8-hr Ozone Attainment Scenario Modeling for Houston: Residual Nonattainment and Sensitivity to Precursor Emissions Reductions

prepared for
Houston 8-hr Coalition

prepared by

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15 Feb '06

Discussion Topics

- Some Implications of EPA Final 8-hr Guidance
- Point Source Inventory Comparisons
- Future Year (2009) 8-hr Ozone Attainment Results
- Year 2009 Emissions Reduction Sensitivities
- Source Apportionment, Rollout, and WOE Modeling
- Summary & Next Steps

Final 8-hr Model Evaluation Guidance

- No single definitive test for model performance evaluation (MPE).
- No 'bright line' criteria (i.e. bias, error, unpaired accuracy statistics) to determine acceptable vs. inadequate performance.
- Variety of MPE tests should be used & results weighed qualitatively to judge model acceptability.
- Give greater weight to tests that assess model capabilities most closely related to how model is used in the attainment test --- *daily maximum 8-hr ozone predictions in near each non-attainment monitor*.
- MPE results should be compared against similar regulatory modeling studies

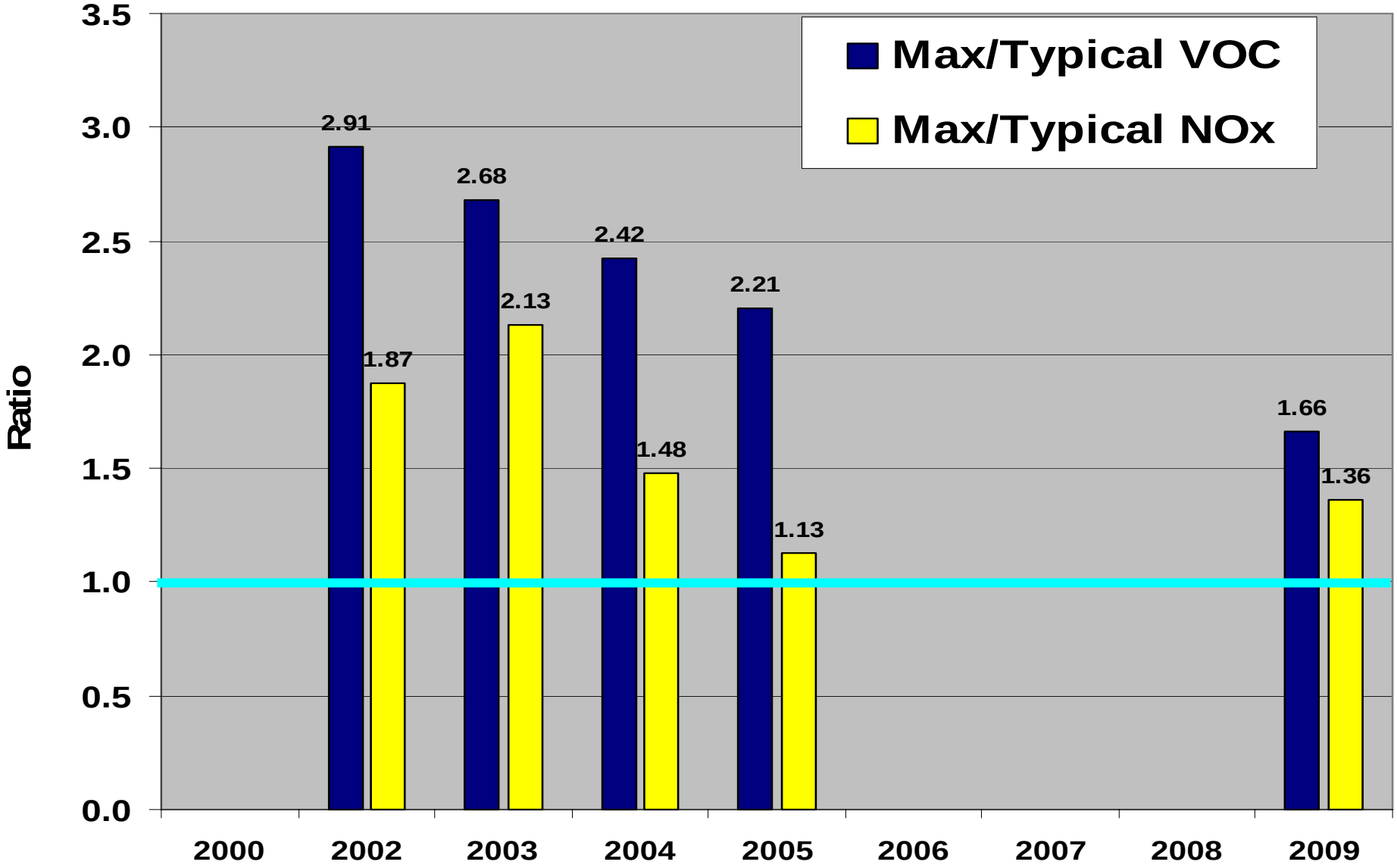
Role of Weight-of-Evidence

- Not a ‘hand-waving’ process
- Stringency of WOE analyses increases progressively as the DV_f at any nonattainment monitor increases above 82 ppb.
- WOE analysis likely to become a very substantial scientific element of the HGB 8-hr attainment demonstration.

Point Source Inventory Comparisons

- Compared our base year (2003, 2004, 2005) and future year (2009) CAMx 36/12/4 km modeling inventories for 8-county region with TCEQ projected totals (*not modeling inventories*)
- Projected totals in TCEQ spreadsheets (Ron Thomas, Karen Hill, Steve Sun, etc) reveal some potentially significant differences (next slide)
- TCEQ staff's projected totals for same years based on some blend of 'actual', 'typical', and 'maximum allowable'
- Our point source emissions based on 'actual' or 'typical' base year and future year emissions.
- Current comparisons are merely interim
- The appropriate comparisons can be made when TCEQ 2009 CAMx modeling inventory is available.

Ratio of Maximum Allowable/Typical HGB Point Source VOC and NOx Emissions (tons/day)



Point Source Inventory Comparisons

- Because these methodological differences potentially influence attainment year control requirements, CAMx modeling was performed to:
  - Examine effects on estimated 2009 attainment
  - Examine the effects of CAMx model responsiveness to controls beyond the 2009 baseline, and
  - Assess the significance of these differences and the need for further reconciliation work

2009 Attainment & 'Fast Track' Emissions Sensitivity Runs

- 2009 baseline runs for all four episodes
- FT-1: 25% VOC & 25% NOx reductions
- FT-2: 50% VOC & 50% NOx reductions
- FT-3: 25% NOx reductions
- FT-4: 25% VOC reductions
- FT-5: 25% VOC & 25% NOx reductions plus zero-out of coastal shipping & platform emissions
- FT-6: 2018 motor vehicle fleet (e.g., fed controls) and 2009 VMT

and

- FT-7: 2009 baseline w/ max. allowable pt. source emissions
- FT-8: 25% VOC/NOx anthro reductions with max. allowable

2009 8-hr Ozone Attainment Results

Table 1. Future 8-hr Ozone Design Value (FDV) for 2009A Baseline Derived From Four Post-2000 HGB Episodes.

AIRS ID	ID	DVC	THRESH	NDAYS	DVBM	DVFM	RRF	FDV
482011039	DRPK	102.0	77	11	90.76	82.43	0.91	93
482010055	BAYP	101.0	78	11	93.86	85.31	0.91	92
482010051	HCQA	100.0	80	10	94.75	86.96	0.92	92
482011015	BAYT	101.0	76	10	90.84	82.09	0.90	91
482011034	HOEA	98.9	82	10	93.14	83.46	0.90	89
482010024	HALC	101.0	82	10	93.89	81.83	0.87	88
480391004	MANV	94.5	81	10	91.69	83.66	0.91	86
482011035	C35C	95.1	77	10	91.06	82.30	0.90	86
482010029	HNWA	98.9	71	10	83.58	72.47	0.87	86
482010062	HSMA	92.2	80	10	90.52	82.97	0.92	85
482010070	HROC	92.9	82	10	92.06	82.97	0.90	84
481670014	GALC	90.0	75	11	82.31	75.65	0.92	83
482011050	SBRK	90.0	80	10	89.30	81.21	0.91	82
482010066	SHWH	90.0	78	10	93.81	84.77	0.90	81
482010026	H04H	89.0	76	11	90.17	80.07	0.89	79
482010075	TXAV	88.8	76	10	93.17	82.24	0.88	78
480391003	CLTA	86.7	69	2	80.99	71.96	0.89	77
482010046	HWAA	86.9	77	10	90.55	78.10	0.86	75
482450011	PAWC	80.3	78	10	91.79	84.16	0.92	74
483611001	WORA	81.6	73	10	83.11	74.57	0.90	73
482450009	BMTC	79.3	73	10	88.13	80.55	0.91	72
481671002	TLMC	79.3	69	2	96.07	87.14	0.91	72
483390078	CONN	81.7	71	10	78.24	68.21	0.87	71
482450018	JEFF	77.0	76	10	88.52	81.78	0.92	71
482010047	HLAA	80.1	72	10	88.37	78.13	0.88	71
480391016	JACK	79.4	69	6	87.04	77.28	0.89	70
482450022	JEFC	77.1	73	10	80.77	73.42	0.91	70
483611100	S42S	75.7	69	7	76.47	68.85	0.90	68

DVf ≥ 88 ppb at 1 or more sites/grid cells

DVf 82-87 ppb at 1 or more sites/grid cells

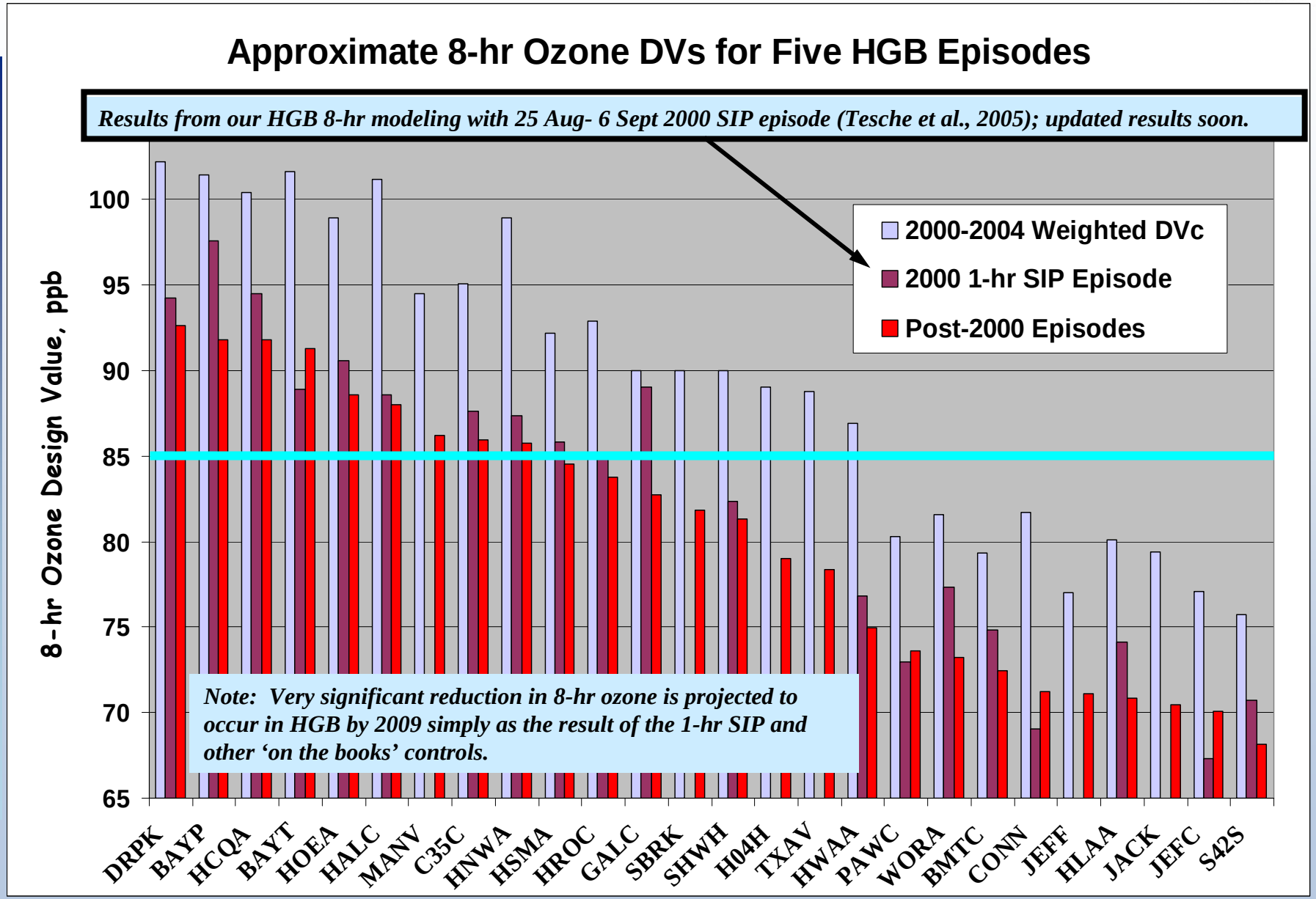
DVf < 82 ppb at all monitor sites

"More qualitative [WOE] results are less likely to support a conclusion differing from the outcome of the modeled attainment test" (EPA, 2005, pg 9)

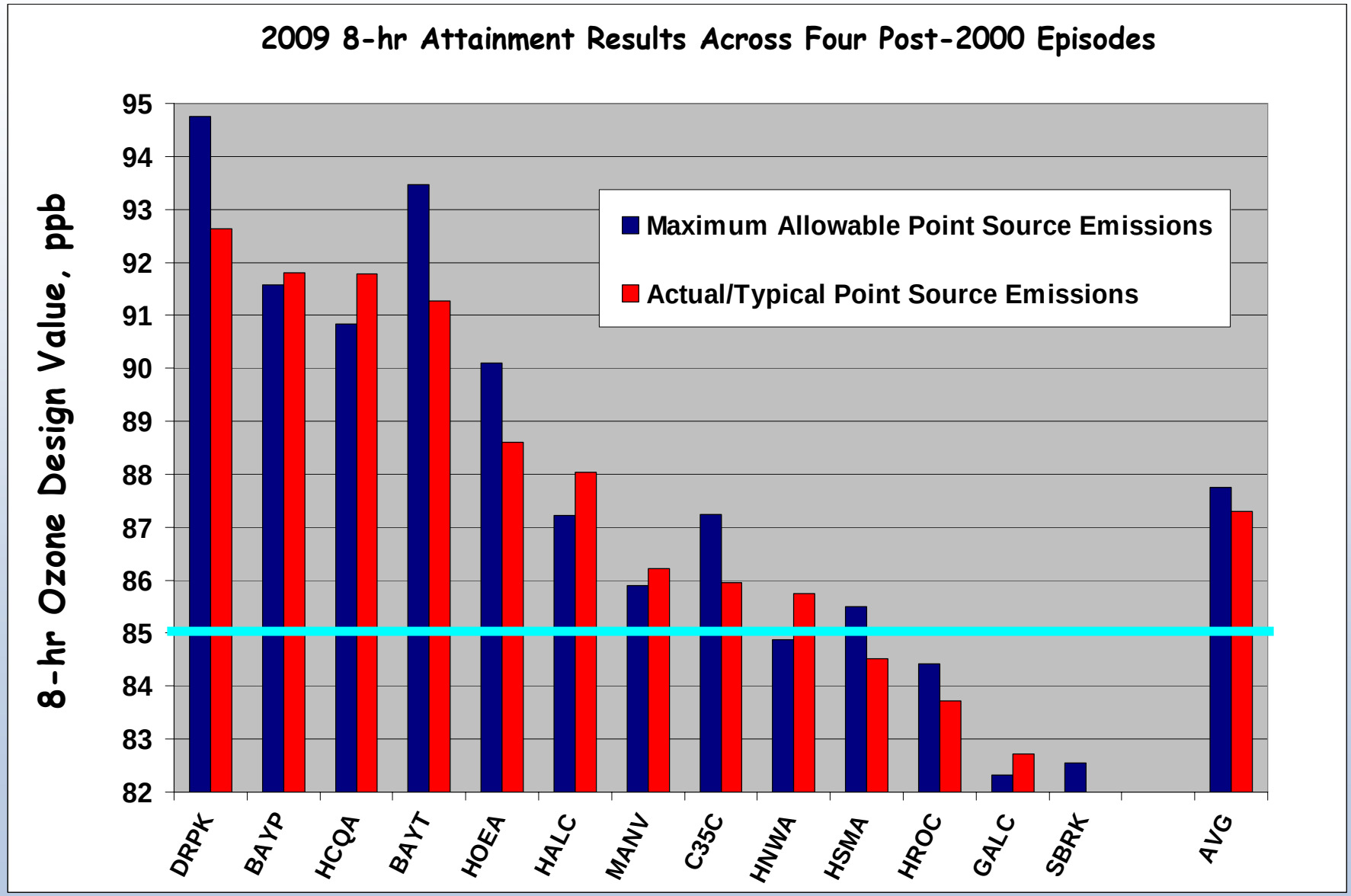
"A WOE demonstration should be conducted to determine if aggregate supplemental analyses support the attainment test".

'Basic' supplemental analyses should be completed to confirm the outcome of the modeled attainment test.

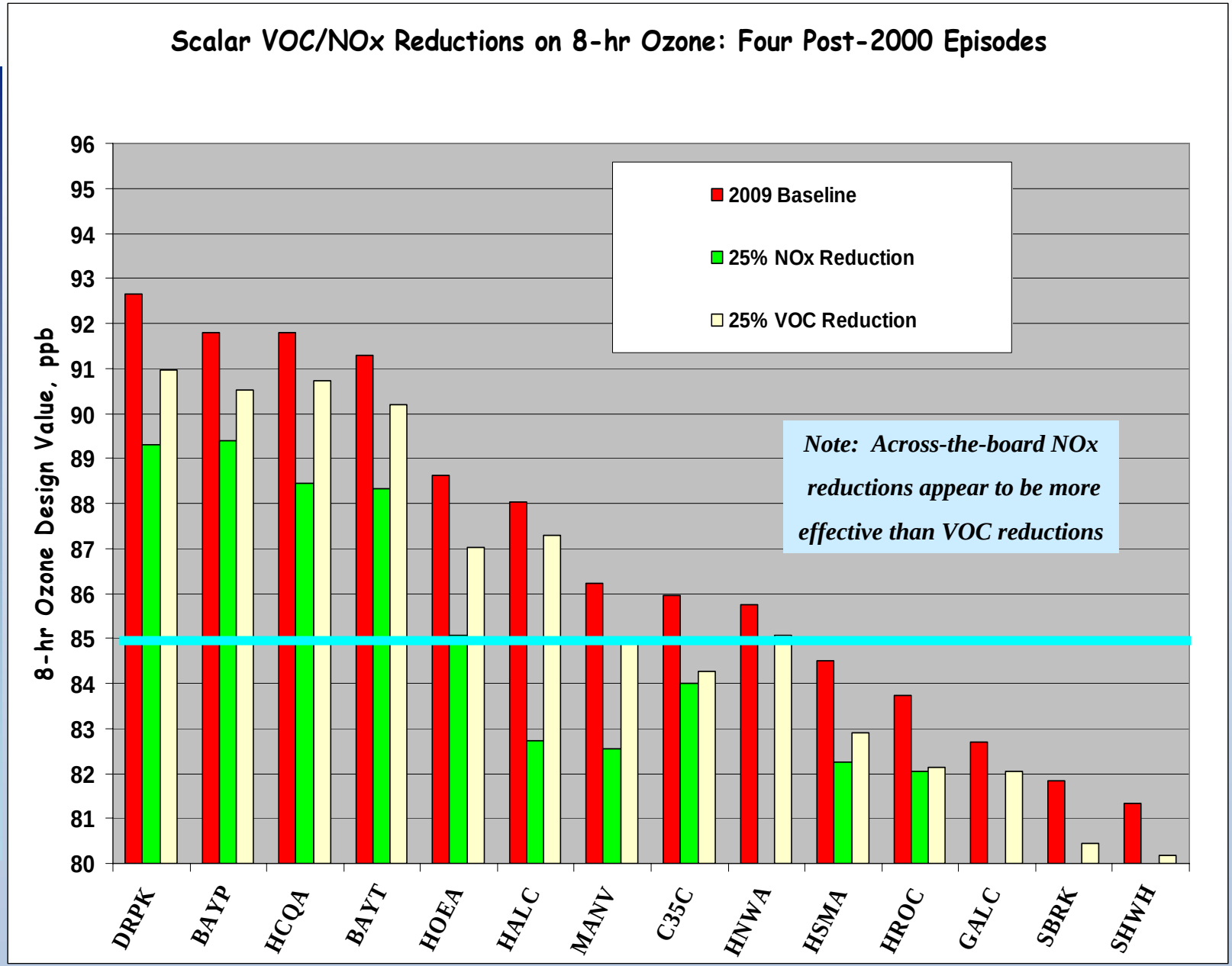
Attainment Estimates: 5 Episodes



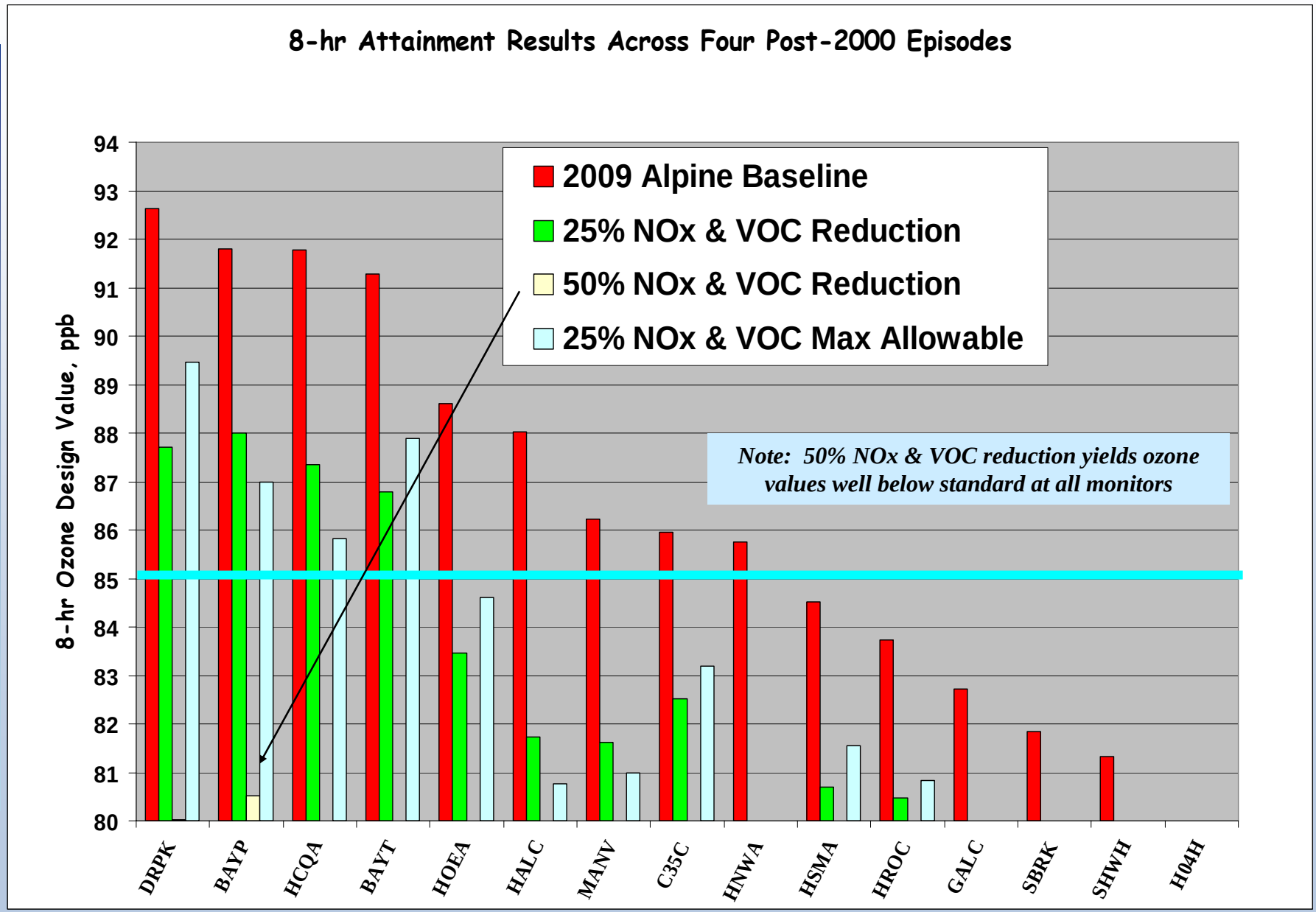
Effects of Point Source Emissions Assumptions on 2009 Design Values



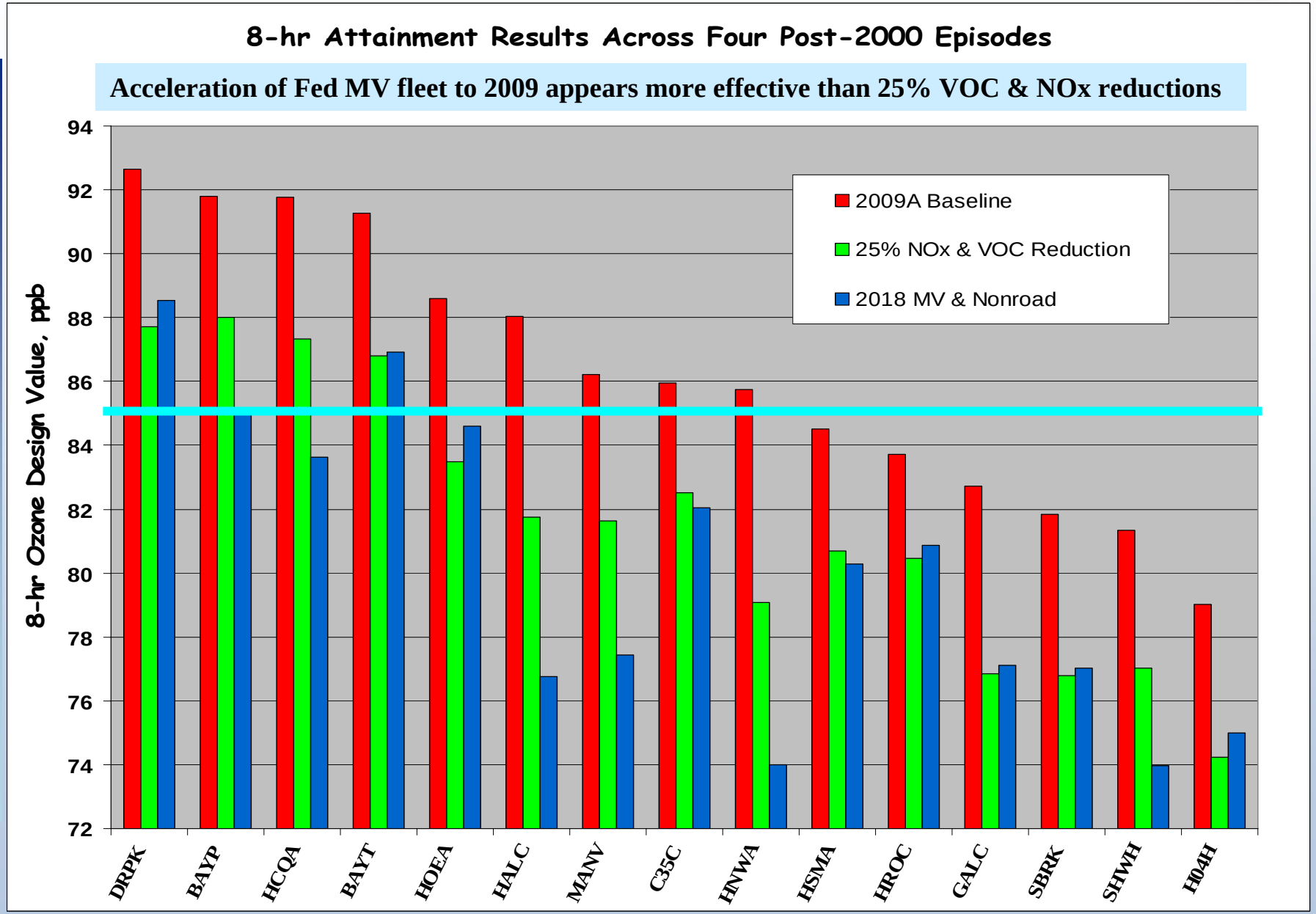
25% VOC vs 25% NOx Reductions



Other VOC & NOx Sensitivities



2018 Fed MV vs. 25% VOC & NOx



Summary

- Four post-2000 CAMx episodes give lower precursor control requirements compared to our previous modeling with Aug-Sept 2000 1-hr SIP episode
- 25% VOC and NOx reductions from 2009 baseline (FT-1) may lower HGB design values to a level near (within 1-3 ppb at remaining four nonattainment monitors) the 8-hr NAAQS.
- Across-the-board scalar anthropogenic NOx reductions (FT-3) appear to be somewhat more effective in lowering peak 8-hr ozone values compared with scalar VOC reductions (FT-4).
- Combined across-the-board scalar VOC and NOx reductions appear to be more effective in lowering ozone compared with scalar reductions in either precursor individually (FT-1-4).

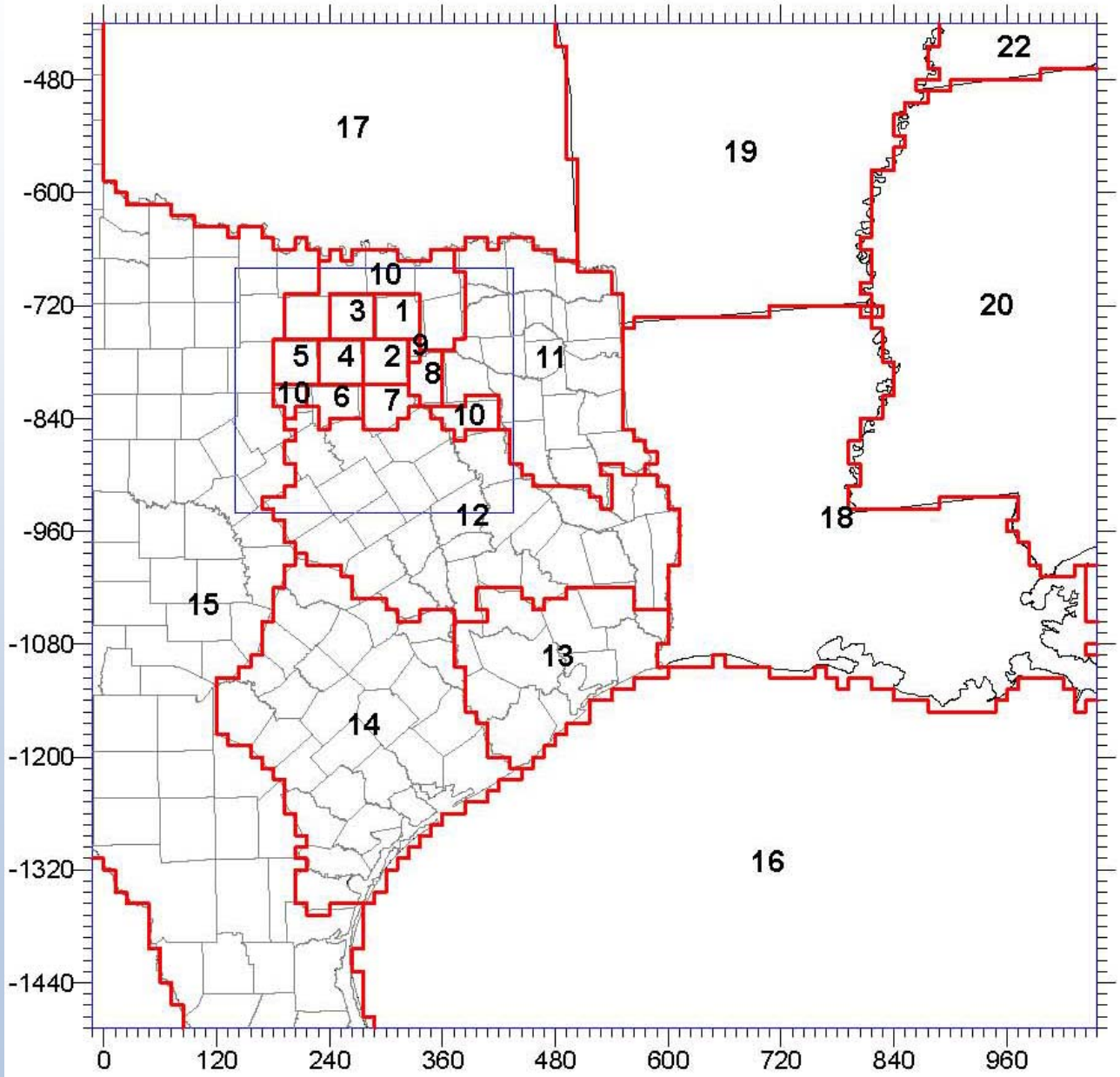
Summary (continued)

- Very substantial reduction in 2009 8-hr DVs in HGB (attainment at all but two monitors with no additional anthropogenic reductions) are estimated to result from implementation of 2018 on-road and non-road federal motor vehicle control programs (assuming 2009 VMT levels—FT-6).
- Future design values for at least 14 HGB monitors fall within the range of 82-87 ppb for many of the emissions sensitivity runs examined so far
- Thus, focused efforts on defining and conducting thoughtful WOE evidence analyses should begin immediately……..

Next Steps

- Resolve point source emissions questions once TCEQ 2009 base case modeling inventory is available.
- Complete diagnostic studies for all 5 episodes
  - OSAT & APCA source apportionment modeling
  - Roll-Out modeling
  - UNC processes analysis and diagnostic transport analyses
- Apply findings of diagnostic studies with five episodes to the design of sub-regional, category- and pollutant-specific emissions control scenarios targeted at the residual nonattainment monitors **(Deer Park, Baytown, Bayland Park, Croquet, Houston East, Manville Croix, Clinton, etc)**

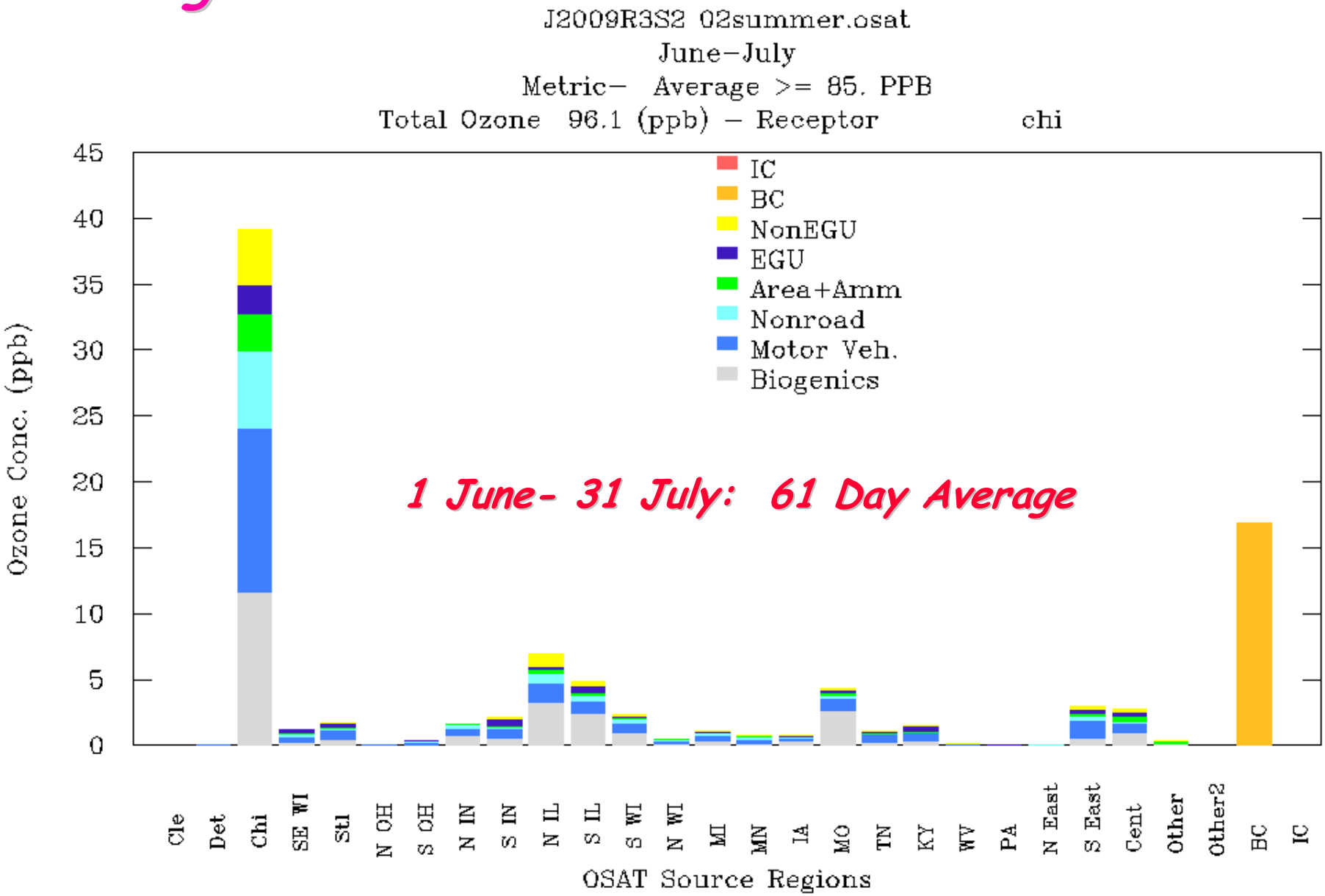
Source Apportionment Domain: 12 km



1. Collin Co.
2. Dallas Co.
3. Denton Co.
4. Tarrant Co.
5. Parker Co.
6. Johnson Co.
7. Ellis Co.
8. Kaufman Co.
9. Rockwall Co.
10. DFW 16-County (Regions 1 - 9 plus Cooke, Fannin, Grayson, Henderson, Hood, Hunt, and Wise Counties)
11. Northeast Texas
12. Central Texas
13. Houston
14. South Texas
15. West Texas
16. Gulf of Mexico and Mexico
17. Oklahoma
18. Louisiana
19. Arkansas
20. Mississippi
21. Alabama
22. Tennessee

Source: Tai et al., 2005

Chicago


J2009R3S2 02summer.osat
June-July
Metric- Average >= 85. PPB
Total Ozone 96.1 (ppb) - Receptor chi
Ozone Conc. (ppb)
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NonEGU
EGU
Area+Amm
Nonroad
Motor Veh.
Biogenics
1 June- 31 July: 61 Day Average
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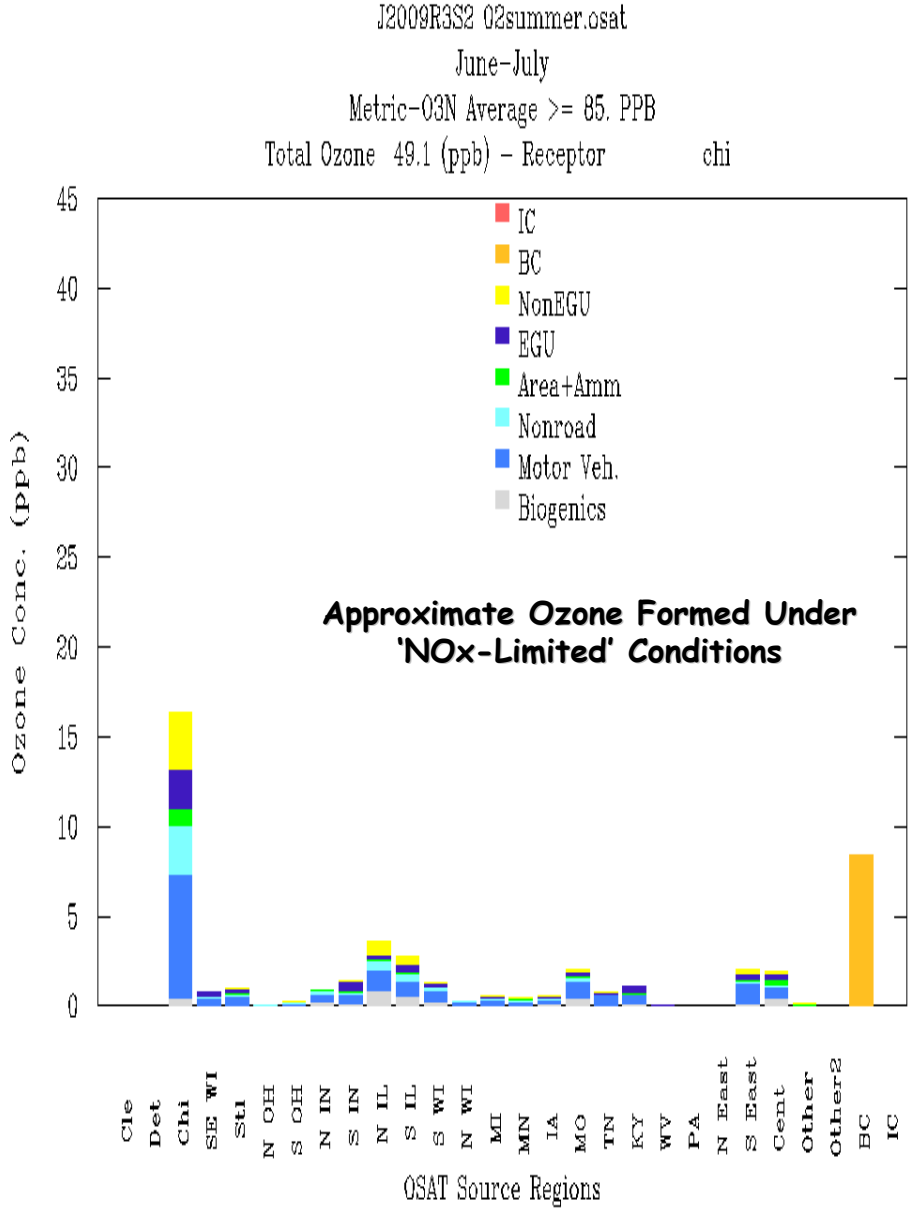
OSAT Source Regions

Chicago


J2009R3S2 02summer.osat
June-July
Metric-03N Average >= 85. PPB
Total Ozone 49.1 (ppb) - Receptor chi
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NonEGU
EGU
Area+Amm
Nonroad
Motor Veh.
Biogenics
Approximate Ozone Formed Under 'NOx-Limited' Conditions
Ozone Conc. (ppb)
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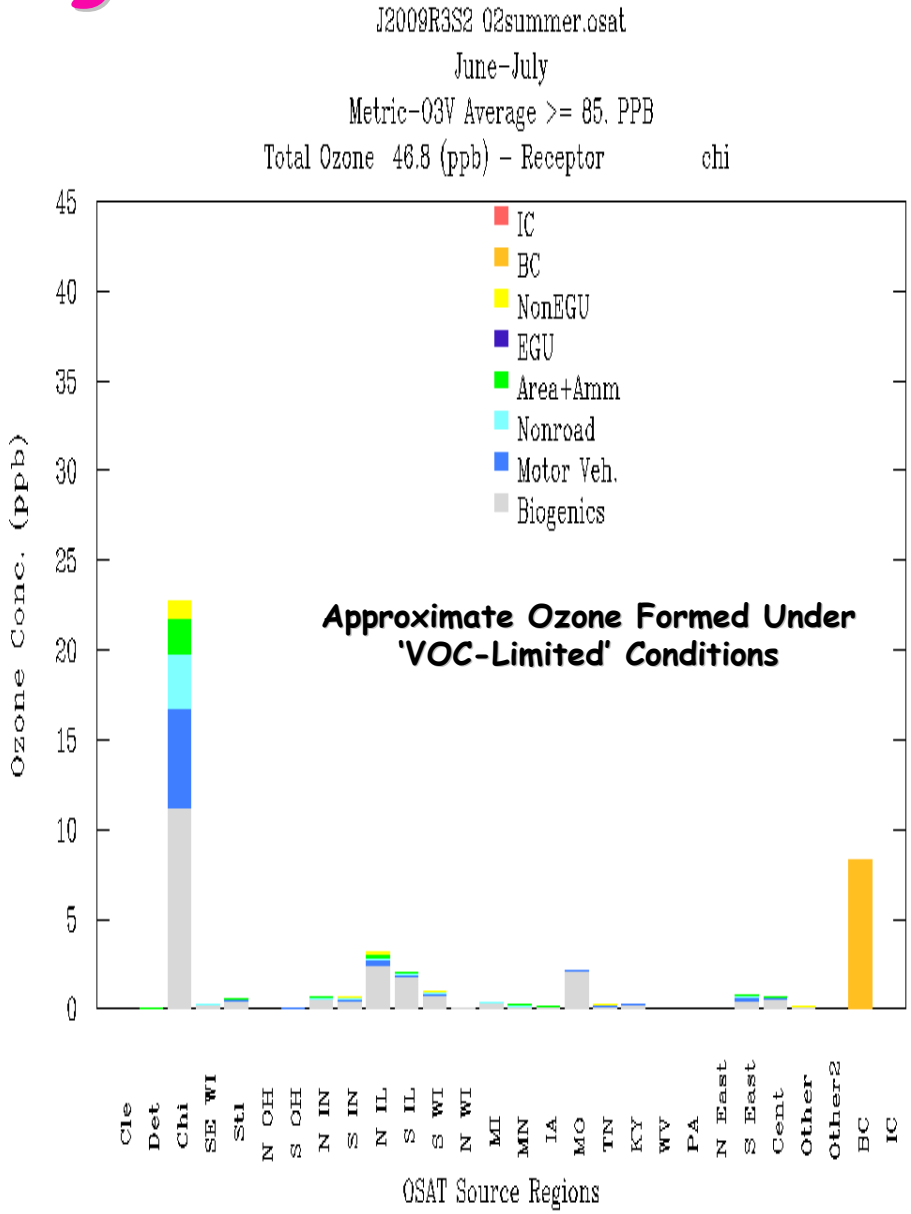
OSAT Source Regions


J2009R3S2 02summer.osat
June-July
Metric-03V Average >= 85. PPB
Total Ozone 46.8 (ppb) - Receptor chi
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NonEGU
EGU
Area+Amm
Nonroad
Motor Veh.
Biogenics
Approximate Ozone Formed Under 'VOC-Limited' Conditions
Ozone Conc. (ppb)
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Other2
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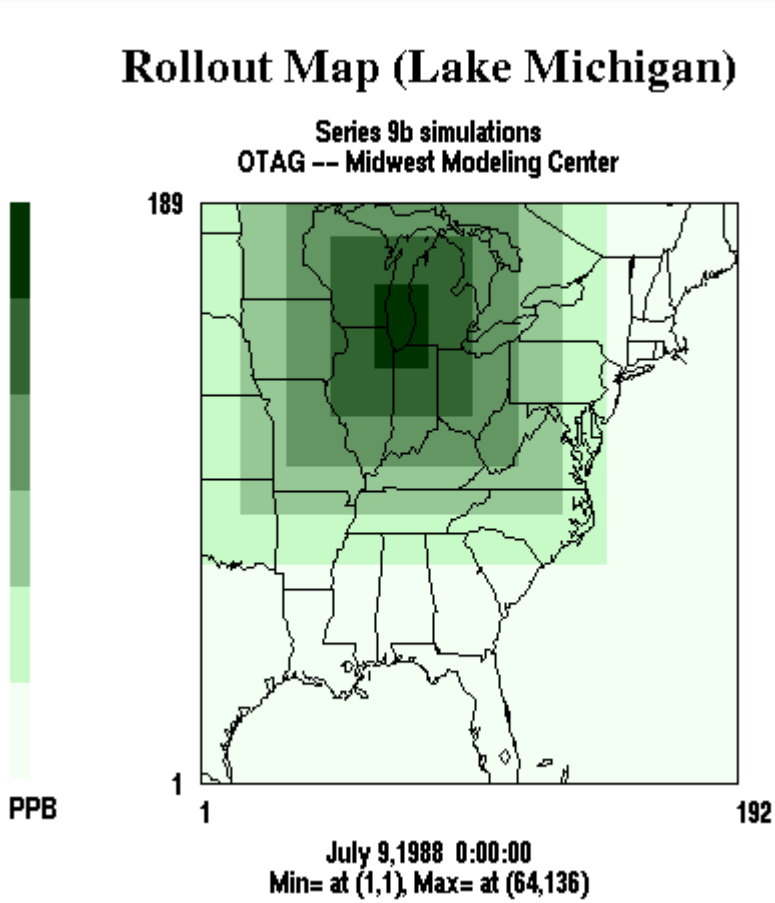
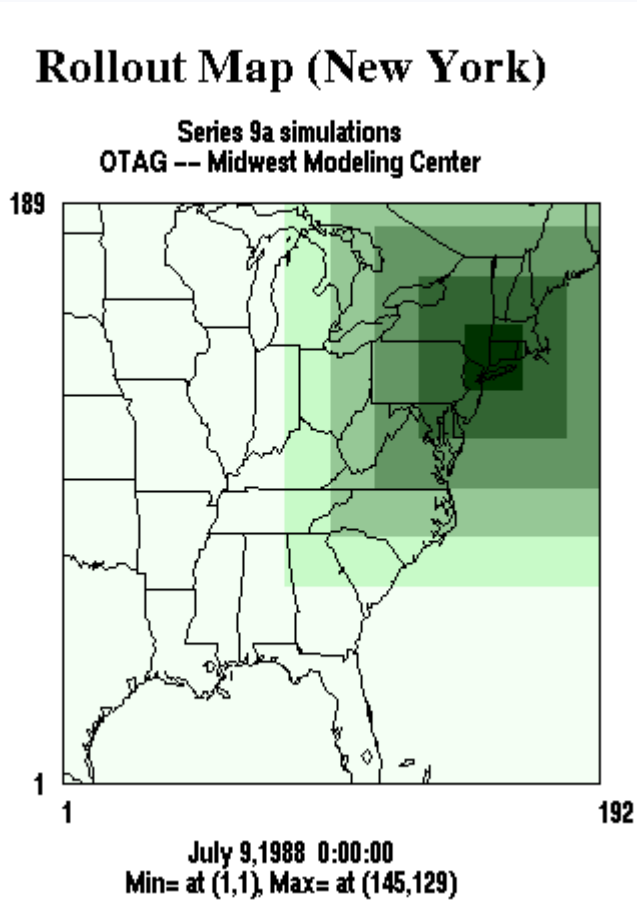
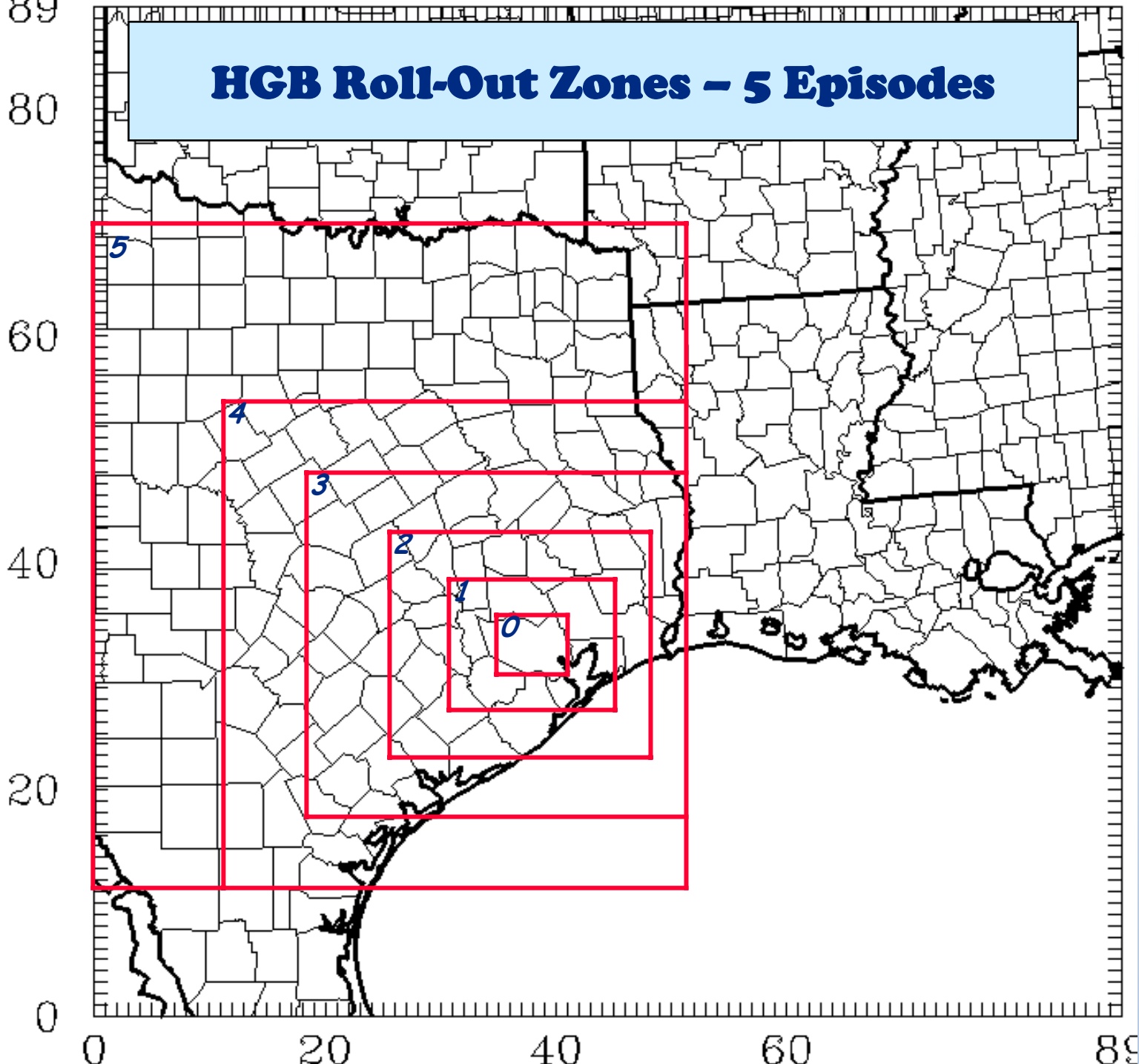
IC
OSAT Source Regions

CAMx Roll-Out Zones in NOx SIP Call Regional Modeling





HGB Roll-Out Zones – 5 Episodes



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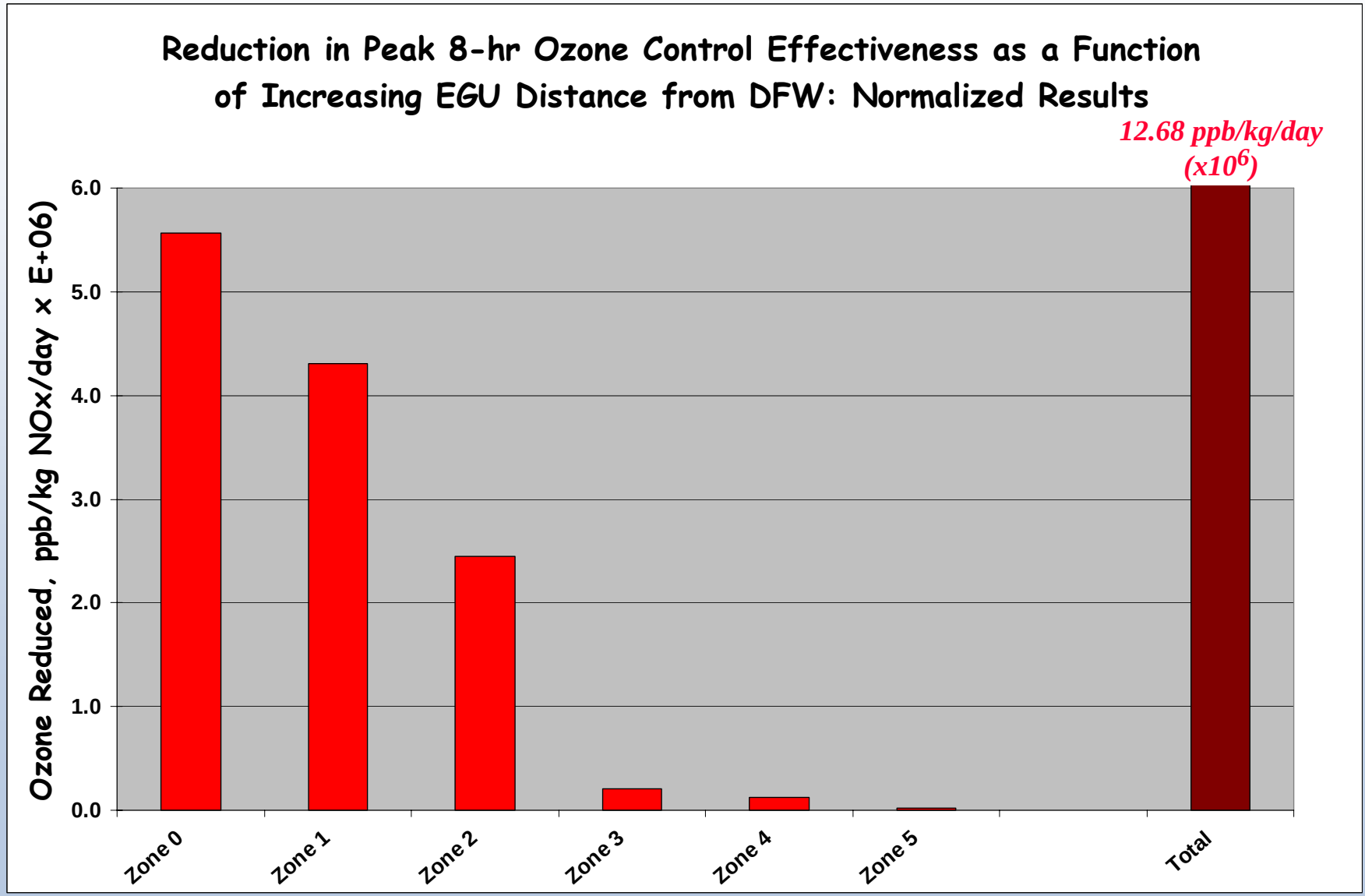
Normalized Impacts as a Function of Distance from DFW



Questions?

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8-hr Ozone Attainment Scenario Modeling for Houston: Appendix (Supporting Materials)

prepared for
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15 Feb '06

Final 8-hr Model Evaluation Guidance

- No single definitive test for evaluating model performance.
- Not appropriate to assign ‘bright line’ criteria to distinguish between adequate and inadequate performance.
- A variety of performance tests should be performed and the results weighed qualitatively to assess model performance.

"Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hr Ozone NAAQS", EPA-454/R-05-002. October 2005 (page 101).

Final 8-hr Model Evaluation Guidance

- Greater weight should be given to those tests which assess the model capabilities most closely related to how the model is used in the modeled attainment test (i.e., peak predictions in 'neighborhood of each non-attainment monitor).
- Evaluation results should be compared against similar modeling exercises to ensure that the model performance approximates the quality of other applications.

"Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hr Ozone NAAQS", EPA-454/R-05-002. October 2005 (page 101).

Role of Weight-of-Evidence

- Not a 'hand-waving' process
- Stringency of WOE analyses increases progressively as the DV_f at any nonattainment monitor increases above 82 ppb.
- WOE analysis likely to become a very substantial scientific element of an 8-hr attainment demonstration.

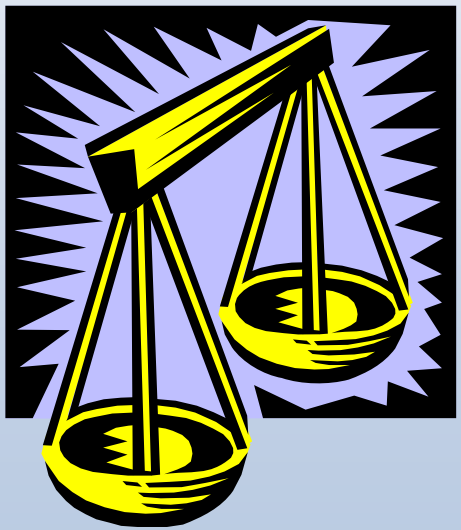

Table 2.1 Guidelines For Weight of Evidence Determinations

Results of Modeled Attainment Test	Supplemental Analyses
Future Design Value < 82 ppb, all monitor sites	Basic supplemental analyses should be completed to confirm the outcome of the modeled attainment test
Future Design Value 82 - 87 ppb, at one or more sites/grid cells	A weight of evidence demonstration should be conducted to determine if aggregate supplemental analyses support the modeled attainment test
Future Design Value ≥ 88 ppb, at one or more sites/grid cells	More qualitative results are less likely to support a conclusion differing from the outcome of the modeled attainment test.

"Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hr Ozone NAAQS", EPA-454/R-05-002. October 2005 (page 9).

'Strength' of Weight-of-Evidence

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Magnitude of Weight of Evidence Challenge

Weight of Technical/Scientific Analyses Likely to be Needed

DVf ≥ 88 ppb at 1 or more sites or grid cells

DVf = 82-87 ppb at 1 or more sites or grid cells

DVf < 82 ppb at all monitors

2009 Point Source Emissions Estimation and Attainment Issues

- In developing base and attainment year inventories, methodological differences in EPA and TCEQ point source emissions estimation techniques becomes evident
- We used EPA procedures for compiling the 2003, 2004, and 2005 base year and 2009 future year CAMx inventories
- Because methodological differences might potentially influence attainment year control requirements, CAMx modeling was performed to
  - Elucidate the effects of alternative methods on 2009 base case and model responsiveness to controls, and
  - Facilitate ongoing discussions with TCEQ inventory specialists to seek the preferred method for developing base and future year EGU and non-EGU point source emissions estimates.

Three HGB Modeling Inventories

- EPA identifies three modeling inventories for the 8-hr Attainment Test
  - Base case inventories for model performance evaluation (MPE) for each modeling episode
  - A baseline inventory corresponding to the year of the current monitored design value (typically 2002); and
  - A future year baseline inventory when attainment of the NAAQS needs to be demonstrated (typically 2009).

Attainment Test Inventories

- Two 'base year' inventories are needed to support 8-hr ozone attainment modeling (EPA, 2005a, pg 24).

  "One is the base case inventory which represents the emissions for the meteorology that is being modeled. These are the emissions that are used for model performance evaluations." "…it is essential to use base case emissions together with meteorology occurring in the modeled episode(s) in order to evaluate model performance."

  "Once the model has been shown to perform adequately, it is no longer necessary to model the base case emissions. It now becomes important to model emissions corresponding to the period with a recent observed design value"

  "The second potential base year inventory corresponds to the middle year of the baseline average design value (e.g., 2002 for a 2000-2004 average design value). This is called the baseline inventory. The baseline emissions inventory is the inventory that is ultimately projected to a future year"

Attainment Test Inventories

- A ‘future year’ inventory is needed to perform the 8-hr ozone attainment test (EPA, 2005a, pg 45).

  “The [future year] **inventory should contain all known emissions controls expected to be in place in the future year as well as projected growth of emissions to the future.”**

  “The attainment test should be performed using the future base case [inventory] **and the base year baseline** [inventory]”.

EPA Attainment Test (EPA, 2005a)

- EPA recommends 2002 as base year (pg 77):

  "…wherever possible, 2002 should be used for baseline modeling for the 8-hr ozone standard."

  "2002 is the recommended inventory year for the baseline modeling (the starting point for future year projections). Other years may be modeled for the base case modeling (for performance evaluation) if episodes are chosen from years other than 2002"

- Other EPA inventory considerations include (pg. 79):

  "Inventories should be built using the most current, accurate, and practical methods available."

  "Several references are available for guidance on building emissions inventories".

  - Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter NAAQS and Regional Haze Regulations"
  - Emission Inventory Improvement Program (EIIP) guidance (Volumes 1-7) http://www.epa.gov/ttn/chief/eiip/techreport/

EPA Attainment Test (continued)

"Day-specific inventory information should be removed and replaced with average data in the baseline inventory, before projecting the baseline to the future. (An exception is the day-specific mobile source or biogenic emissions data which may be dependent on day specific (or even hourly) meteorological data for the time periods modeled.) (pg. 79)

"…it may not be appropriate to project day-specific emissions to the future because they may not be representative of typical base case ozone days". (pg. 45)

"Where available, the operating information that may be available from the point-source inventory should be used to create inventory-specific temporal factors." (pg. 80)

"The goal in making future year emissions projections is to obtain reasonable estimates that account for the key variables that will affect future emissions." (pg. 86)

EPA Attainment Test (concluded)

"Emissions modelers should choose an approach that is representative of future expected behavior and not limited to any single year's closures and maintenance schedule." (pg 88).

"Every attempt should be made to use consistent approaches between the future year and the base year for all of these modeling steps." (pg 94).

"Inconsistencies in approaches between the future-year modeling and the base-year modeling can lead to artificial differences in air quality modeling results that can affect conclusions. Therefore, it is critical to avoid such differences whenever possible." (pg 94).

"If needed, a separate baseline model run should be completed for the purpose of calculating relative reduction factors." (pg 45).

EPA Inventory Procedures (EPA, 2005b)

"For all three applications, the 8-hr ozone NAAQS, PM 2.5 NAAQS, and regional haze rule, the emission inventory should be based on actual emissions". (pg. 14).

"For the 8-hr ozone NAAQS emissions inventory, VOC, NOx, and CO emissions should be reported as actual annual and actual summer weekday." (pg. 17).

"For most SIP purposes, emissions inventories should contain estimates of actual emissions to the air during the relevant time period." (pg. 17).

"If emissions data reported under an operating permits program are used, the State or local agency should ensure that the emissions represent actual rather than allowable or potential emissions for the base year inventory.' (pg. 16).

Motor Vehicle Emissions (AG)

- MOBILE6.2 module of SMOKE used to develop emissions.
- VMT interpolated between TCEQ/TTI estimates for 2000 and 2007.
- On-network emissions spatially allocated by link location.
- Off-network emissions spatially allocated based on FHWA V.2 network and population.
- MV emissions outside 8 counties based on 2002 MVT and MOBILE6.2 options used by VISTAS and CENRAP.

Point Source Emissions

- 2000 Episode:
  - Emissions for Aug-Sept 2000 base case derived mostly from reported ‘actuals’
  - Where ‘actuals’ not reported, ‘maximum’ rates used for 2000 base in some cases;
  - Future 2009 emissions derived from ‘maximum’ permitted rates.
- Post-2000 Episodes (AG):
  - Emissions based on ‘actual’ or ‘typical’ source data derived from most up-to-date 2002 CENRAP/VISTAS/MRPO inventories available at the time
  - Contains EGU and non-EGU point source (‘actual’ or ‘typical’) data submitted by TCEQ and other CENRAP states
  - Believed to be most up-to-date summary of point source emissions for central U.S. region based on joint RPO work efforts
  - 2003, 2004, and 2005 base case inventories ‘grown’ from CENRAP 2002 using State SIC level growth rates from EGAS (v.5), assuming no incremental control between 2003 and 2005 (a proposed refinement to come…)
  - For EGUs and some large industrial sources, hourly CEM data from EPA used.

8-County Point Source Emissions

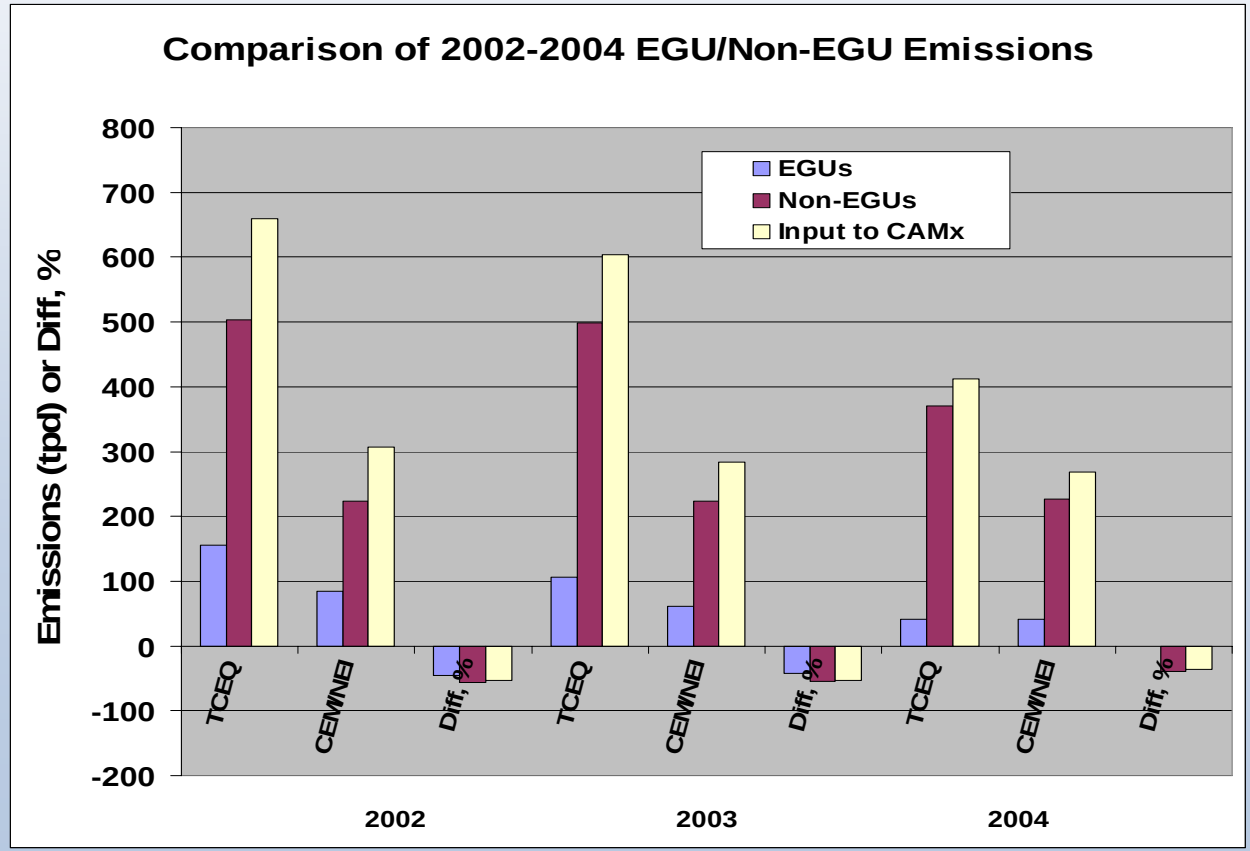
Point Source Emissions Comparisons (TCEQ Recommended & AG Emissions Calculated from Current NEI 2002 Inventory)									
	2002			2003			2004		
	TCEQ	CEM/NEI	Diff, %	TCEQ	CEM/NEI	Diff, %	TCEQ	CEM/NEI	Diff, %
EGUs (tpd)	154.8	83.8	-46	106.2	61.0	-43	41.5	41.7	0
NEGUs (tpd)	503.8	223.0	-56	498.2	223.1	-55	370.3	226.8	-39
Input to CAMx	658.6	306.8	-53	604.4	284.2	-53	411.8	268.5	-36

AG EGU emissions are calculated based on CEM emissions totals

EGU's are identified as any point source with SIC = 4911 or 4931

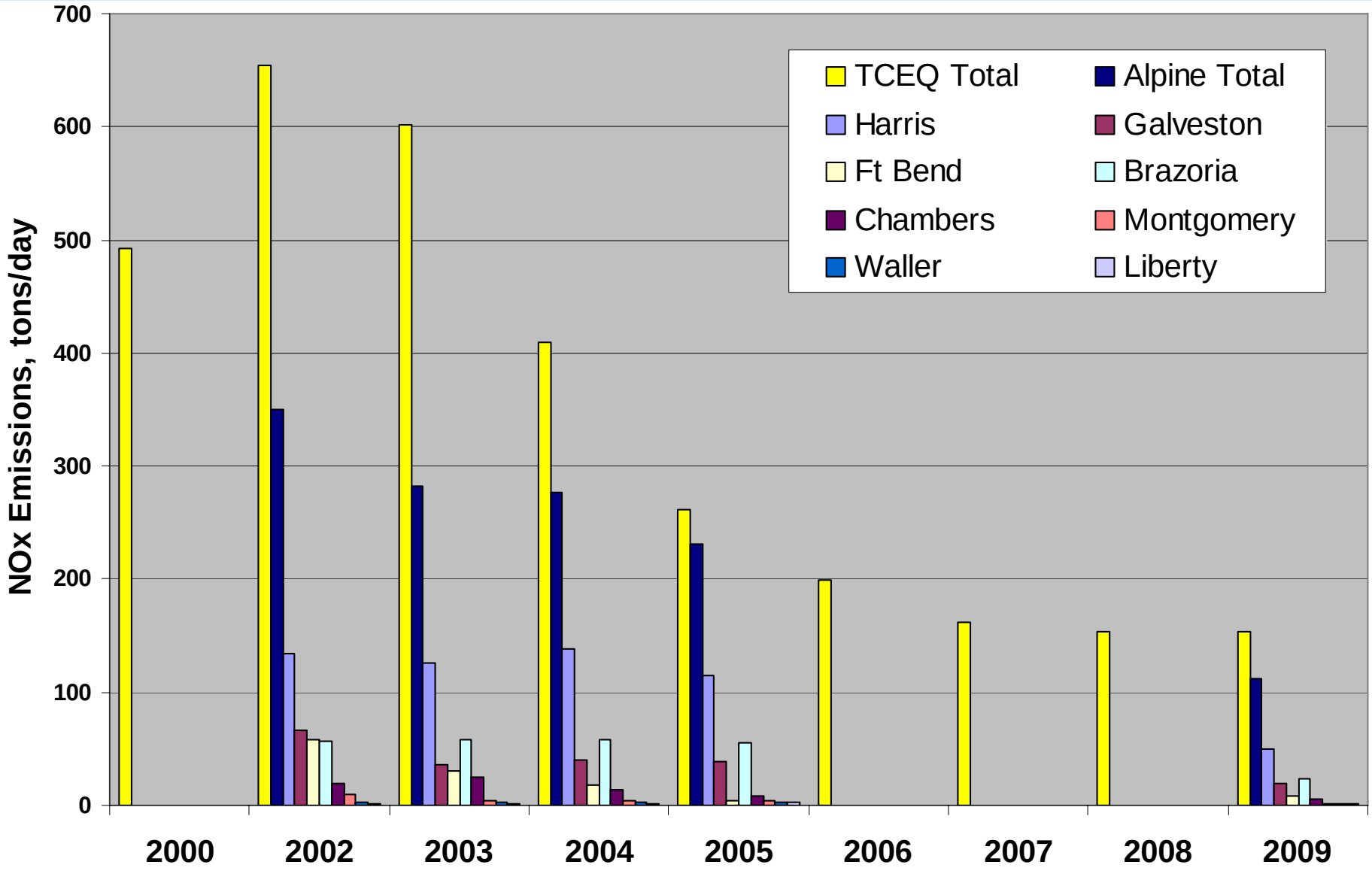
All other sources are considered NEGU

Difference between these two methods tends to diminish somewhat in later years.



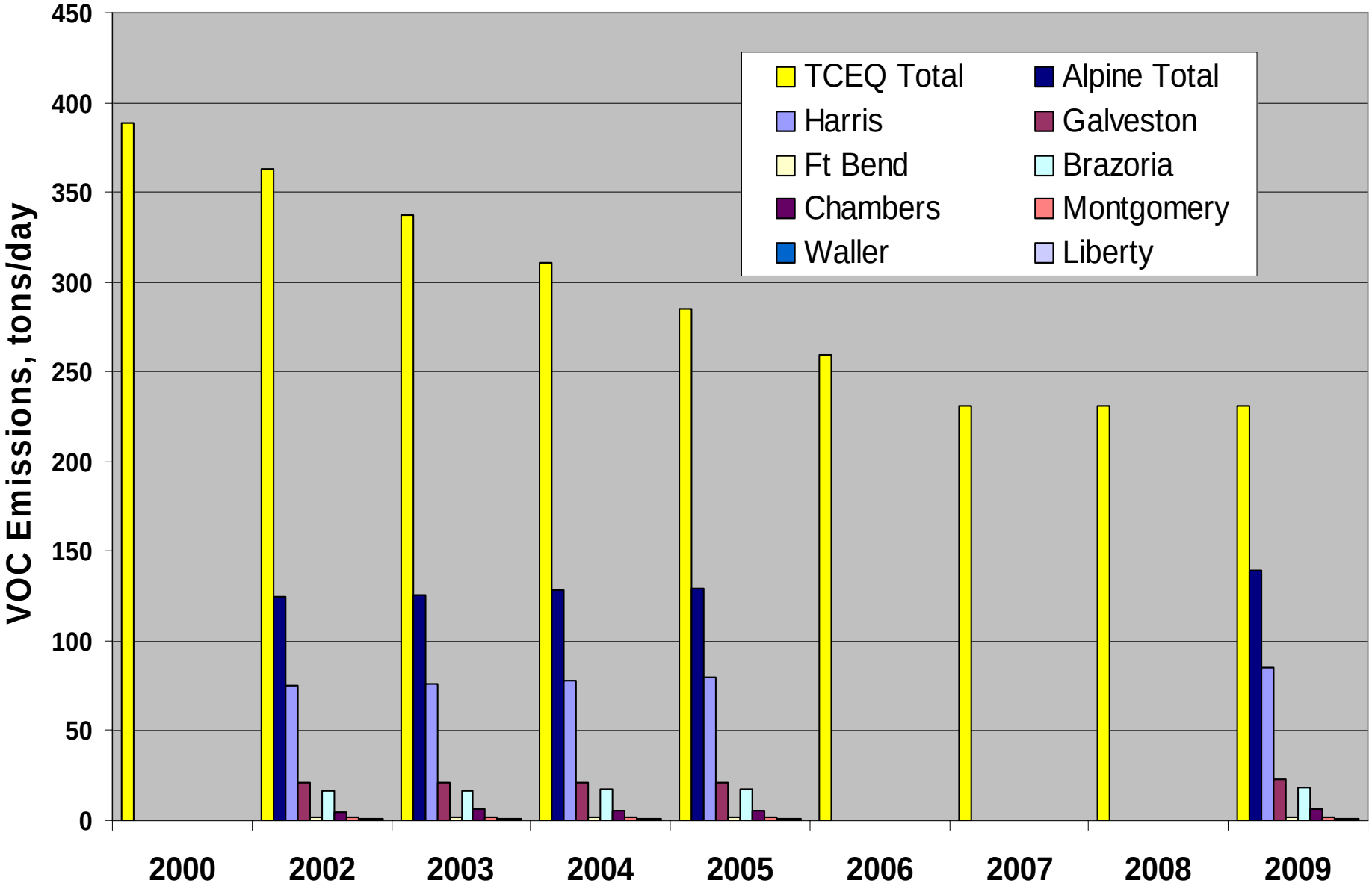
NOx Point Source Emissions by Year and County

TCEQ Total = 8-county total of NOx emissions by year; Alpine Total = 8-county total of NOx emissions by year.



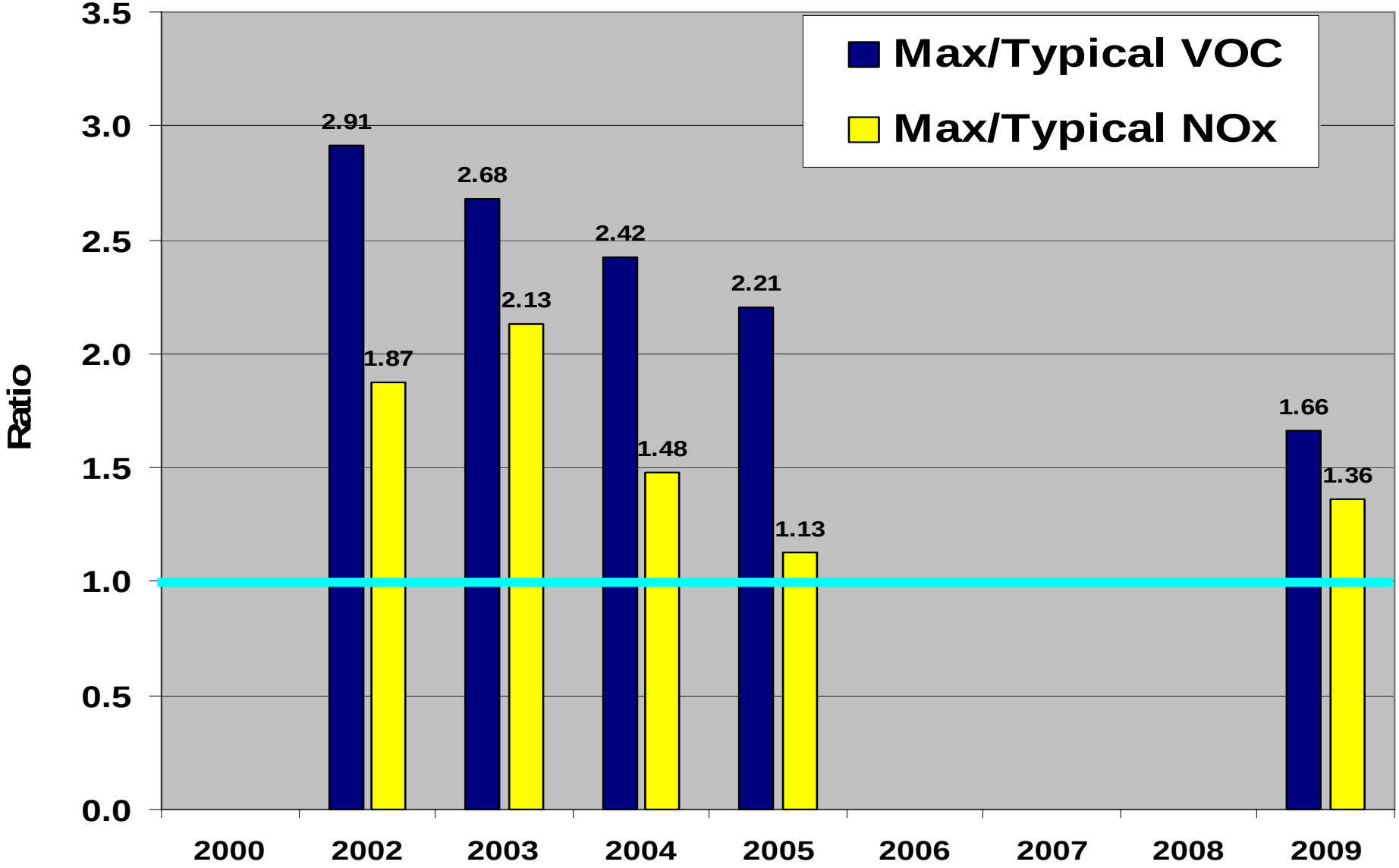
VOC Point Source Emissions by Year and County

TCEQ Total = 8-county total of VOC emissions by year; Alpine Total = 8-county total of VOC emissions by year.



Ratio of Maximum Allowable/Typical HGB Point Source VOC and NOx Emissions (tons/day)

"Max" = TCEQ point source method; "Typical" = EPA method.



CAMx 2009 Sensitivity Simulations

Four post-2000 episodes (44 CAMx runs)

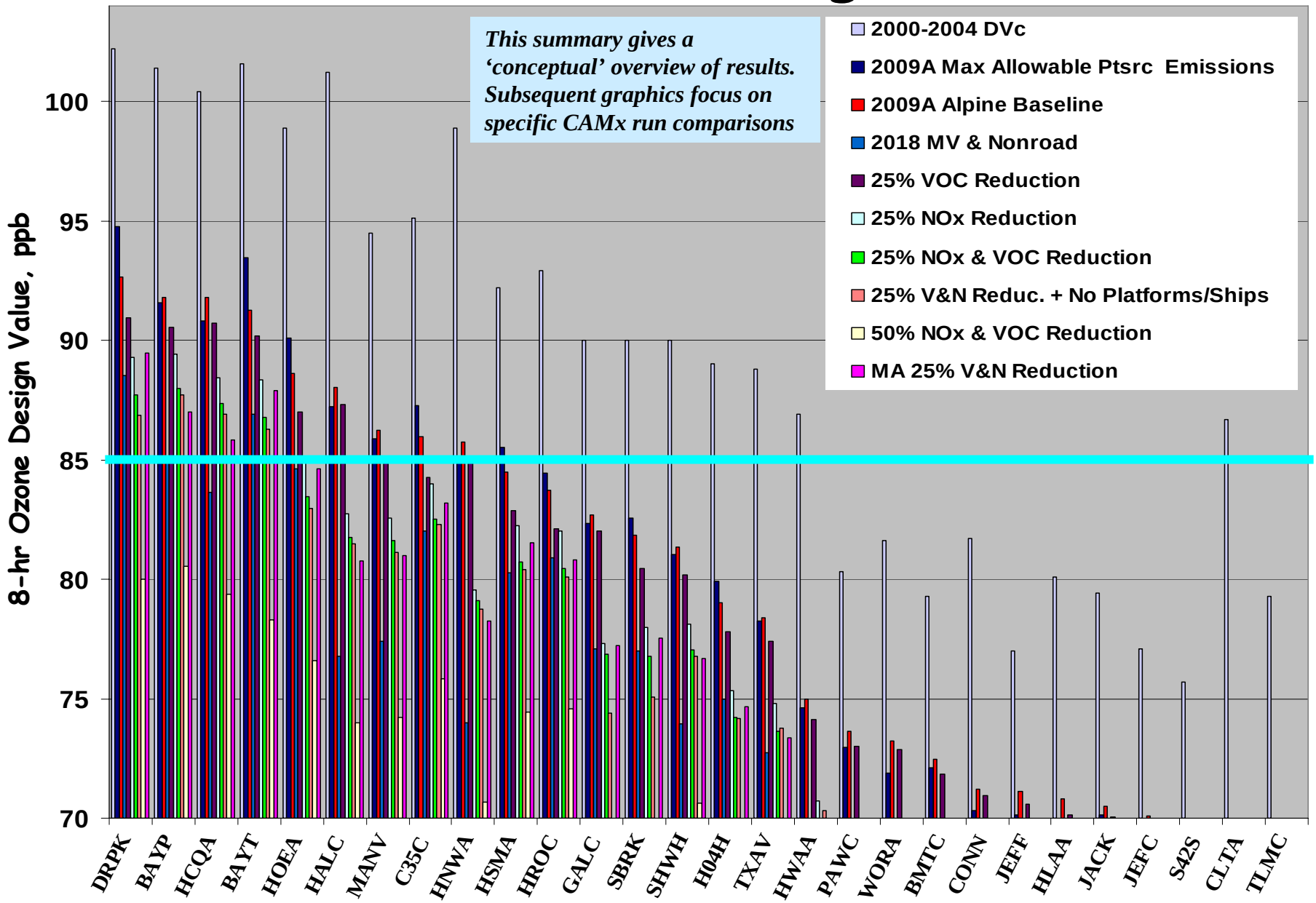
- 2009 baseline runs for all four episodes
- FT-1: 25% VOC & 25% NOx reductions
- FT-2: 50% VOC & 50% NOx reductions
- FT-3: 25% NOx reductions
- FT-4: 25% VOC reductions
- FT-5: 25% VOC & 25% NOx reductions plus zero-out of coastal shipping & platform emissions
- FT-6: 2018 motor vehicle fleet (e.g., fed controls) and 2009 VMT

and

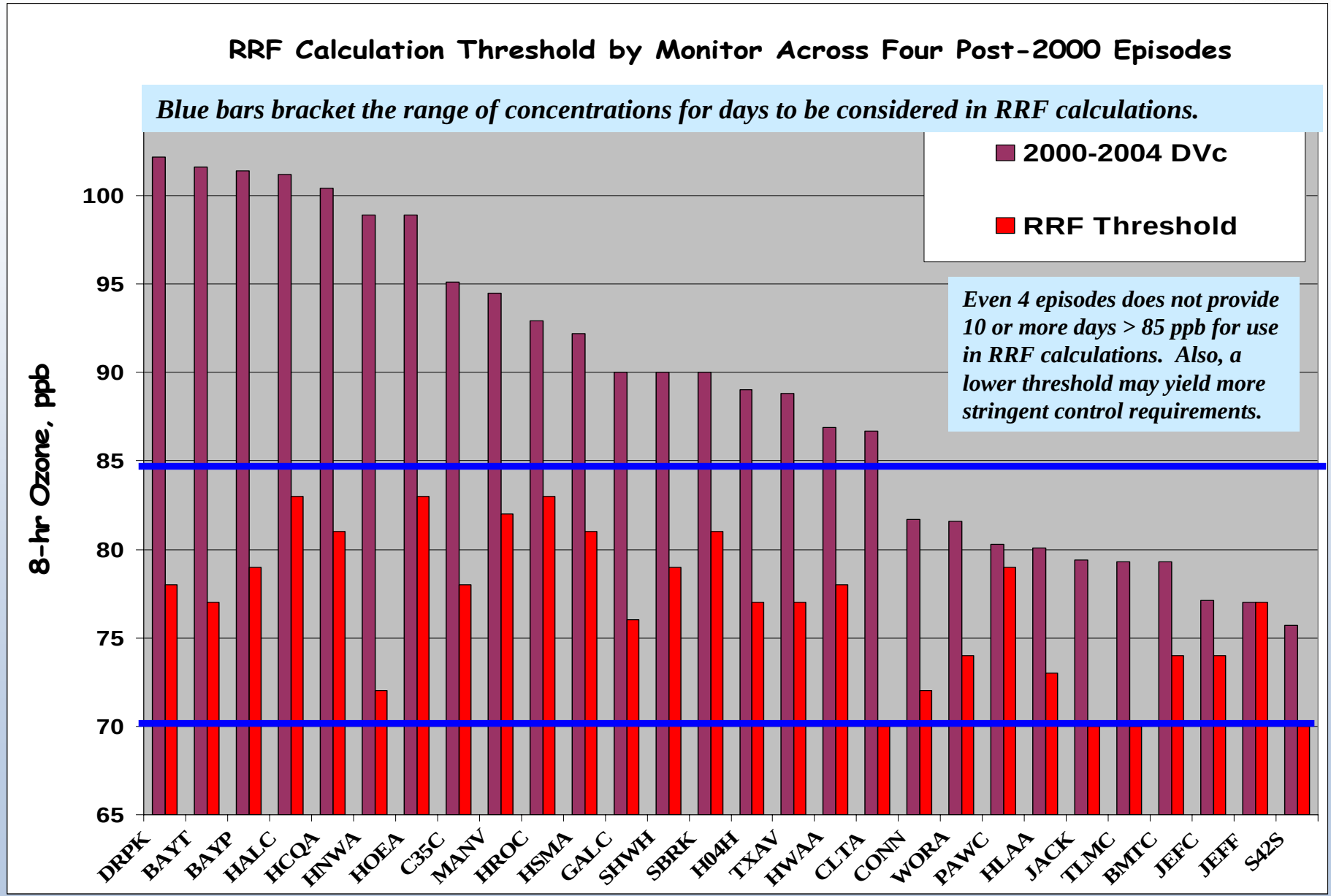
- FT-7: 2009 baseline w/ max. allowable pt. source emissions
- FT-8: 25% VOC/NOx anthro reductions with max. allowable

8-hr Attainment Results Across Four Post-2000 Episodes

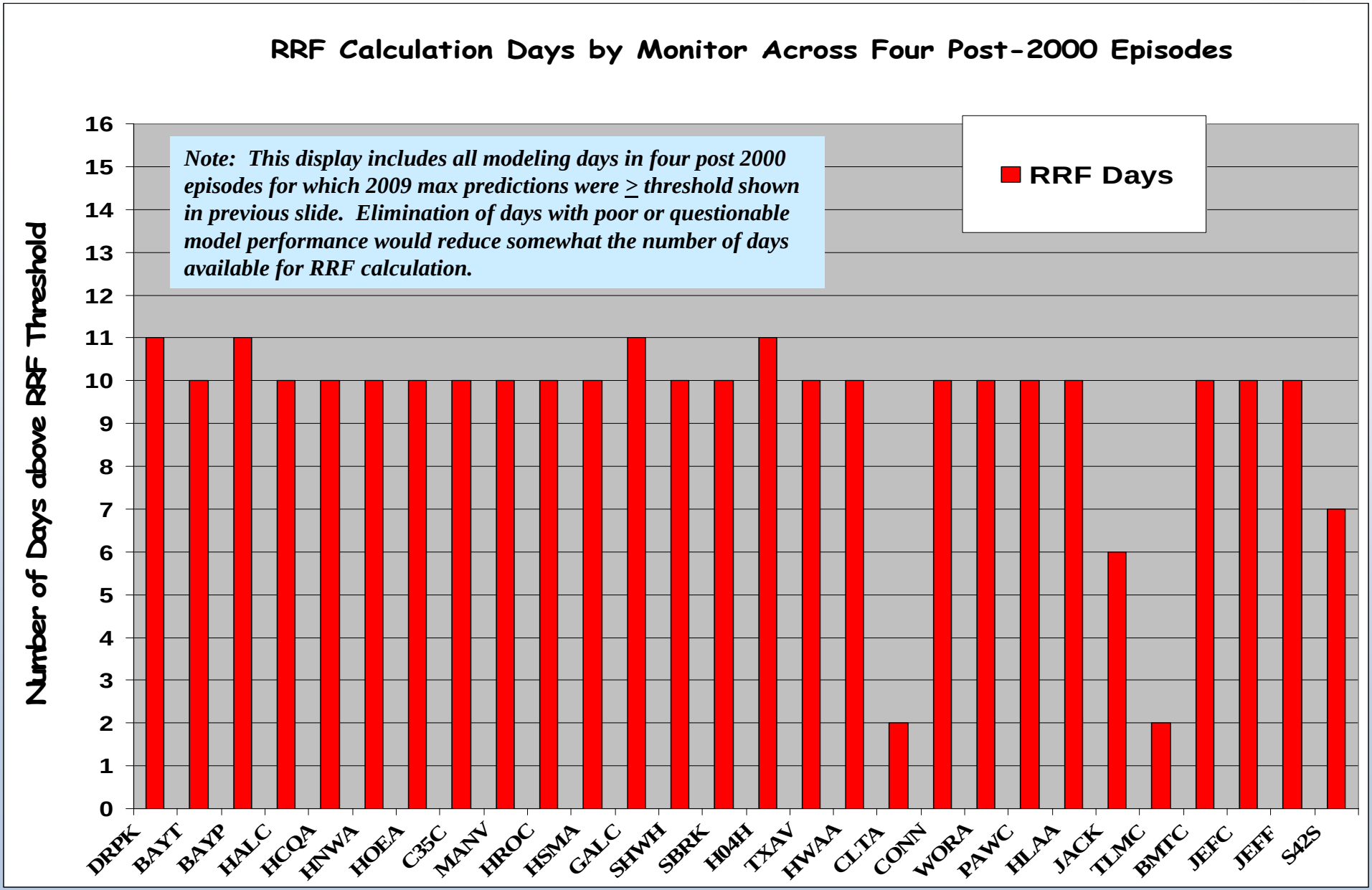
Post-2000 CAMx Modeling Sensitivities



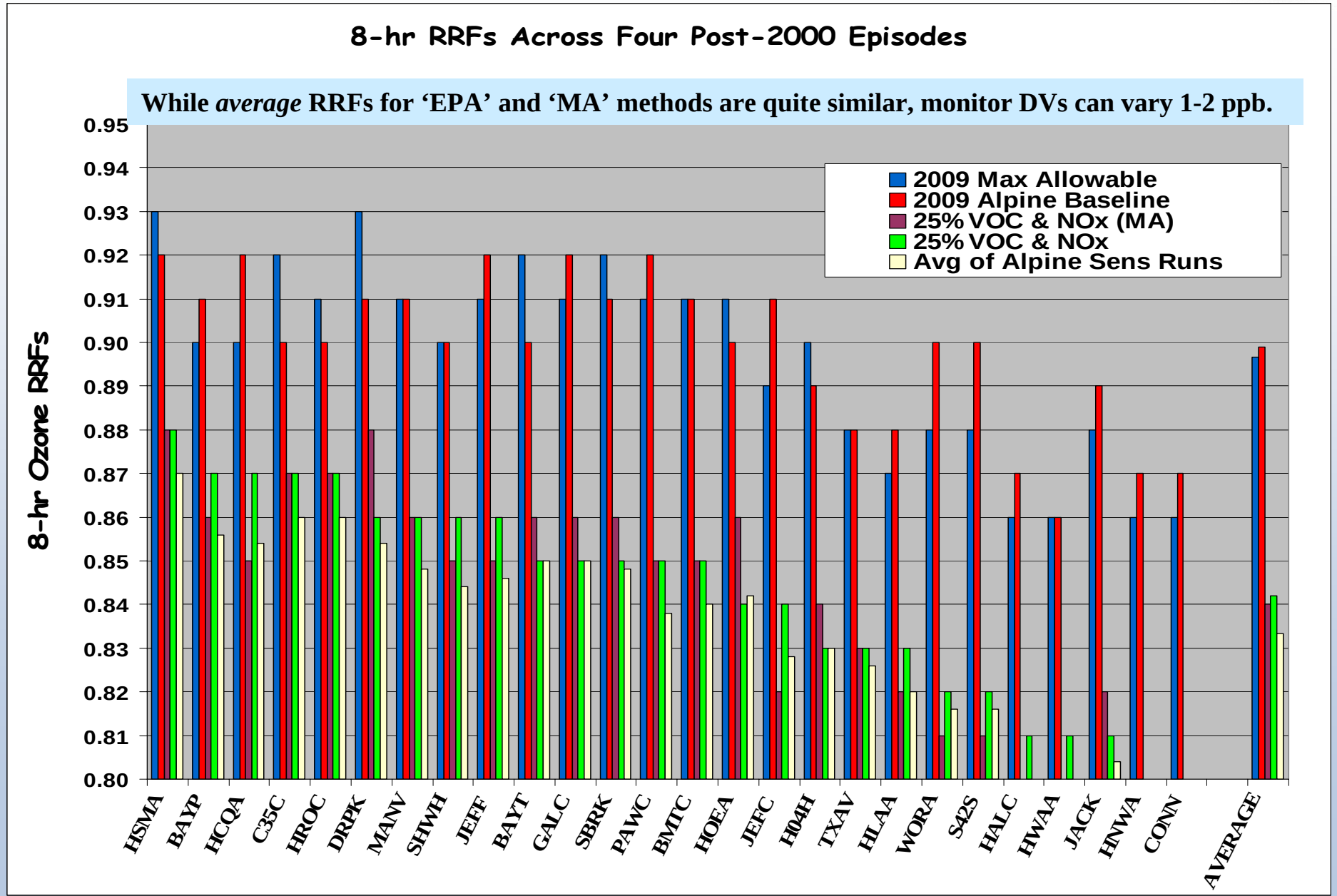
RRF Thresholds



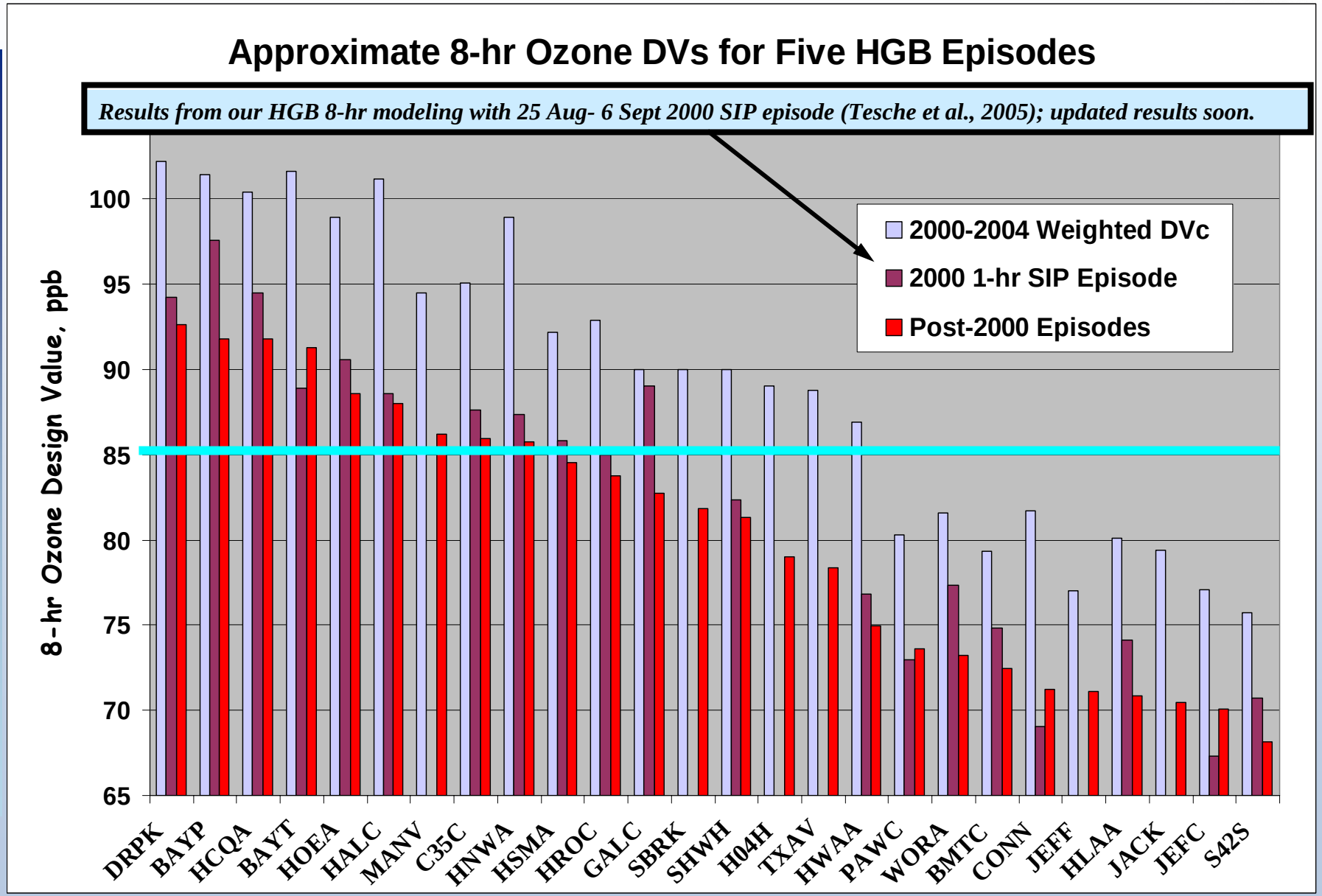
RRF Days Available



RRFs from Post-2000 Episodes



Attainment Estimates: 5 Episodes



Residual 8-hr Non-Attainment

Table 1. Future 8-hr Ozone Design Value (FDV) for 2009A Baseline Derived From Four Post-2000 HGB Episodes.

AIRS ID	ID	DVC	THRESH	NDAYS	DVBM	DVFM	RRF	FDV
482011039	DRPK	102.0	77	11	90.76	82.43	0.91	93
482010055	BAYP	101.0	78	11	93.86	85.31	0.91	92
482010051	HCQA	100.0	80	10	94.75	86.96	0.92	92
482011015	BAYT	101.0	76	10	90.84	82.09	0.90	91
482011034	HOEA	98.9	82	10	93.14	83.46	0.90	89
482010024	HALC	101.0	82	10	93.89	81.83	0.87	88
480391004	MANV	94.5	81	10	91.69	83.66	0.91	86
482011035	C35C	95.1	77	10	91.06	82.30	0.90	86
482010029	HNWA	98.9	71	10	83.58	72.47	0.87	86
482010062	HSMA	92.2	80	10	90.52	82.97	0.92	85
482010070	HROC	92.9	82	10	92.06	82.97	0.90	84
481670014	GALC	90.0	75	11	82.31	75.65	0.92	83
482011050	SBRK	90.0	80	10	89.30	81.21	0.91	82
482010066	SHWH	90.0	78	10	93.81	84.77	0.90	81
482010026	H04H	89.0	76	11	90.17	80.07	0.89	79
482010075	TXAV	88.8	76	10	93.17	82.24	0.88	78
480391003	CLTA	86.7	69	2	80.99	71.96	0.89	77
482010046	HWAA	86.9	77	10	90.55	78.10	0.86	75
482450011	PAWC	80.3	78	10	91.79	84.16	0.92	74
483611001	WORA	81.6	73	10	83.11	74.57	0.90	73
482450009	BMTC	79.3	73	10	88.13	80.55	0.91	72
481671002	TLMC	79.3	69	2	96.07	87.14	0.91	72
483390078	CONN	81.7	71	10	78.24	68.21	0.87	71
482450018	JEFF	77.0	76	10	88.52	81.78	0.92	71
482010047	HLAA	80.1	72	10	88.37	78.13	0.88	71
480391016	JACK	79.4	69	6	87.04	77.28	0.89	70
482450022	JEFC	77.1	73	10	80.77	73.42	0.91	70
483611100	S42S	75.7	69	7	76.47	68.85	0.90	68

DVf ≥ 88 ppb at 1 or more sites/grid cells

"More qualitative [WOE] results are less likely to support a conclusion differing from the outcome of the modeled attainment test" (EPA, 2005, pg 9)

DVf 82-87 ppb at 1 or more sites/grid cells

"A WOE demonstration should be conducted to determine if aggregate supplemental analyses support the attainment test".

DVf < 82 ppb at all monitor sites

'Basic' supplemental analyses should be completed to confirm the outcome of the modeled attainment test.

2009 Future Baseline Estimates

Residual nonattainment beyond 1-hr SIP and 'on-the-books' controls

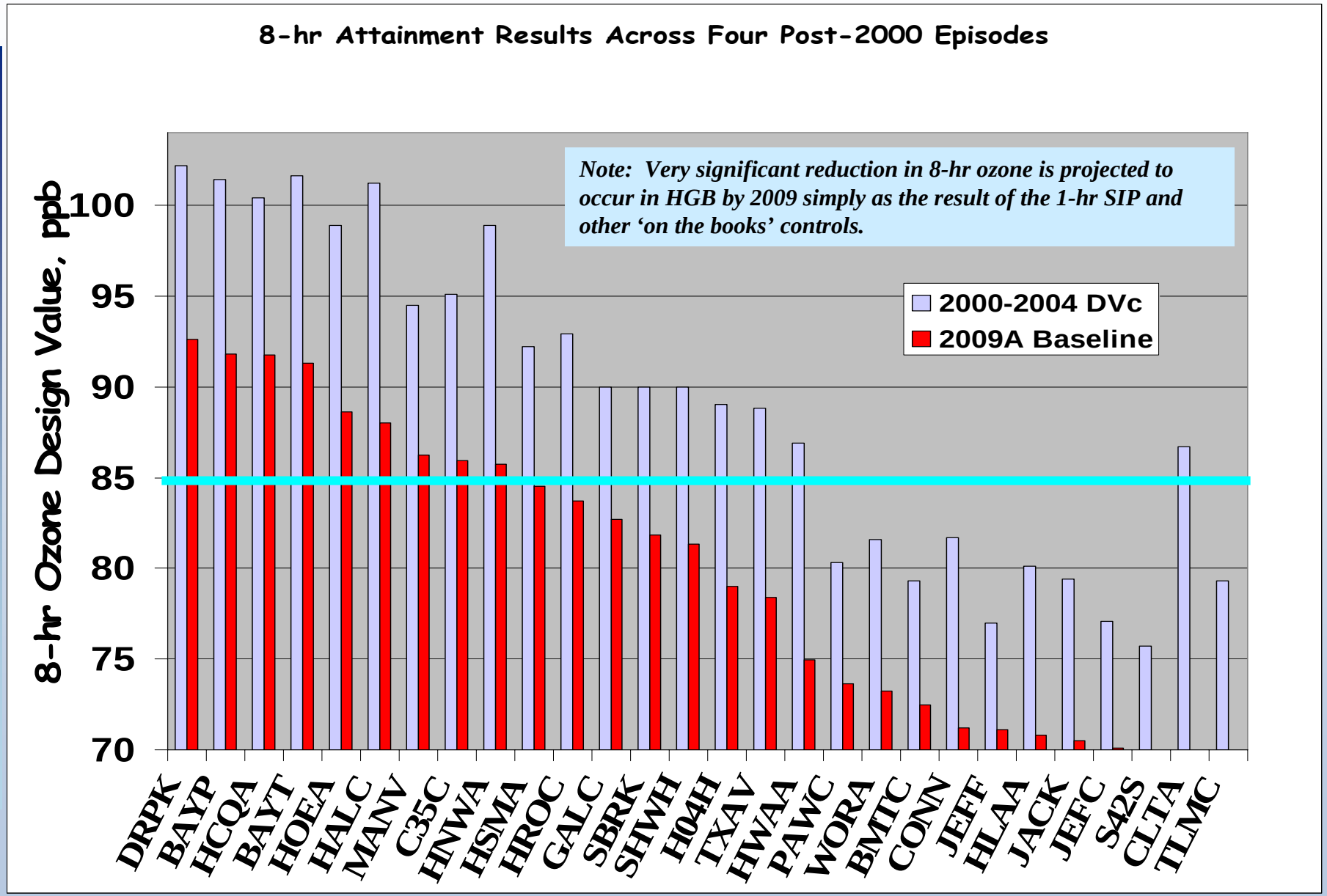
ALPINE GEOPHYSICS
Atmospheric & Hydrologic Sciences

Table 1. Future 2009 Baseline Design Value Estimates From Four Post-2000 HGB Episodes

AIRS ID	MAPS ID	2000-2004 Weighted DVc, ppg	Base Yr Cutoff (ppb)	No. Days ≥Cutoff	2009 Alpine Future Baseline RRF	2009 Alpine Future Baseline FDV	2009 Max Allow Future Baseline RRF	2009 Max Allow Future Baseline FDV
482011039	DRPK	102.2	78	11	0.91	93	0.93	95
482010055	BAYP	101.4	79	11	0.91	92	0.90	92
482010051	HCQA	100.4	81	10	0.92	92	0.90	91
482011015	BAYT	101.6	77	10	0.90	91	0.92	93
482011034	HOEA	98.9	83	10	0.90	89	0.91	90
482010024	HALC	101.2	83	10	0.87	88	0.86	87
480391004	MANV	94.5	82	10	0.91	86	0.91	86
482011035	C35C	95.1	78	10	0.90	86	0.92	87
482010029	HNWA	98.9	72	10	0.87	86	0.86	85
482010062	HSMA	92.2	81	10	0.92	85	0.93	86
482010070	HROC	92.9	83	10	0.90	84	0.91	84
481670014	GALC	90.0	76	11	0.92	83	0.91	82
482011050	SBRK	90.0	81	10	0.91	82	0.92	83
482010066	SHWH	90.0	79	10	0.90	81	0.90	81
482010026	H04H	89.0	77	11	0.89	79	0.90	80

Whether the EPA/CEM method (2009 Alpine) or the Max Allowable method yields the higher 2009 DV varies by monitor!

Effects of 'On-the-Books' Controls



2009 Emission Sensitivity Runs

Six hypothetical emissions reduction scenarios to examine model response

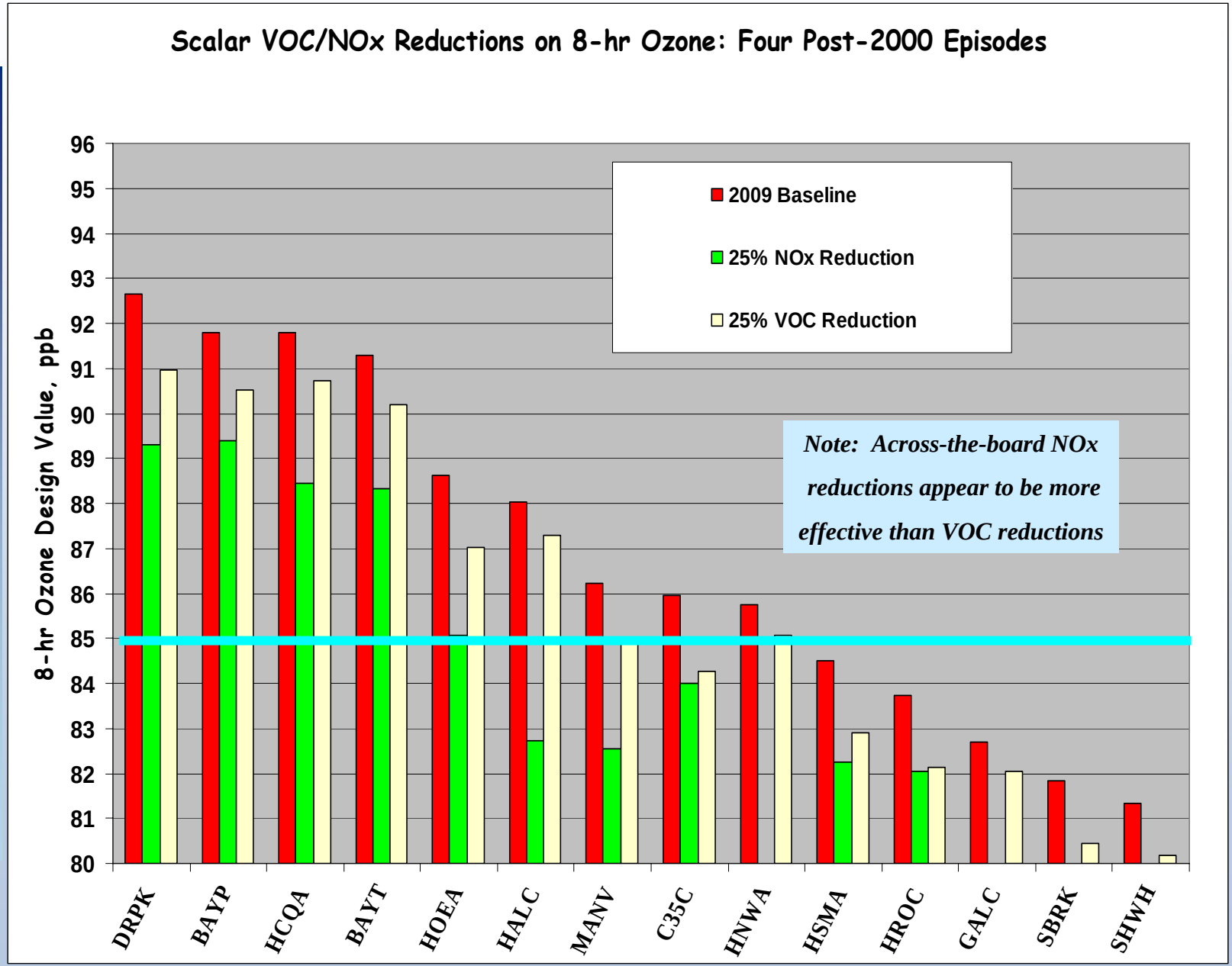
ALPINE GEOPHYSICS
Atmospheric & Hydrologic Sciences

Table 2. Future 2009 Design Value Estimates For Six Emissions Sensitivity Experiments (All Four Post-2000 Episodes)

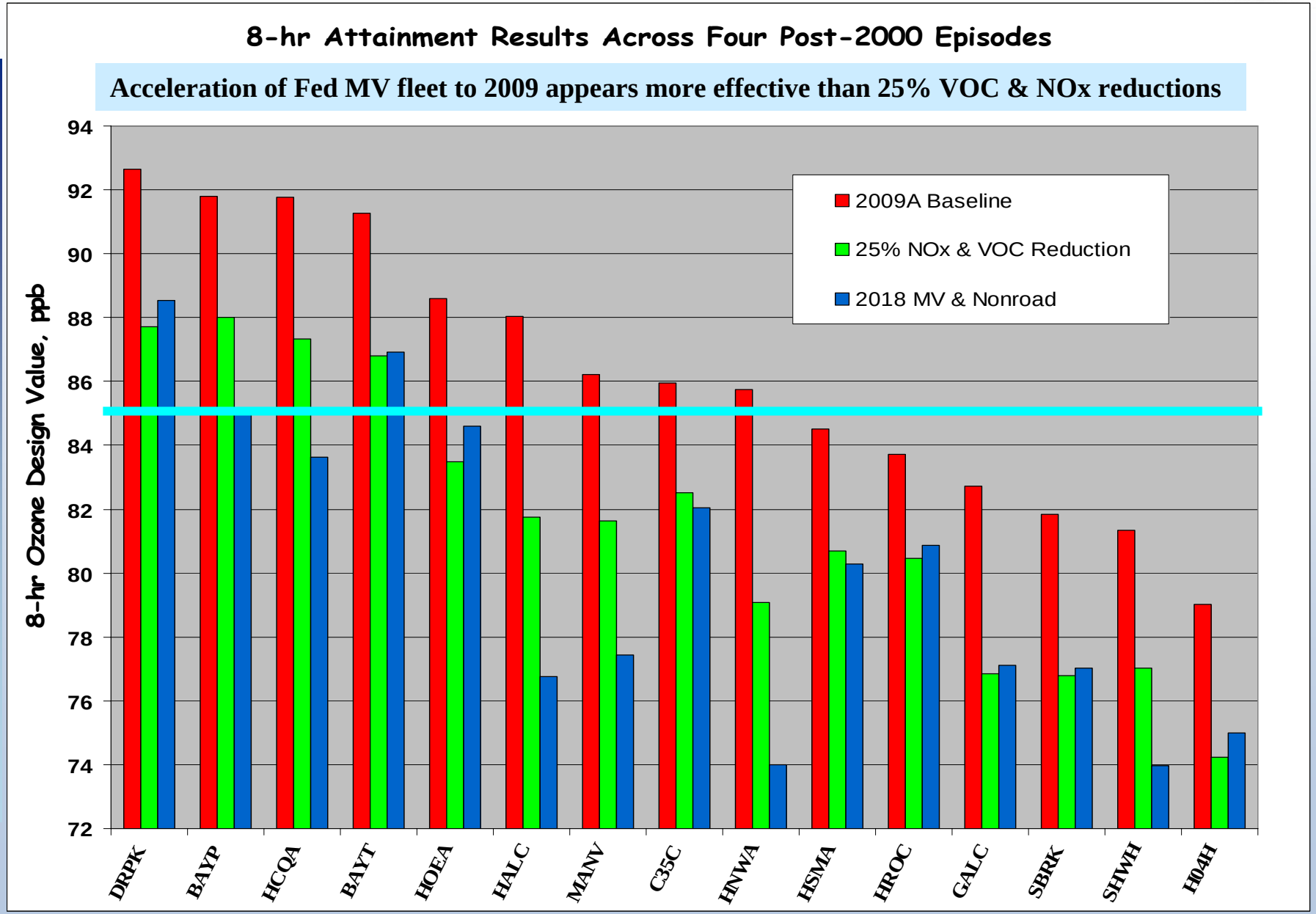
AG	2009 Base		FT-Run 1		FT-Run 2		FT-Run 3		FT-Run 4		FT-Run 5		FT-Run 6	
MAPS	Future Baseline		25% VOC/NOx		50% VOC/NOx		25% NOx		25% VOC		No Ship & Plat		2018 MV	
ID	RRF	FDV	RRF	FDV	RRF	FDV	RRF	FDV	RRF	FDV	RRF	FDV	RRF	FDV
DRPK	0.91	93	0.86	88	0.78	80	0.87	89	0.89	91	0.85	87	0.87	89
BAYP	0.91	92	0.87	88	0.80	81	0.88	89	0.89	91	0.87	88	0.84	85
HCQA	0.92	92	0.87	87	0.79	79	0.88	88	0.90	91	0.87	87	0.83	84
BAYT	0.90	91	0.85	87	0.78	78	0.87	88	0.89	90	0.85	86	0.86	87
HOEA	0.90	89	0.84	83	0.77	77	0.86	85	0.88	87	0.84	83	0.86	85
HALC	0.87	88	0.81	82	0.73	74	0.82	83	0.86	87	0.81	81	0.76	77
MANV	0.91	86	0.86	82	0.79	74	0.87	83	0.90	85	0.86	81	0.82	77
C35C	0.90	86	0.87	83	0.80	76	0.88	84	0.89	84	0.87	82	0.86	82
HNWA	0.87	86	0.80	79	0.71	71	0.80	80	0.86	85	0.80	79	0.75	74
HSMA	0.92	85	0.88	81	0.81	74	0.89	82	0.90	83	0.87	80	0.87	80
HROC	0.90	84	0.87	80	0.80	75	0.88	82	0.88	82	0.86	80	0.87	81
GALC	0.92	83	0.85	77	0.77	69	0.86	77	0.91	82	0.83	74	0.86	77
SBRK	0.91	82	0.85	77	0.77	69	0.87	78	0.89	80	0.83	75	0.86	77
SHWH	0.90	81	0.86	77	0.78	71	0.87	78	0.89	80	0.85	77	0.82	74
H04H	0.89	79	0.83	74	0.76	68	0.85	75	0.87	78	0.83	74	0.84	75

Note: Future baseline design values listed highest to lowest

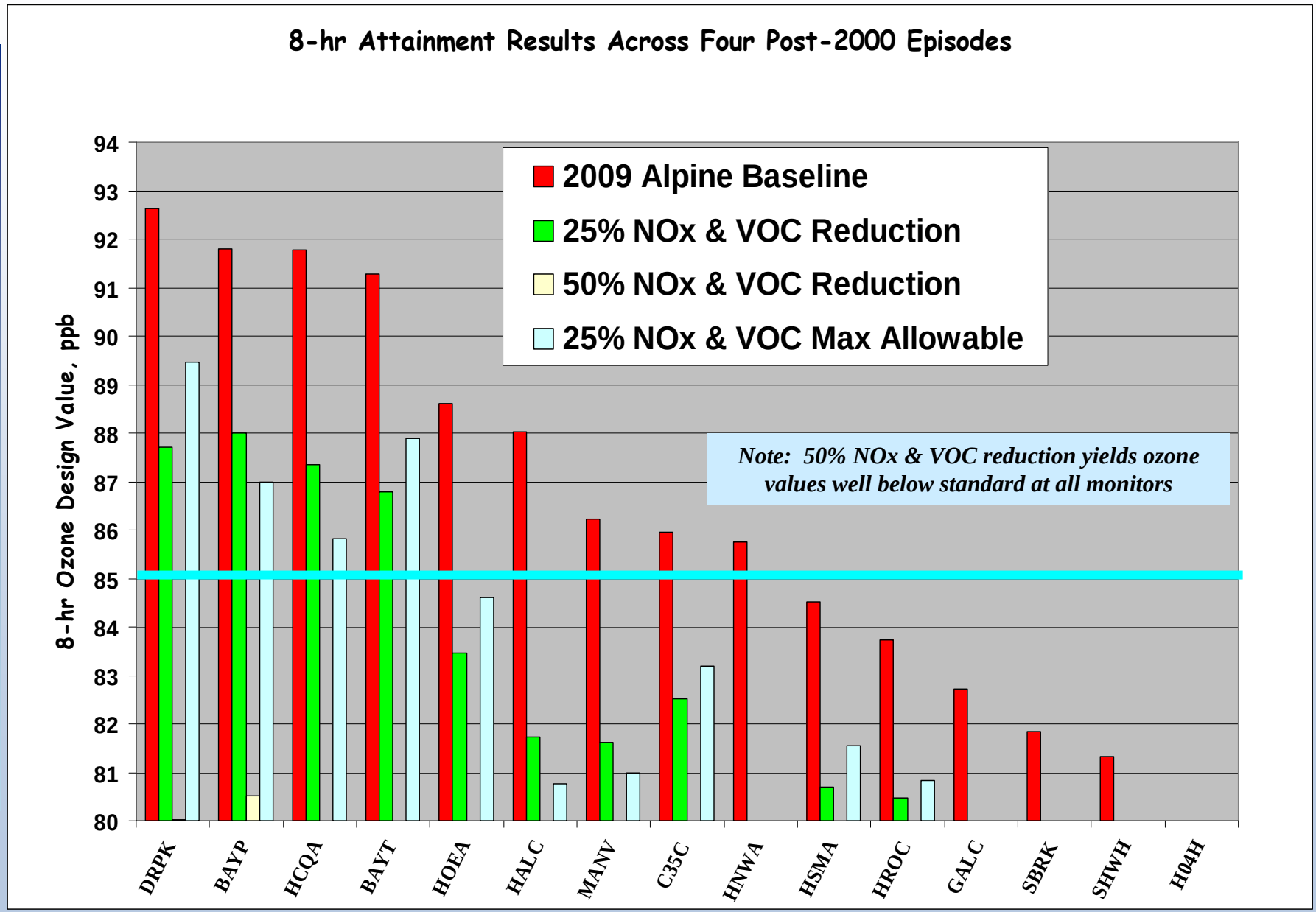
25% VOC vs 25% NOx Reductions



2018 Fed MV vs. 25% VOC & NOx



Other VOC & NOx Sensitivities



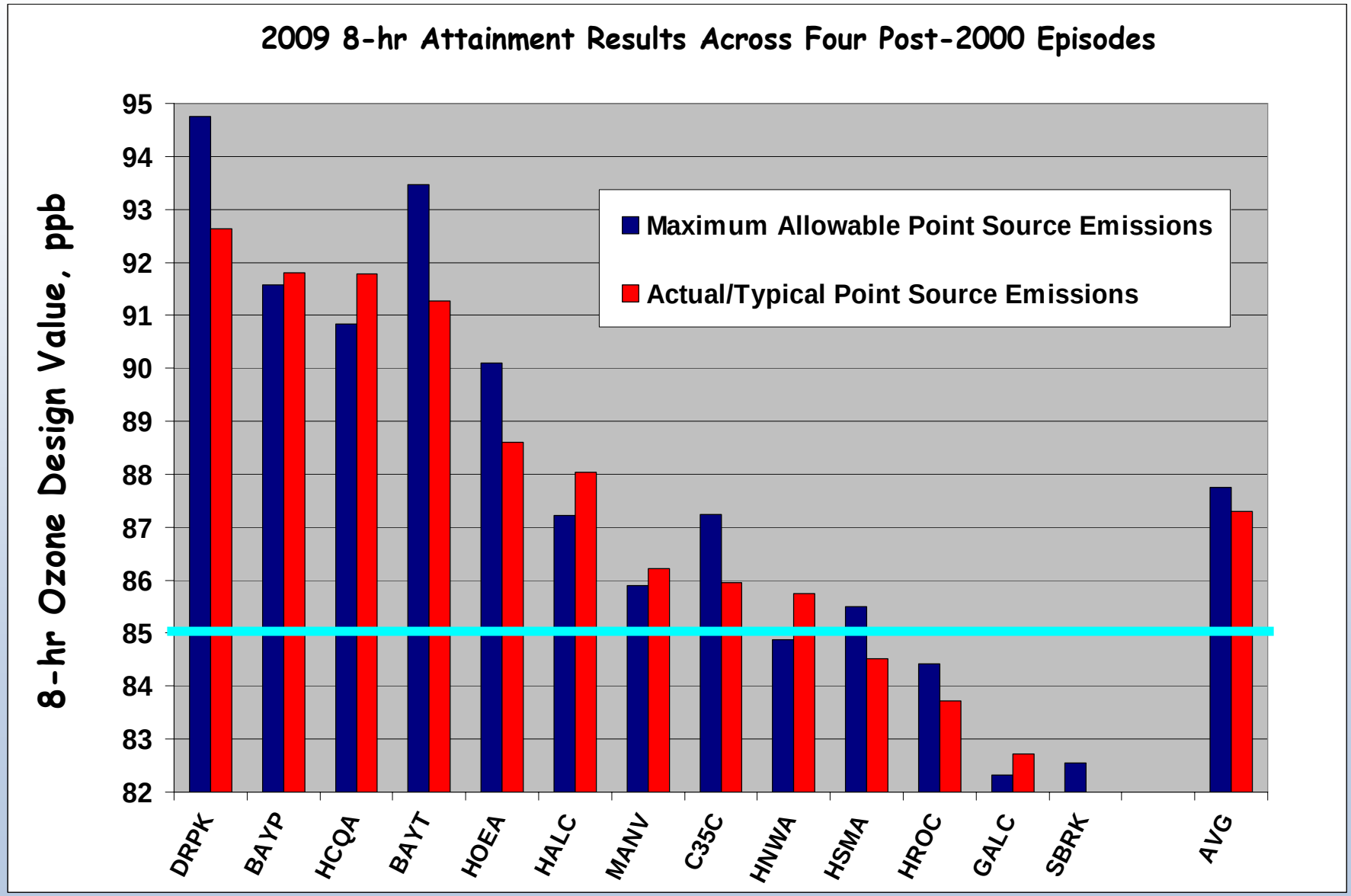
Effects of Actual vs. Max Allowable

Two sensitivity experiments to examine model response to maximum allowable emissions

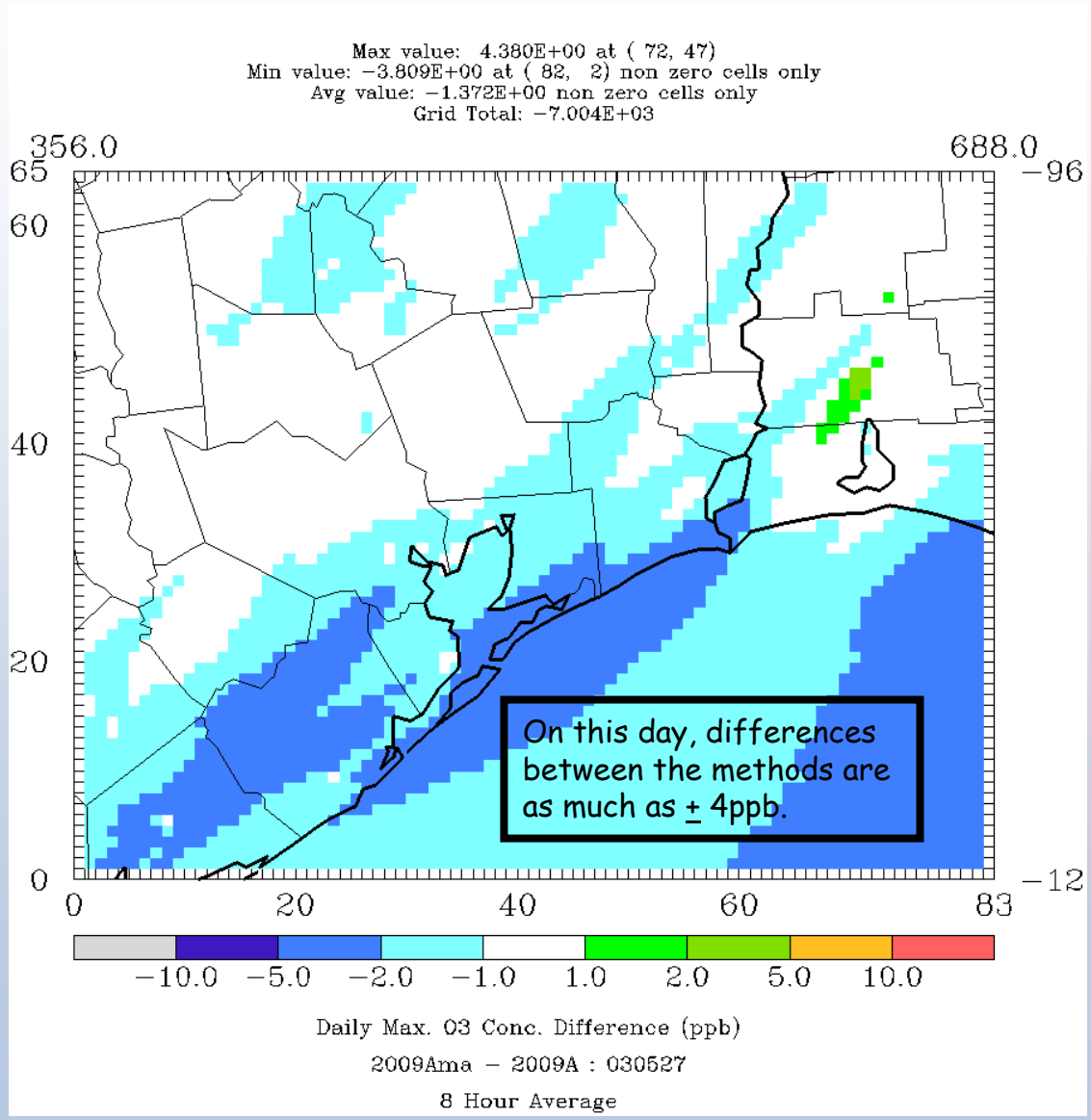
Table 3. Effects of Typical vs. Max Allowable Pt. Source Emissions Estimates on 2009 DVs.								
AG	2009 Base		2009 Max Allow		FT-Run 1		FT-Run 8	
MAPS	Future Baseline		Future Baseline		25% VOC/NOx		25% VOC/NOx (MA)	
ID	RRF	FDV	RRF	FDV	RRF	FDV	RRF	FDV
DRPK	0.91	93	0.93	95	0.86	88	0.88	89
BAYP	0.91	92	0.90	92	0.87	88	0.86	87
HCQA	0.92	92	0.90	91	0.87	87	0.85	86
BAYT	0.90	91	0.92	93	0.85	87	0.86	88
HOEA	0.90	89	0.91	90	0.84	83	0.86	85
HALC	0.87	88	0.86	87	0.81	82	0.80	81
MANV	0.91	86	0.91	86	0.86	82	0.86	81
C35C	0.90	86	0.92	87	0.87	83	0.87	83
HNWA	0.87	86	0.86	85	0.80	79	0.79	78
HSMA	0.92	85	0.93	86	0.88	81	0.88	82
HROC	0.90	84	0.91	84	0.87	80	0.87	81
GALC	0.92	83	0.91	82	0.85	77	0.86	77
SBRK	0.91	82	0.92	83	0.85	77	0.86	78
SHWH	0.90	81	0.90	81	0.86	77	0.85	77
H04H	0.89	79	0.90	80	0.83	74	0.84	75

The total mass reduced in Run 8 is somewhat greater than the reduction in Run 1 since the 2009 Max Allow Future Baseline has a higher emission rate.

Effects of Point Source Emissions Assumptions on 2009 Design Values



Spatial Effects of 'Max. Allowable' vs. 'Typical' Pt. Source Emissions Estimates

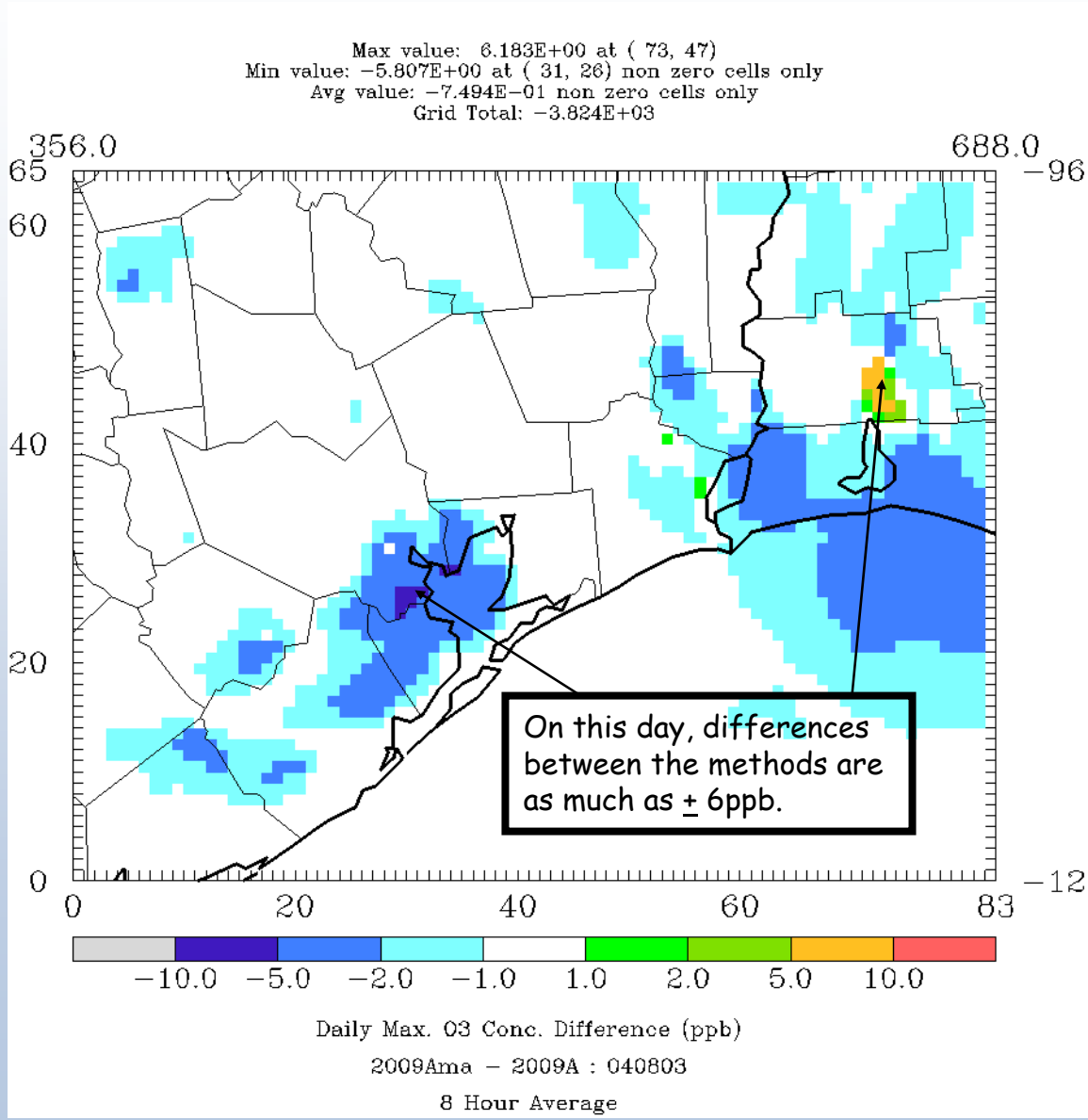


27 May 2003

Daily maximum difference plot for the "2009A Max Allowable" minus "2009A typical" baseline simulations.

Blue colors indicate areas where the 2009 baseline levels are higher with the 'max allowable' emissions estimation procedure.

Spatial Effects of 'Max. Allowable' vs. 'Typical' Pt. Source Emissions Estimates

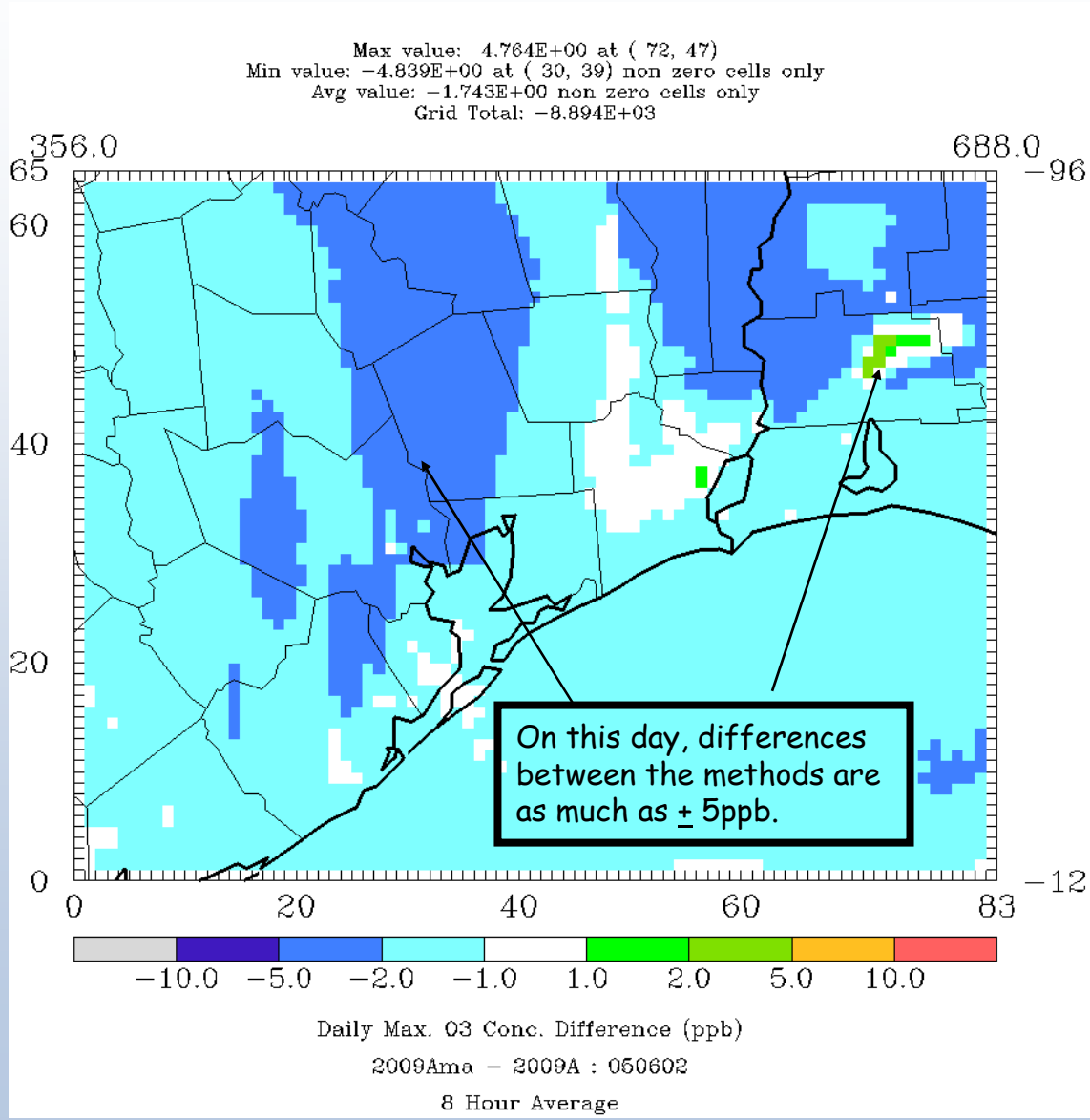


3 August 2004

Daily maximum difference plot for the "2009A Max Allowable" minus "2009A typical" baseline simulations.

Blue colors indicate areas where the 2009 baseline levels are higher with the 'max allowable' emissions estimation procedure.

Spatial Effects of 'Max. Allowable' vs. 'Typical' Pt. Source Emissions Estimates

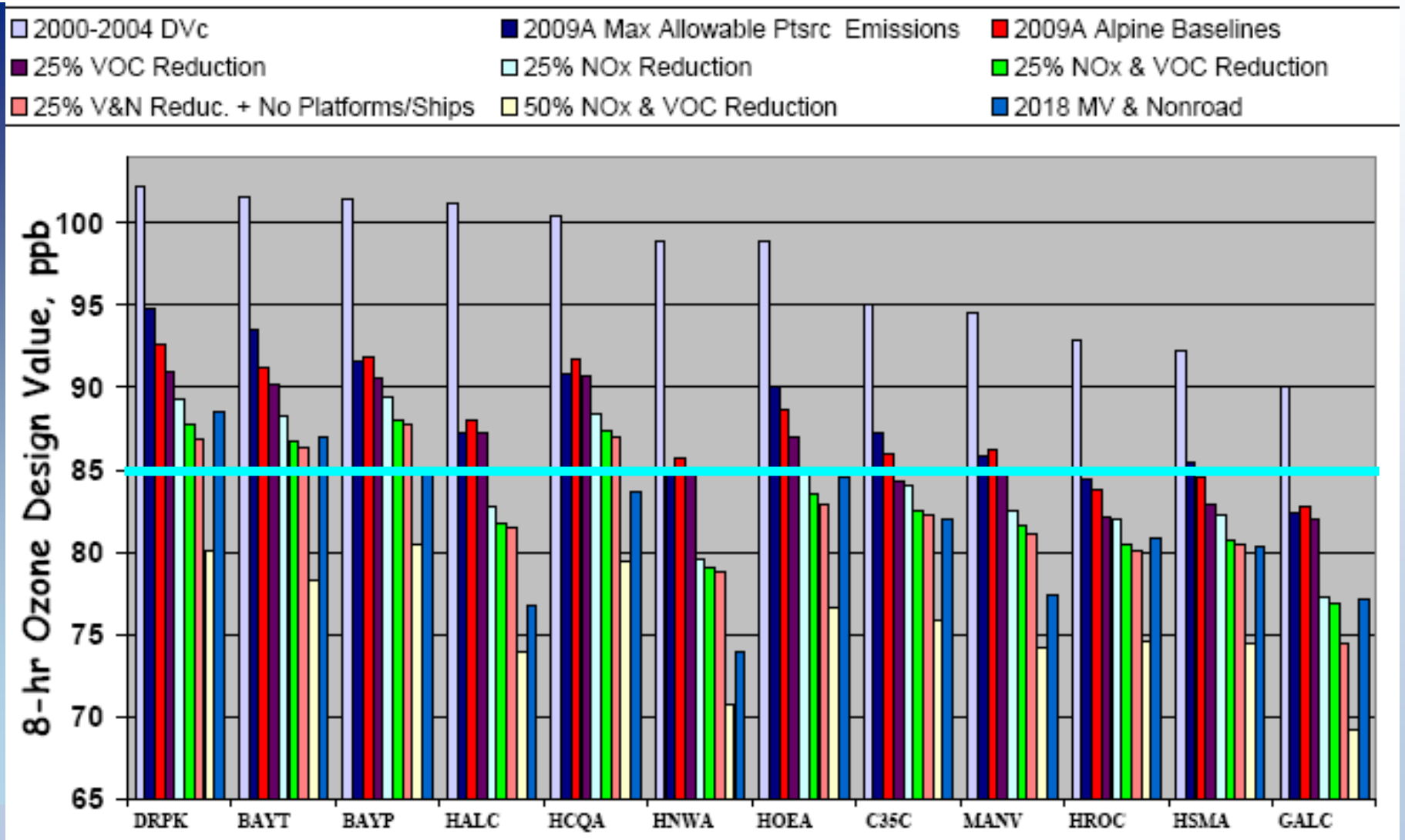


2 June 2005

Daily maximum difference plot for the "2009A Max Allowable" minus "2009A typical" baseline simulations.

Blue colors indicate areas where the 2009 baseline levels are higher with the 'max allowable' emissions estimation procedure.

Highlights of 2009 Sensitivity Results



WOE Emissions Modeling Initiatives

- Continue work to refine and update post-2000 base and future year modeling inventories
- With TCEQ modeling staff assistance, we are running the most recent version of the 16 Aug-6 Sept 2000 SIP episode to explore:
  - The influence on 'residual 2009 nonattainment' based on (a) 'typical' 2009 emissions vs. (b) 'max allowable' 2009 emissions
  - Whether the 1-2 ppb ozone differential identified with the four post-2000 episodes holds for the 2000 episode when comparing the two procedures for estimating point source emissions.
  - The influence on 2009 design values obtained in one or more emissions reduction experiments (e.g., 25% VOC & NOx reductions) based on (a) 'typical' 2009 emissions vs. (b) 'max allowable' 2009 emissions.
  - The residual attainment modeling and investigation of the impacts of 'max allowable' vs. 'typical' point source emissions estimation will be completed within two weeks.

WOE Air Quality Modeling Initiatives

- For five (5) HGB episodes, we are developing a modeling plan for:
  - CAMx Ozone Source Apportionment (OSAT) to quantify ozone source-receptor relationships within and beyond HGB nonattainment area (e.g., all of Texas and adjoining states); and
  - CAMx Roll-Out Modeling to quantify the relative effectiveness of VOC and NOx controls on source categories and source regions in at various distances from current HGB non-attainment monitors

Summary

- CAMx modeling with four post-2000 episodes yields somewhat lower precursor control requirements beyond 1-hr SIP compared to our previous modeling with Aug-Sept 2000 episode (Tesche et al., 2005)**http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html**
- Current modeling suggests VOC and NOx reductions slightly more than 25% beyond 2009 baseline (FT-1) may lower HGB design values to a level near (within 1-3 ppb at remaining four nonattainment monitors) the 8-hr NAAQS.
- Across-the-board scalar anthropogenic NOx reductions (FT-3) appear to be somewhat more effective in lowering peak 8-hr ozone values compared with scalar VOC reductions (FT-4).
- Combined across-the-board scalar VOC and NOx reductions appear to be more effective in lowering ozone compared with scalar reductions in either precursor individually (FT-1-4).

Summary (continued)

- Eliminating offshore platform and coastal shipping emissions on top of combined 25% VOC & NOx reductions (FT-5) has only a small additional benefit (fractions of a ppb) when compared to the 25% VOC/NOx sensitivity run.
- Very substantial reduction in 2009 8-hr DVs in HGB (attainment at all but two monitors with no additional anthropogenic reductions) are estimated to result from implementation of 2018 on-road and non-road federal motor vehicle control programs (assuming 2009 VMT levels—FT-6).
- Future design values for at least 14 HGB monitors fall within the range of 82-87 ppb for many of the emissions sensitivity runs examined so far, within the acceptable range of WOE guidance (FT-1-6).

Summary (concluded)

- Results of the 'typical' vs 'maximum allowable' 2009 baseline runs and the 25% VOC & 25% NOx emissions sensitivity experiments suggests that in Houston use of 'maximum allowable' point source emissions might yield DVs that are approximately 1-2 ppb higher than the use of 'typical' 2009 emissions at some important nonattainment monitors.
- EPA reports that "Regional ozone modeling completed by EPA indicates that, on average, considerable amounts of precursor control (e.g., 20-25 percent) may be needed to lower projected ozone design values by 3 ppb or more" (EPA, 2005a, pg 9)
- However, the 1-2 ppb increment we have found at some HGB monitors is somewhat lower than EPA's experience elsewhere in the US. But, in some unmonitored grid cells, the differences may be as large as $\pm$ 5-6 ppb.
- Preliminary results of the post-2000 modeling (and EPA's findings above) suggest that use of 'maximum allowable' emissions may lead to the need for larger precursor emissions reduction requirements compared to the use of EPA's 'actual/typical' emissions estimation approach.

Implications

- The post-2000 episode sensitivity studies suggest that significant precursor reductions may still be required to overcome projected 8-hr ozone nonattainment in 2009.
- The impact of point source emissions inventory choices needs to be carefully examined due to the significance of these choices on future control levels.
- Given the very significant ozone reductions associated with the 2018 federal motor vehicle measures, consideration should be given to existing policy options for incorporating on-the-books control strategies that offer emission reductions for HGB.

Next Steps

- Explore further the impact of future baseline point source emissions inventory choices with the 2000 and post-2000 episodes.
- Review results of the current round of 2009 attainment sensitivity modeling with TCEQ and other interested organizations.
- Explore the utility of the post-2000 episodes in providing support for the HGB SIP (e.g., OSAT, Roll-Out modeling).

Next Steps

- Explore the known policy/legal options available for addressing the very substantial challenge in demonstrating attainment by 2009 to:
  - Address the significant benefits expected from federal on-the-books on-road and off-road mobile and point source control programs
  - Explore and account for the ozone reduction levels attributable to items not yet quantified in our current 8-hr HGB photochemical modeling (HRVOC reductions, episodic emissions controls, optical imaging camera, etc.)

References

EPA, (2005a), "Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hr Ozone NAAQS". Office of Air Quality Planning and Standards, U.S. EPA, Research Triangle Park, NC.

EPA, (2005b), "Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter NAAQS and Regional Haze Regulations", Office of Air Quality Planning and Standards, U.S. EPA, Research Triangle Park, NC.

Tesche, T. W., et al., (2005), "Estimated Emissions Reductions Required to Meet the 8-hr Ozone NAAQS in the Houston-Galveston-Brazoria Area", Alpine Geophysics, LLC, Ft. Wright, KY (http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html)