HGB Retrospective Modeling Diagnostic Evaluation - Update

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CAMx Ozone Modeling in SIP Development

The Big Picture

Base Case	Day-specific meteorology and emissions; replicate what actually happened
Baseline Case	Day-specific meteorology and 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

CAMx Ozone Modeling in SIP Development

Base Case – Historical Episode Replication

Meteorological Modeling

Winds, Mixing Depth, Temperature, etc.

Emissions Modeling

VOC, CO & NO_X
Point, Area, on- & Non-Road & Biogenic

CAMx Modeling

O_3, NO_X, VOC, CO, etc.
Chemical Mechanism (CBIV, CB05), “Mixing” schemes

Evaluate CAMx Performance

(How well does the model replicate the episode?)

Bias, Time Series, Contour Plots

Suitable Base Case

Updates to Retrospective Analysis

- This presentation updates a similar presentation given on November 20, 2006. Changes since that time are:
  - New baseline year (2006 vs. 2005)
  - New version of the baseline model configuration
  - Updated the 2000 baseline design values to use EPA-approved values (some of them increased). This had the side effect of removing HRM-3 from the sites considered.

Retrospective Modeling

- Retrospective modeling is rarely conducted, due to the difficulty of creating an inventory for years past.
  - Area not previously modeled
  - New modeling domain
  - Obsolete inventories
  - Newer modeling methodologies
- But our modeling for 2005/6 is substantially similar to that conducted for the 2000 episode:
  - Same modeling domain
  - Relatively minor enhancements to anthropogenic inventory
  - CB05 chemical mechanism is (more-or-less) backwards compatible with the CB-IV mechanism used previously

Retrospective Modeling (Cont.)

- Biogenic emissions were extensively updated for the current modeling, so we used the newer biogenics for the 2000 Baseline; otherwise we just used the existing 2000 emissions.
  - This approach would not be acceptable for control strategy evaluations, but was deemed suitable for performing tests of the model's response to large changes in emissions.

- We then modeled the 2000 Baseline inventory using meteorology from the 2005 and 2006 episodes; this is the same technique used to model future years, except in this case the prior year 2000 is modeled.

Evaluating Model Response

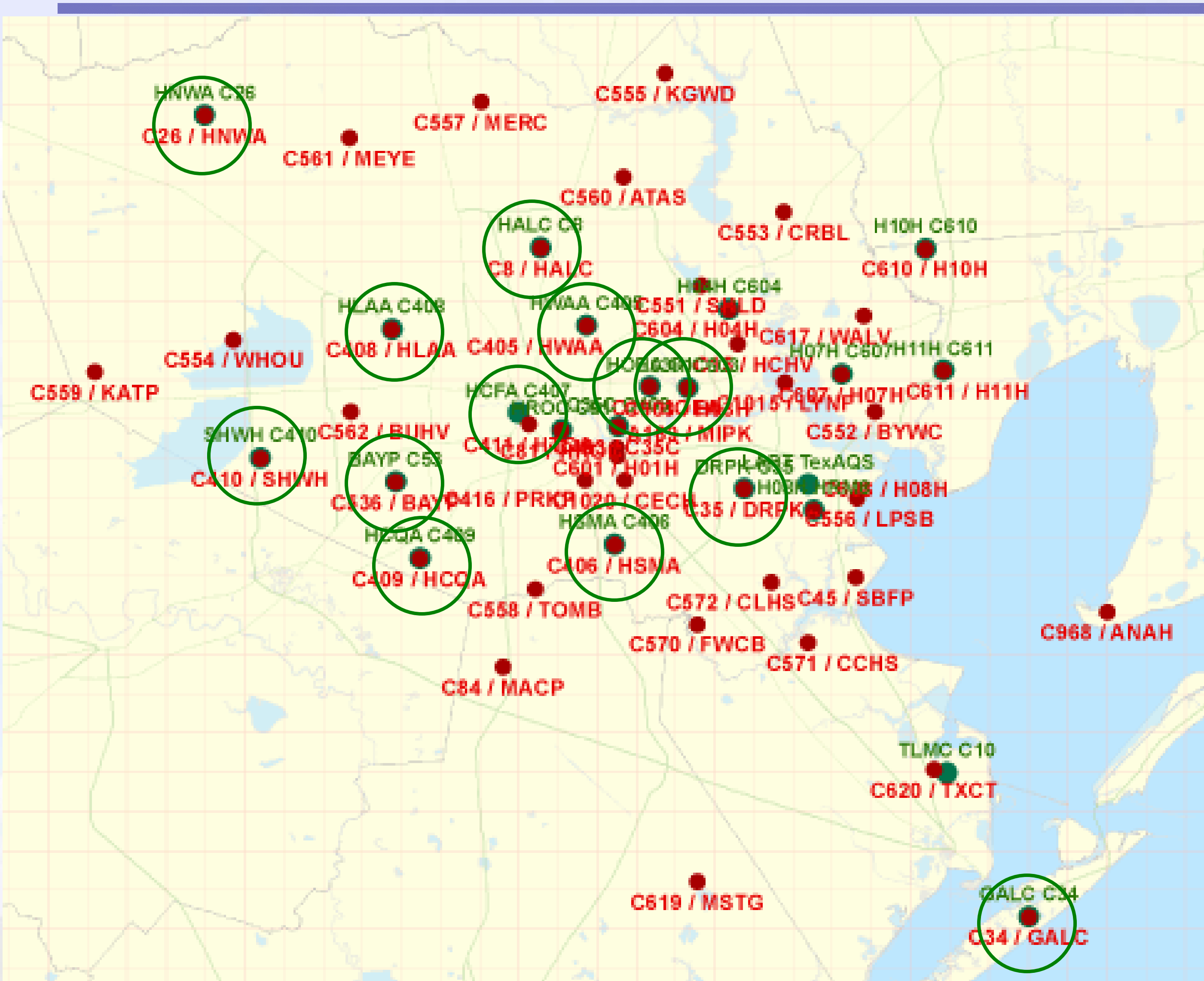
- To assess model response to the change in emissions from 2006 to 2000, we calculated Relative Response Factors (RRFs) at monitors which have Design Values (DVs) in both 2000 and either 2005 or 2006.

- The RRF for monitor i is calculated from the modeled results as:

$$\text{RRF(i)} = \frac{\text{Avg. Projection Year Daily Max. 8-hour } O_3 \text{ conc. near Monitor i}}{\text{Avg. Base Year Daily Max. 8-hour } O_3 \text{ conc. near Monitor i}}$$

(Average is taken across days with modeled Max O_3 > 80 ppb)

Monitors with 2000 & 2006 Design Values



Evaluating Model Response (cont.)

- The RRF for a monitor is used to calculate that monitor's projected Design Value (DV_P) as follows:

  $$DV_P(i) = RRF(i) * DV_B(i)$$

  where $DV_B(i)$ is monitor i's Baseline Design Value.

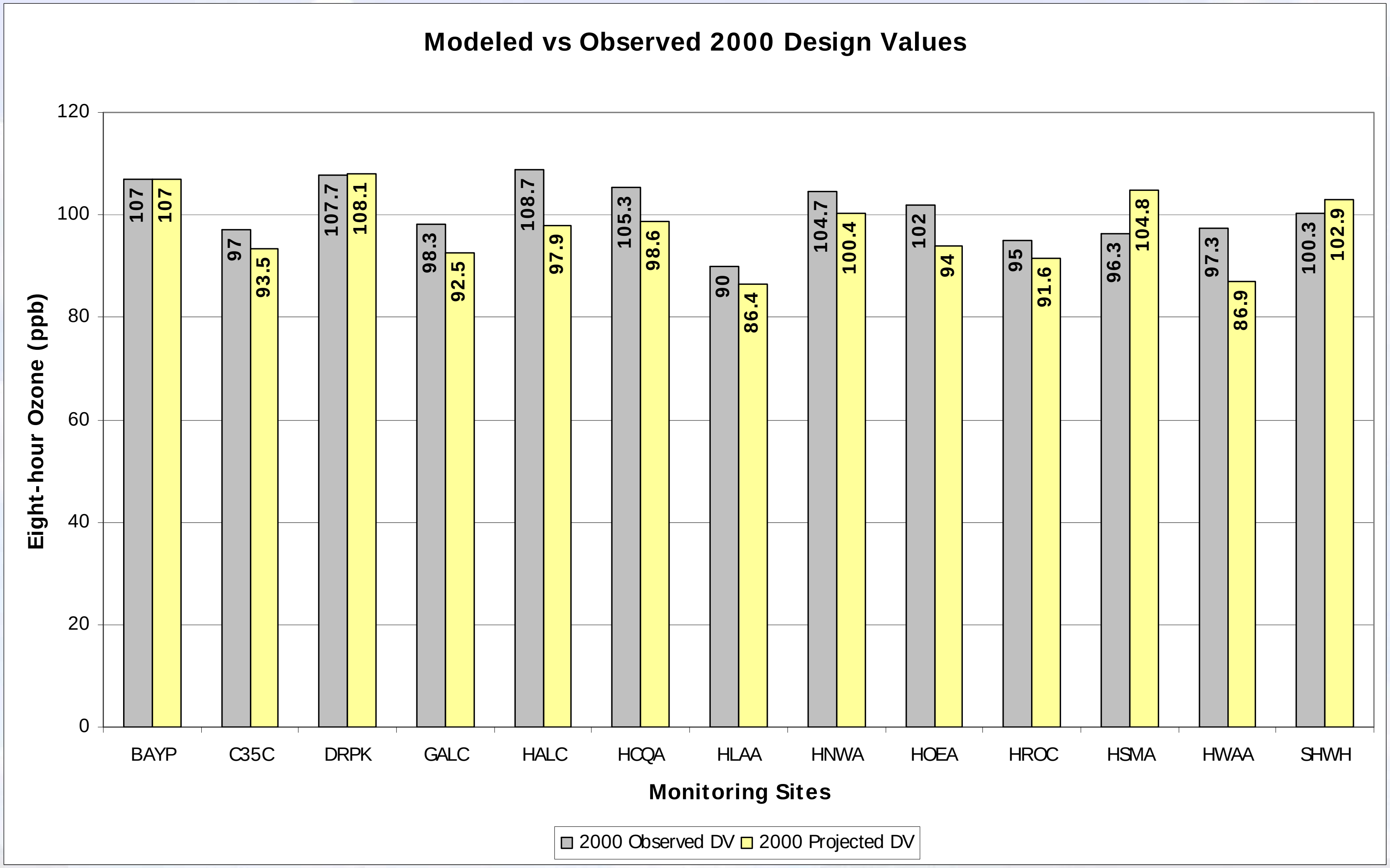
  – Per EPA guidance, the Baseline DV is an average of three consecutive years' DVs. For 2006, the DV_B is calculated from 2006, 2007, and 2008 design values.

- For our retrospective analysis, the Baseline Year is 2006, and the Projection Year is 2000.

Evaluating Model Response

- Now we already know the 2000 DVs, so we can evaluate the model's response to emission changes by comparing these with the model's predictions.
  - For purposes of this comparison, we actually used three-year average DVs for 2000 (similar to the baseline DV calculation). That is, we averaged the 2000, 2001, and 2002 design values for each site to calculate a 2000 baseline.

Evaluating Model Response



Evaluating Model Response

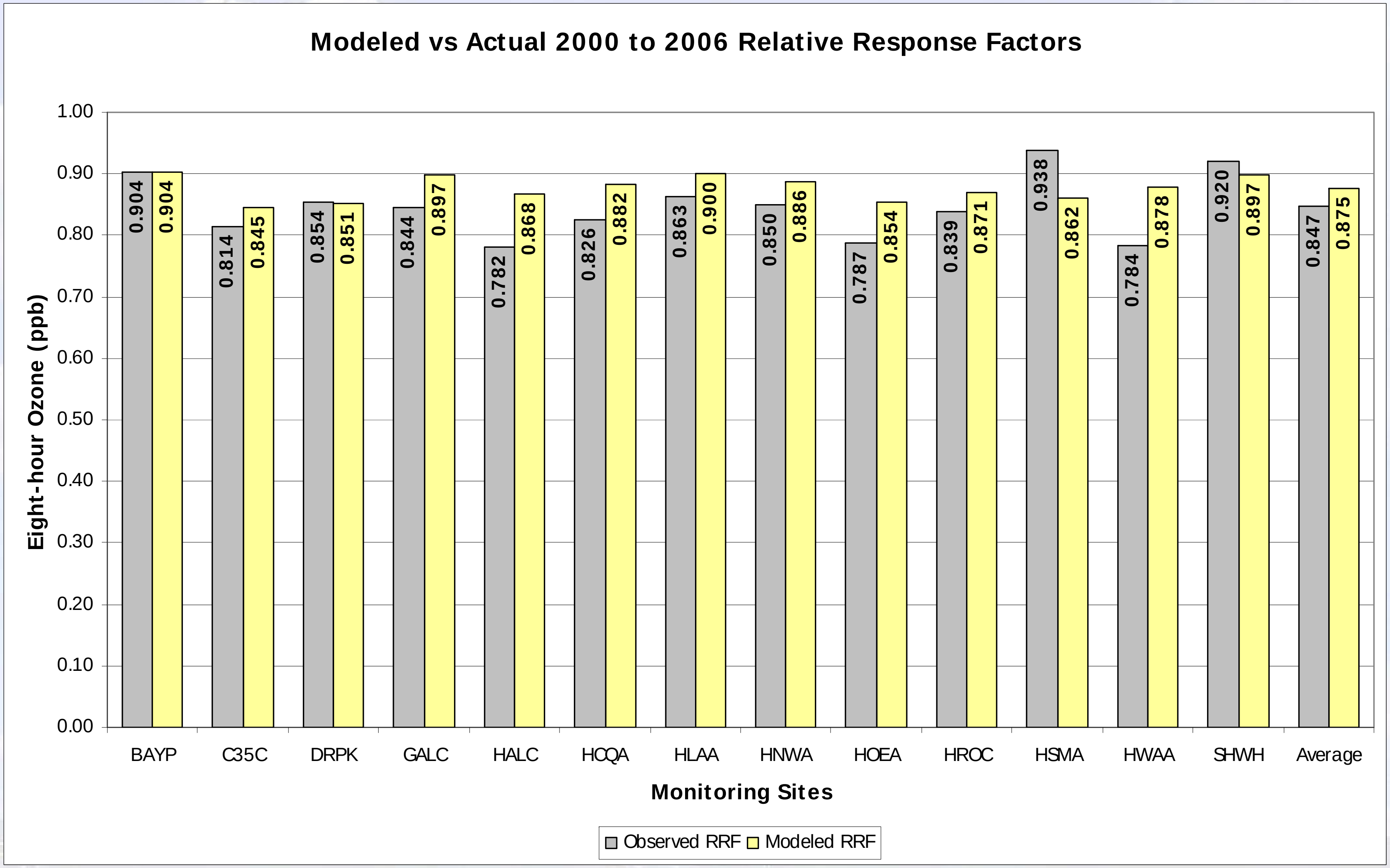
- The comparison between the model projected 2000 DVs and the observed 2000 DVs are quite favorable at several monitors, including BAYP,C35C, DRPK, HCQA, HROC, and SHWH.
- At a few monitors, including HALC, HOEA, and HWAA, the predicted 2000 DVs are notably less than observed, indicating these monitors are more responsive to emission changes than the model predicts.
- The HSMA monitor is noteworthy in that the model over-predicts the 2000 DV. This is because the DV at this site changed relatively little between 2000 and 2006.

Evaluating Model Response

- Another way of assessing model response is to consider the ratio of the observed Design Values.
  - This ratio of observed baseline design values can be considered a “measured” RRF and can be compared to the modeled RRF.

- The following slide shows modeled and observed RRFs from 2000 to 2006, moving forward in time (this represents the inverse of the calculation used to estimate the 2000 DVs).

Evaluating Model Response



Evaluating Model Response

- While the modeled RRFs don't vary as widely as the measured RRFs, overall average response across monitors is close to what was observed:
  - Average Observed RRF = 0.847
  - Average Modeled RRF = 0.875

- Conclusion: The model does a reasonably good job of reproducing the observed response to emissions changes between 2000 and 2006.