

# HGB Retrospective Modeling Diagnostic Evaluation

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Jim Smith, Ph.D.  
Air Modeling & Data Analysis Section





# 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

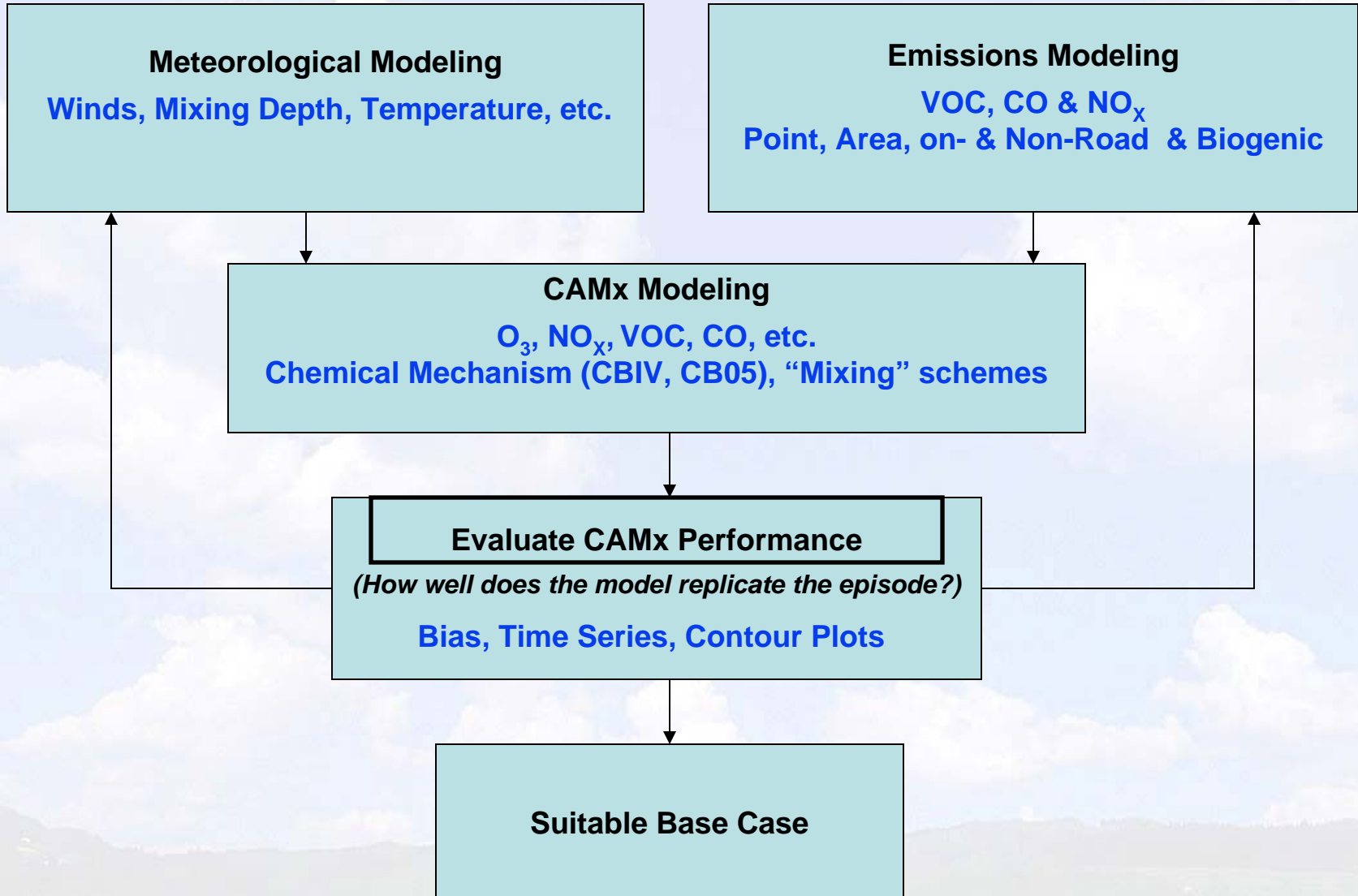
SIP

Document modeling procedures



# CAMx Ozone Modeling in SIP Development

## Base Case – Historical Episode Replication





# Retrospective Modeling

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- 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.)

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- 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

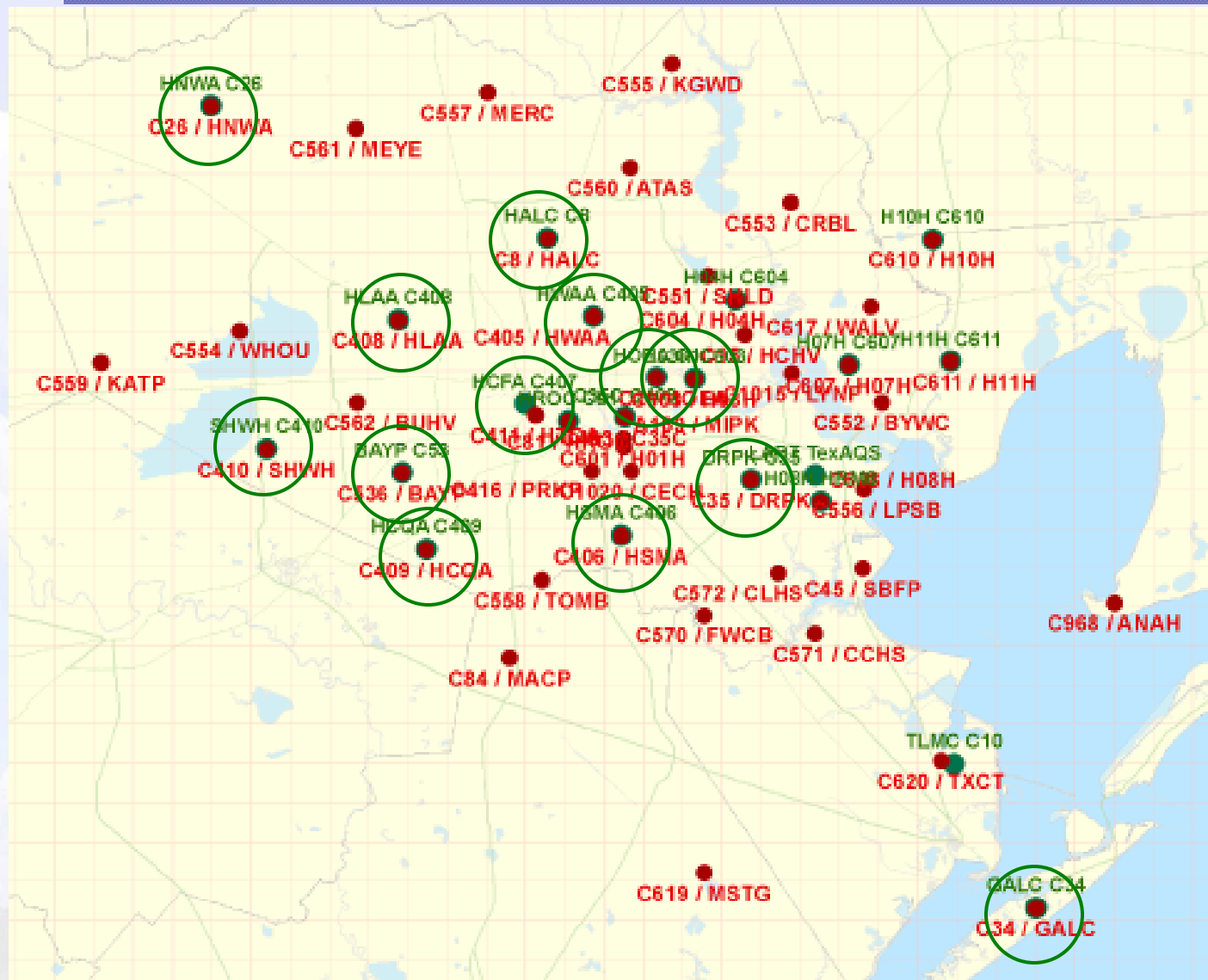
- To assess model response to the change in emissions from 2005 to 2000, we calculated Relative Response Factors (RRFs) at monitors which have Design Values (DVs) in both 2000 and either 2005 or 2006.
- The RRF for monitor *i* is calculated from the modeled results as:

$$\text{RRF}(i) = \frac{\text{Avg. Projection Year Daily Max. 8-hour O}_3 \text{ conc. near Monitor } i}{\text{Avg. Base Year Daily Max. 8-hour O}_3 \text{ conc. near Monitor } i}$$

(Average is taken across days with modeled Max O<sub>3</sub> > 80 ppb)



# Monitors with 2000 & 2005 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 2005, the  $DV_B$  is calculated from 2005, 2006, and 2007 design values.
- For our retrospective analysis, the Baseline Year is 2005, and the Projection Year is 2000.





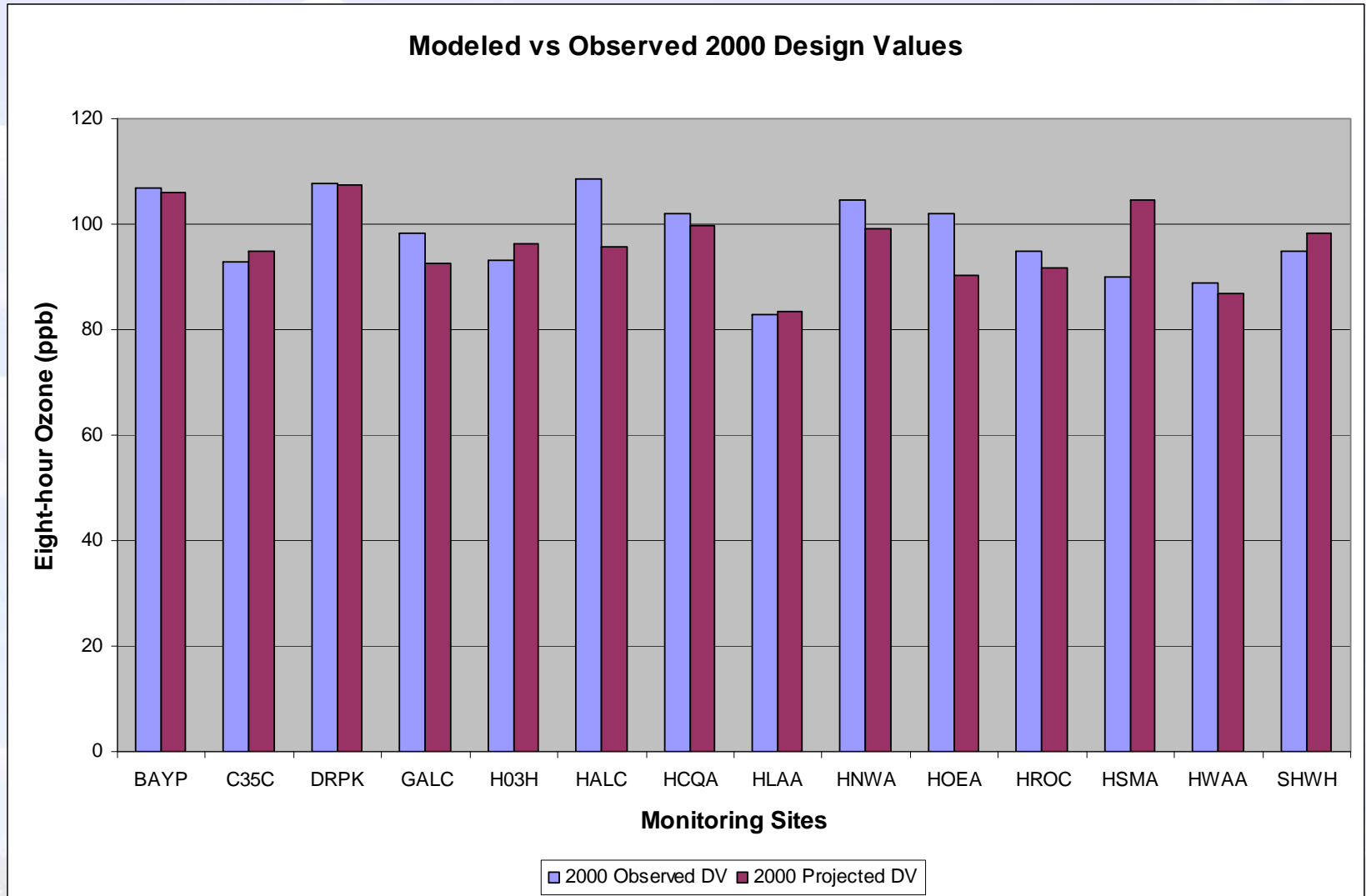
# Evaluating Model Response

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- 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).



# Evaluating Model Response





# Evaluating Model Response

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- 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, HWAA, SHWH.
- At a few monitors, including HALC and HOEA, 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, i.e., the predicted 2000 DV is notably greater than observed, which may be due to the atypical feature that the 2005 DV is greater than the 2000 DV.



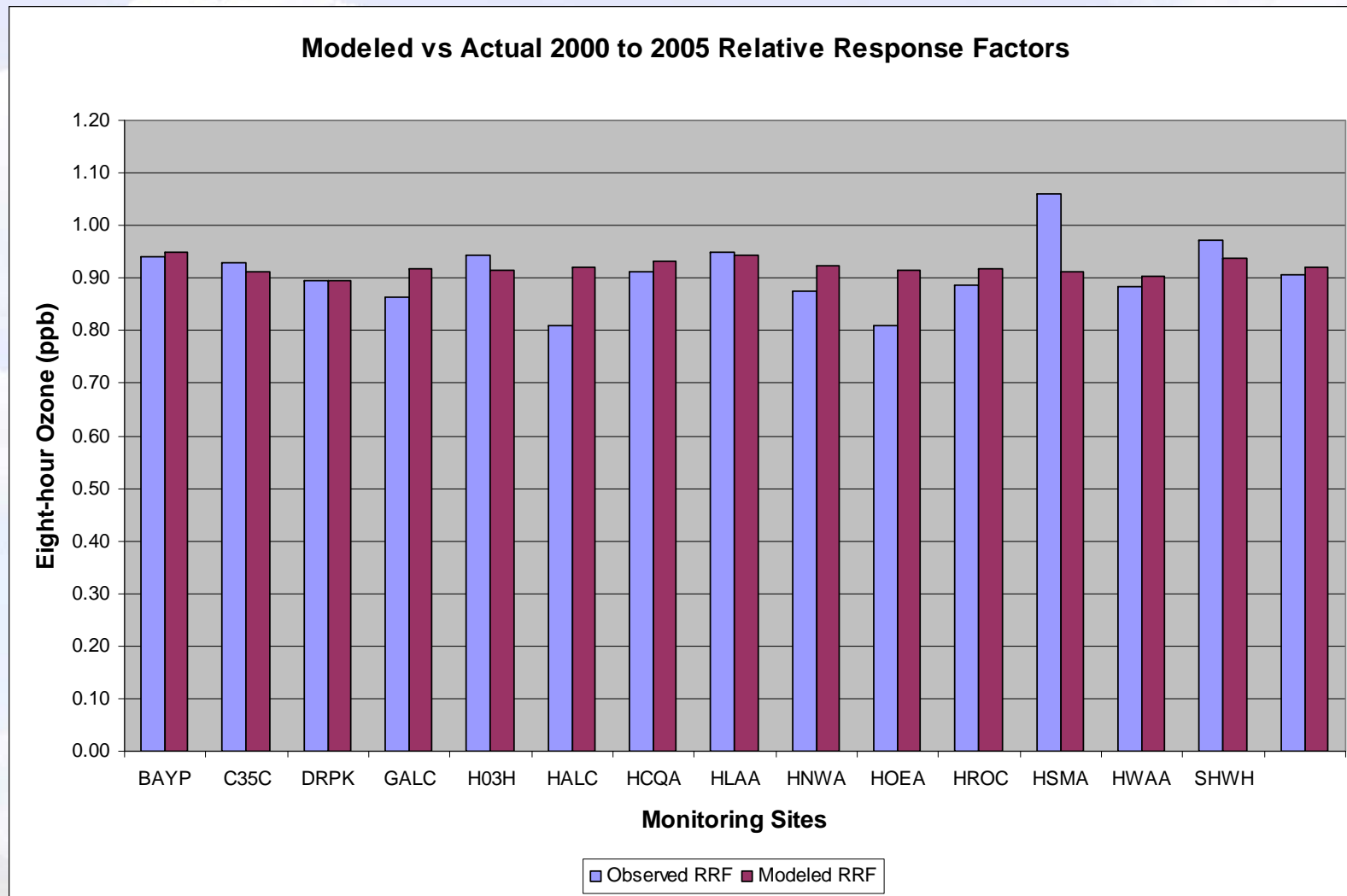
# Evaluating Model Response

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- 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 2005, moving forward in time (this represents the inverse of the calculation used to estimate the 2000 DVs).



# Evaluating Model Response





# Evaluating Model Response

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- 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 = 0.9051
  - Average Modeled RRF = 0.9196
- Conclusion: The model does a reasonably good job of reproducing the observed response to emissions changes between 2000 and 2005.