Initial 2018 HGB Modeling Results

Dick Karp
Air Modeling Team
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

Future Case – Future Baseline Emissions

Meteorological Modeling

Base Case Meteorological Modeling used

Emissions Modeling

VOC, CO & NO_X
Point, Area, On- & Non-Road & Biogenic
Growth + On-the-books Controls

CAMx Modeling

O_3, NO_X, VOC, CO, etc.

Run Model Sensitivities

(How does ozone respond to various emission changes?)

Matrix Runs, Control Measure Runs, etc.

Future Case Suitable for Control Strategy Modeling

2005 Baseline Modeling Emissions

- Point Sources
  - ARD sources (e.g., EGUs) used 2005 third quarter emissions
  - Non-ARD sources used 2005 STARS OSD emissions, except
    - Tank landing losses used average of 2005 episodic emissions
    - PSCFv2 EI-Reconciliation of HRVOC emissions
- On-Road Mobile Sources
  - All on-road used 2005 summer day-types
- Non-Road and Off-Road Sources
  - Non-Road used 2005 NMIM (same as base case emissions)
  - Off-Road used 2005 TexAER (same as base case emissions)
- Area sources used 2005 TexAER (same as base case emissions)
- Biogenic sources used episodic base case emissions

2018 Future Point Source Modeling Emissions

- For the region outside Texas, the CENRAP/RPO regional haze 2018 emission levels (e.g. IPM, CAIR2 trading, controls) were used

- For the attainment region of Texas,
  - CAIR Phase 2 allocations were used for existing EGUs, new EGUs were limited to the 9.5% set-aside
  - All controls included in the recent DFW and BPA SIPs (e.g., East Texas Engine Rule) were applied

- For the DFW and BPA nonattainment areas, CAIR Phase 2 and Chapter 117 ESAD were used

- For the HGB nonattainment area, MECT and HECT were used, as well as controls included in the recent HGB SIP (e.g., VOC from tanks and degassing)

2018 Future On-Road Modeling Emissions

- For areas outside of Texas, county-level emissions derived from NMIM were used and projected to 2018
- For Texas counties outside of BPA and HGB, county-level hourly emissions by summer day-type from TTI based on 2018 projected traffic count data from TxDOT were used
- For both HGB and BPA, link-based hourly emissions by summer day-type from TTI based on projected travel demand modeling were used

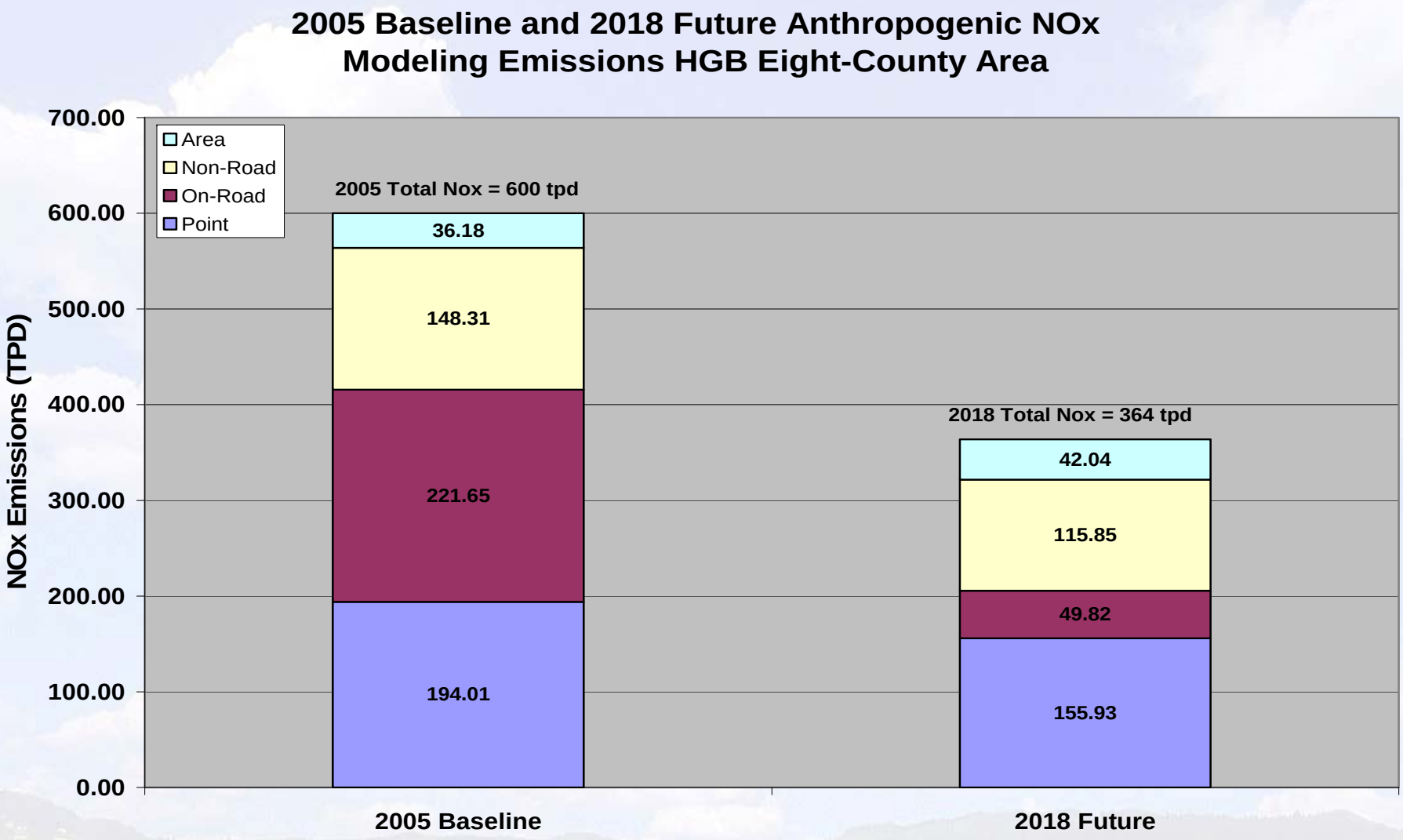
2018 Future Non- and Off-Road Modeling Emissions

- For the region outside Texas, EPA's NMIM was used for non-road categories, and 2002 NEI with EGAS growth was used for all off-road categories with national controls on locomotives and marine vessels
- For the non-road categories within Texas, the Tex-N model was used
- For the off-road categories within Texas
  - 2005 TexAER was used with REMI-EGAS growth and national controls for locomotives and marine vessels, except locomotives in HGB and DFW, and marine vessels in HGB and BPA
    - 2018 emissions for locomotives in HGB and DFW were provided from a contract with ERG (now in TexAER)
    - 2018 emissions for marine vessels in HGB and BPA were developed using emission trends provided by the HGB and BPA Port Authorities and 2007 and 2000 emission projections, respectively, provided from a contract with Starcrest
  - For aircraft within Texas
    - 2002 TexAER was used with REMI-EGAS growth, except for HGB and DFW
    - For HGB and DFW, 2005 emission estimates from AQP were used with REMI-EGAS growth.

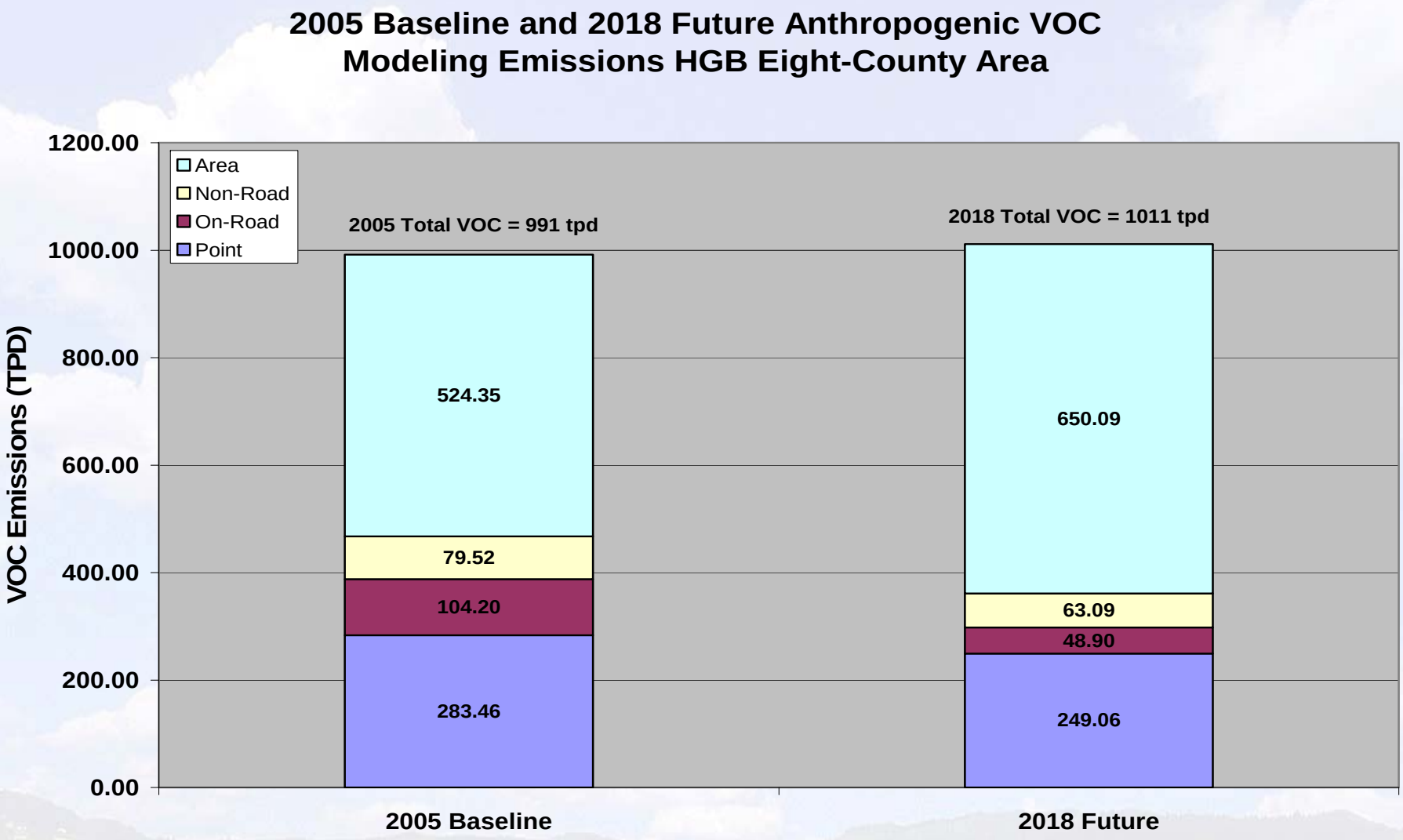
2018 Future Area Source Modeling Emissions

- For the region outside Texas, 2002 NEI with EGAS growth was used
- For the region within Texas, 2005 TexAER with REMI-EGAS growth was used

2005 Baseline and 2018 Future Modeling Emissions



2005 Baseline and 2018 Future Modeling Emissions



Met Modeling for 2005 Baseline and 2018 Future

Met modeling, same as for base case, includes:

- New UT-CSR land use/land cover (LU/LC) data for surface characteristics
- Observational nudging using radar profiler data
- Hourly and spatially varying sea surface temperatures (U of H algorithm)

2005 Baseline Ozone Design Value

4th high 2003	4th high 2004	4th high 2005			2005 Design Value
	4th high 2004	4th high 2005	4th high 2006		2006 Design Value
		4th high 2005	4th high 2006	4th high 2007	2007 Design Value

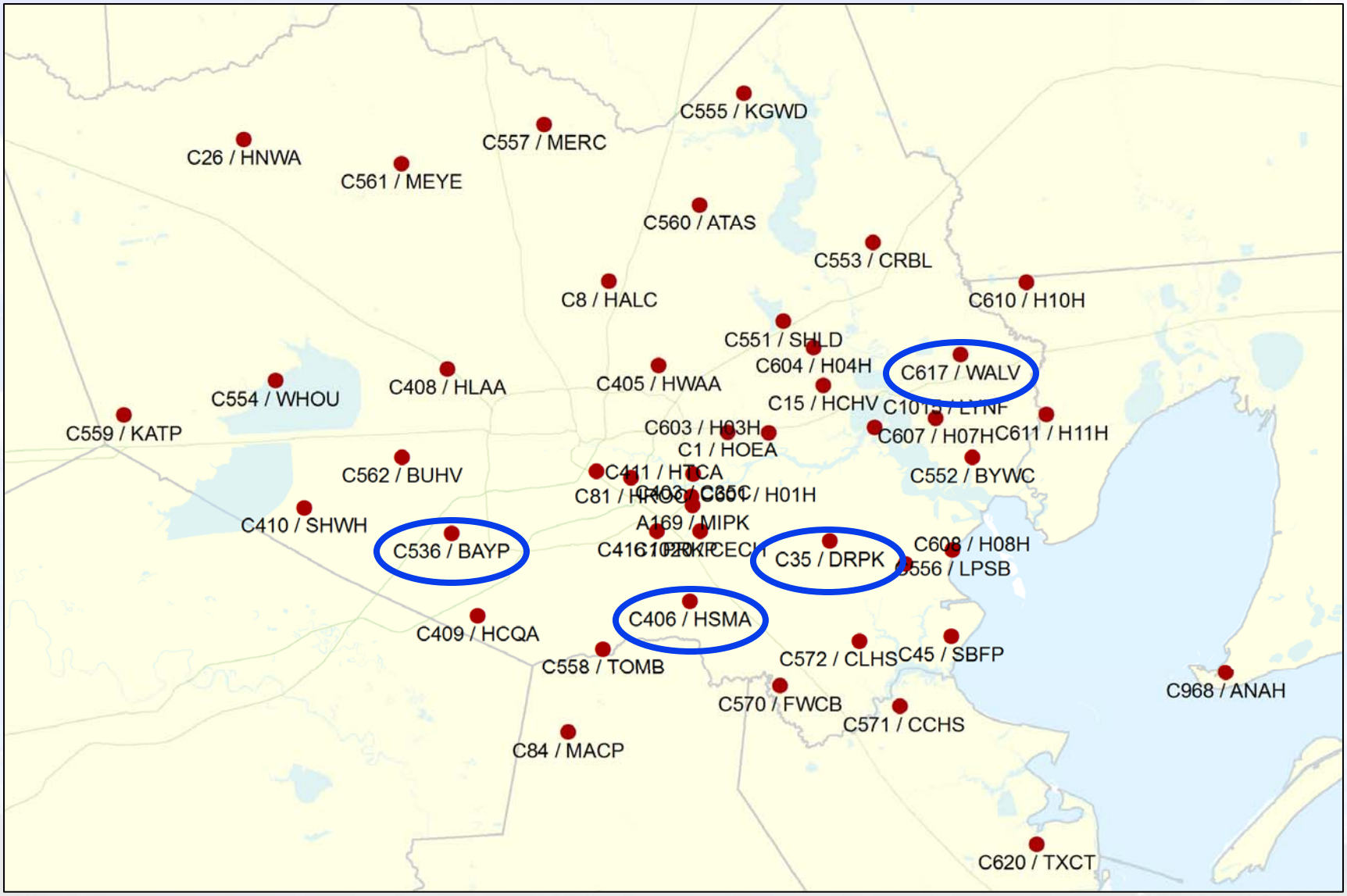
Average of 2005 DV, 2006 DV, and 2007 DV

→ weights the 2005 4th high 8-hour ozone value as most influential

Initial 2018 Future Modeling Results

Site Code	2005 Baseline Design Value (ppb)	2005 Baseline Average 8-Hr O_3 > 80.0 ppb	2018 Future Average 8-Hr O_3 (ppb)	Relative Response Factor (RRF)	2018 Future Design Value (ppb)
BAYP	100.67	90.67	78.16	0.862	**86.8**
C35C	86.33	89.52	82.80	0.925	79.9
CNR2	85.00	91.05	77.85	0.855	72.7
DNCG	81.50	91.02	77.37	0.85	69.3
DRPK	96.33	86.97	80.10	0.921	**88.7**
GALC	85.00	85.05	78.59	0.924	78.5
H03H	88.00	89.44	83.45	0.933	82.1
HALC	88.00	90.13	79.67	0.884	77.8
HCHV	85.67	89.41	83.78	0.937	80.3
HCQA	93.00	90.93	77.84	0.856	79.6
HLAA	78.67	89.28	76.60	0.858	67.5
HNWA	91.67	88.48	74.85	0.846	77.6
HOEA	82.67	90.65	83.58	0.922	76.2
HROC	84.33	90.37	83.05	0.919	77.5
HSMA	95.33	88.76	79.52	0.896	**85.4**
HTCA	83.33	90.92	82.74	0.91	75.8
HWAA	78.67	91.86	82.95	0.903	71.0
LKJK	77.50	85.18	74.02	0.869	67.3
LYNF	89.00	89.36	84.45	0.945	84.1
MACP	94.67	88.71	76.64	0.864	81.8
MSTG	88.67	89.42	78.24	0.875	77.6
SBFP	89.33	86.79	80.02	0.922	82.3
SHWH	92.33	92.22	77.74	0.843	77.9
TXCT	87.67	84.91	77.77	0.916	80.3
WALV	94.00	90.24	83.38	0.924	**86.8**

Regulatory Monitoring Sites with DV_{18}s $\geq$ 85 ppb



Caveats to the 2018 Modeling

- CAIR phase 2 allocations were used throughout the modeling domain in estimating 2018 future emissions; the CAIR program has been vacated
- Emission adjustments for the Motiva, Valero and TOTAL refinery expansions have not been included
- Emission adjustments for ERCs and DERCs have not been included
- No growth was applied to non-ARD stationary sources in Texas
- There are a number of improvements to the 2005 and 2006 base case modeling that are in progress, which may affect the 2005 baseline, including:
  - Reconciling HRVOC emissions with the TexAQS II monitored data
  - Changing the toluene chemistry in the photochemical model chemical mechanism
  - Episode-specific boundary conditions
  - Cloud assimilation
  - Results of TexAQS II studies are still forthcoming and may impact other modeling assumptions
- Some of these can be expected to increase the DV_{18}'s, while others may result in a decrease

TexAQS II SIP Relevant Inputs

- Emission Reconciliation:
  - Review enhanced data set of the vast array of primary pollutants (e.g., HRVOCs) and reaction products (e.g., NO_Y, formaldehyde) compiled by TexAQS II researchers
  - Compare the measurements with current emission estimates (e.g., 2006 STARS, 2005 TexAER) of source categories, including stationary sources, area sources and on- and non-road mobile sources
  - Develop source specific emission reconciliations.

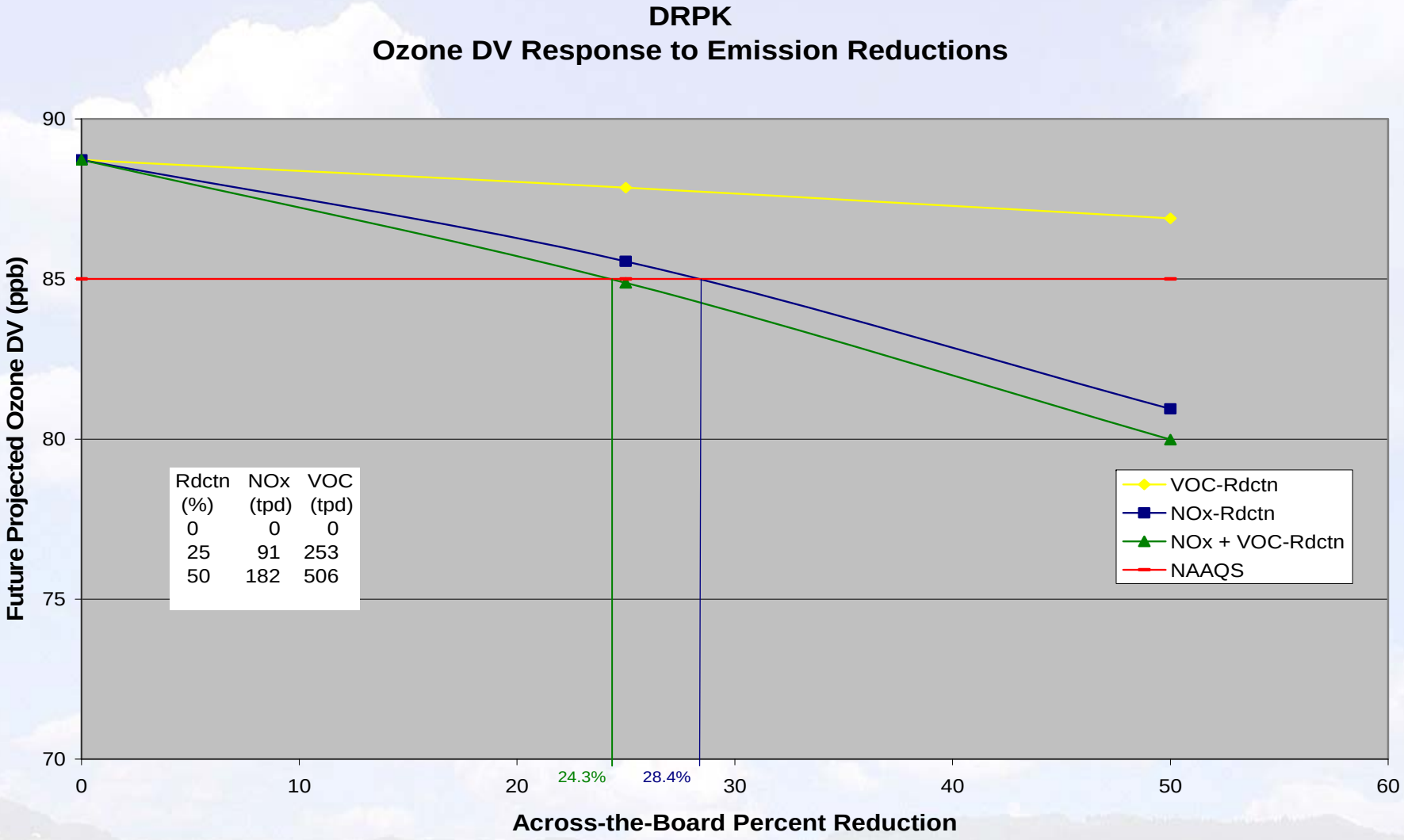
- Chemical Mechanism Update:
  - Review TexAQS II research findings to identify key reactions controlling the formation and destruction of ozone in the HGB area
  - Develop and prioritize a list of potential chemical mechanism updates (e.g., toluene)
  - Contracted with Environ to update the reactions in the CAMx model's chemical mechanism

- Meteorological and Photochemical Model Performance Evaluation:
  - Compare episode modeling predictions of meteorological parameters (e.g., winds, mixing depths) with meteorological observations from surface sites, elevated towers, balloons launches, aircraft, the Ron Brown research vessel, and on- and off-shore radar profiler to ensure that the meteorological model is adequately replicating the atmospheric meteorology
  - Compare episode modeling predictions of ambient concentrations (e.g., O_3, NO_X, HRVOCs) with ambient concentrations measured at surface sites, elevated towers, balloon launches, aircraft and the Ron Brown research vessel to ensure that the photochemical model is adequately replicating the atmospheric chemistry

2018 Matrix Modeling

- Matrix modeling consists of CAMx runs using various NO_X and VOC "across-the-board" anthropogenic emission reduction scenarios (e.g., 25%, 50%, etc.)
- Matrix modeling results are used to develop ozone DV_{18}s versus emission reduction response curves
- The response curves are used to estimate the amount of emissions reduction needed for attainment

Eight-Hour Ozone Response Curves



2018 Matrix Modeling Summary

- The matrix modeling of emission reductions resulted in decreases in the projected DV_{18}s at all four monitors
- The response of the DV_{18}s was greatest for the NO_X + VOC reduction and least for the VOC-only reduction
- The response of the DV_{18}s for NO_X-only was almost as much as the response for NO_X + VOC emission reductions
- With less than a 25 percent reduction of NO_X emissions (approximately 90 tpd), three of the four monitors are projected to be in attainment
- A 28 percent reduction in NO_X (approximately 100 tpd) would be needed for DRPK to reach a DV_{18} of 85 ppb
- A 24 percent combined reduction in NO_X (approximately 87 tpd) and VOC (approximately 243 tpd) would be needed for DRPK to reach a DV_{18} of 85 ppb

2018 Matrix Modeling Summary

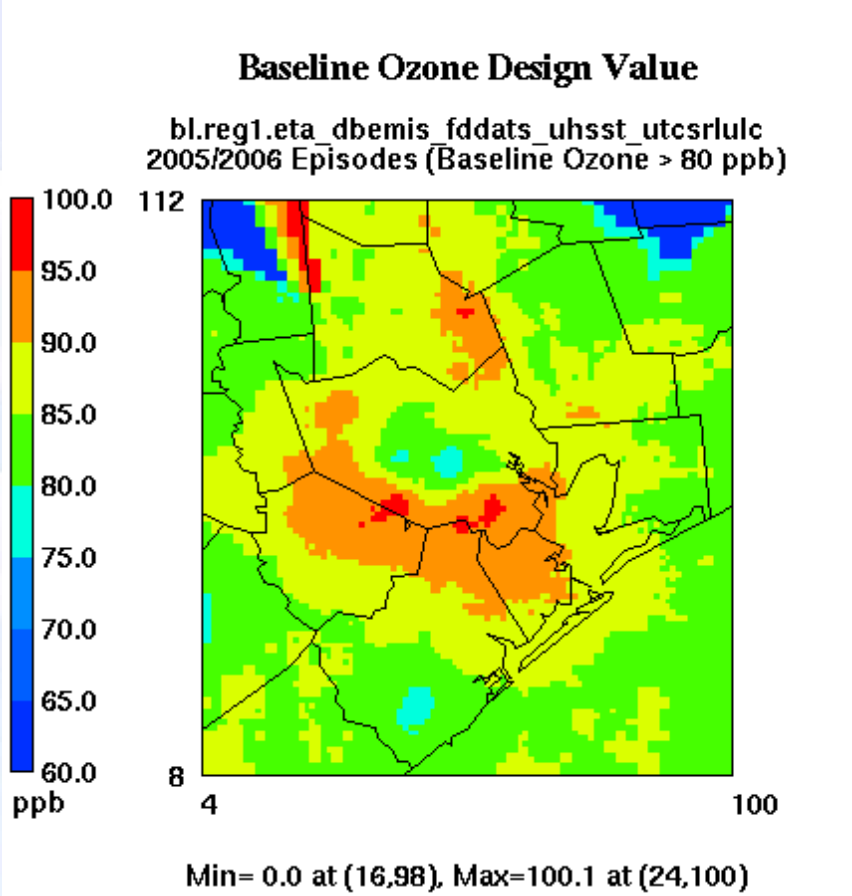
Monitoring Site Code	2005 8-Hour Design Value (ppb)	RRFs	2018 8-Hour Design Value (ppb)	Estimated NO_X Reduction (tpd)
DRPK – C35	96.3	0.921	88.7	103
BAYP – C53	100.7	0.862	86.8	35
HSMA –C406	95.3	0.896	85.4	9.8
WALV – C617	94.0	0.924	86.8	45

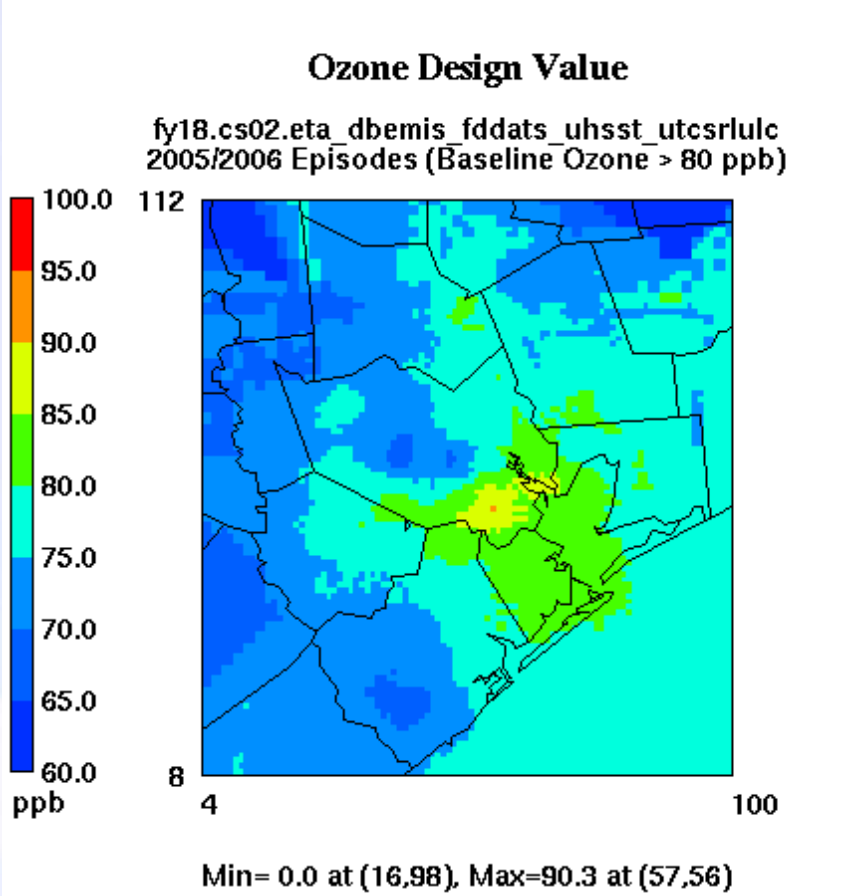
Corroborative Analyses

- Modeling Analyses
  - Exceedance area reduction
  - Retrospective modeling
- Trend Analyses
  - Design value
  - Exceedance days

(Note: as part of the attainment demonstration SIP, the TCEQ is considering additional corroborative analyses, such as weekday versus weekend modeling analyses.)

Exceedance Area Reduction





2005 Baseline

HGB Area $\geq$ 85 ppb

17,268 km^2

2018 Future

HGB Area $\geq$ 85 ppb

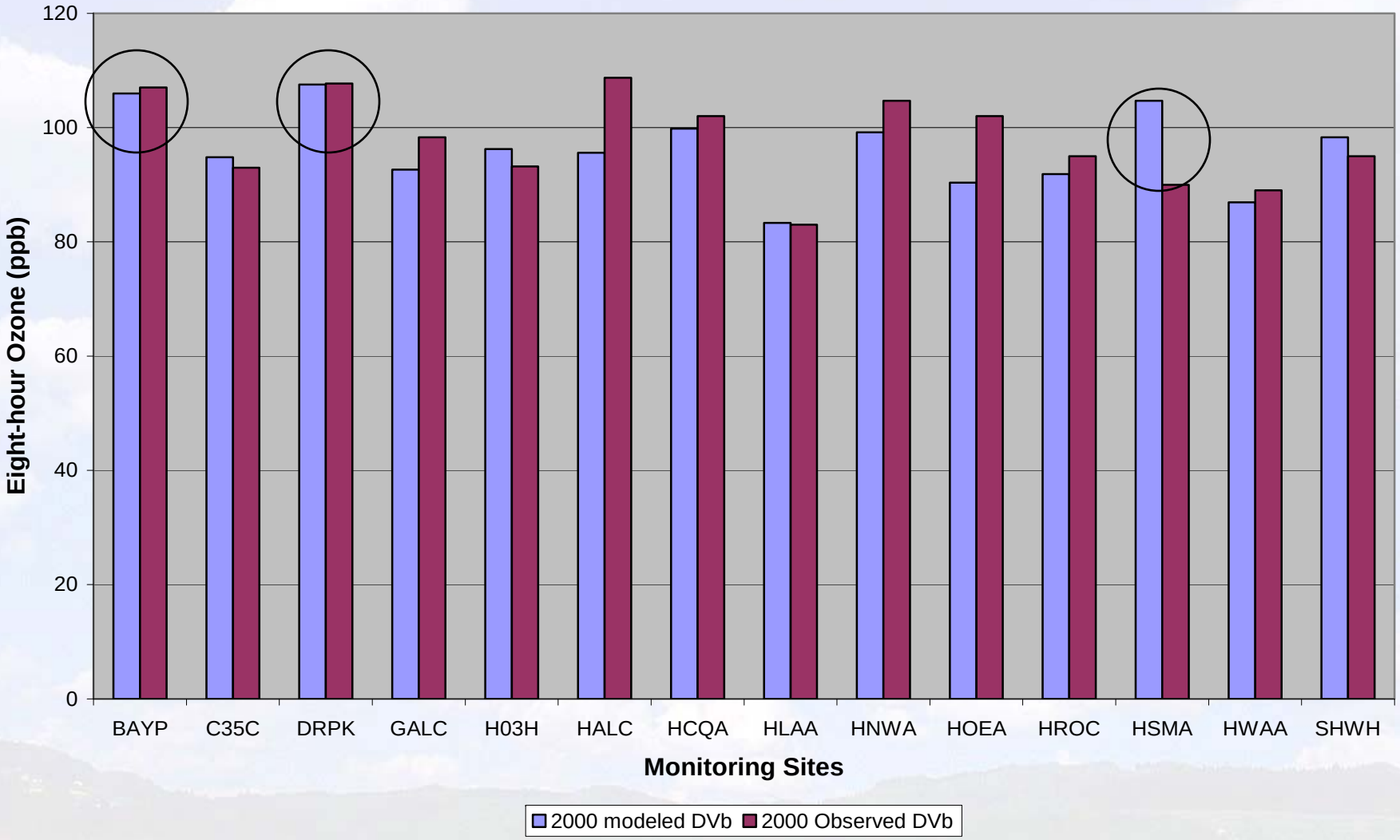
404 km^2

Retrospective Modeling

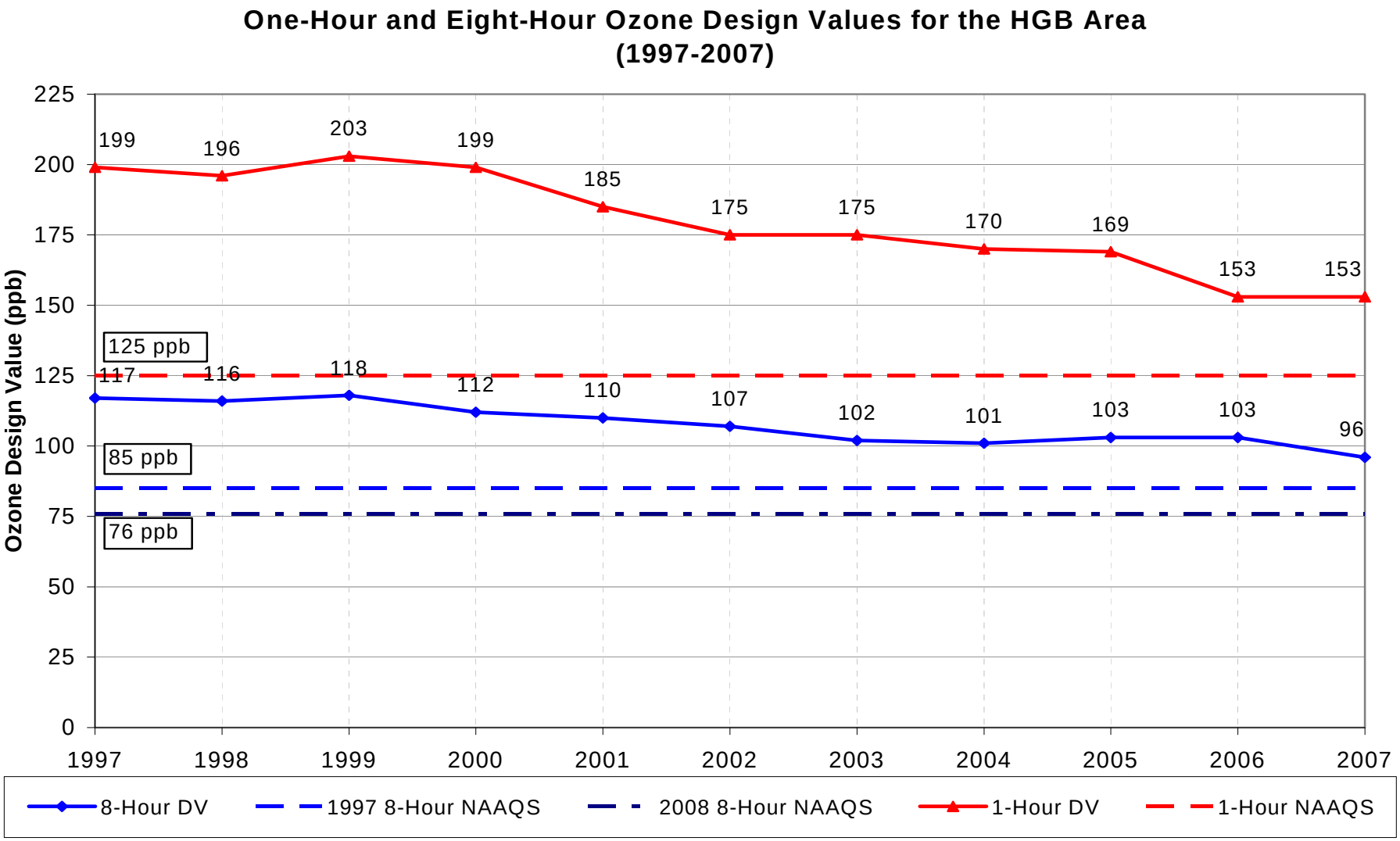
- Projects historical ozone design values
- Tests the model's response to large emission changes
- Used 2000 as the historical year, since 2000 and 2005 use the same model configuration
- Used 2000 baseline emissions with 2005/2006 meteorology

Retrospective Modeling

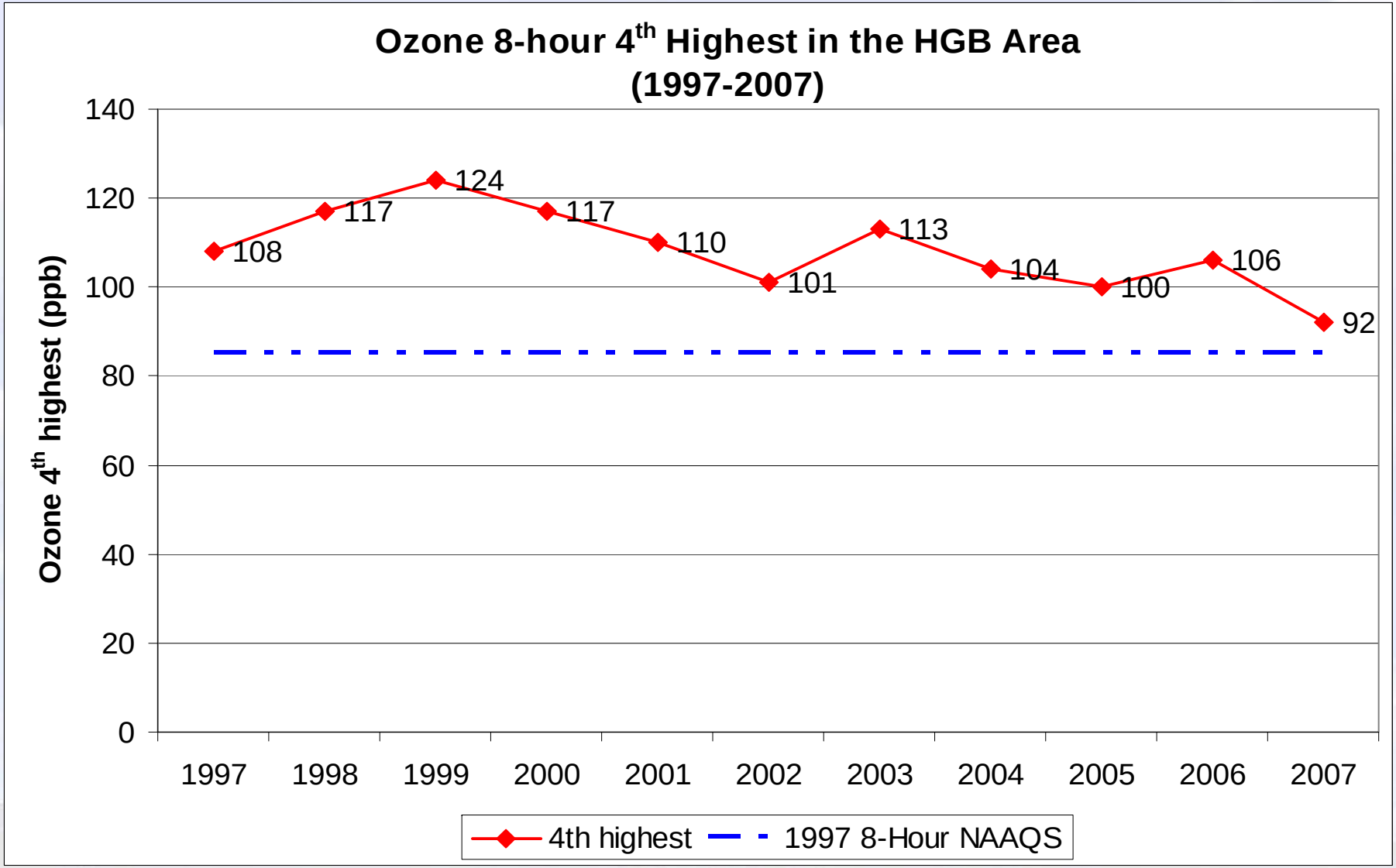
Modeled vs Observed 2000 Baseline Design Values (DVb)



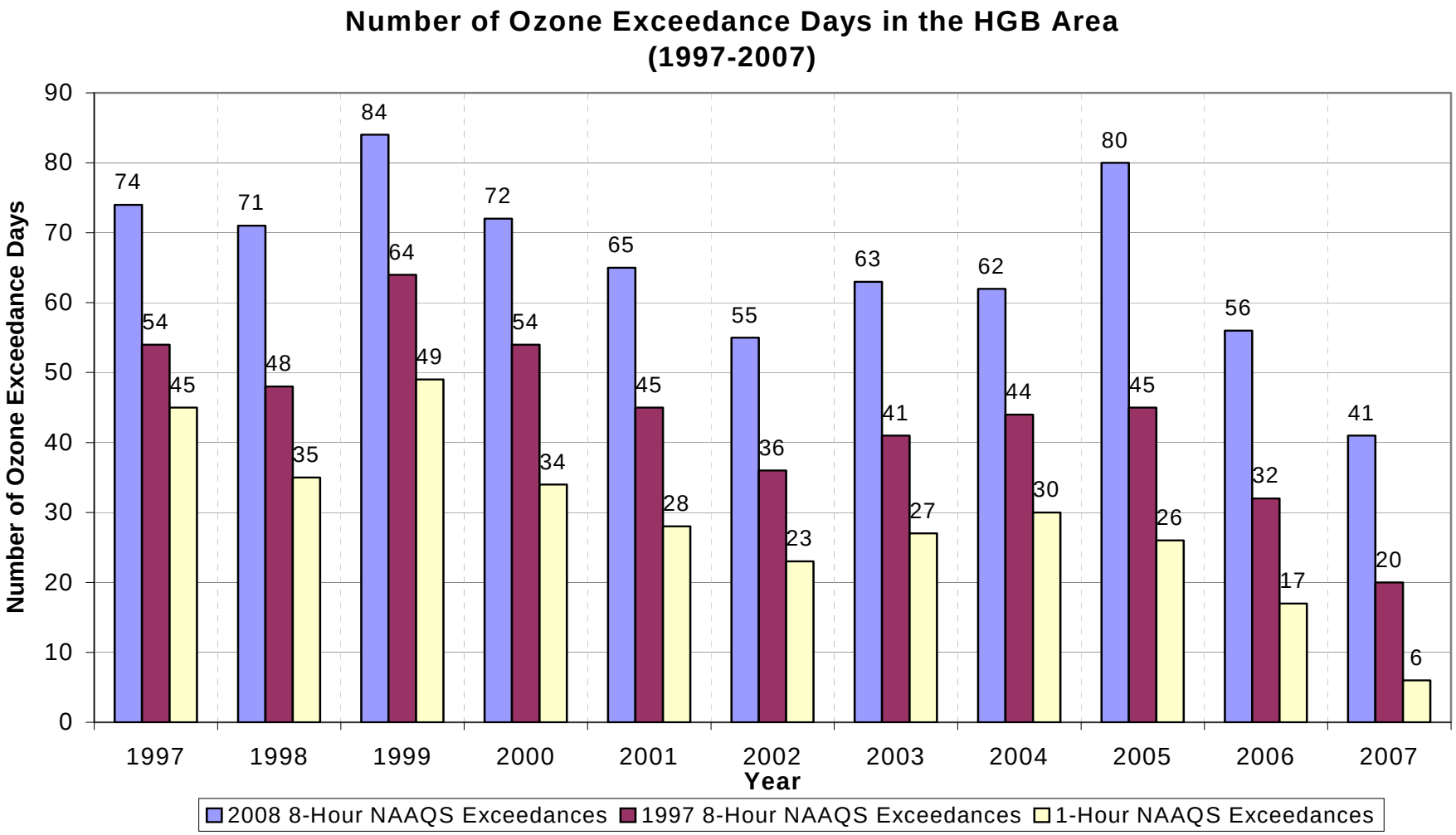
Ozone Design Value Trends



Ozone Fourth Highest Trends



Number of Exceedance Days Trend



*Source: Ozone - EPA's Air Quality System, May 23, 2008

**One-hour ozone values of 125 ppb or greater exceed the one-hour NAAQS. Eight-hour values of 85 ppb or greater exceed the 1997 eight hour NAAQS, and eight-hour values of 76 ppb or greater exceed the 2008 eight-hour NAAQS.