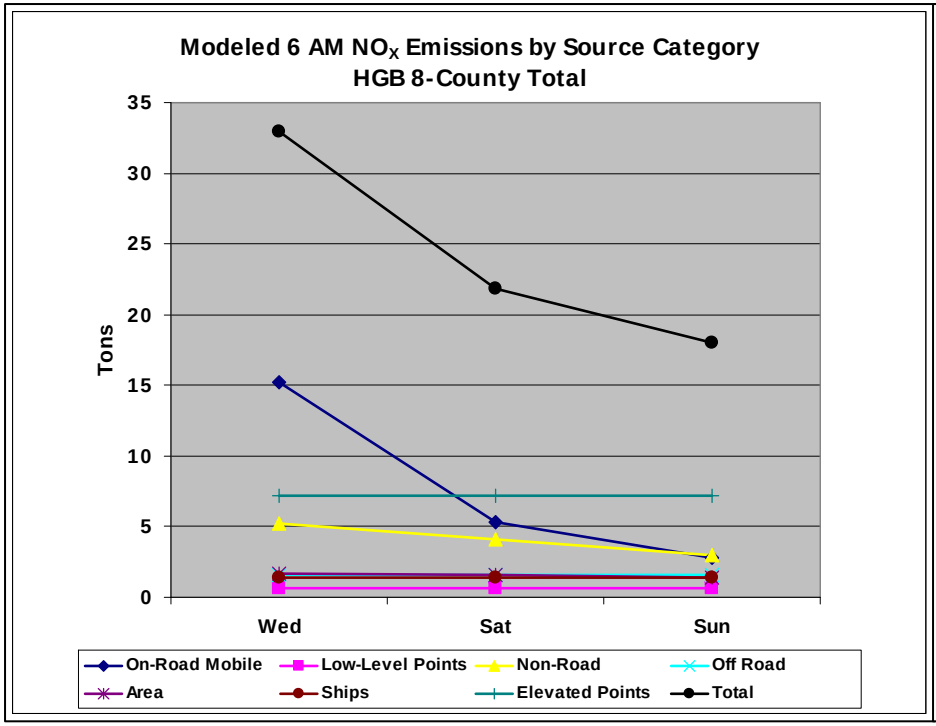
CAMx Ozone Modeling in SIP Development
The Big Picture

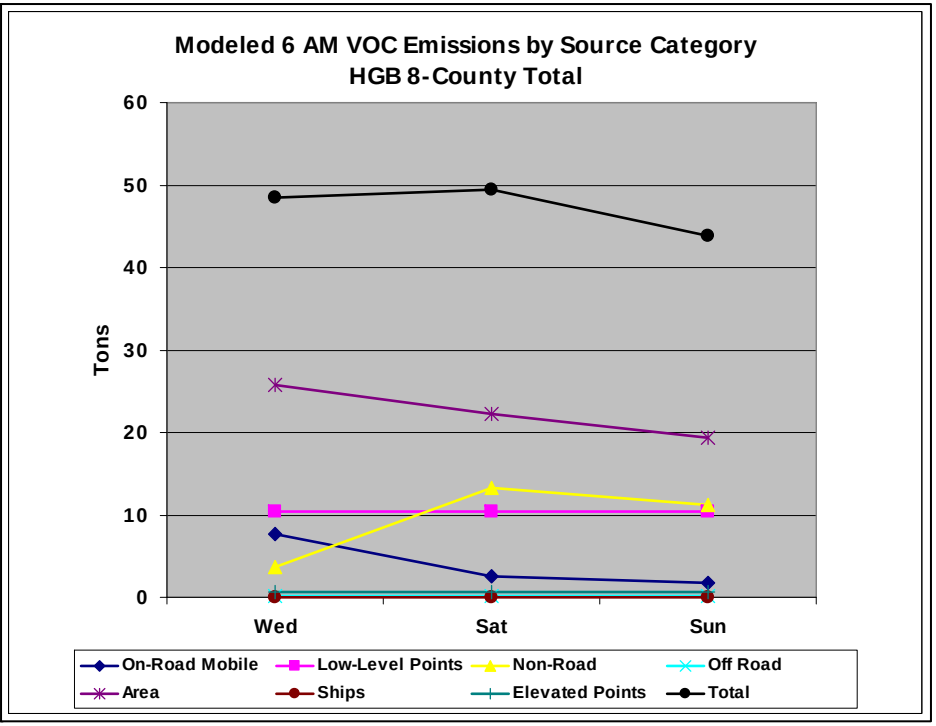
Base Case	**Day-specific emissions; replicate what actually happened**
Baseline Case	**Typical emissions; used in RRF to predict future design values**
Future Base Case	**Apply future growth + on-the-books controls to estimate future ozone**
Control Strategy Testing	**Determine control strategies that will effectively reduce ozone**
SIP	**Document modeling procedures**

Weekday-Weekend Analysis

- *Modeled emissions of NO_X are highest on weekdays (Wednesday was used as a "typical" weekday), decrease on Saturday, are lowest on Sunday.*
  - *Mostly due to reduction in on-road and diesel-powered non-road activity*
  - *More pronounced differences in morning*
- *Modeled VOC emissions vary less, are actually highest on Saturday.*
  - *Decrease in on-road and diesel non-road activity is counterbalanced by increased use of gasoline-powered non-road equipment*

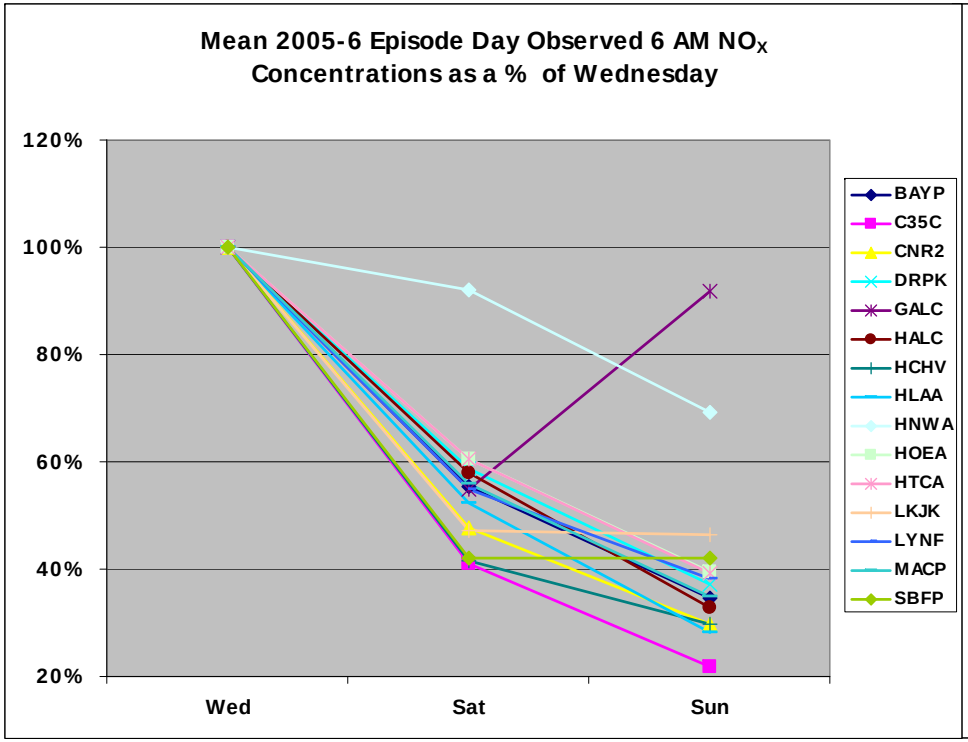
Modeled HGB 6:00 VOC and NO_X Emissions

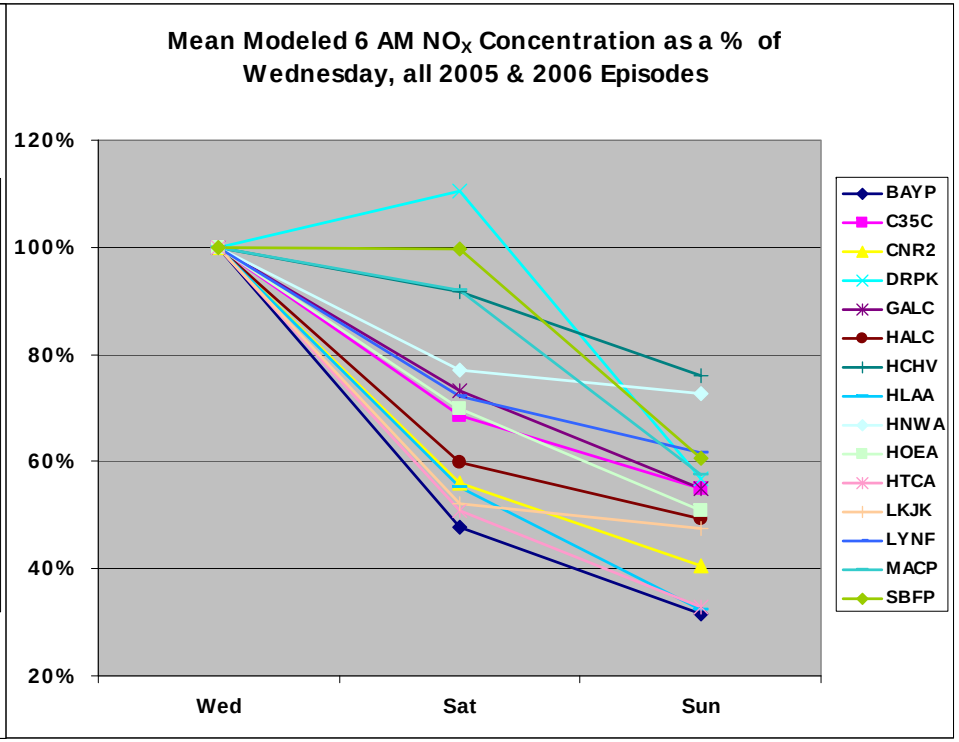




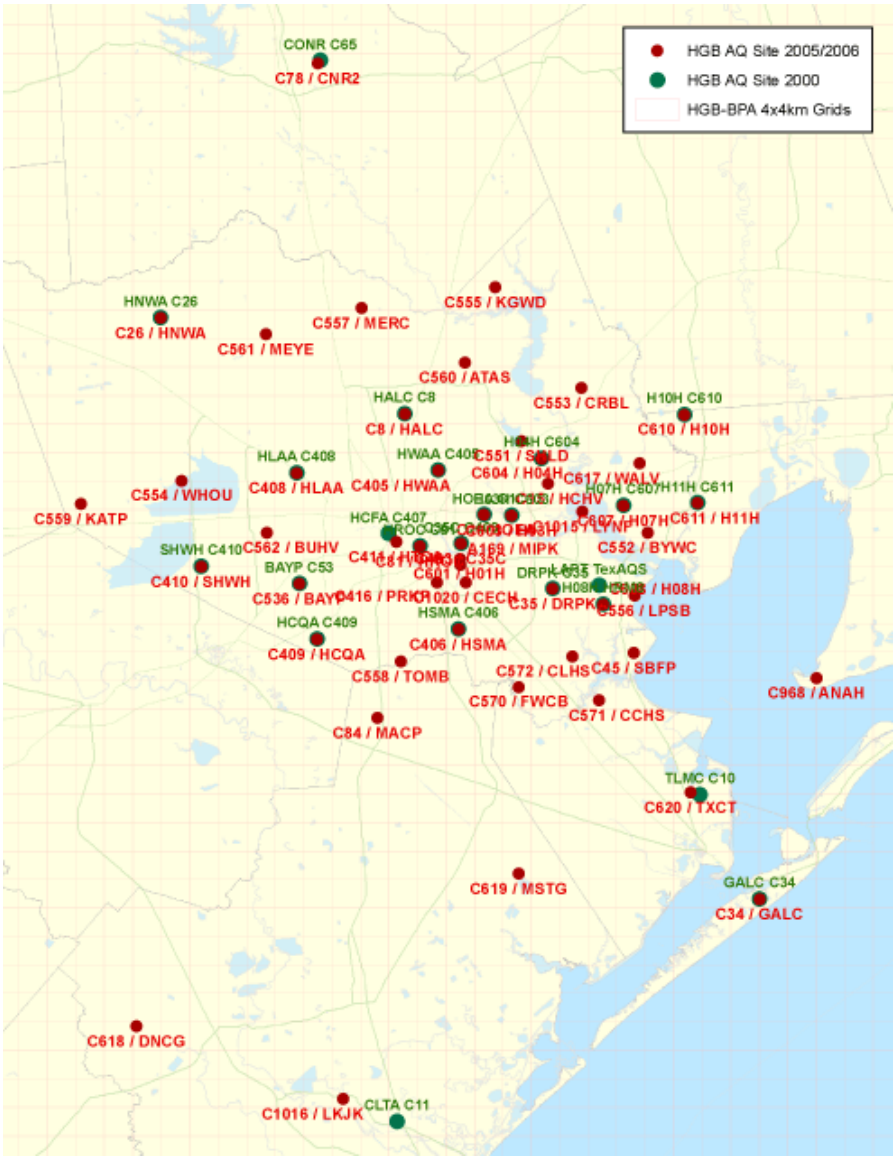
Mean Observed and Modeled 6:00 HGB NO_X Concentrations as a Percent of Wednesday

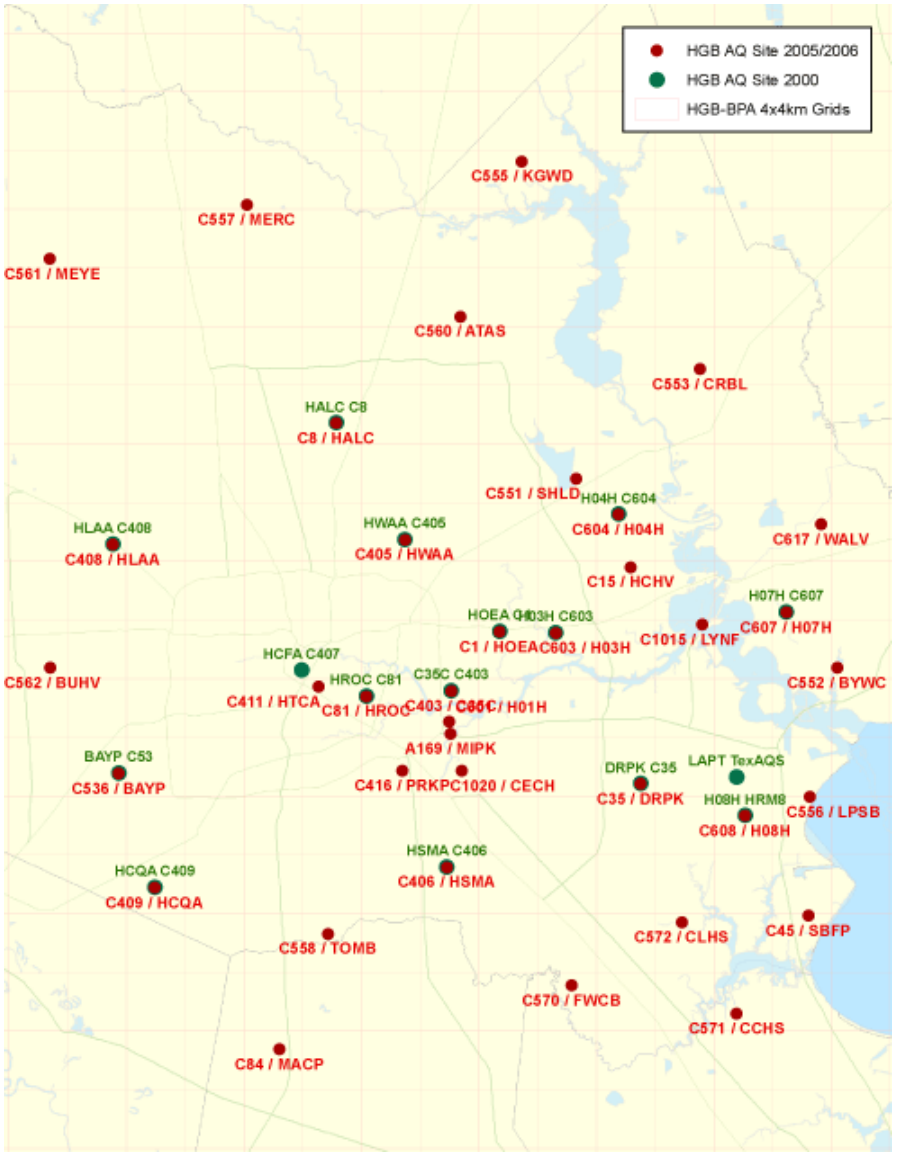
2005 and 2006 Modeled Episode Days





HGB Area Monitor Locations



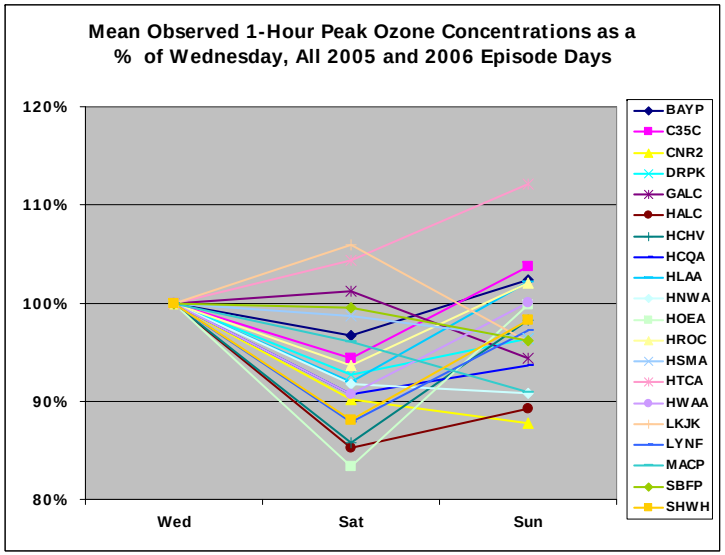


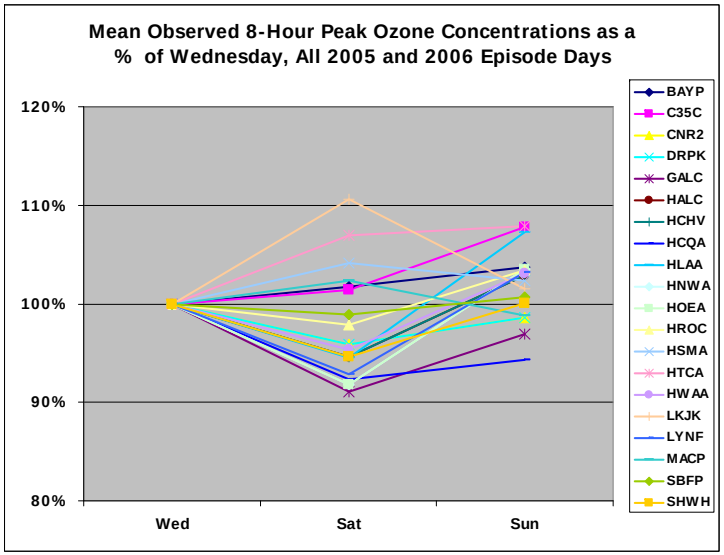
Weekday-Weekend Analysis

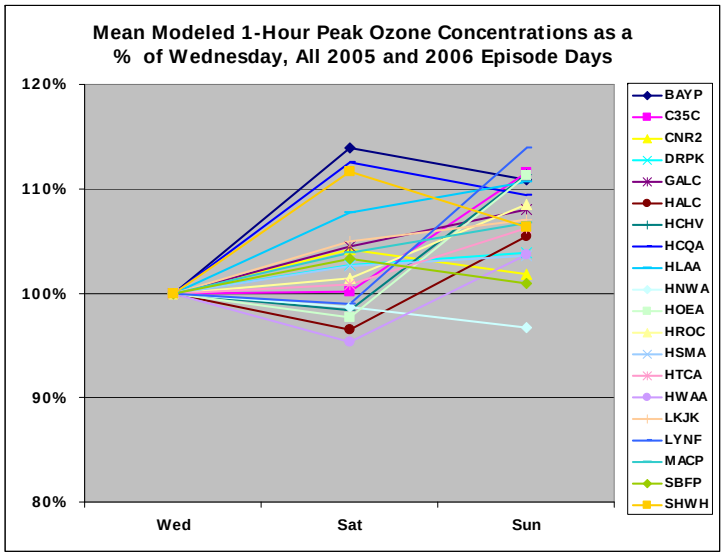
- *Pattern of observed NO_X concentrations match well the modeled on-road mobile source emissions, with a couple of exceptions.*
- *Modeled NO_X concentrations differ from observations, especially near East Harris County industrial areas. Why?*
  - *Model may mix down industrial plumes in early morning too strongly, which would dampen overall response to weekend effects*
  - *Mobile source emissions in model may have incorrect temporal allocation in some areas*

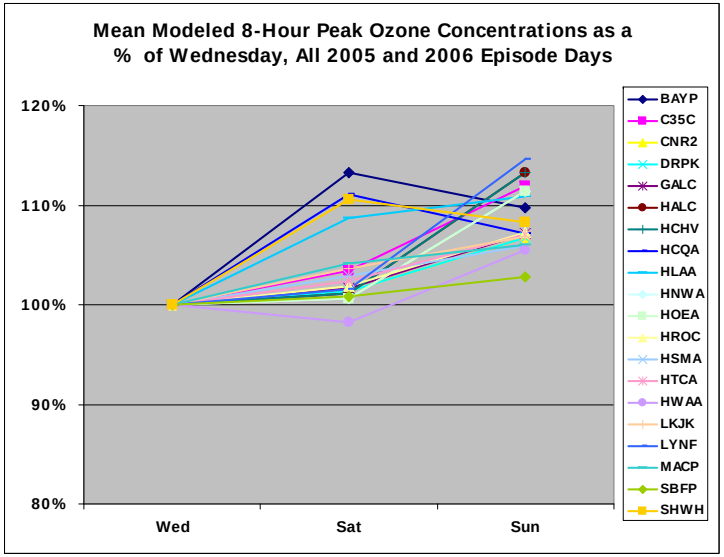
Mean Observed and Modeled HGB Peak Ozone Concentrations as a Percent of Wednesday

2005 and 2006 Modeled Episode Days









Weekday-Weekend Analysis

- *Observed one-hour peak ozone concentrations generally decrease from Wednesday to Saturday and from Wednesday to Sunday, suggesting peak ozone concentrations are mostly NO_X - limited.*
- *Little evidence of a weekend effect is seen for observed eight-hour peak concentrations.*
- *Both modeled one- and eight-hour ozone concentrations tend to be higher on weekend days than on Wednesday, suggesting modeled ozone peaks are VOC-limited.*
- *Relatively small sample sizes (16 Wednesdays, 11 each Saturdays and Sundays) make analysis susceptible to random or cyclical*

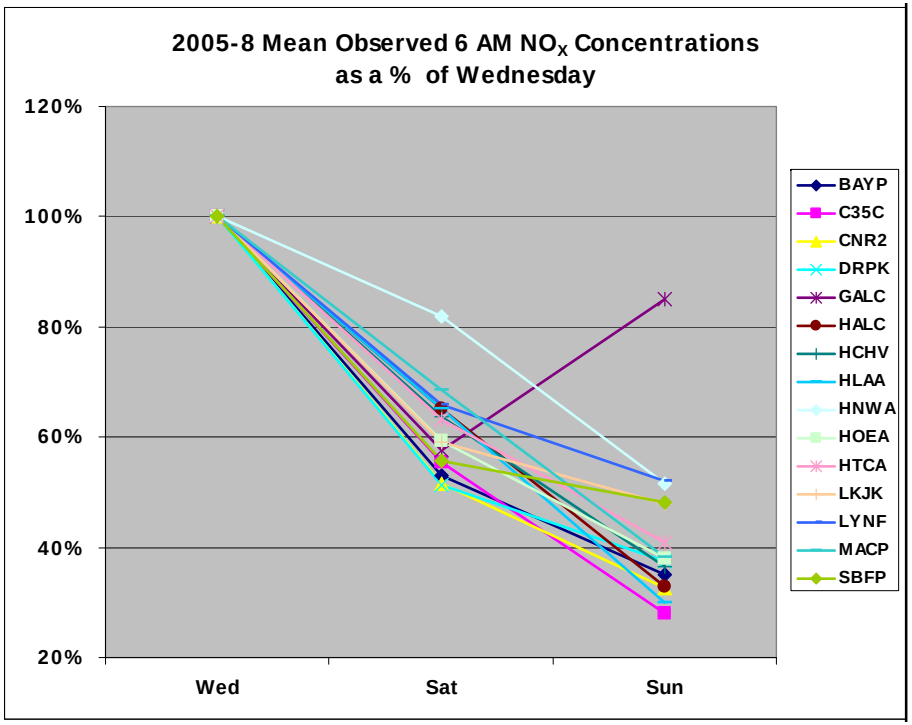
Extended Analysis

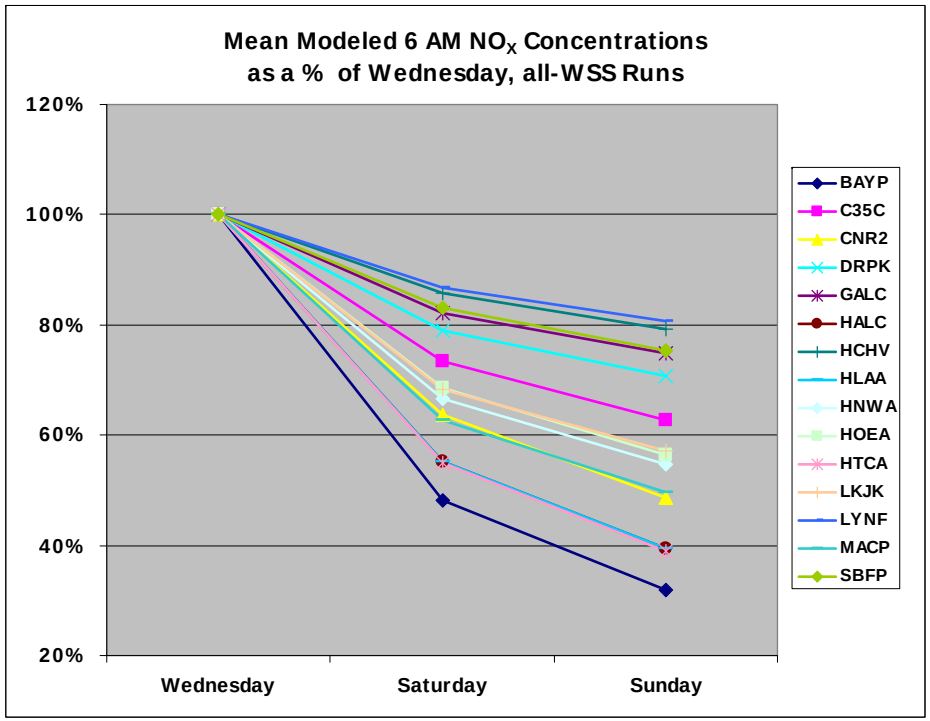
- *To minimize the potential effects of weather patterns on the analysis, observed concentrations between May 15 and October 15 were analyzed for 2005-2008:*
  - *88 each Wednesdays, Saturdays, and Sundays*
  - *Includes large number of non-ozone-conducive days*

- *To increase the number of modeled days, every modeled day was run, successively, with Wednesday, Saturday, and Sunday emissions:*
  - *94 each Wednesdays, Saturdays, and Sundays*
  - *Did not account for pollutant carry-over from one day-type to another*
  - *Mostly ozone-conducive days*

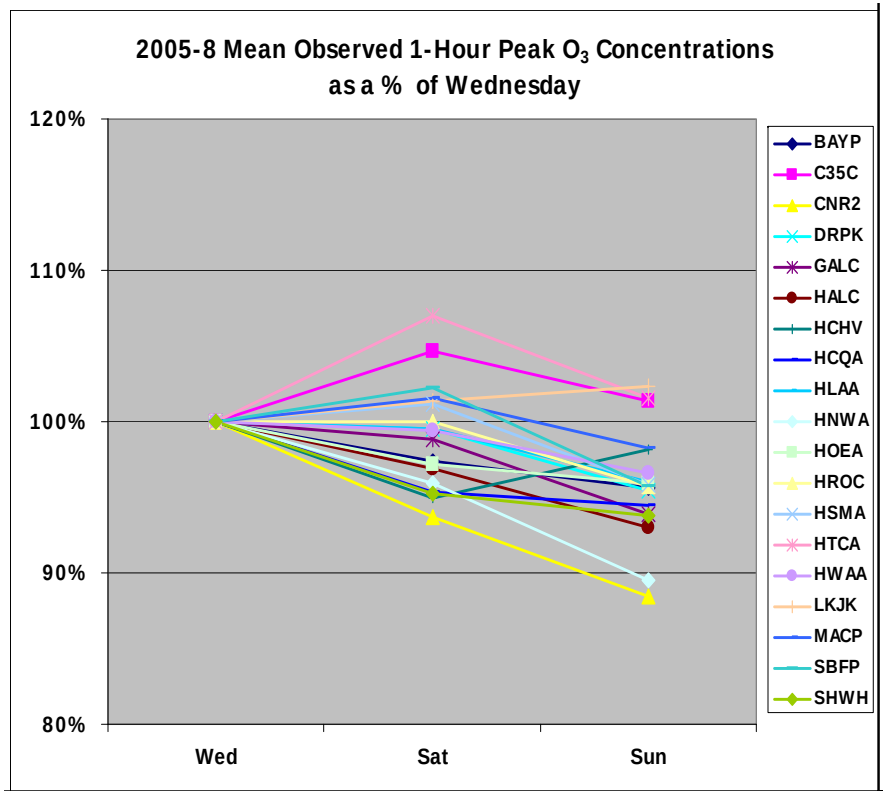
Mean Observed and Modeled 6:00 HGB NO_X Concentrations as a % of Wednesday

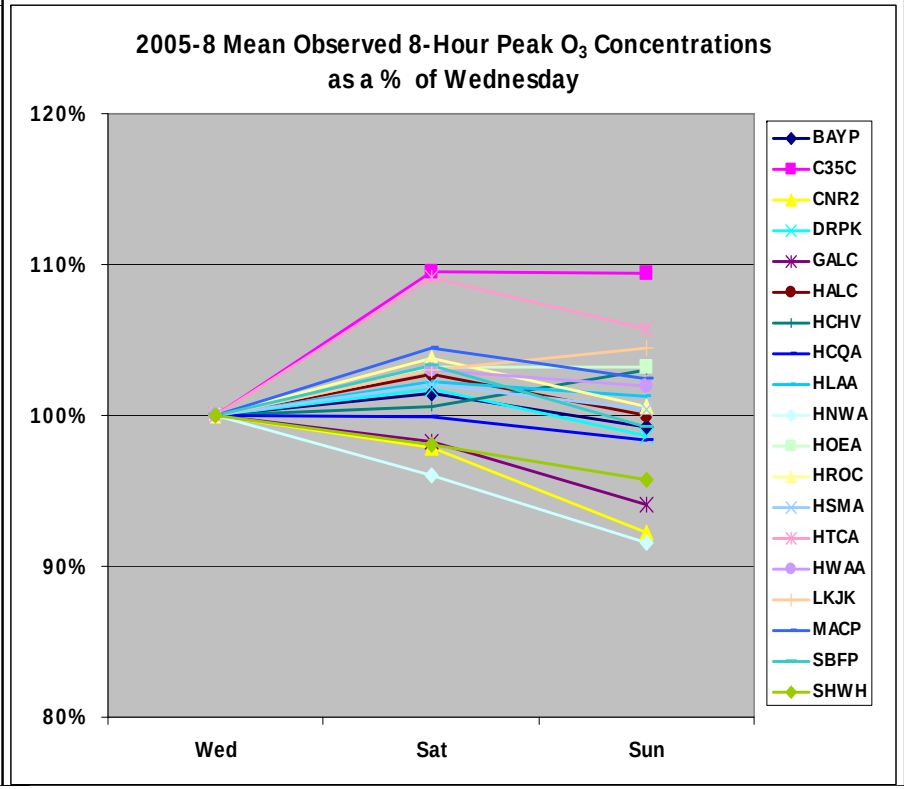
May 15-October 15 Observations, all-WSS Model Runs



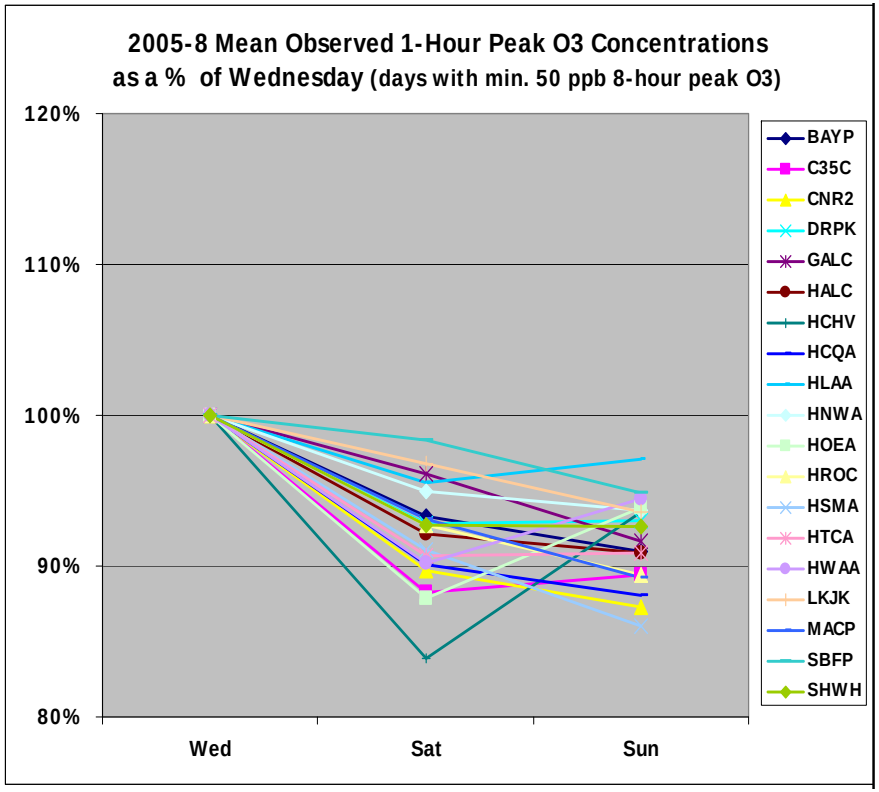


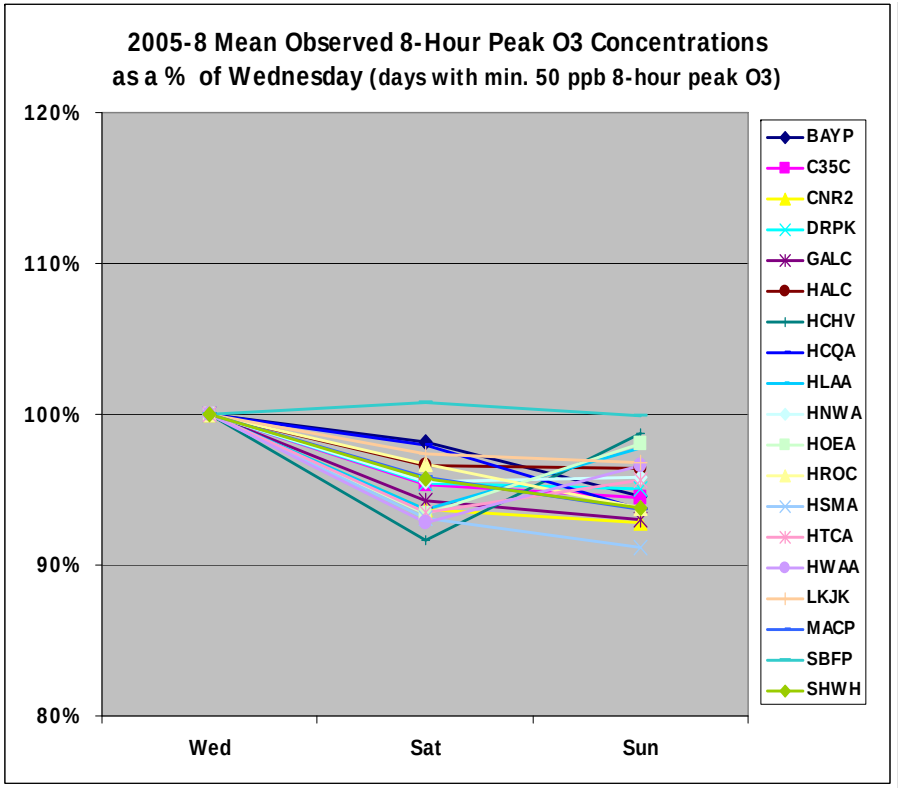
Mean Observed HGB Peak Ozone Concentrations as a Percent of Wednesday May 15-October 15, 2005-2008



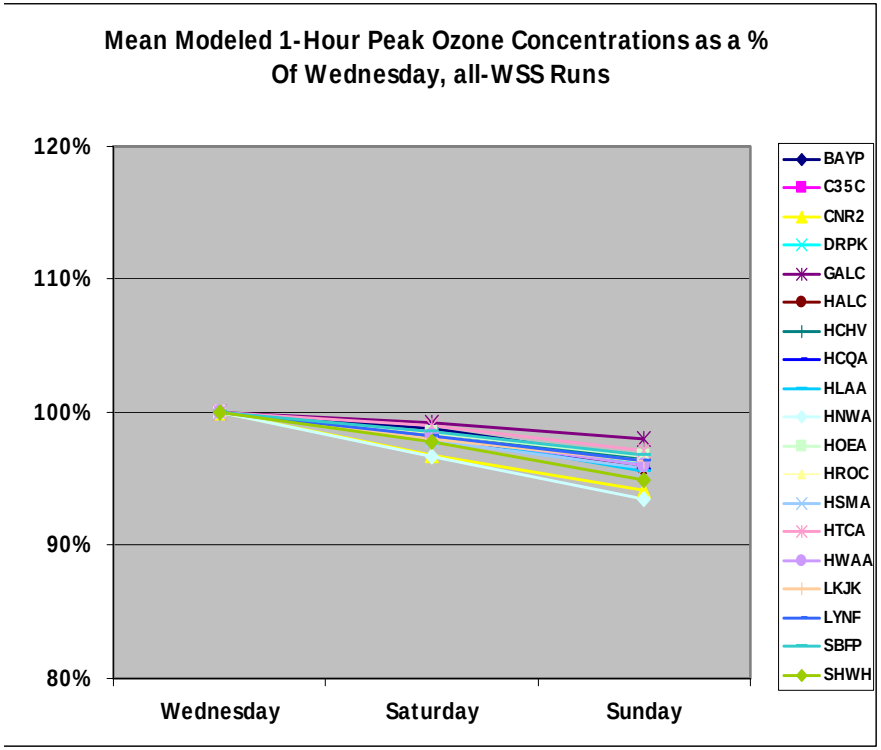


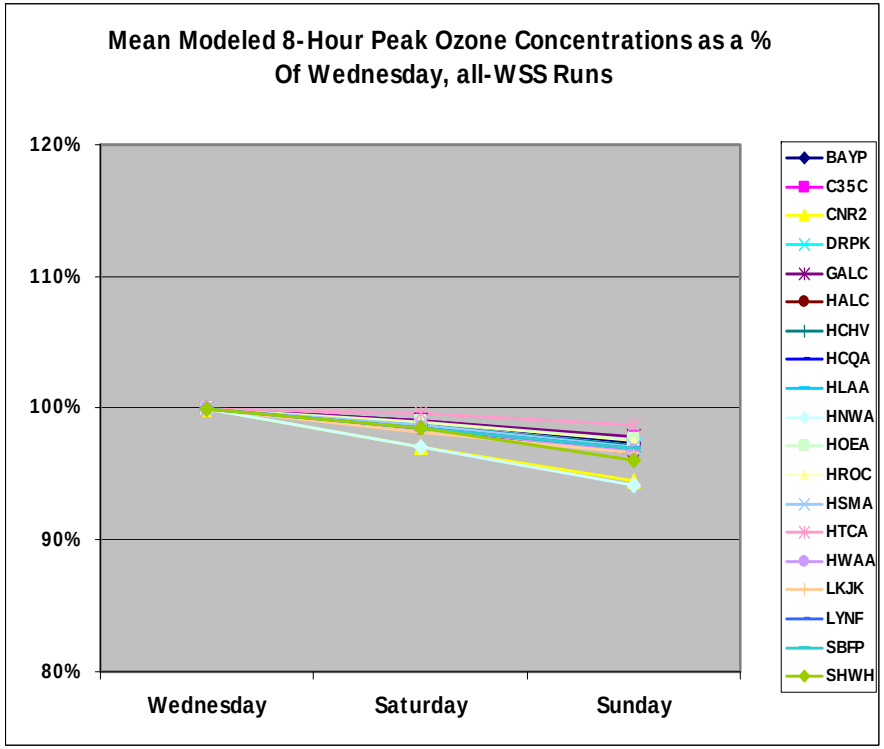
Mean Observed HGB Peak Ozone Concentrations as a Percent of Wednesday, Days with Minimum 50 ppb Eight-Hour Peak Ozone Concentration, May 15-October 15, 2005-2008





Mean Modeled HGB Peak Ozone Concentrations as a Percent of Wednesday, All-WSS Runs





Extended Analysis

- *When low-ozone days are excluded, observed one- and eight-hour ozone peaks show a decline from Wednesday to Saturday and Sunday.*
- *Model shows similar tendency, less variability.*
- *Both model and observations indicate peak ozone concentrations are NO_X-sensitive.*
- *Observations tend to show somewhat greater NO_X sensitivity than the model, which may indicate that the airshed will be more responsive to reductions than predicted.*