BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	R08-19
NITROGEN OXIDES EMISSIONS FROM	)	(Rulemaking - Air)
VARIOUS SOURCE CATEGORIES:	)	
AMENDMENTS TO 35 ILL. ADM. CODE	)	
PARTS 211 and 217	)	

NOTICE OF FILING

TO: Mr. John T. Therriault
Assistant Clerk of the Board
Illinois Pollution Control Board
100 W. Randolph Street
Suite 11-500
Chicago, Illinois 60601
(VIA ELECTRONIC MAIL)

Timothy Fox, Esq.
Hearing Officer
Illinois Pollution Control Board
100 W. Randolph Street
Suite 11-500
Chicago, Illinois 60601
(VIA U.S. MAIL)

(SEE PERSONS ON ATTACHED SERVICE LIST)

PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Illinois Pollution Control Board the **POST-HEARING COMMENTS OF THE ILLINOIS ENVIRONMENTAL REGULATORY GROUP,** copies of which are herewith served upon you.

Respectfully submitted,

By: /s/ Alec M. Davis
Alec M. Davis

Dated: January 20, 2009

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CERTIFICATE OF SERVICE

I, Alec M. Davis, the undersigned, hereby certify that I have served the attached POST-HEARING COMMENTS OF THE ILLINOIS ENVIRONMENTAL REGULATORY GROUP upon:

Mr. John T. Therriault
Assistant Clerk of the Board
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via electronic mail on January 20, 2009; and upon:

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by depositing said documents in the United States Mail, postage prepaid, in Springfield, Illinois on January 20, 2009.

/s/ Alec M. Davis
Alec M. Davis

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POST-HEARING COMMENTS OF
THE ILLINOIS ENVIRONMENTAL REGULATORY GROUP

IERG appreciates the opportunity to provide comments with regard to the December 9, 2008 NO_x RACT hearing in Chicago. IERG will attempt to clarify points made at hearing and respond to the Illinois Pollution Control Board's ("Board") specific requests for additional information. IERG intends to participate in the third hearing, on February 3, 2009, and will provide additional clarification if necessary.

I. SUMMARY OF TESTIMONY

To reiterate and emphasize the points made in testimony and responses to questions made by both Ms. Deirdre K. Hirner and Mr. David J. Kolaz, IERG, believes that the emissions limits proposed by the Illinois Environmental Protection Agency ("Agency") go beyond what is required to meet the Clean Air Act ("CAA") requirements for NO_x RACT.

IERG recognizes that the CAA mandates that the State have rules in place for its nonattainment areas for both ozone and fine particulate matter that satisfy the requirement of RACT for NO_x. Pre-filed Testimony of David J. Kolaz, *In the Matter of: Nitrogen Oxides Emissions from Various Source Categories: Amendments to 35 Ill. Adm. Code Parts 211 and 217*, R08-19 at 3 (Ill.Pol.Control.Bd. Nov. 25, 2008) ("Kolaz Testimony"). However, as described at hearing, the United States Environmental

Protection Agency ("USEPA") has spoken, through rulemakings and guidance, as to what it considers sufficient to meet the NO_x RACT requirement. Simply, the USEPA has stated that emission reductions of 30 to 50 percent satisfy NO_x RACT. Hearing Transcript, *In the Matter of: Nitrogen Oxides Emissions from Various Source Categories: Amendments to 35 Ill. Adm. Code Parts 211 and 217*, R08-19 at 84-85 (Ill.Pol.Control.Bd. Dec. 9, 2008) ("Dec. 9 Transcript") (referencing 70 Fed. Reg. 71657, Hearing Exhibit 6). The Agency's proposed 61% reduction is more stringent than is necessary to meet Illinois' obligation. Dec. 9 Transcript at 122. The alternative limits proposed by IERG fall within the range specified by the USEPA and, therefore, satisfy NOx RACT. *Id.*; *see also* Kolaz Testimony at Exhibits 1 and 2.

IERG acknowledges that the State has discretion to adopt measures more stringent than required by USEPA. However, IERG does not believe that the justification for such stringent rules has been provided by the Agency in its proposed rule, which is the subject of this rulemaking.

IERG understands that the emissions limits proposed by the Agency cannot be attained by affected industry by the proposed compliance date. As described by IERG in testimony, and supported by various industry witnesses at hearing, the compliance deadline of May 1, 2010 does not provide adequate time for affected sources to plan, and implement major capital projects. Kolaz Testimony at 20, *see also* Pre-Filed Testimony of David W. Dunn, *In the Matter of: Nitrogen Oxides Emissions from Various Source Categories: Amendments to 35 Ill. Adm. Code Parts 211 and 217*, R08-19 at 3-6 (Ill.Pol.Control.Bd. Nov. 25, 2008) and Pre-Filed Testimony of Larry G. Siebenberger, *In*

the Matter of: Nitrogen Oxides Emissions from Various Source Categories: Amendments to 35 Ill. Adm. Code Parts 211 and 217, R08-19 at 7-8 (Ill.Pol.Control.Bd. Nov. 25, 2008).

IERG would again offer its proposed options to adopt a rule that, IERG maintains, will meet the CAA requirements for NO_x RACT, and will be achievable by affected industries by the proposed compliance date. Kolaz Testimony at 21. These are:

1. Adopt emissions limits equal to values, such as those proposed by IERG, that are "reasonably available," given the time frame for implementation, based on the Agency's proposed compliance date;

2. If the Board chooses to retain the emissions limits originally proposed by the Agency, extend the compliance date to one that affected industries can meet; and,

3. Incorporate a provision in the rule that would allow for site-specific RACT determinations.

IERG believes there are deficiencies in the proposed rule that need to be addressed prior to the Board's moving this proposal to first notice. Kolaz Testimony at 19-25. Mr. Kolaz's testimony outlined IERG's concerns and suggested changes to be made to the proposal. IERG is committed to work with the Agency to arrive at a mutually agreeable solution.

II. SUPPLEMENTAL RESPONSES

Mr. Kolaz, at hearing, mentioned documents indicating the roles of time and economics in determining what constitutes "reasonably available" for determining RACT. Dec. 9 Transcript at 101-102 and 127. In this regard, IERG would like to draw the Board's attention to the Phase 2 of the Final Rule to Implement the 8-Hour Ozone National Ambient Air Quality Standard – Notice of Reconsideration, 72 Fed. Reg. 31727

(June 8, 2007). On its face, this document explains why compliance with the Clean Air Interstate Rule ("CAIR") satisfies the ozone NO_x RACT requirement for EGUs. Further, IERG contends that the analysis provides some insight into the role that time plays in determining what is RACT:

- CAIR is designed to achieve the greatest amount of reductions that are reasonable to achieve by the 2009 target date. One factor in determining the reasonableness is what is achievable "in the timeframe." *Id.* at 31733.

- CAIR requires the installation of NOx controls on the maximum capacity on which it is feasible to install such controls by 2009. Therefore, additional controls are not "reasonably available." *Id.* at 31734.

Also, see the Clean Air Fine Particle Implementation Rule, 72 Fed. Reg. 20586, April 25, 2007, which provides:

> One of the factors that could affect estimated compliance costs of an emission reduction measure is the *timing* of its implementation. Hypothetically, if a short compliance period were contemplated for a set of sources, and if the short compliance period resulted in high demand for a limited supply of labor or other resources, compliance costs could be higher than if the same measure were implemented by a later compliance date. In such a case, it may be reasonable for the State to find that the measure is *reasonable only if implemented by the later date*.

Id. at 20619-20. (Emphasis added.)

A. Alternative Modeling

At the December 9, 2008 hearing, Ms. Hirner committed to provide the name of the modeling group to which she referred in her prefiled testimony. Dec. 9 Transcript at 36. The modeling was a project of the Midwest Ozone Group ("MOG"). IERG contributed to the funding of the modeling efforts. The modeling was performed by Alpine Geophysics and ENVIRON International Corporation. Mr. Rao, at the December 9, 2008 hearing, queried whether Ms. Hirner could enter the results of the

MOG modeling into the record. *Id.* at 38. Also, Ms. Roccaforte asked who belongs to MOG. *Id.* at 40. In response, see the attached documents, which list the MOG members, and summarize the culmination of the MOG modeling effort, as provided to LADCO in July of 2007.

It is important to note, that Ms. Hirner, in her testimony timeline, and again in response to questions at hearing, referred to these modeling efforts to illustrate the level of IERG's involvement and running dialog with the Agency on various issues that are the subject of this rulemaking. Based on the MOG modeling results, which at the end of the process comports with the LADCO results on which the Agency based this rule, IERG believes that the modeling does not show the need for additional stringent controls, beyond what is currently "on the books" to achieve the NAAQS for ozone. Nor, during the course of testimony, has the Agency attempted to show by modeling that the controls imposed by the proposed rule are necessary to advance the PM2.5 attainment date.

B. CEMS Implementation

At hearing, the issue of implementing Continuous Emissions Monitoring Systems ("CEMS") was brought up in the course of discussing extensions to compliance deadlines. Both Saint-Gobain Containers and ConocoPhillips referred to ongoing negotiations with the Agency, that included provisions for extending the timeline for implementation of CEMS. *Id.* at 11, 140. IERG understands that the situations faced by these two industries are not unique. Rather, the difficulty of both obtaining the financing, as well as of obtaining the CEMS themselves, is of concern to all of the impacted facilities. IERG would suggest that the Board consider amending the proposal under

consideration to allow for compliance with the requirements for CEMS by a future date that is achievable for all affected sources.

C. Compliance Date

At hearing, Mr. Kolaz, testifying on behalf of IERG, was asked when it would be feasible for affected industries to comply with the emissions limits contained in the Agency's proposal. When pressed for a specific date, Mr. Kolaz suggested January 1, 2014. *Id.* at 49-50. In discussions with IERG Members subsequent to the hearing, it has come to IERG's attention that January 1, 2014 may not, in fact, be feasible for all affected sources in that such a date may not fall within the specific range of planned maintenance outages that some industries operate within. IERG understands that the Agency has been actively working with some of the affected industries (such as the refineries) for whom this presents a problem.

III. CONCLUSION

IERG would like to thank the Board for providing the opportunity to participate in this rulemaking, and to submit these comments. IERG supports the adoption of a federally required NOx RACT rule. However, in so stating, IERG strongly believes that

any such rule adhere to its letter and intent that emissions reductions be economically reasonable and technologically achievable within a given compliance timeframe.

Respectfully submitted,

By: /s/ Alec M. Davis
Alec M. Davis

Dated: January 20, 2009

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IERG:001/R-Dockets/Fil/R08-19/IERG Post-Hearing Comments

As of January 19, 2009, the Membership of the Midwest Ozone Group includes the following:

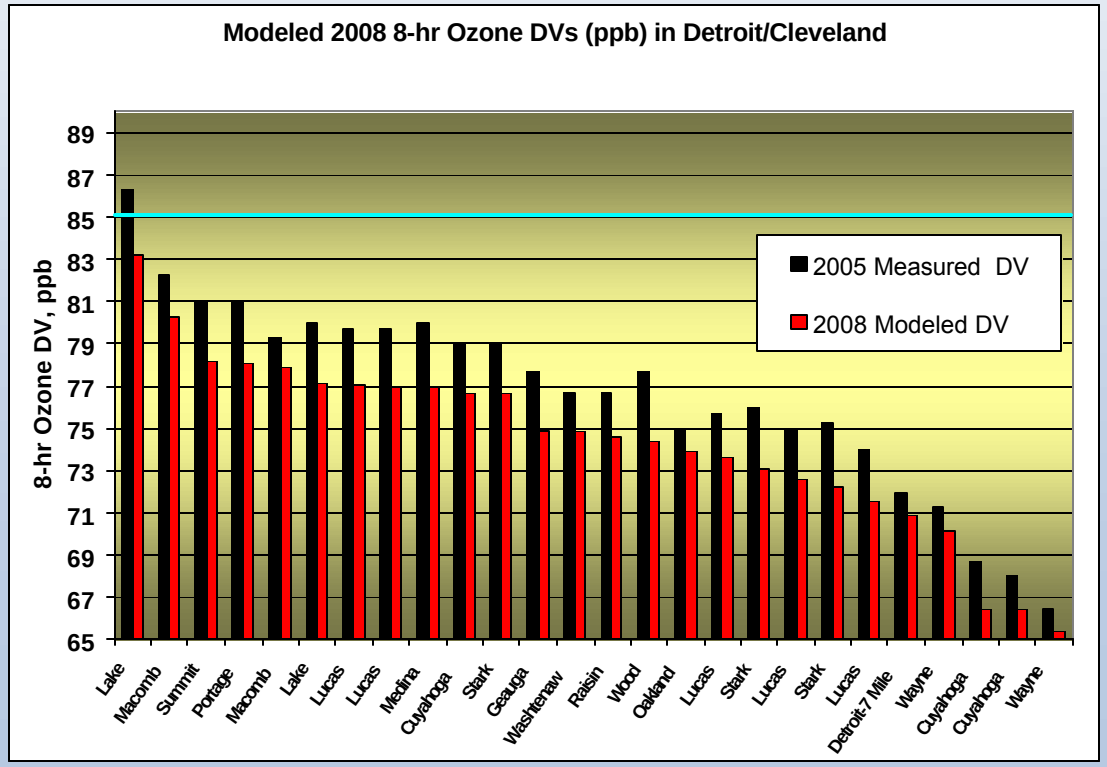
American Electric Power
Ameren
DPL
Duke
First Energy
E On US
Springfield City Water P&L
Alcoa
American Coalition for Clean Coal Energy

Modeled Ozone and $PM_{2.5}$ Attainment in the Five States Region in 2008 and 2015

prepared for:
Five States Stakeholders

prepared by:
T. W. Tesche
Dennis McNally
Gregory Stella
Cyndi Loomis
Alpine Geophysics, LLC

18 July 2007



Outline

- Part I – Summary of Results and Recommendations
  - Differences in AG and LADCo 2005 base case modeling
  - 2005 Ozone and $PM_{2.5}$ base case model evaluation findings
  - 2008 & 2015 8-hr ozone and $PM_{2.5}$ attainment test findings
  - Recommendations
- Part II – Modeling Support Information
  - 8-hr Ozone Model Evaluation on 4 km Grid
  - Annual $PM_{2.5}$ Model Evaluation on the 12 km grid
  - 2008 and 2015 8-hr ozone attainment estimates: 4 km grids (Detroit/Cleveland; Lower Lake Michigan)
  - 2008 & 2015 8-hr ozone attainment estimates: 12 km grid over 5 States
  - 2008 & 2015 8-hr ozone attainment estimates: 12 km grid in Cincinnati/Dayton areas
  - 2008 & 2015 $PM_{2.5}$ attainment estimates: 36 km grid
  - 2008 & 2015 $PM_{2.5}$ attainment estimates: Cincinnati/Dayton areas

Part I: Summary of Results and Recommendations

AG vs. LADCO Emissions Modeling Differences for 2005 Base Case

- AG modeling based on LADCO BaseK inventories and Round IV Growth and Control Factors
  - Latest available LADCO data at time of processing
    - Base year of 2002
  - LADCO staff indicates (June 27, 2007 e-mail) that final BaseM not available until late in July 2007
  - Forecast to 2005, 2008, and 2015
    - Growth and Control Factors from E.H. Pechan reports dated June 30, 2004 and December 29, 2005 (Round IV factors)
      - Exception EGU and onroad mobile
        - EGU forecast using LADCO IPM runs of IPM 2.1.9
        - Onroad forecast using interpolated LADCO VMT
        - No onroad network data used

LADCO vs. AG Design Value Choices for 2005 Base Year 8-hr Ozone Modeling

- AG Measured Design Values (DV_m) used in AttainDemo
  - DVs supplied by LADCo (10 May 2007)
  - We used average of 2004-2006 4th Highest 8-hr ozone to yield 2005 DVs
- LADCo Measured Design Values (DV_m)
  - Estimated DV_m for 2005-2007 period (2007 year still in progress);
  - So DV_m based on average of '03-'05, '04-'06, and '05-'06 4th highest 8-hr ozone values calculated by LADCo;
  - OEPA believes this is a "conservative estimate" (OEPA Cincinnati-Hamilton DRAFT 8-hr ozone SIP, page 23);
  - LADCo will issue 'final calculation' of 2005 8-hr Ozone Design Values (DV_m) when 2007 ozone season is complete.

LADCo 2005 DV Alternatives for 8-hr Ozone Using Currently Available Data

Key Site	Actual 4th High 8-Hr Value '00	'01	'02	'03	'04	'05	'06	2005 Base Year - Design Values Options '04-'06	'03-'05,'04-'06,'05-'06	'02-'04,'03-'05,'04-'06	2002BaseYear '00-'02,'01-'03,'02-'04
Lake Michigan Area											
Chiwaukee	86	99	116	88	78	93	79	83.3	**85.2**	**87.9**	**98.4**
Racine	78	92	111	82	69	95	71	78.3	81.1	82.6	**92.0**
Milwaukee-Bayside	83	93	99	92	73	93	73	79.7	82.9	84.6	**91.4**
Harrington Beach	86	102	93	99	72	94	72	79.3	83.6	**85.2**	**93.2**
Sheboygan	90	102	105	93	78	97	83	**86.0**	**88.4**	**89.1**	**97.0**
Kewaunee	84	90	92	97	73	88	76	79.0	82.3	84.1	**89.7**
Door County	84	95	95	93	78	101	79	**86.0**	**88.9**	**88.4**	**91.4**
Hammond	86	90	101	81	67	87	75	76.3	78.6	79.2	**88.7**
Michigan City	80	90	107	82	70	84	75	76.3	78.2	80.4	**90.6**
Holland	80	92	105	95	79	94	91	**88.0**	**89.9**	**90.1**	**94.2**
Muskegon	78	95	96	94	70	90	91	83.7	**86.3**	**85.0**	**90.4**
Indianapolis Area											
Noblesville	90	88	101	101	75	87	79	80.3	83.7	**86.8**	**94.0**
Fortville	86	89	101	92	72	80	76	76.0	78.4	81.9	**91.4**
Fort B. Harrison	83	87	100	91	73	80	76	76.3	78.6	81.9	**90.2**
Detroit Area											
New Haven	75	95	95	102	81	88	79	82.7	**85.5**	**88.6**	**92.8**
Warren	77	94	92	101	71	89	78	79.3	83.3	84.8	**90.4**
Port Huron	80	84	100	86	74	88	78	80.0	81.9	83.1	**88.2**
Cleveland Area											
Ashtabula	82	97	103	99	81	93	86	**86.7**	**89.1**	**90.7**	**96.0**
Geauga	85	99	115	97	75	88	70	77.7	81.1	**86.7**	**99.7**
Eastlake	83	89	104	92	79	97	83	**86.3**	**88.6**	**89.1**	**92.9**
Cincinnati Area											
Wilmington	97	93	99	96	78	83	81	80.7	82.8	**85.8**	**94.4**
Sycamore	81	88	100	93	76	89	80	81.7	84.1	**85.8**	**91.0**
Lebanon	86	85	98	95	81	92	86	**86.3**	**88.2**	**89.0**	**91.2**

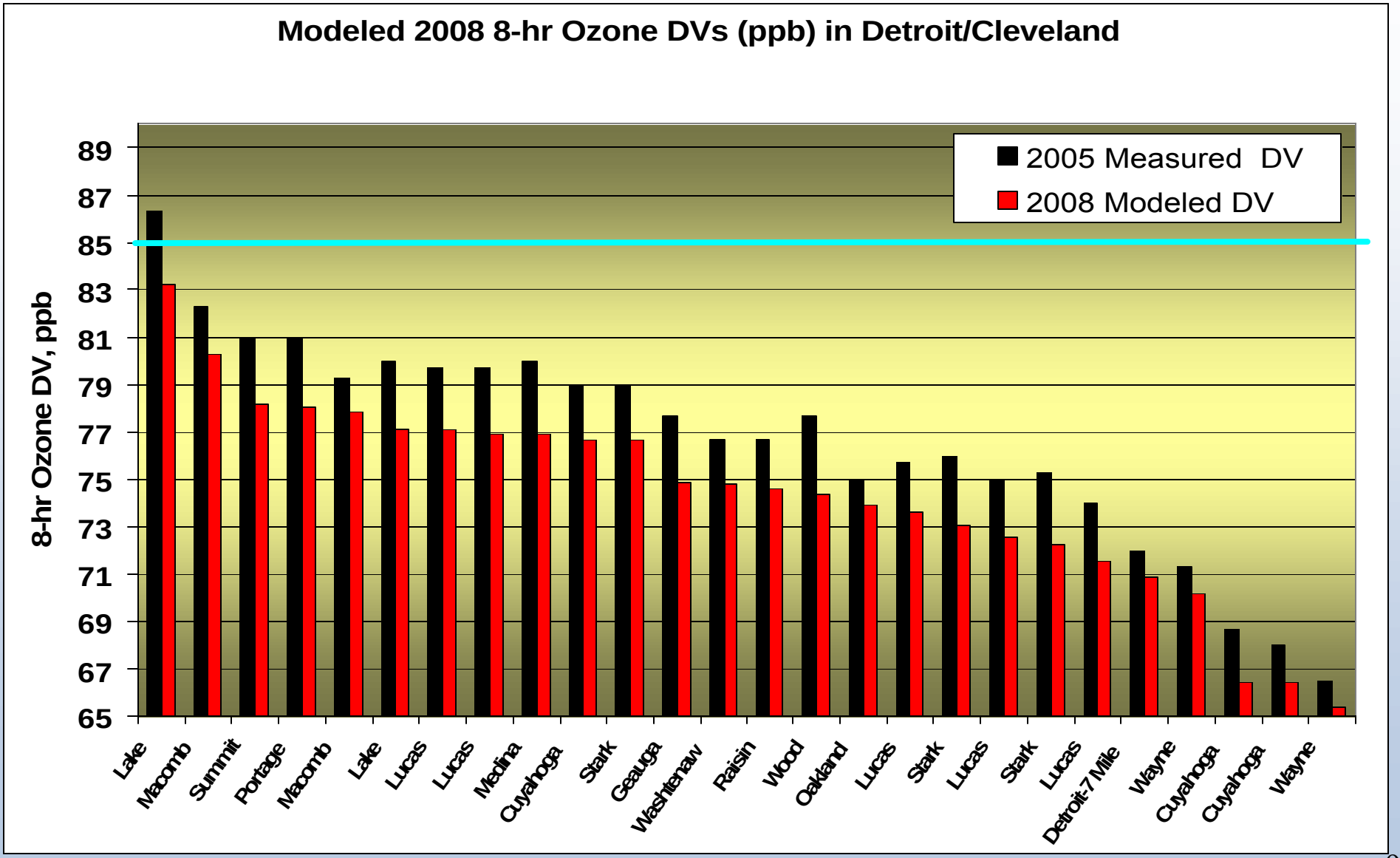
CAMx O_3 Evaluation Summary

- Episode average bias and error for 1-hr and 8-hr ozone over the two 4 km domains are good, i.e., -1.5% to -9.6% (bias) and 13.4% to 18.1% (error);
- Daily mean normalized bias in 1-hr and 8-hr ozone on both 4 km domains generally satisfies EPA performance goals;
  - Some days have low (< 60 ppb) ozone so bias/error histograms do not appear
  - A few days have biases two time greater than goals.
- Daily mean normalized gross errors in 1-hr and 8-hr ozone on both grids are almost always well below the EPA performance goal; Bias & Error statistics for ozone agree very well with VISTAS CMAQ base G results
- The CAMx operational evaluation for 1-hr and 8-hr ozone concentrations does not suggest presence of serious bias or compensating errors; and
- Therefore, the current summertime 2005 36/12/4 km CAMx ozone modeling simulation appears suited for policy explorations
  - Further multi-species, multi-scale evaluations of the current simulation are encouraged in order to search further for potential model limitations in certain sub areas or time intervals.

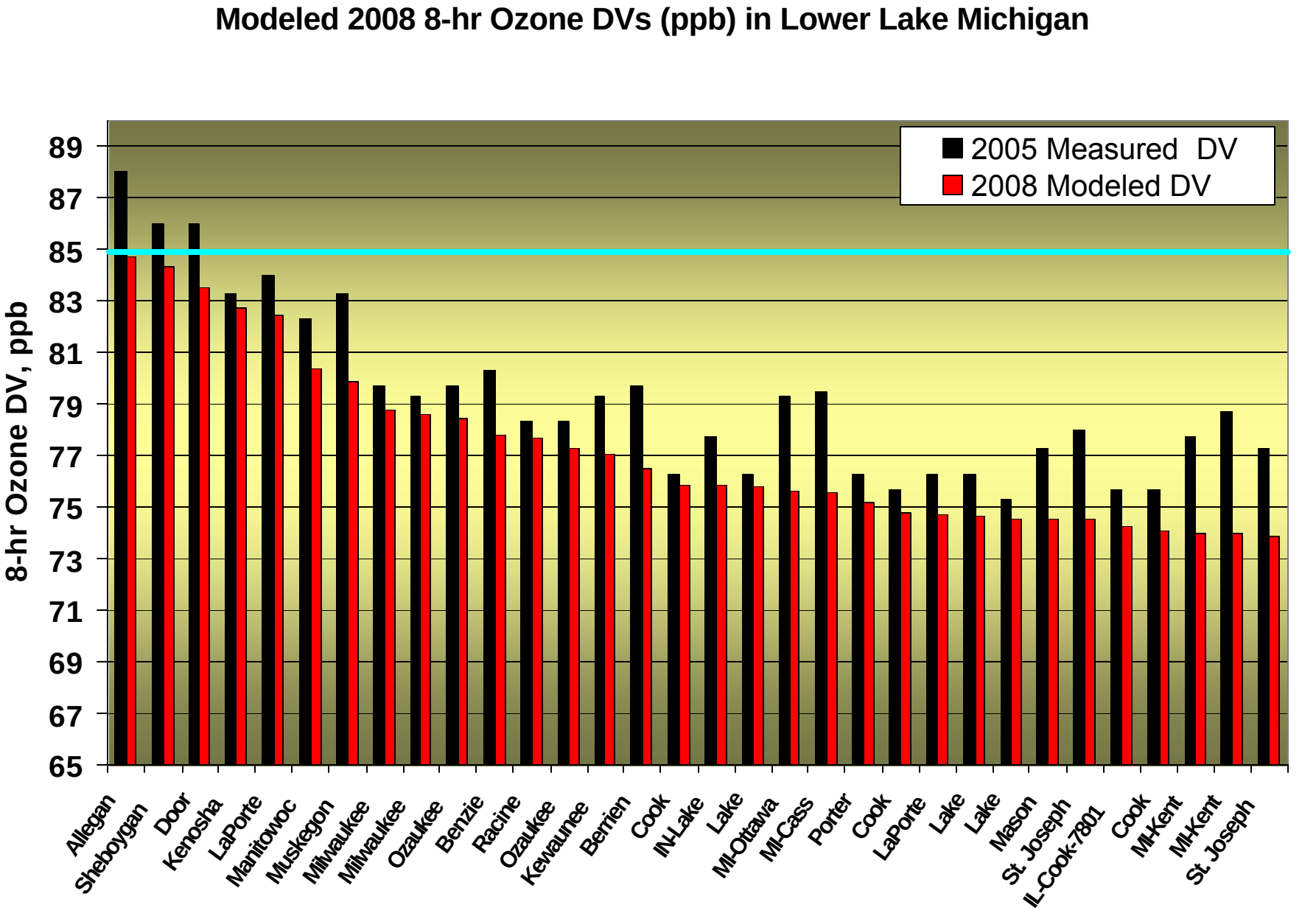
8-hr Ozone Attainment Findings

- 8-hr Ozone: 4 km Grid
  - All regulatory monitors in the Five States region 4 km grid domains are estimated to be in attainment of the 8-hr NAAQS by 2008 as well as in 2015;
  - The highest DVs in the Detroit/Cleveland 4 km study area in 2008 occur at Eastlake (83.24 ppb), New Haven (80.28 ppb), Akron-Patterson (78.17ppb), Akron Revena (78.05 ppb), Warren Fire Station (77.83ppb), and Painsville (77.14 ppb);
  - The highest DVs in the Lower Lake Michigan 4 km study area in 2008 occur at Holland (84.74 ppb), Kohler Andre (84.33 ppb), Door County (83.51ppb), Pleasant Prairie (82.7 ppb), and La Porte (82.47ppb);
  - Since EPA(2007) guidance calls for focused weight of evidence for those monitors with modeled design values in the range of 82-87 ppb, it appears that five monitors in the Lower Lake Michigan domain will need WOE treatment while the Eastlake monitor would be the only in the Detroit/Cleveland area needing such supplemental analyses.

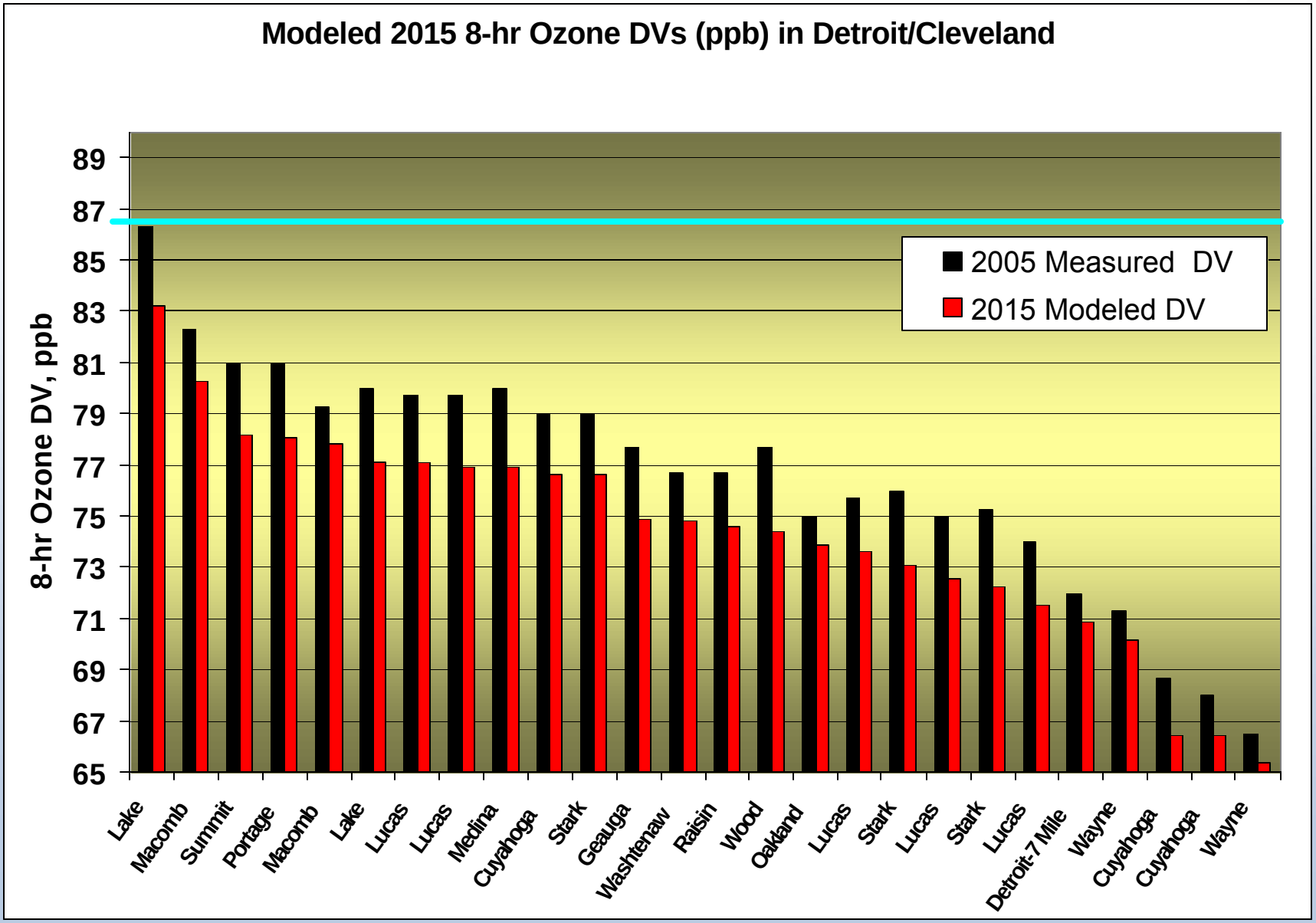
Modeled 2008 8-hr Ozone Design Values on 4 km D/C Grid



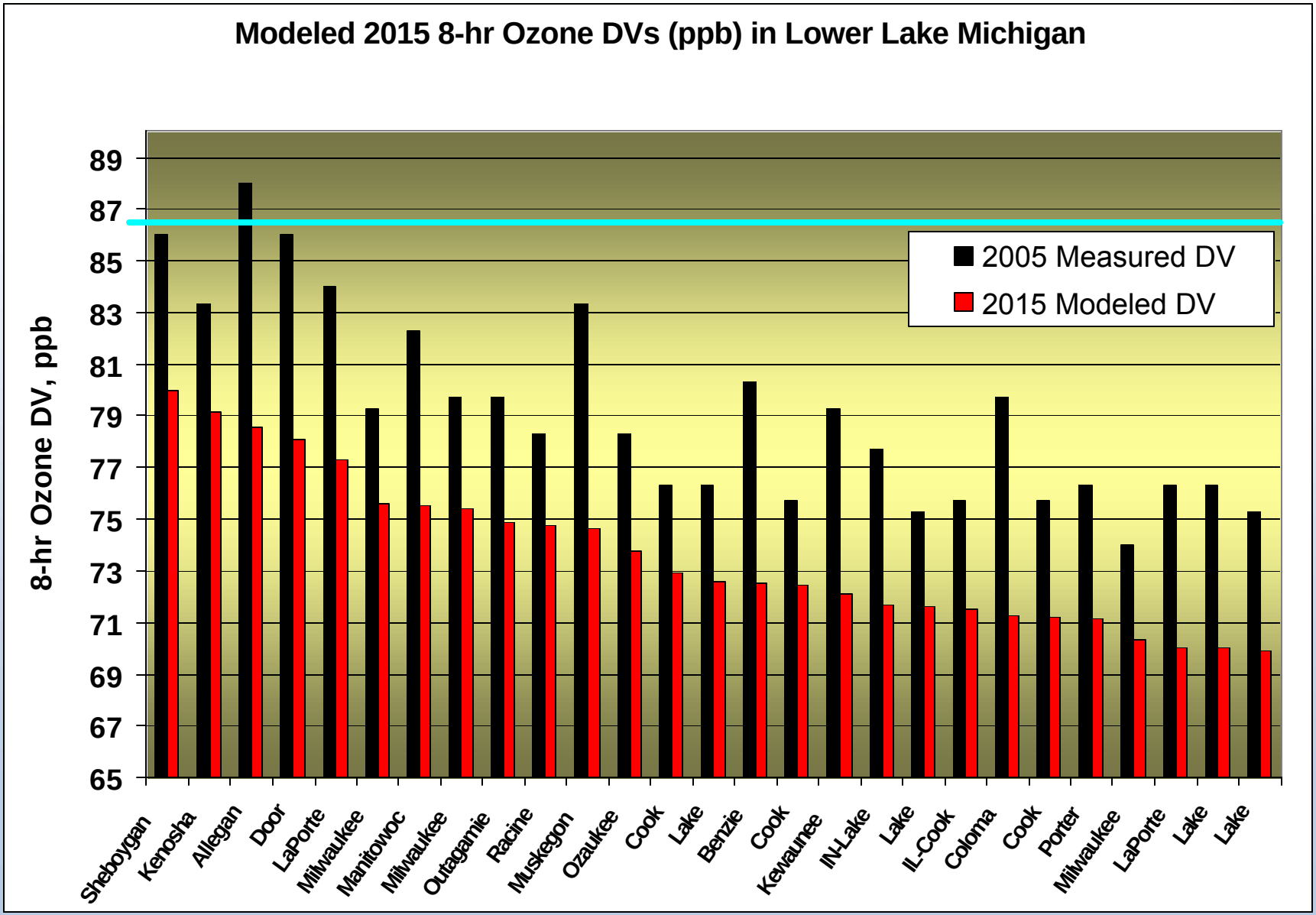
Modeled 2008 8-hr Ozone Design Values on 4 km LLM Grid



Modeled 2015 8-hr Ozone Design Values on 4 km D/C Grid



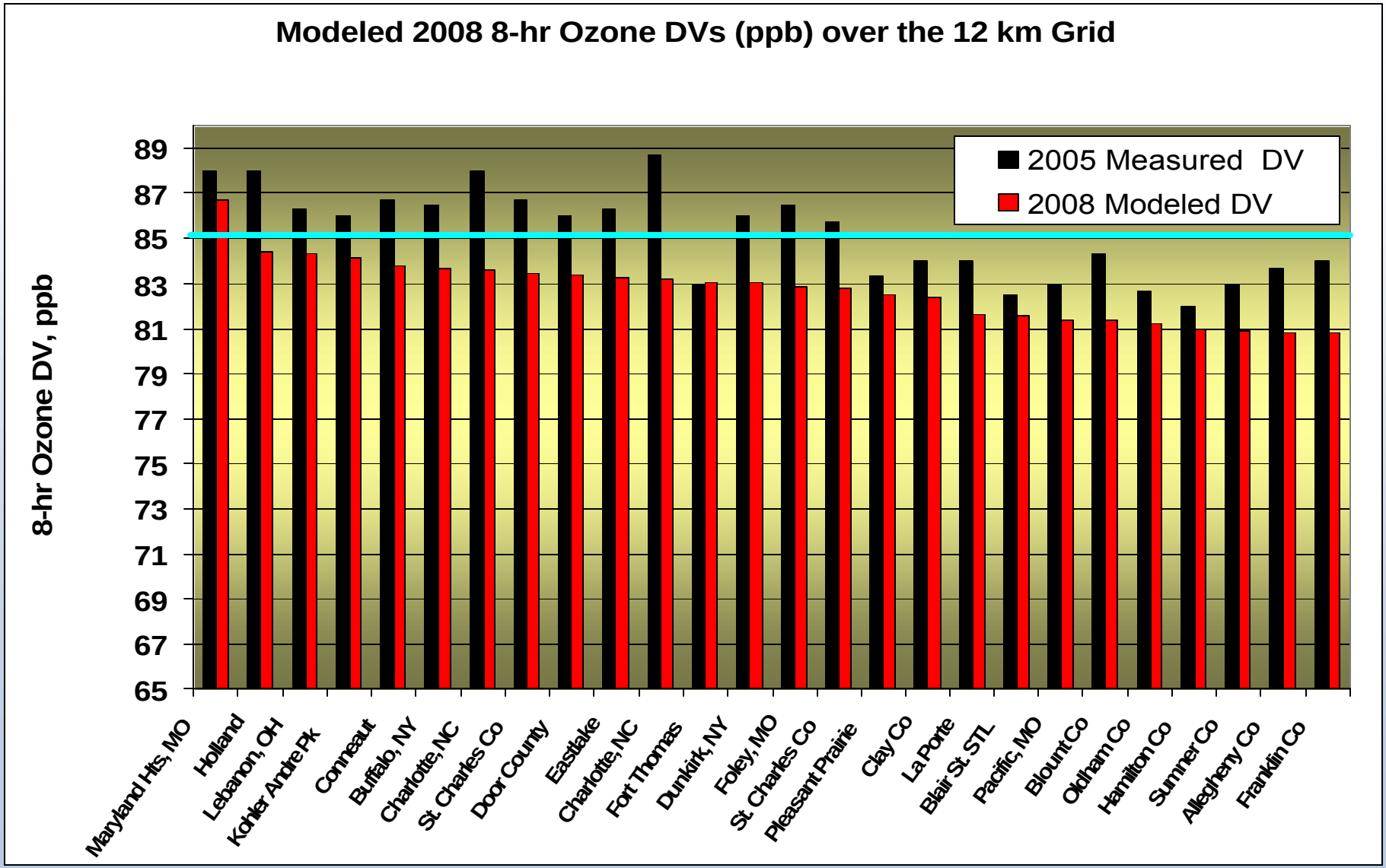
Modeled 2015 8-hr Ozone Design Values on 4 km LLM Grid



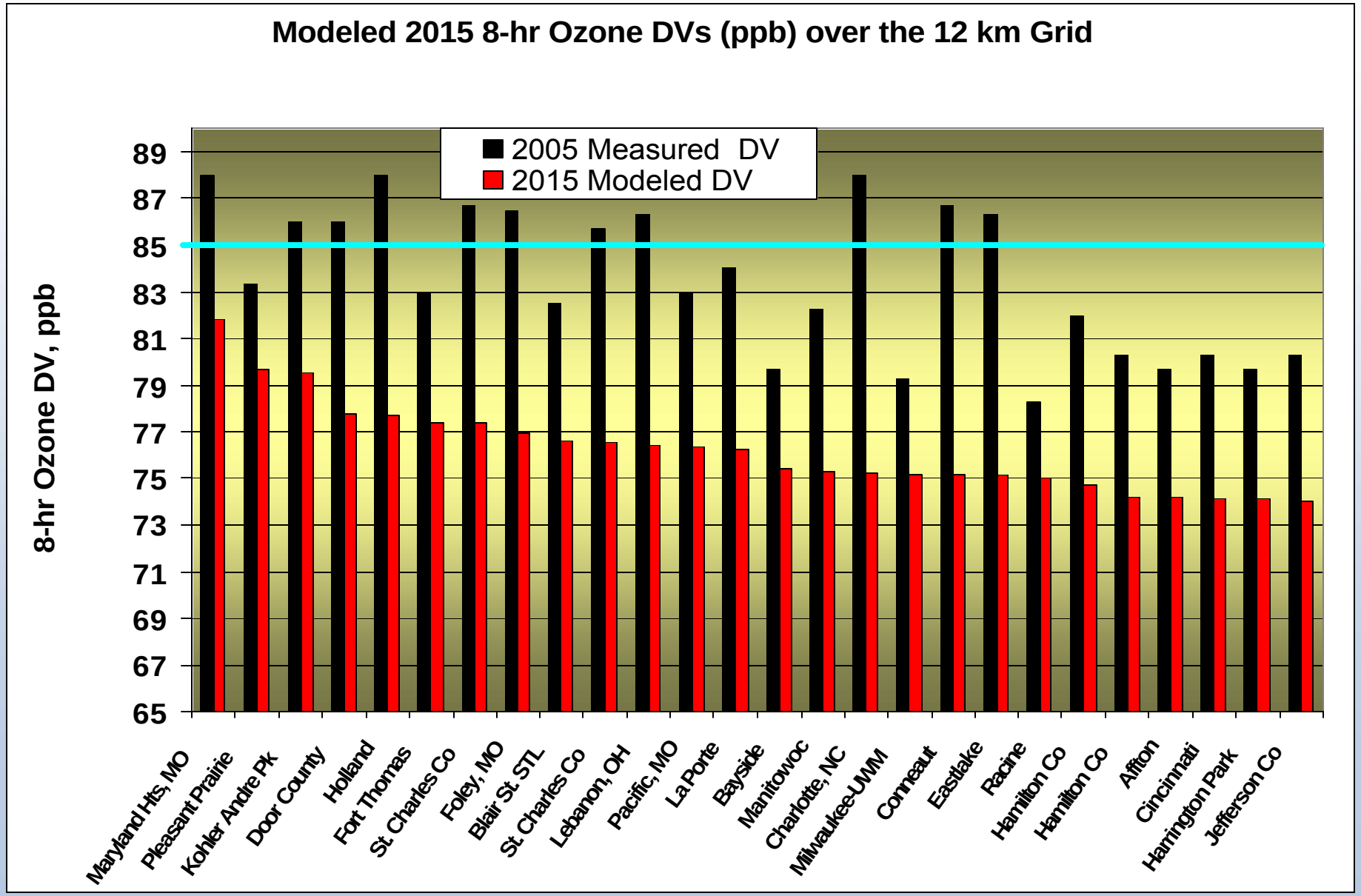
Ozone Attainment Findings

- 8-hr Ozone: 12 km Grid
  - On the 12 km grid, only the Maryland Heights, MO monitor is projected to be nonattainment in 2008 with a Design Value 86.51 ppb;
  - All regulatory monitors in Five States 12 km grid region are estimated to be in attainment of the 8-hr NAAQS by 2015;
  - In the Cincinnati/Dayton area, the Lebanon, OH monitor has the highest DV of 84.31 ppb in 2008; and
  - In the Cincinnati/Dayton area, the Fort Thomas, KY monitor has the highest DV of 77.39 ppb in 2015.

Modeled 2008 8-hr Ozone Design Values over 5 States on 12 km Grid



Modeled 2015 8-hr Ozone Design Values over 5 States for 12 km Grid



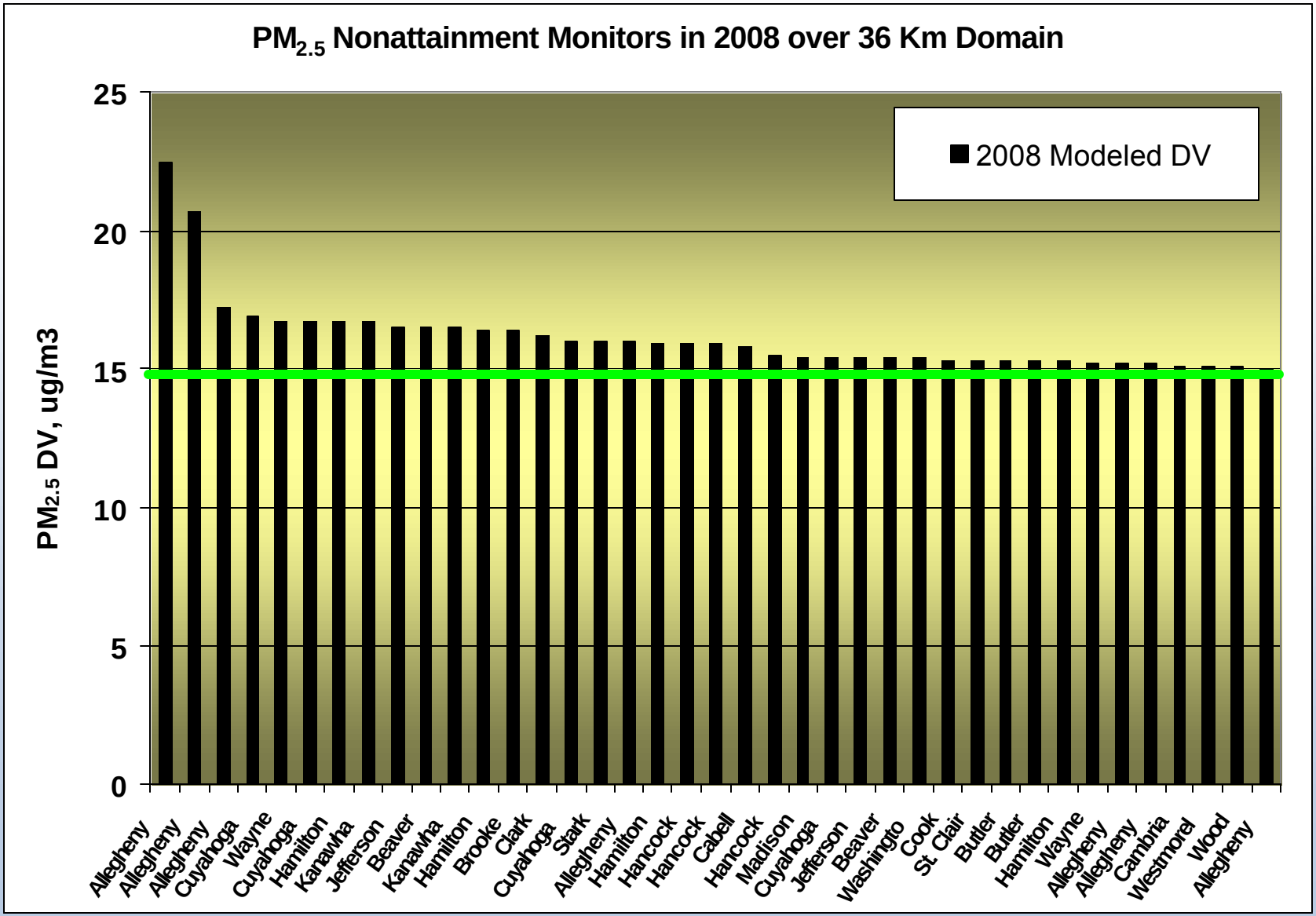
CAMx $PM_{2.5}$ Evaluation Summary

- The annual average fractional bias in CAMx $PM_{2.5}$ estimates for the 2005 Base Case using the FRM and IMPROVE measurements are 28.6% and 49.4%, respectively while the Fractional Errors are 46.4% and 58.2%.
- Except for nitrate, the bias and errors in the 2005 Base Case evaluation compare favorably with ***Ad Hoc*** Goals & Criteria.
- Nitrate continues to present a simulation challenge, with systematic overprediction in the Winter, Spring, and Autumn and underprediction in the summer on 12 km domain.
- CAMx model performance for the 2005 base case (12 km grid) compares favorably with the final VISTAS CMAQ Base 2002G2 simulation for both fractional bias and error.

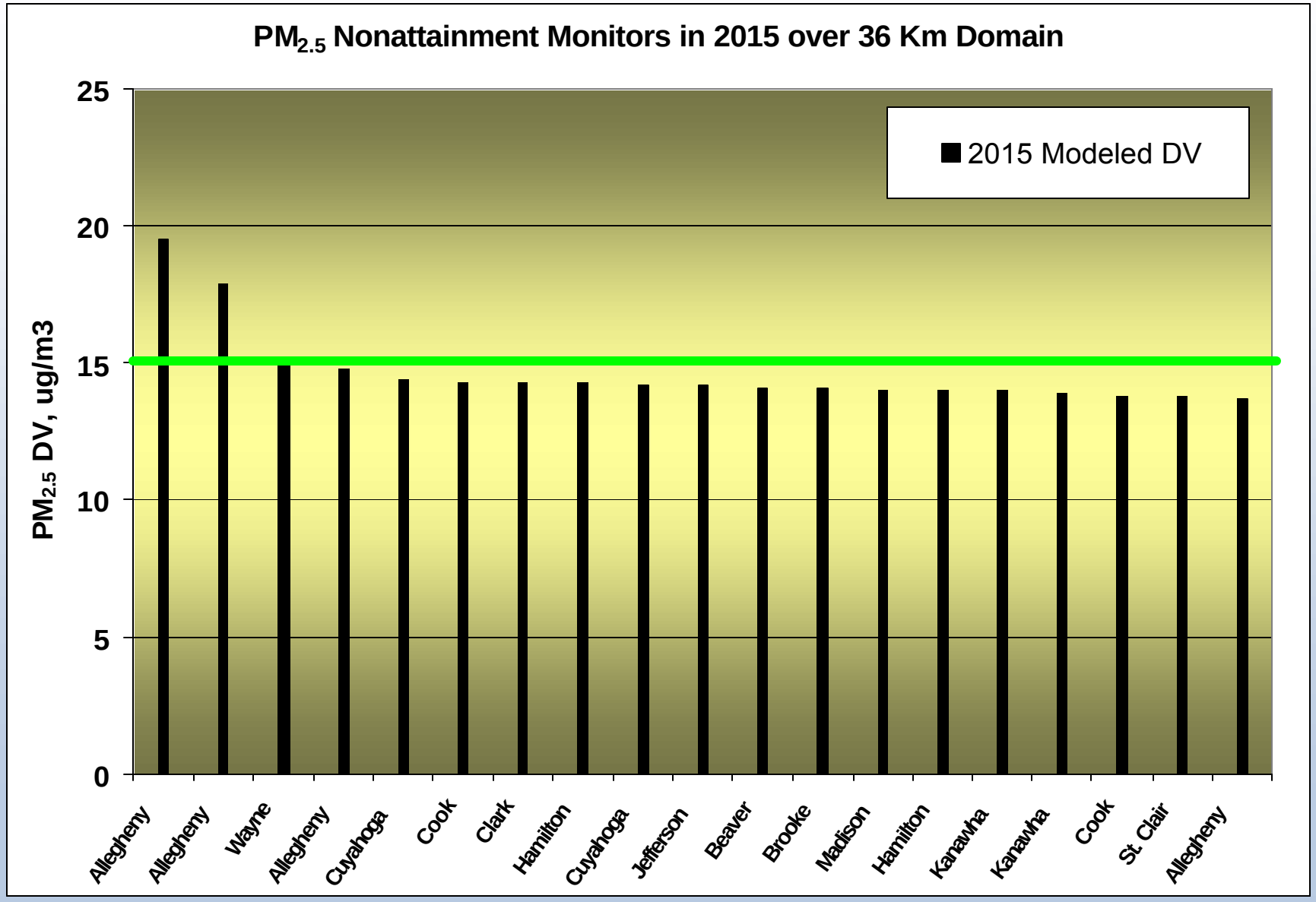
Annual $PM_{2.5}$ Attainment Findings

- Over the Five States 36 km Domain:
  - In 2008, a total of 39 out of 351monitors are projected to exceed the annual NAAQS over the Five State 36 km Domain.
  - In 2015 two (2) monitors in Allegheny County, PA are projected to exceed the annual NAAQS (19.5 $\mu g/m^3$ and 17.9 $\mu g/m^3$) over the Five State 36 km domain.

Modeled 2008 $PM_{2.5}$ Nonattainment and Attainment Monitors on 36 km Grid



Modeled 2015 $PM_{2.5}$ Nonattainment and Attainment Monitors on 36 km Grid



Recommendations

- Re-assess ozone and $PM_{2.5}$ modeled attainment status when final 2007 air quality data are available;
- Perform further attainment test calculations exploring sensitivity of ozone & PM DVs to model performance given the day-to-day variability in model skill:
- Perform focused weight of evidence analyses for:
  - The various procedures potentially justifiable for use in estimating the base year 2005 ozone measured Design Values (DV_m)
  - The 8-hr ozone monitors in the 4 km domain that fall within the 72-75 ppb range.
  - The $PM_{2.5}$ monitors on the 36 km domain that fall within the 14-16 $\mu g/m^3$ concentration ranges.

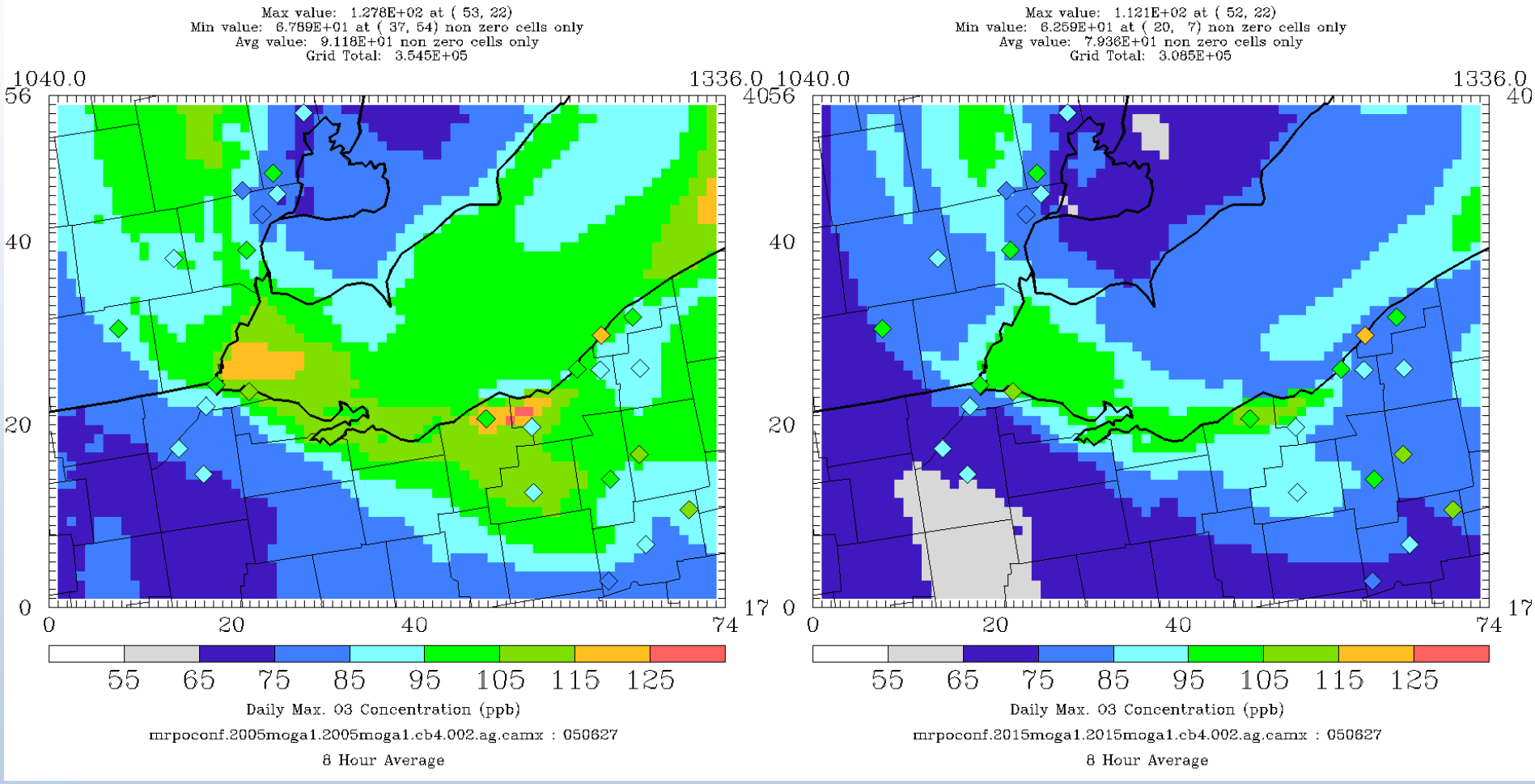
Part II: Modeling Support Information

8-hr Ozone Model Evaluation for 2005

CAMx Ozone Evaluation

- 1-hr and 8-hr operational evaluation statistics
  - Nearly two dozen performance metrics calculated for ozone, NO_2, and NOx;
  - All standard EPA graphical displays produced for ozone, NO_2, and NOx; full evaluation data sets and input emissions inventories available upon request
  - Emphasis on mean normalized bias & mean normalized gross error (with standard ozone cutoff of 60 ppb)
- Evaluation metrics and displays developed for
  - All monitors in 12 km or 4 km domain
  - All monitors in each of eleven (11) states
    - IA, IL, IN, KY, MI, MN, MO, OH, TN, WI and WV

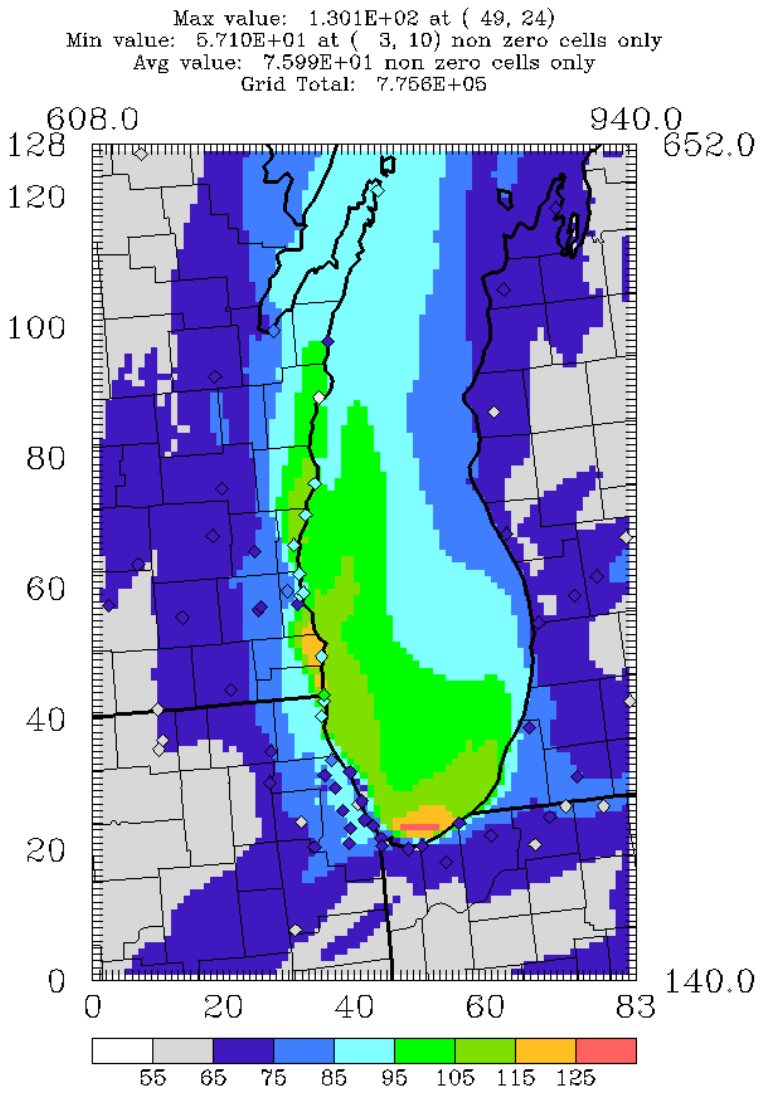
4 Km Grid over Detroit/Cleveland



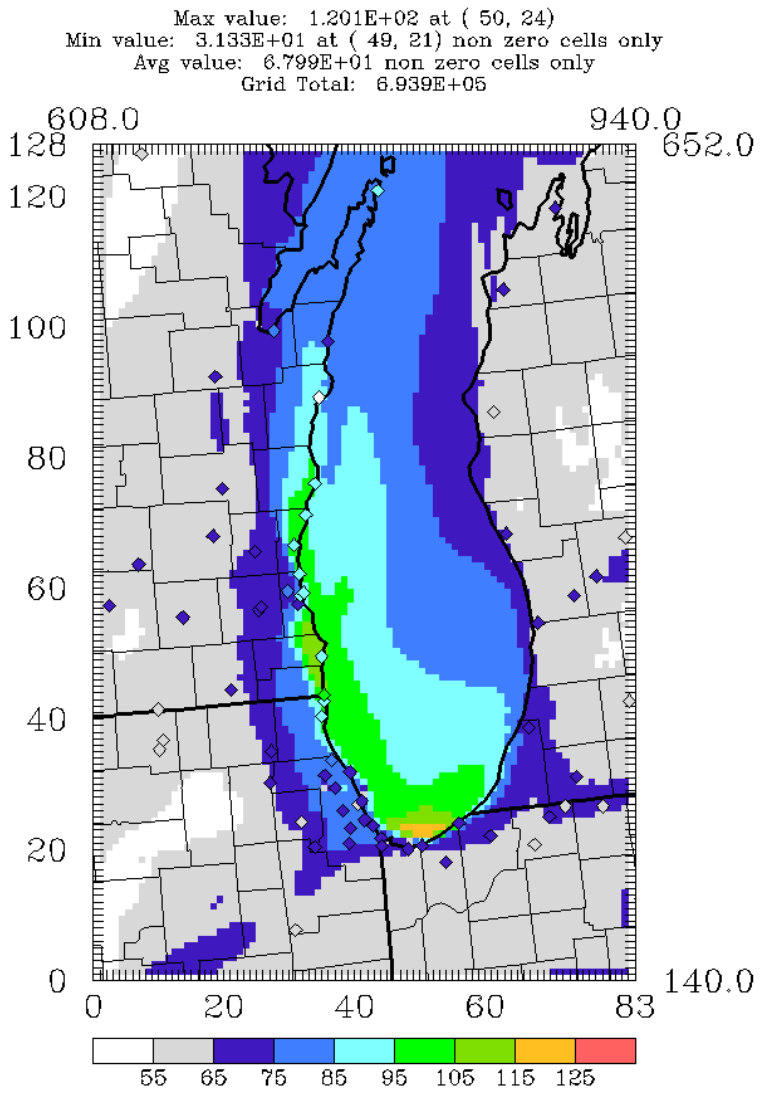
2005 **2015**

4 Km Grid over Lower Lake Michigan

2005

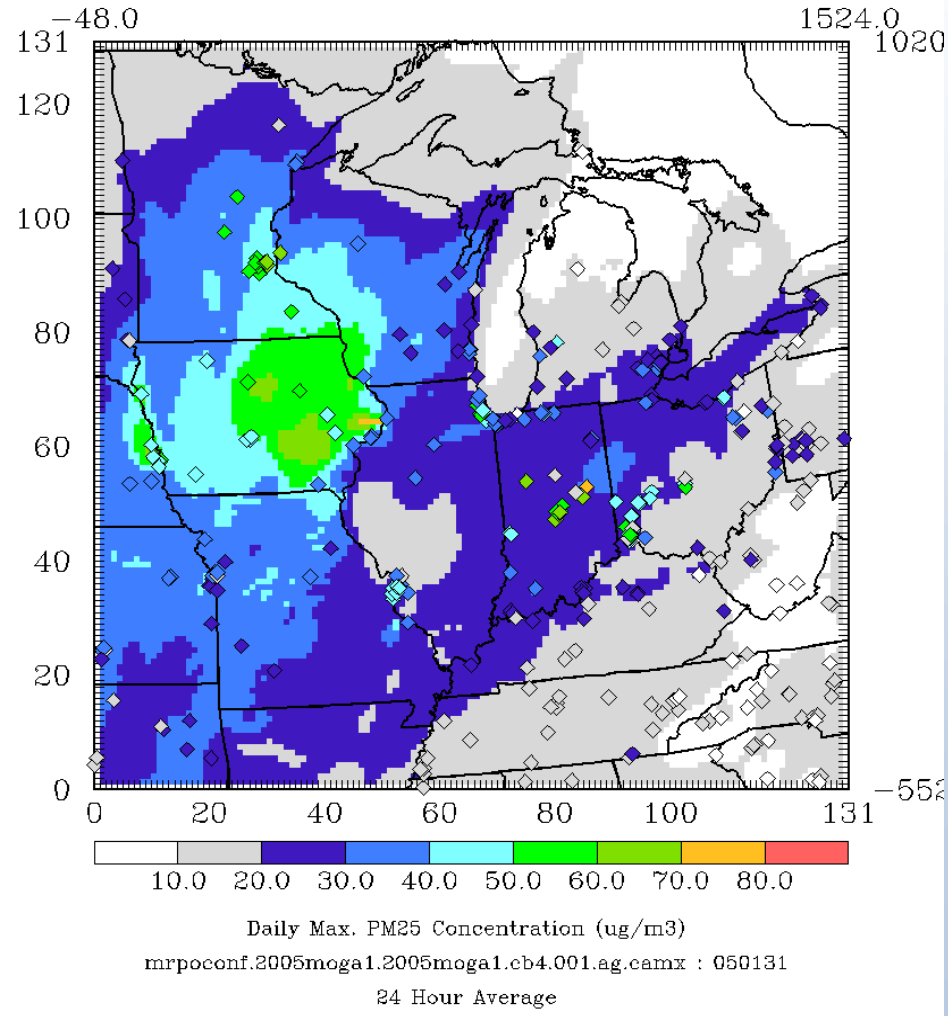


2015

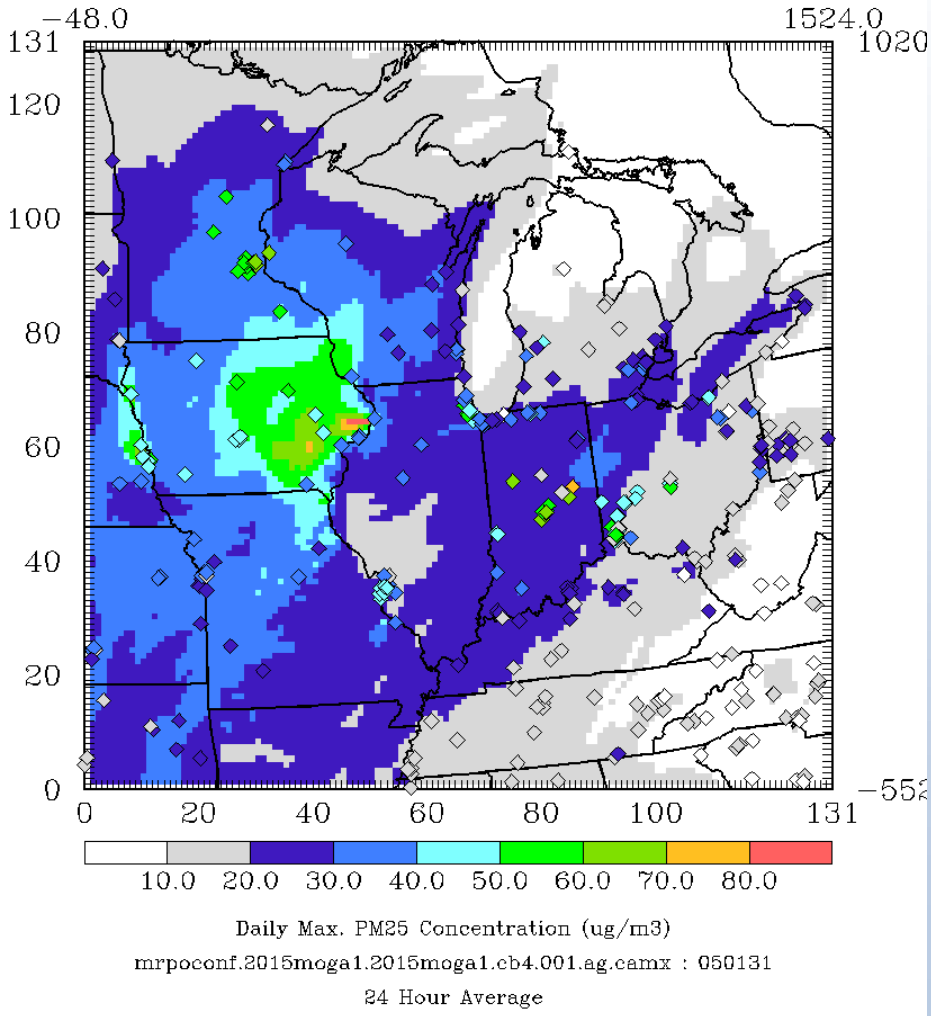


12 Km Grid over 5 States Region

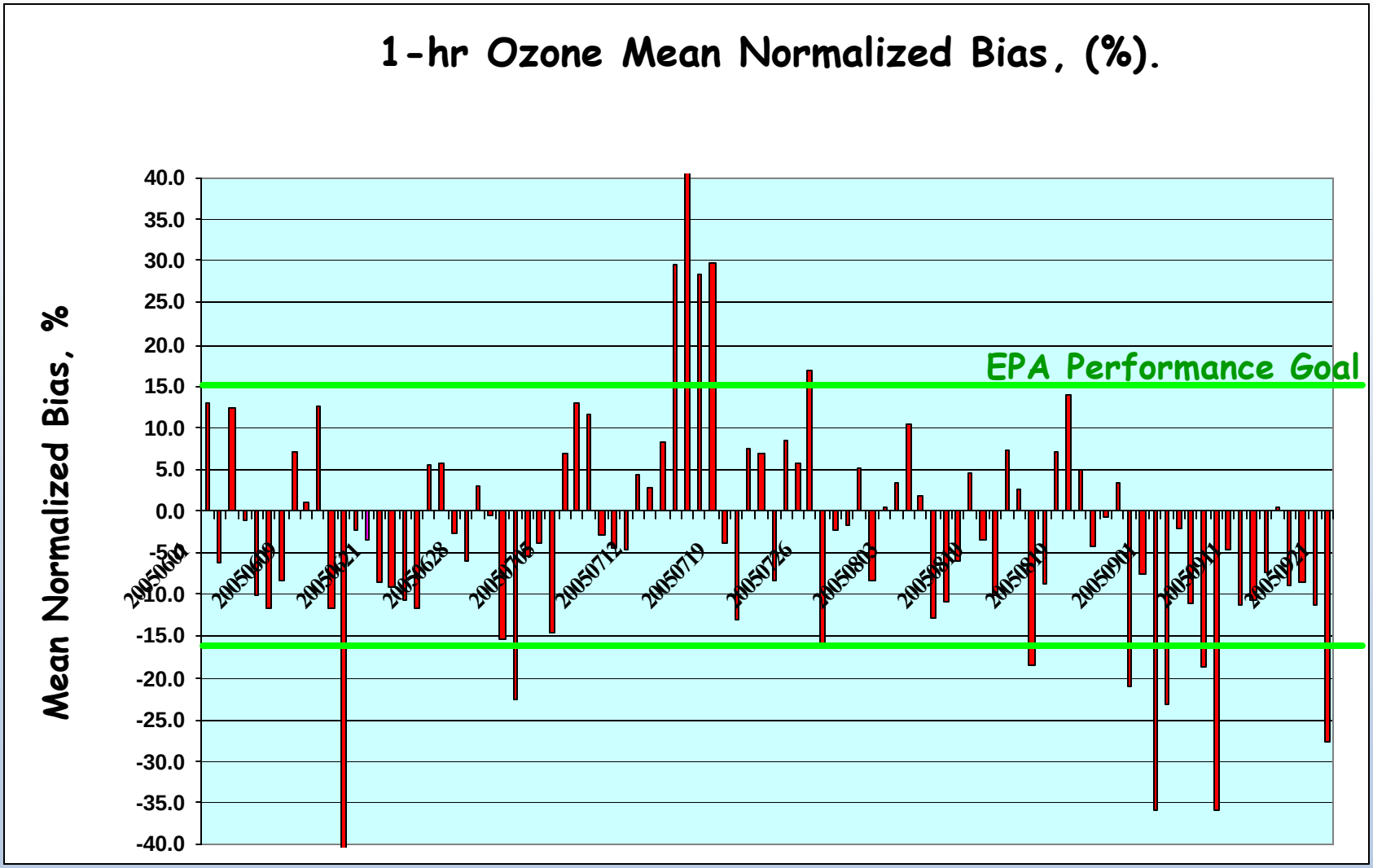
2005



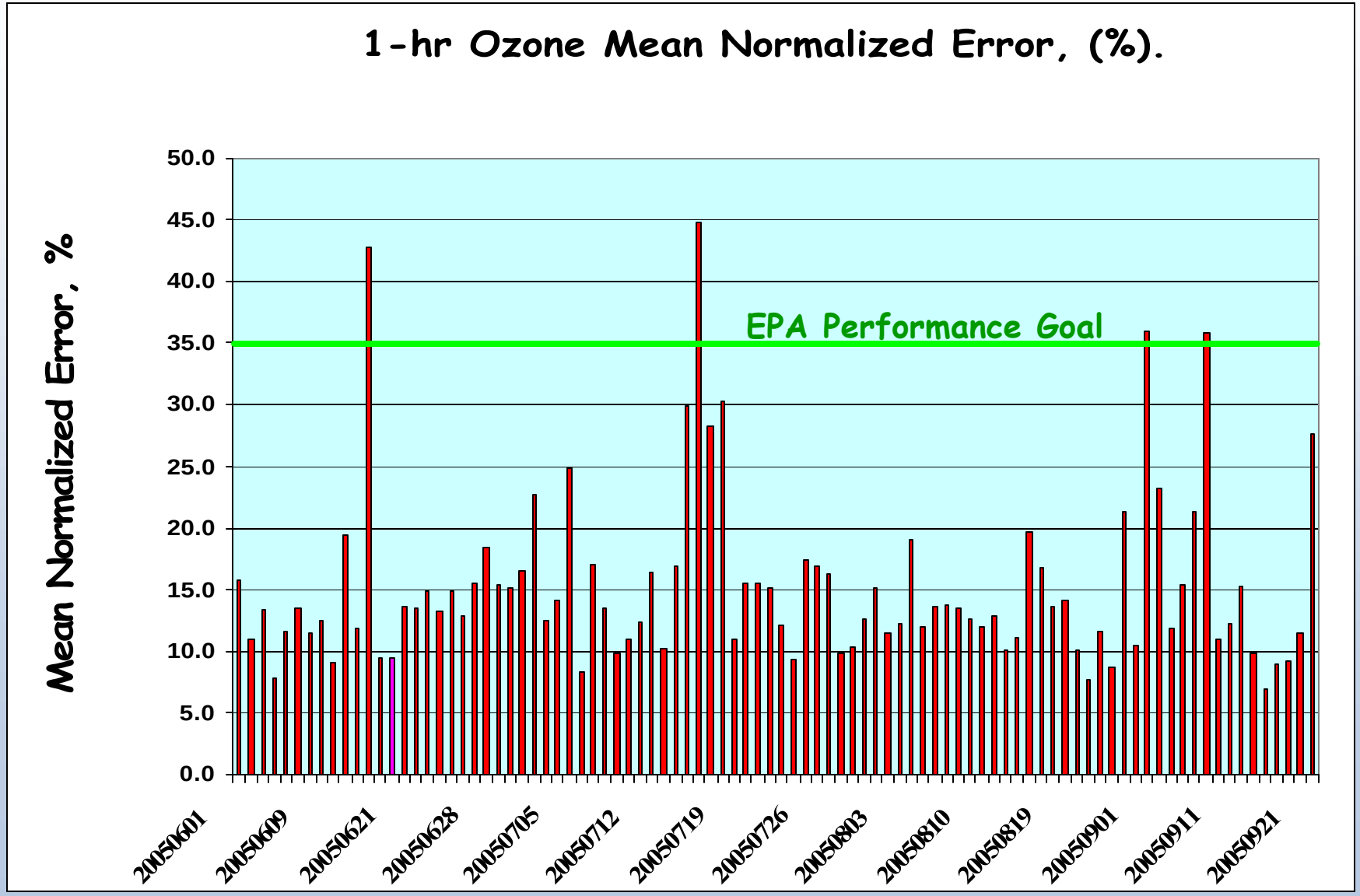
2015



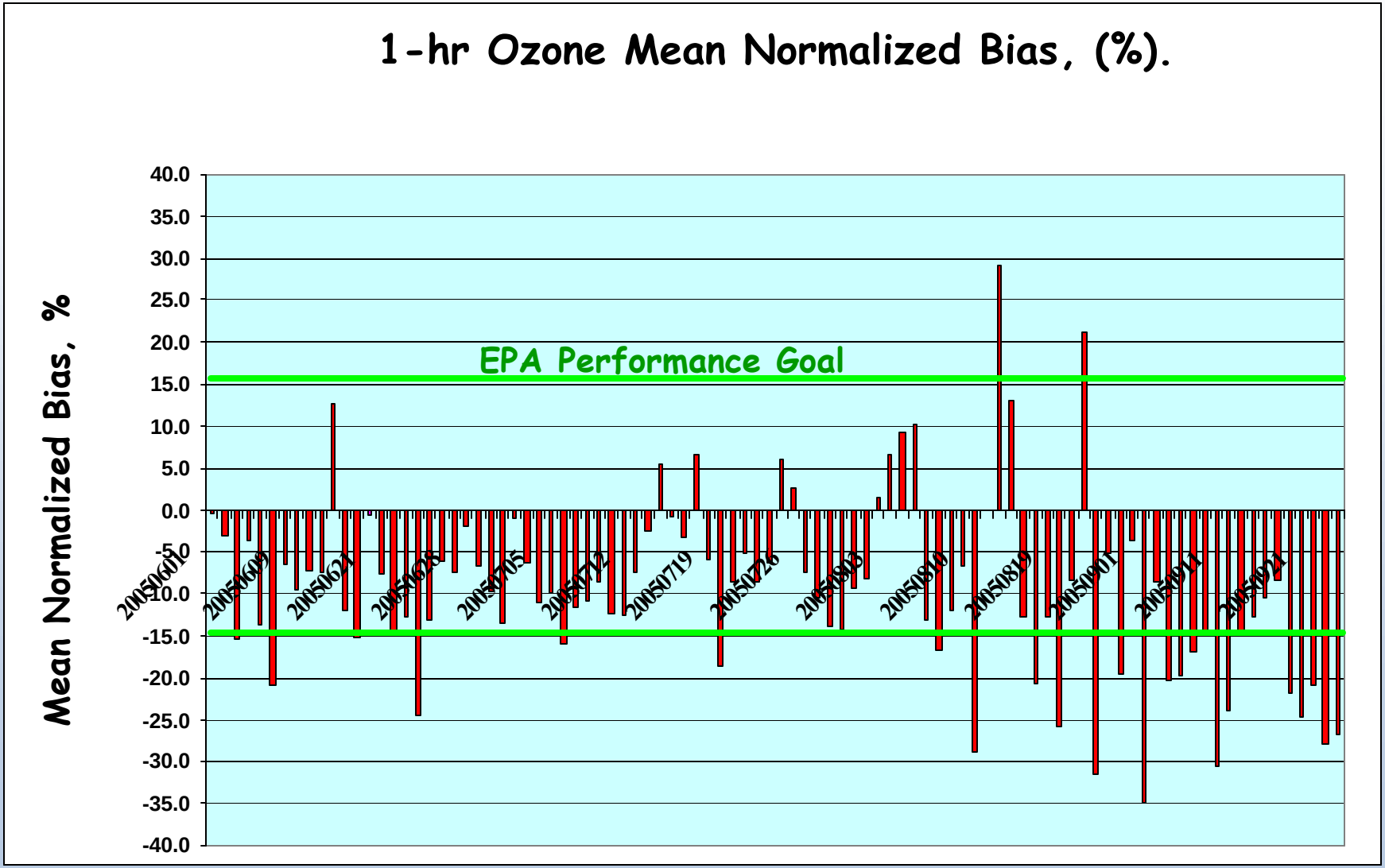
Ozone Mean Normalized Bias
1hr – Detroit/Cleveland



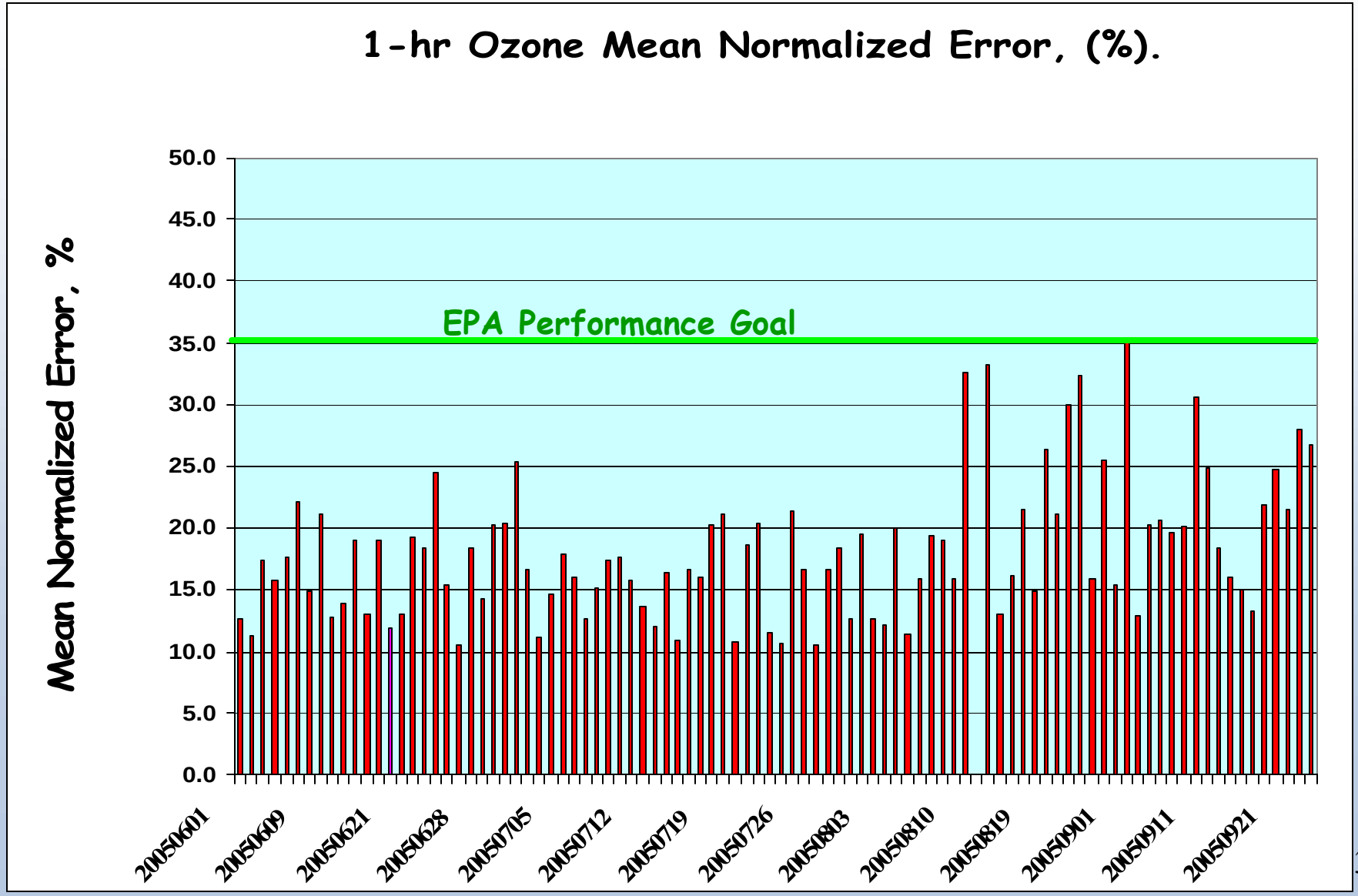
Ozone Mean Normalized Gross Error 1hr – Detroit/Cleveland



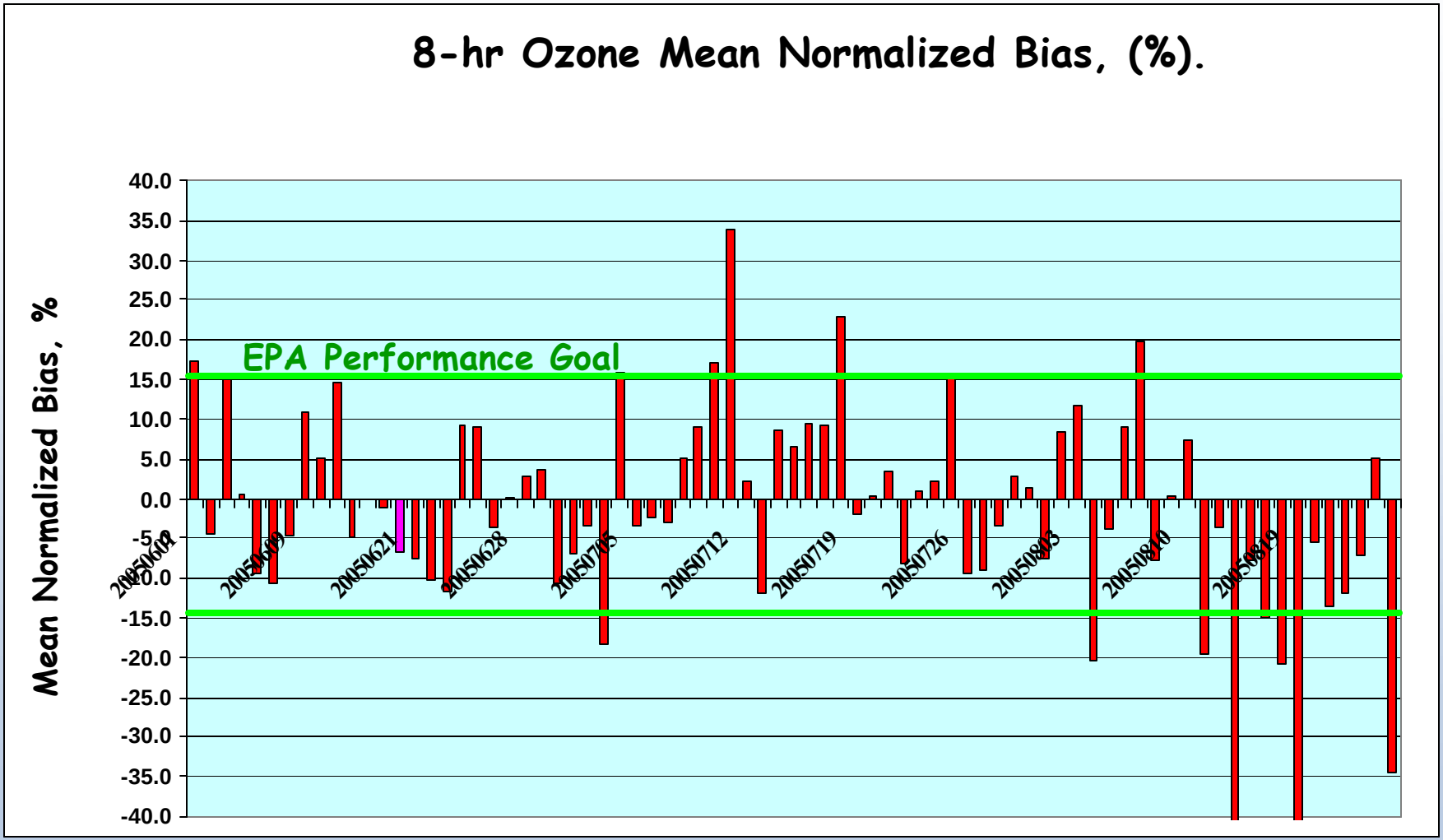
Ozone Mean Normalized Bias 1hr – Lower Lake Michigan



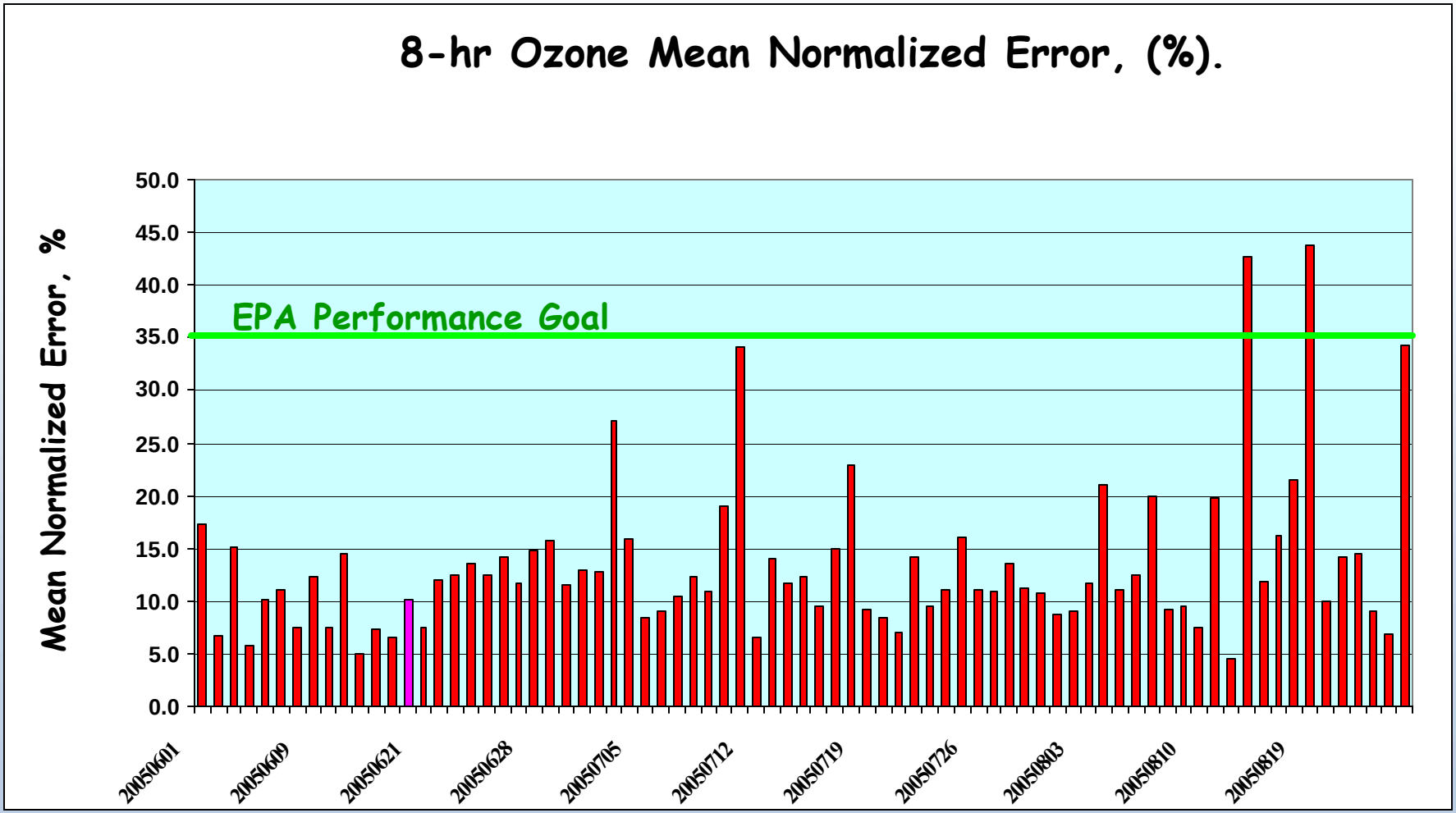
Ozone Mean Normalized Gross Error 1hr – Lower Lake Michigan



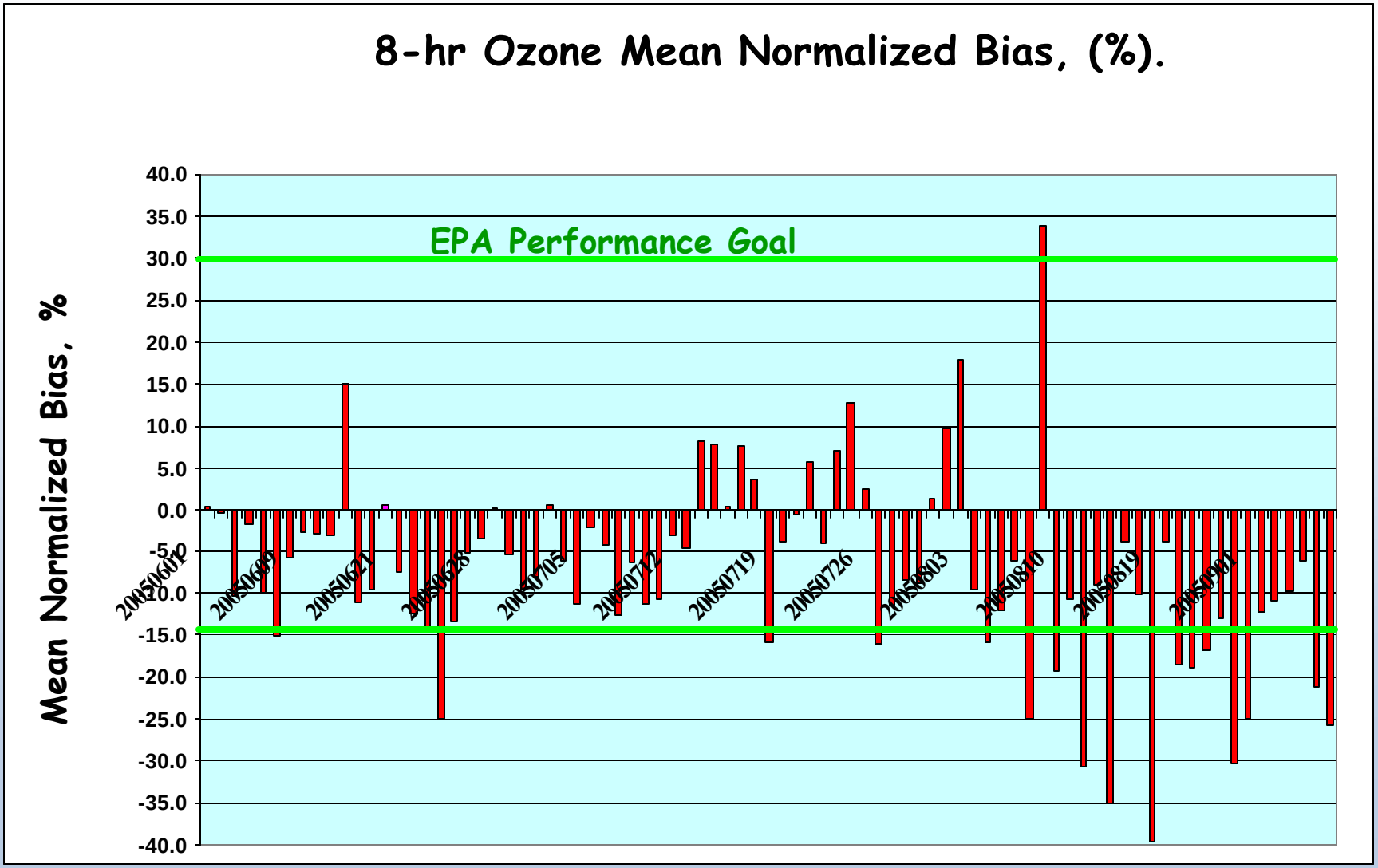
Ozone Mean Normalized Bias 8hr - Detroit/Cleveland



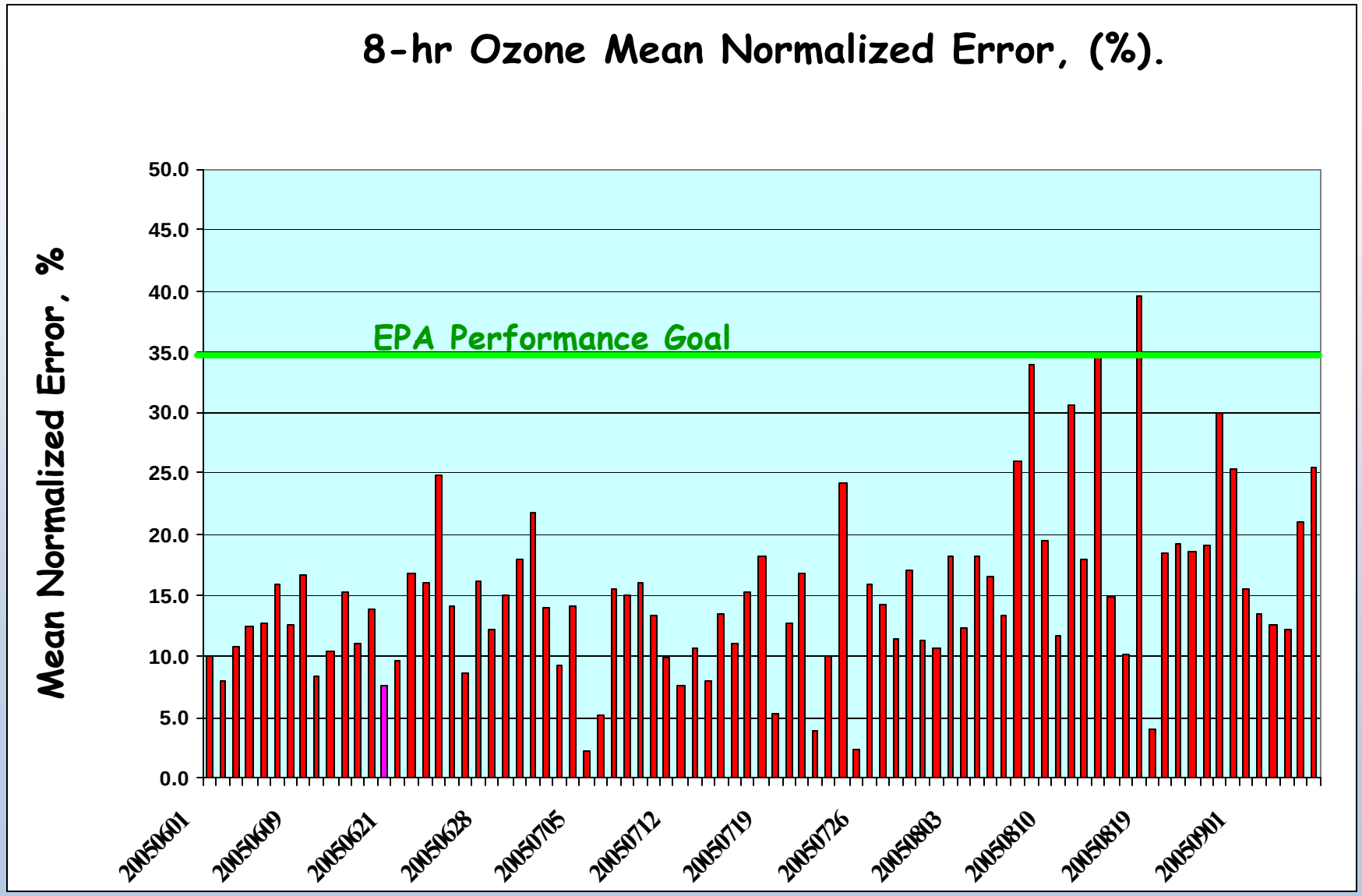
Ozone Mean Normalized Gross Error 8hr - Detroit/Cleveland



Ozone Mean Normalized Bias 8hr – Lower Lake Michigan



Ozone Mean Normalized Gross Error 8hr – Lower Lake Michigan



CAMx Ozone Evaluation:

(1 June – 21 Sept Average)

2005 Ozone Performance Statistics for the Detroit/Cleveland and Lower Lake Michigan Grids. (cutoff = 60 ppb)													
Avg Time	4 km Dom	MNB	MNGE	MEAN_O	MEAN_P	RATIO	MB	NMB	MFB	ME	NME	MFE	N
1-hr	Det/Clev	-2.7	15.3	68.8	66.6	1.0	-2.2	-3.1	-4.8	10.5	15.3	16.0	106
1-hr	LLMich	-9.6	18.1	68.7	61.8	0.9	-6.8	-9.9	-12.9	12.5	18.3	20.4	250
8-hr	Det/Clev	-1.5	13.4	66.9	65.6	1.0	-1.3	-1.8	-3.2	9.0	13.4	14.1	96
8-hr	LLMich	-7.5	15.0	66.4	61.4	0.9	-5.0	-7.6	-9.8	10.0	15.1	16.6	227

Mean Normalized Gross Error:
EPA Goal: < 30-35%
for daily metrics

Mean Normalized Bias
EPA Goal: < ± 10-15%
for daily metrics

$PM_{2.5}$ Model Evaluation for 2005

CAMx $PM_{2.5}$ Evaluation

- Annual $PM_{2.5}$ data from AQS and speciated IMPROVE networks
- Operational evaluation statistics
  - Fractional bias, fractional error (cutoff of 0.0 $\mu g/m^3$ used)
- CAMx 'Operational' performance statistics and graphics evaluated on both 36 km and 12 km grids
- Focus of 'operational' evaluation on 12 km grid
- CAMx annual 2005 evaluation results compared with 'ad hoc' performance goals set in other recent regional studies (e.g., VISTAS, CENRAP)

CAMx $PM_{2.5}$ Evaluation

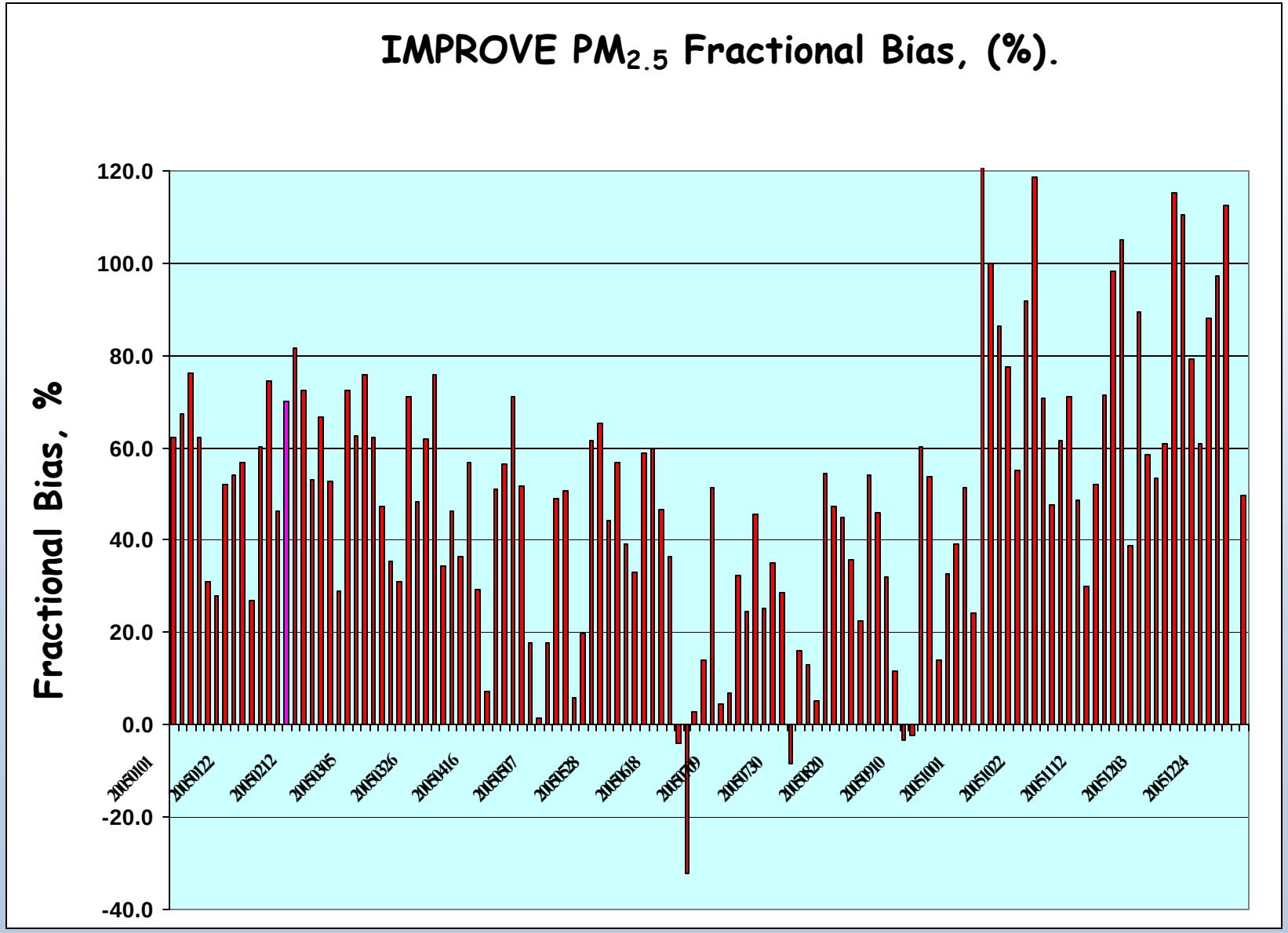
Species	MNB	MNGE	MEAN_C	MEAN_F	RATIO	MB	NMB	MFB	ME	NME	MFE	RSQR	N
IMP-PM2.5	109.4	116.6	9.7	14.7	2.1	5.0	72.0	49.4	6.5	83.1	58.2	0.4	21.4
FRM-PM2.5	115.4	129.5	14.4	18.8	2.2	4.4	38.9	28.6	7.5	58.2	46.4	0.2	145.1
NH4	28.3	79.9	1.3	1.1	1.3	-0.2	7.4	-13.0	0.7	61.1	58.1	-6.5	2.5
NO3	420.4	480.0	1.1	2.0	5.2	1.0	75.3	5.8	1.3	136.9	112.2	0.3	21.8
SO4	67.4	87.1	3.6	4.2	1.7	0.6	32.9	22.6	1.8	57.6	48.0	0.5	21.8
OC	144.7	153.9	2.0	4.0	2.4	1.9	96.9	56.8	2.3	112.6	68.7	0.2	21.5
EC	23.8	68.1	0.4	0.3	1.2	-0.1	-4.9	-8.2	0.2	50.2	51.9	0.3	21.4

Boylan et al	Fractional Bias		Fractional Error	
Species	Goals	Criteria	Goals	Criteria
IMP-PM2.5	35%	60%	50%	75%
FRM-PM2.5	35%	60%	50%	75%
NH4	35%	60%	50%	75%
NO3	35%	60%	50%	75%
SO4	35%	60%	50%	75%
OC	35%	60%	50%	75%
EC	35%	60%	50%	75%

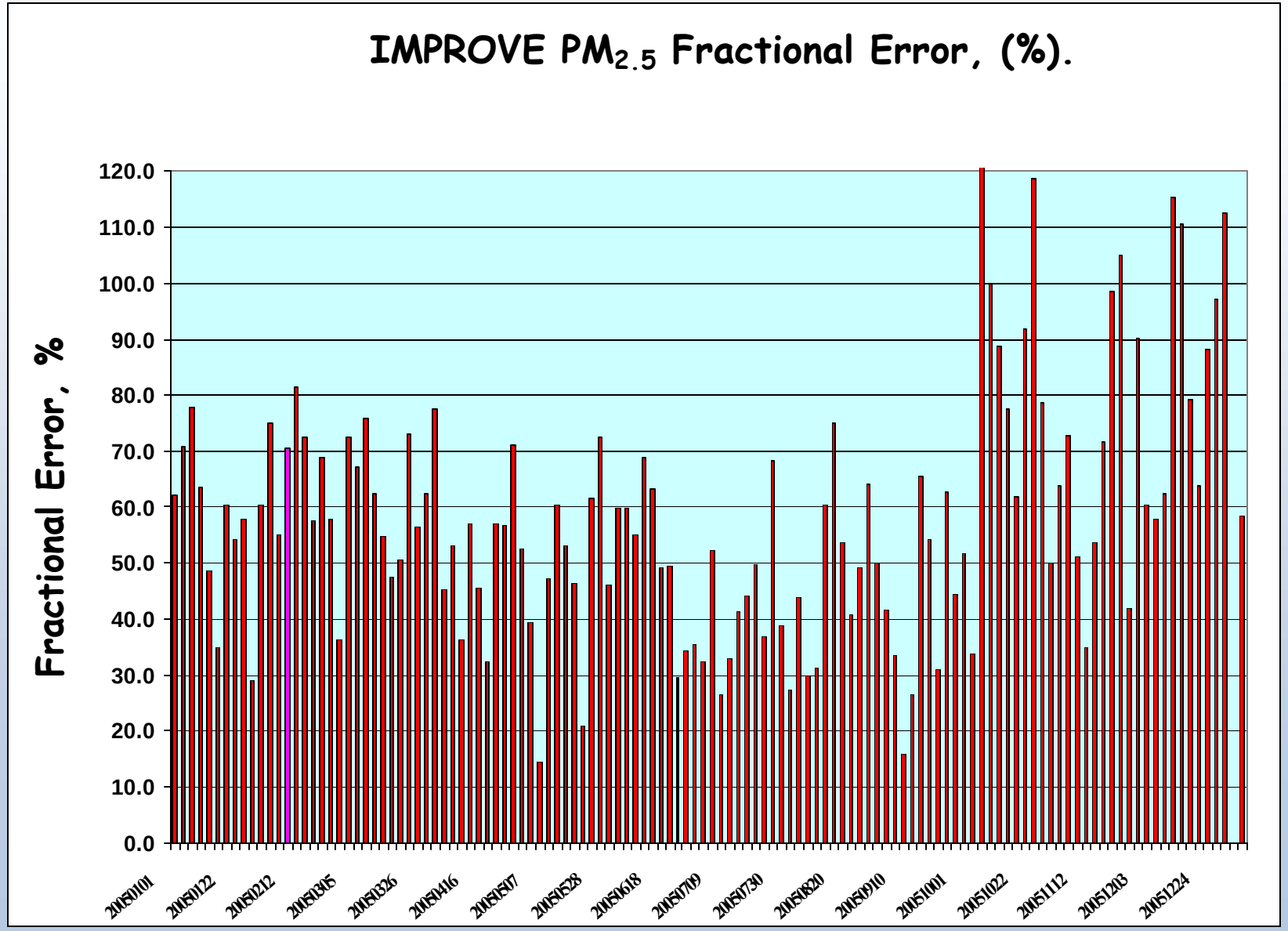
Except for nitrate FE, all species fall within the goals/criteria range being used by VISTAS and CENRAP

Boylan, J., and A. G. Russell, 2006. PM and light extinction model performance metrics, goals, and criteria for three-dimensional air quality models. *Atmospheric Environment*, 40, 4946-4959

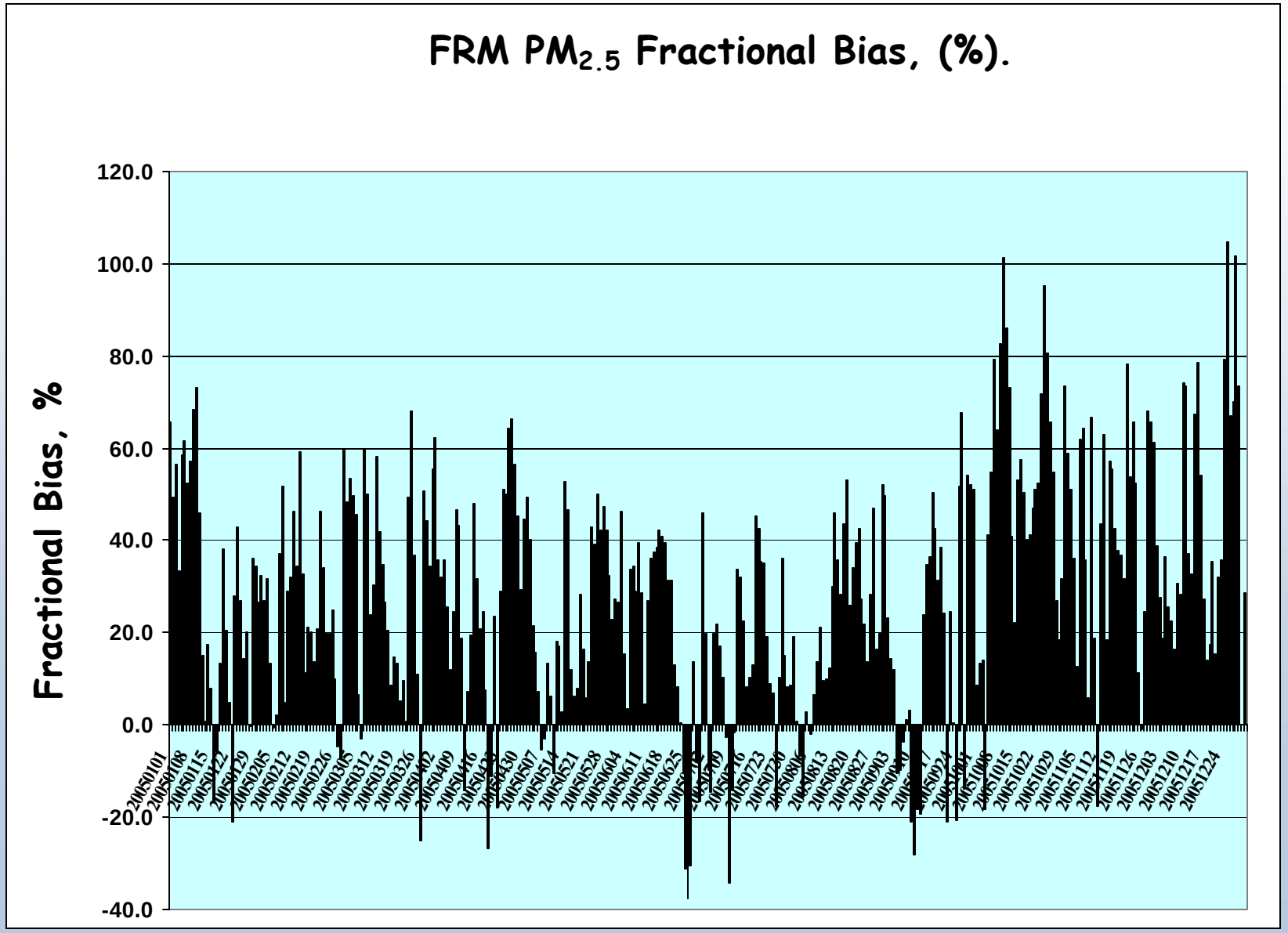
Daily $PM_{2.5}$ Fractional Bias



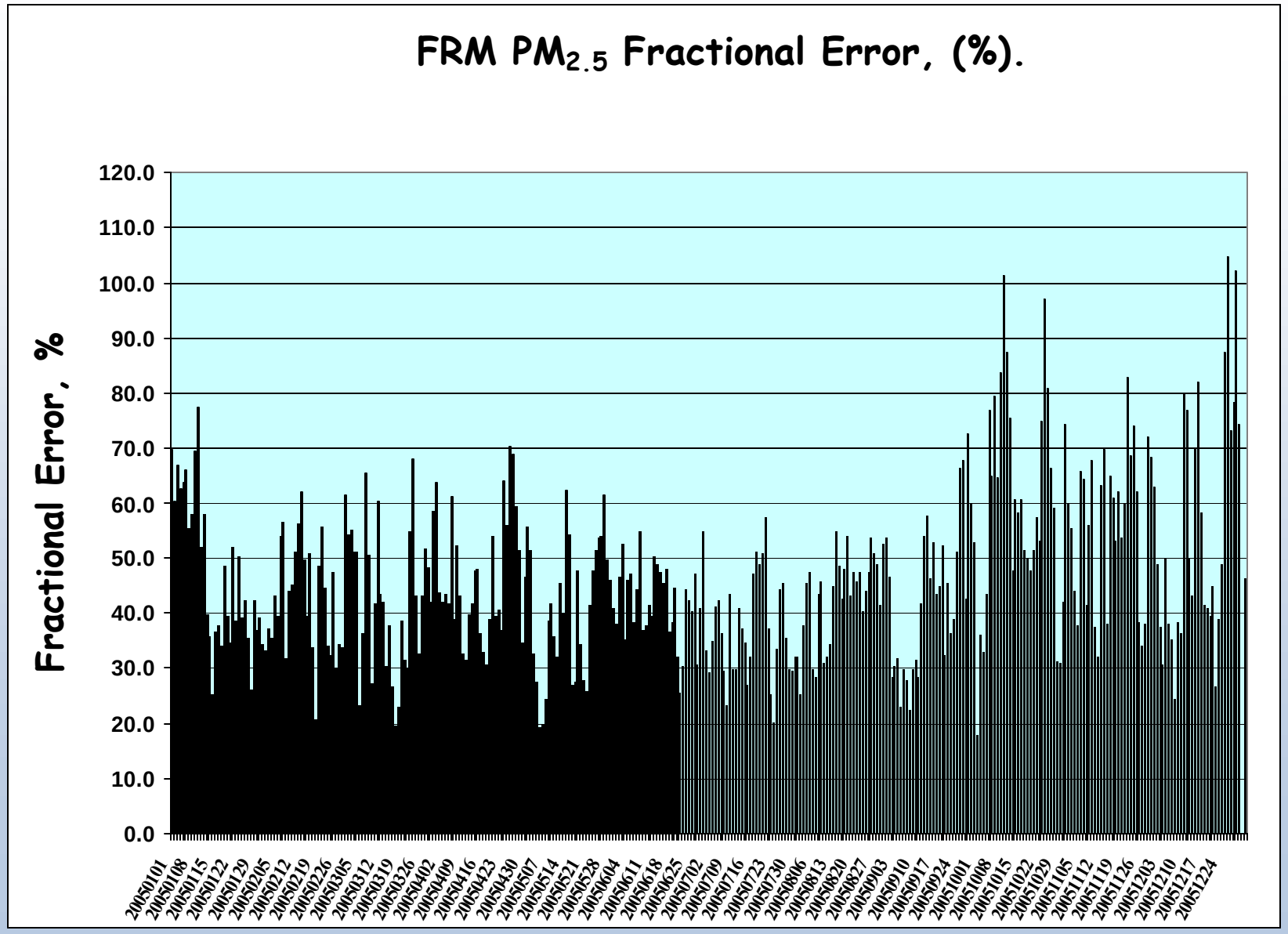
Daily $PM_{2.5}$ Fractional Error



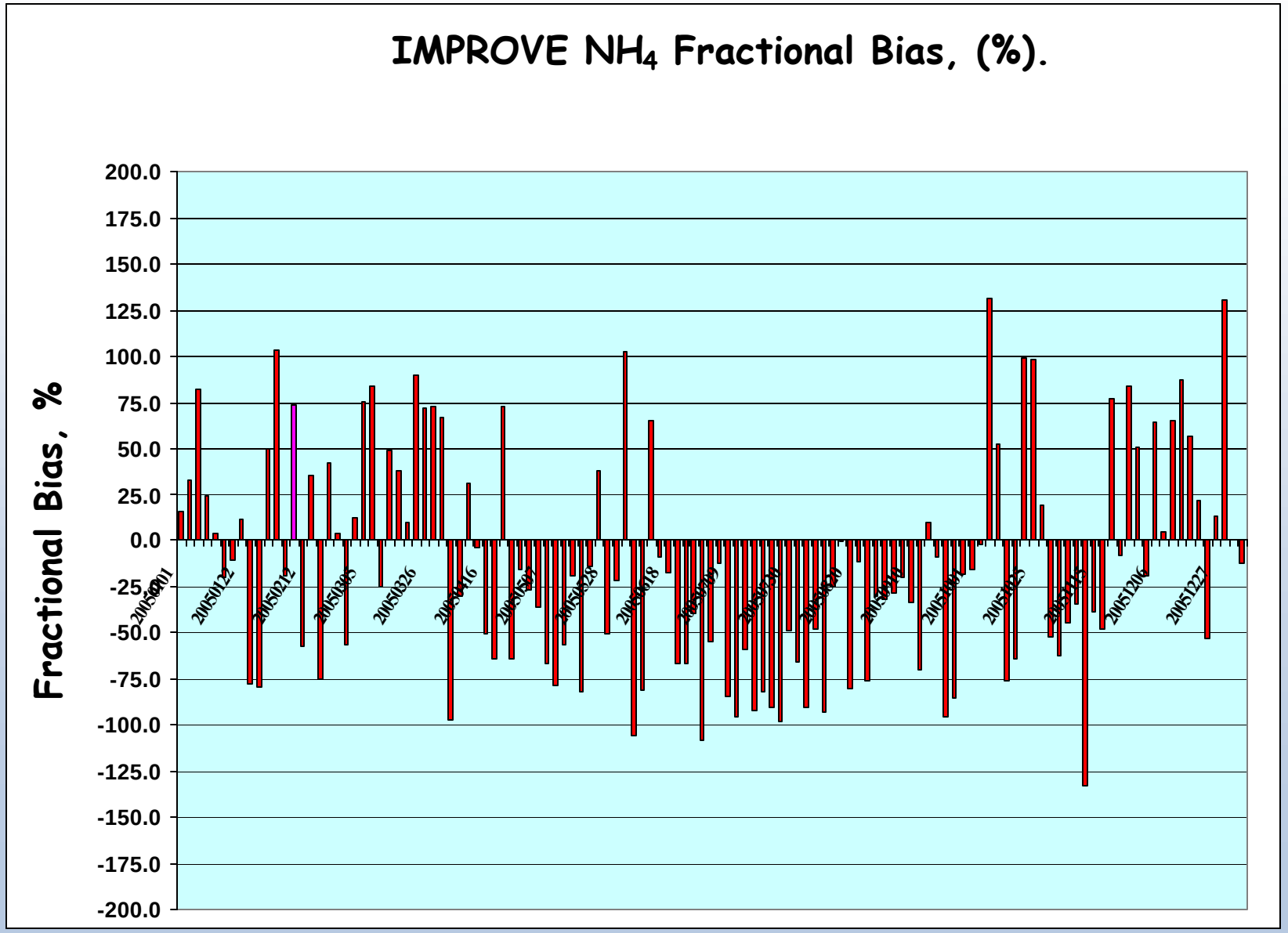
Daily $PM_{2.5}$ Fractional Bias



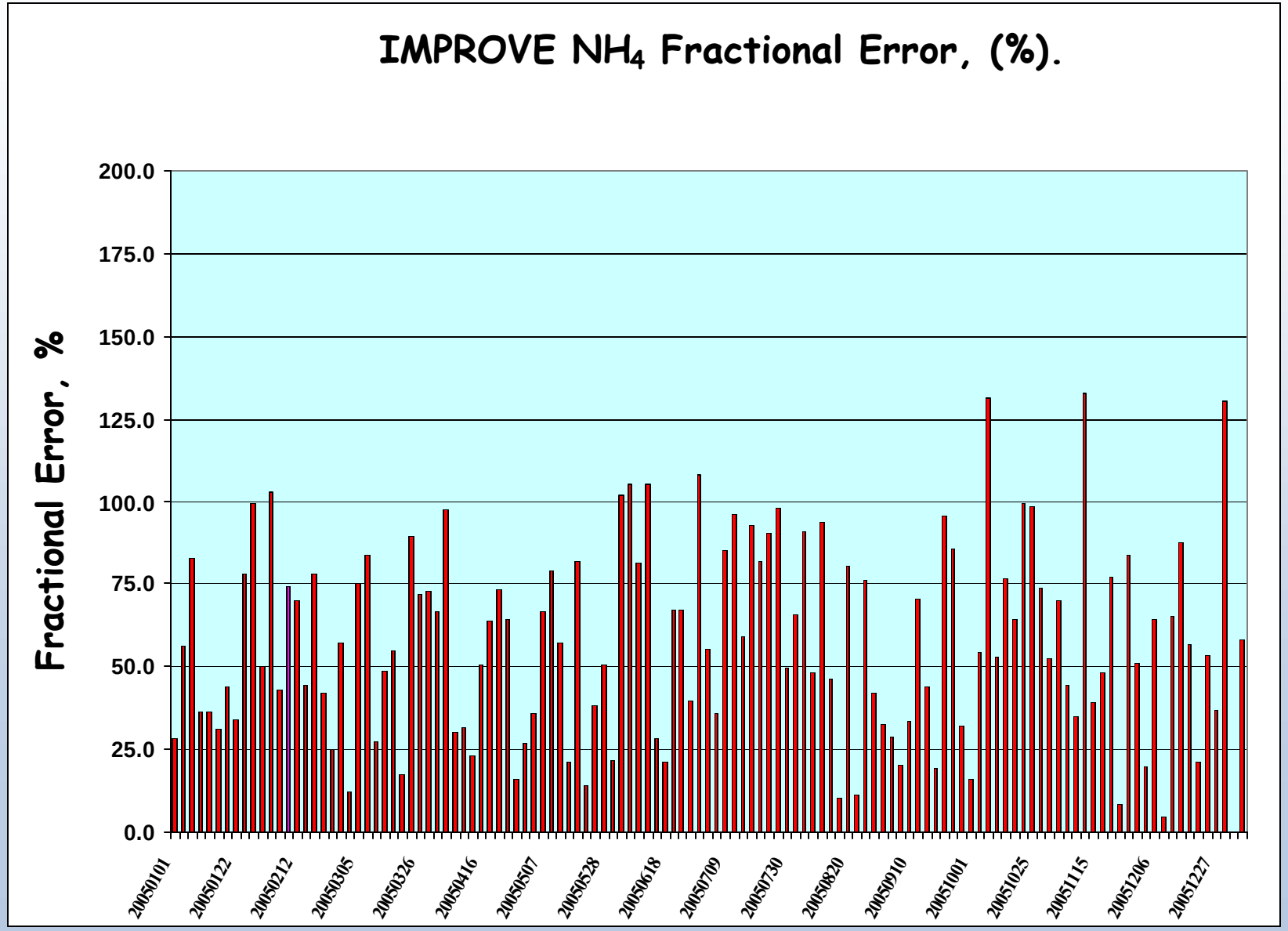
Daily $PM_{2.5}$ Fractional Error



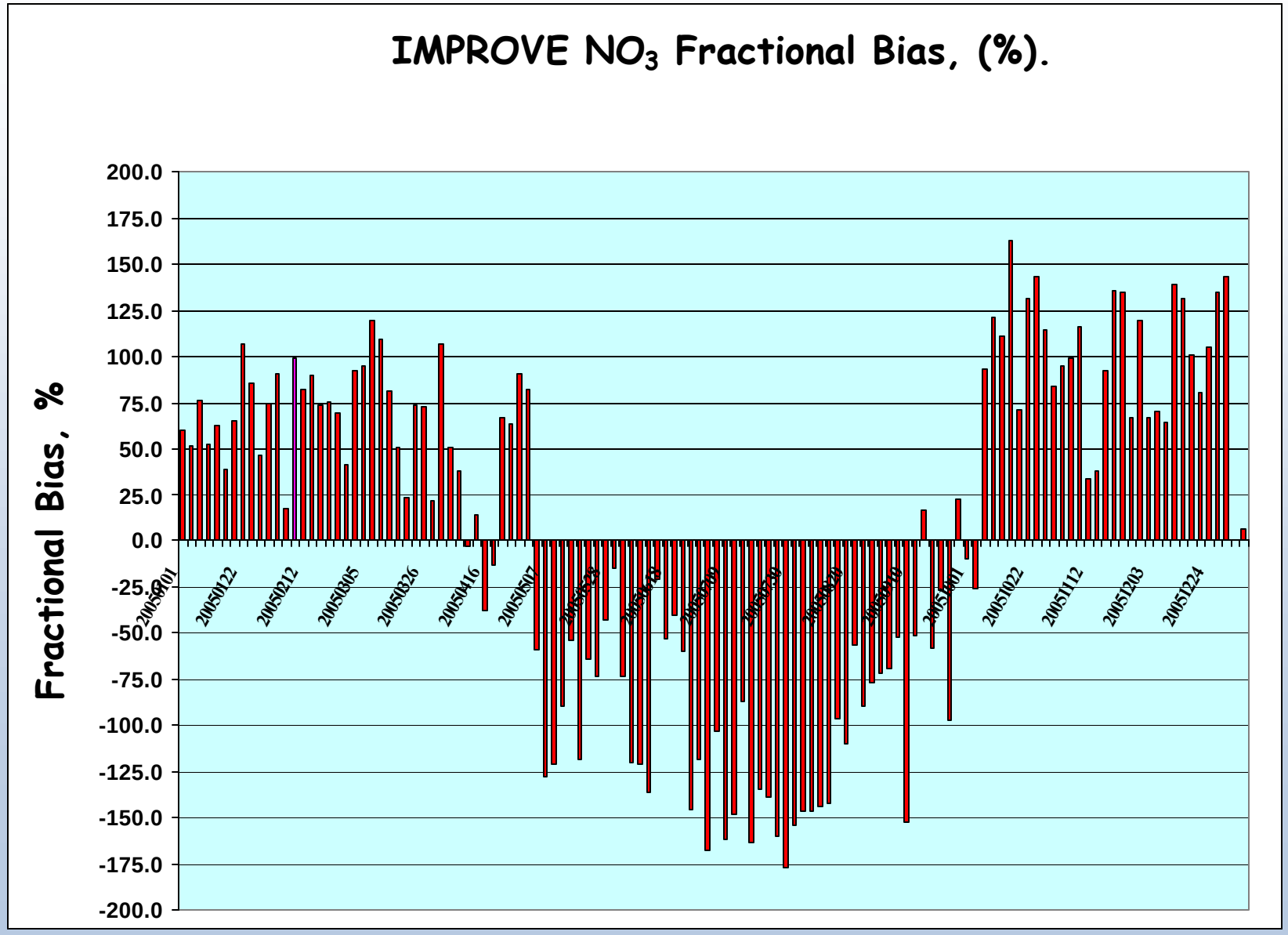
Daily NH_4 Fractional Bias



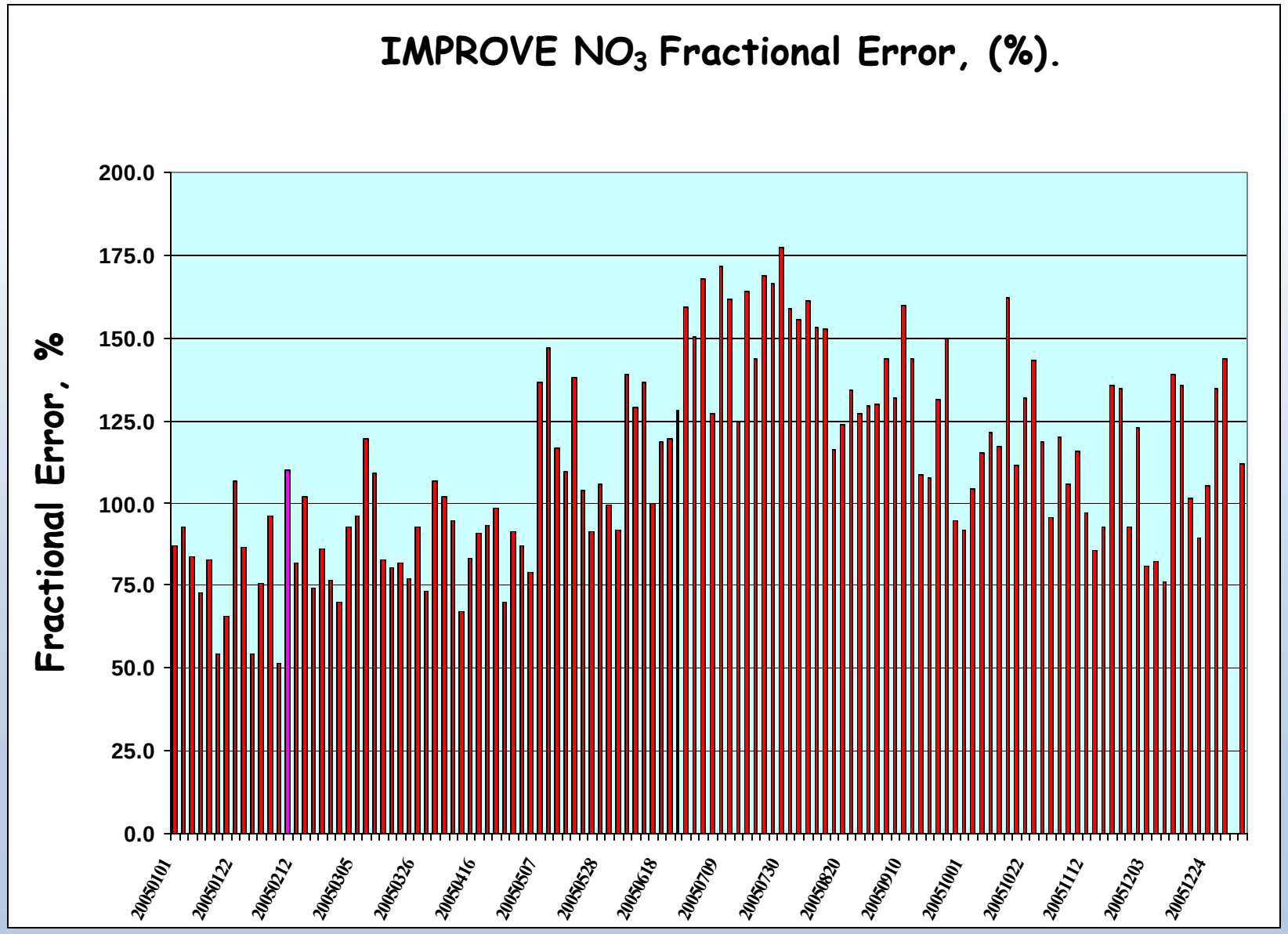
Daily NH_4 Fractional Error



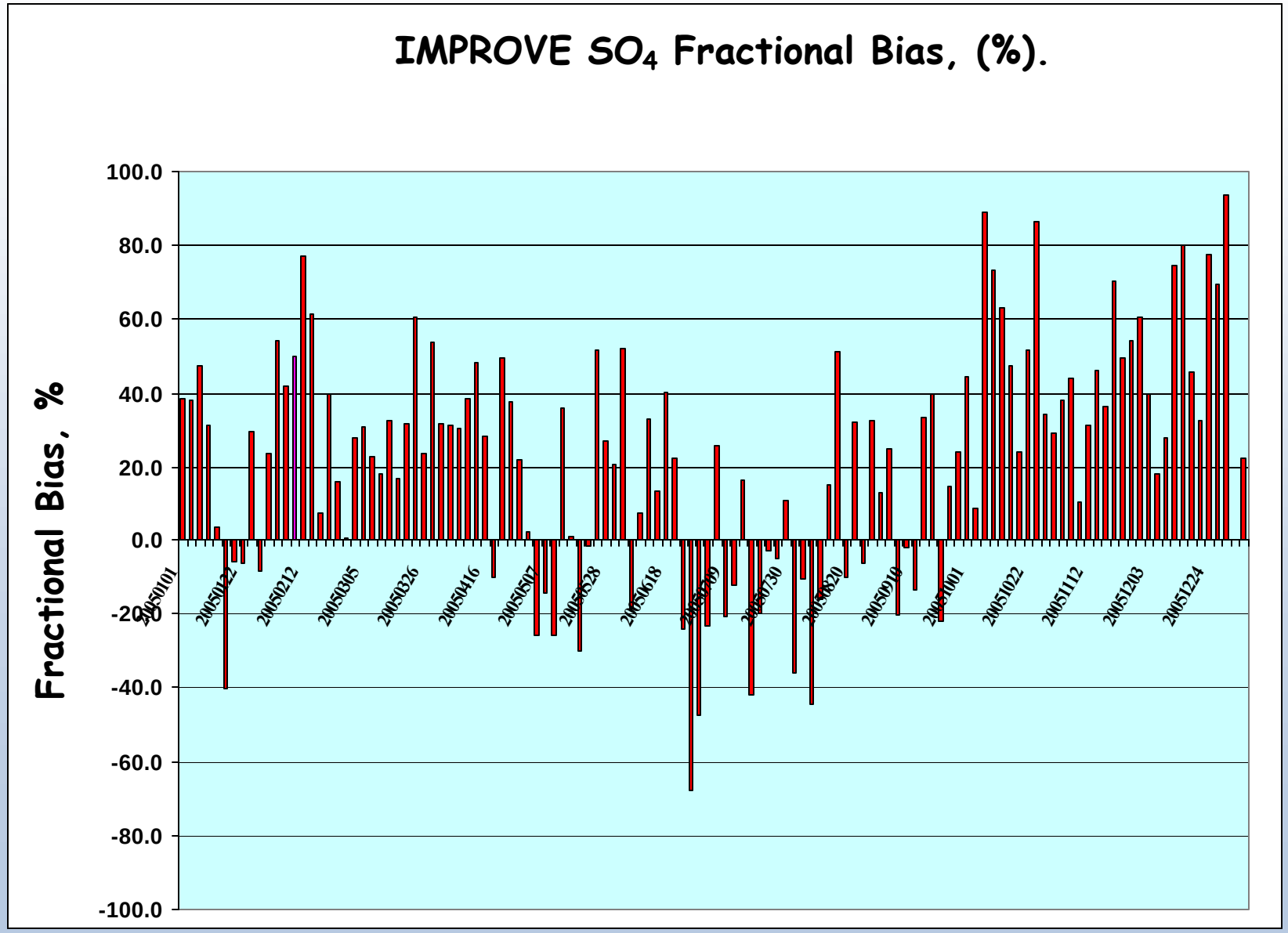
Daily NO_3 Fractional Bias



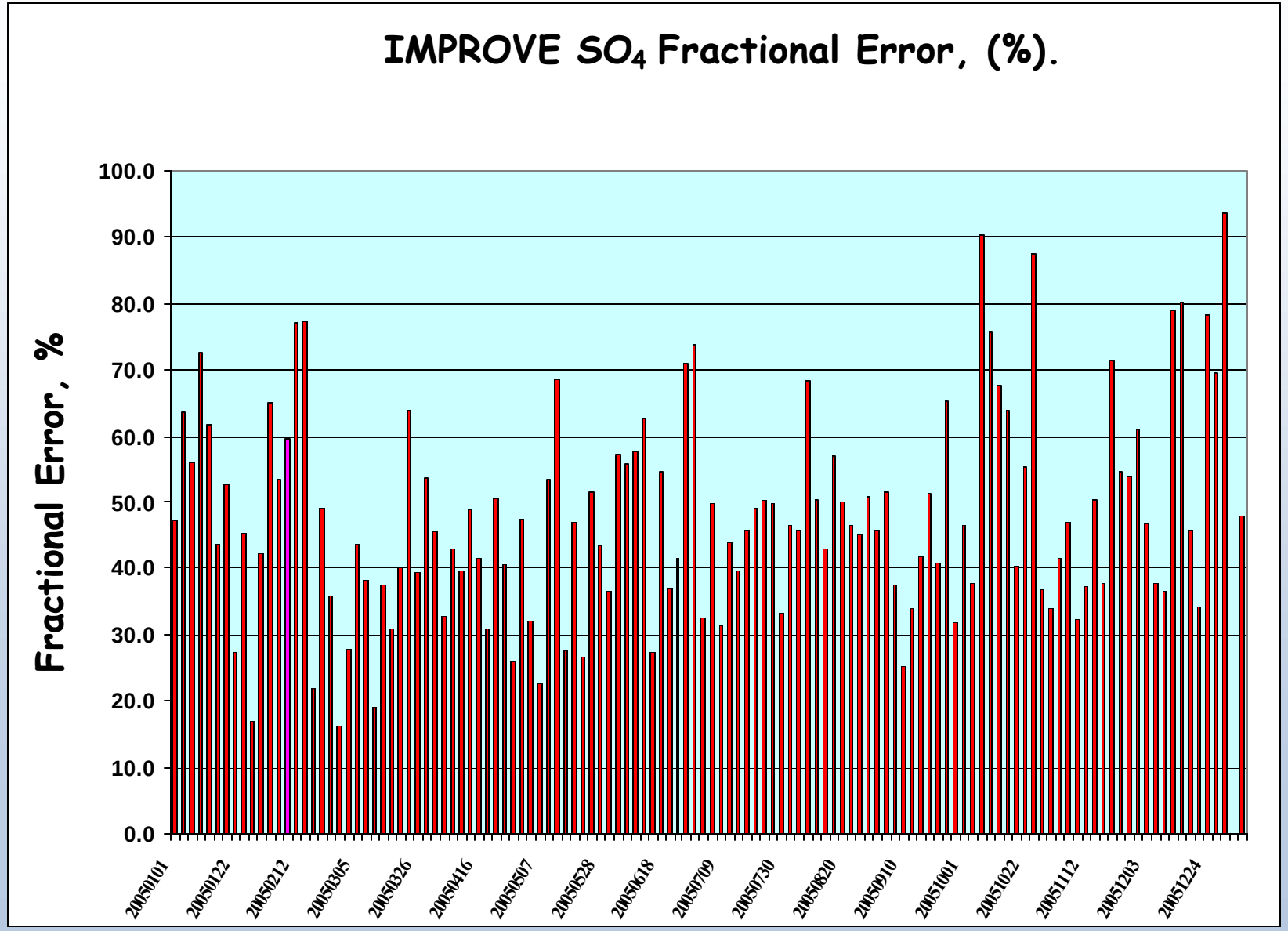
Daily NO_3 Fractional Error



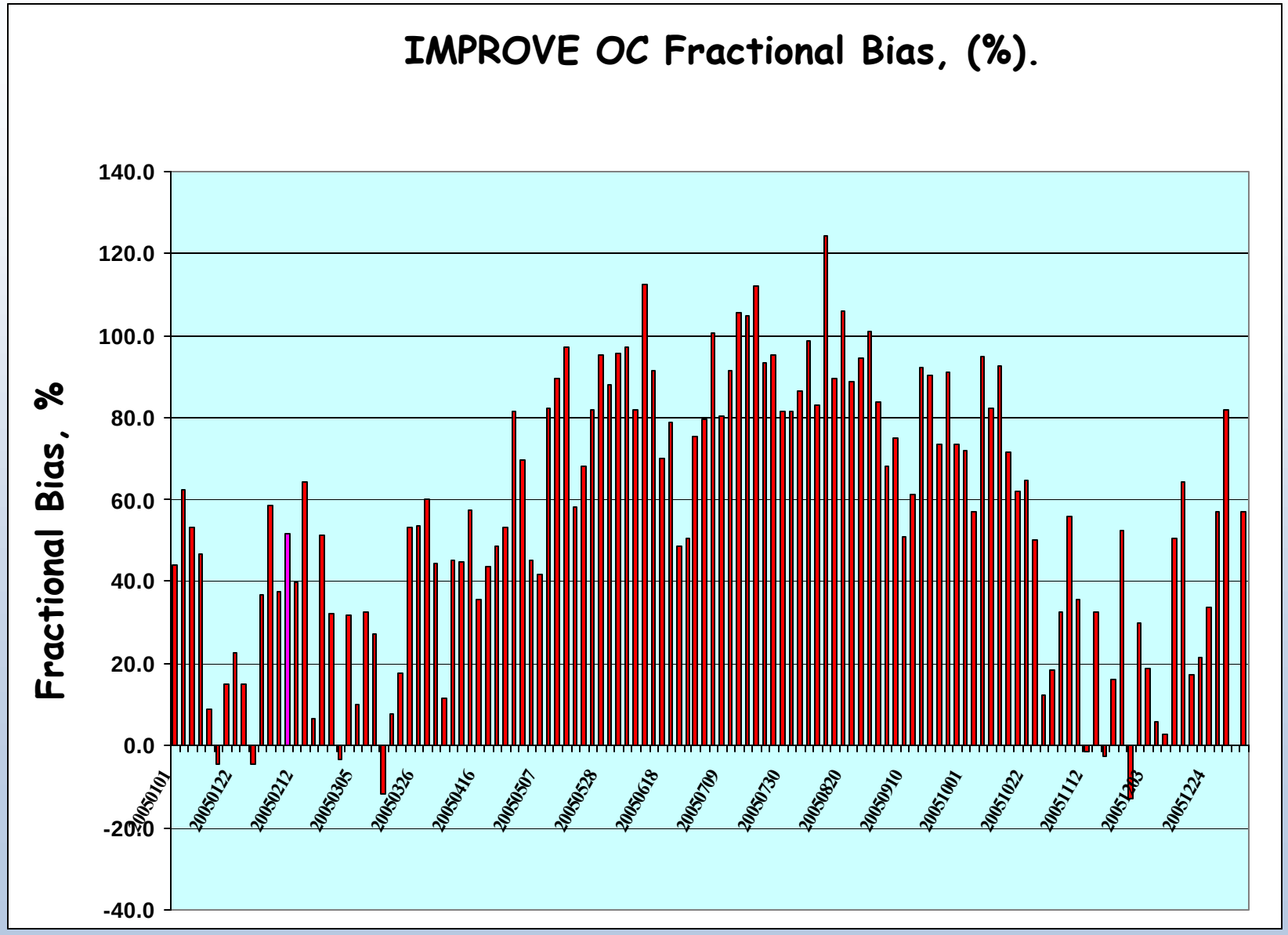
Daily SO_4 Fractional Bias



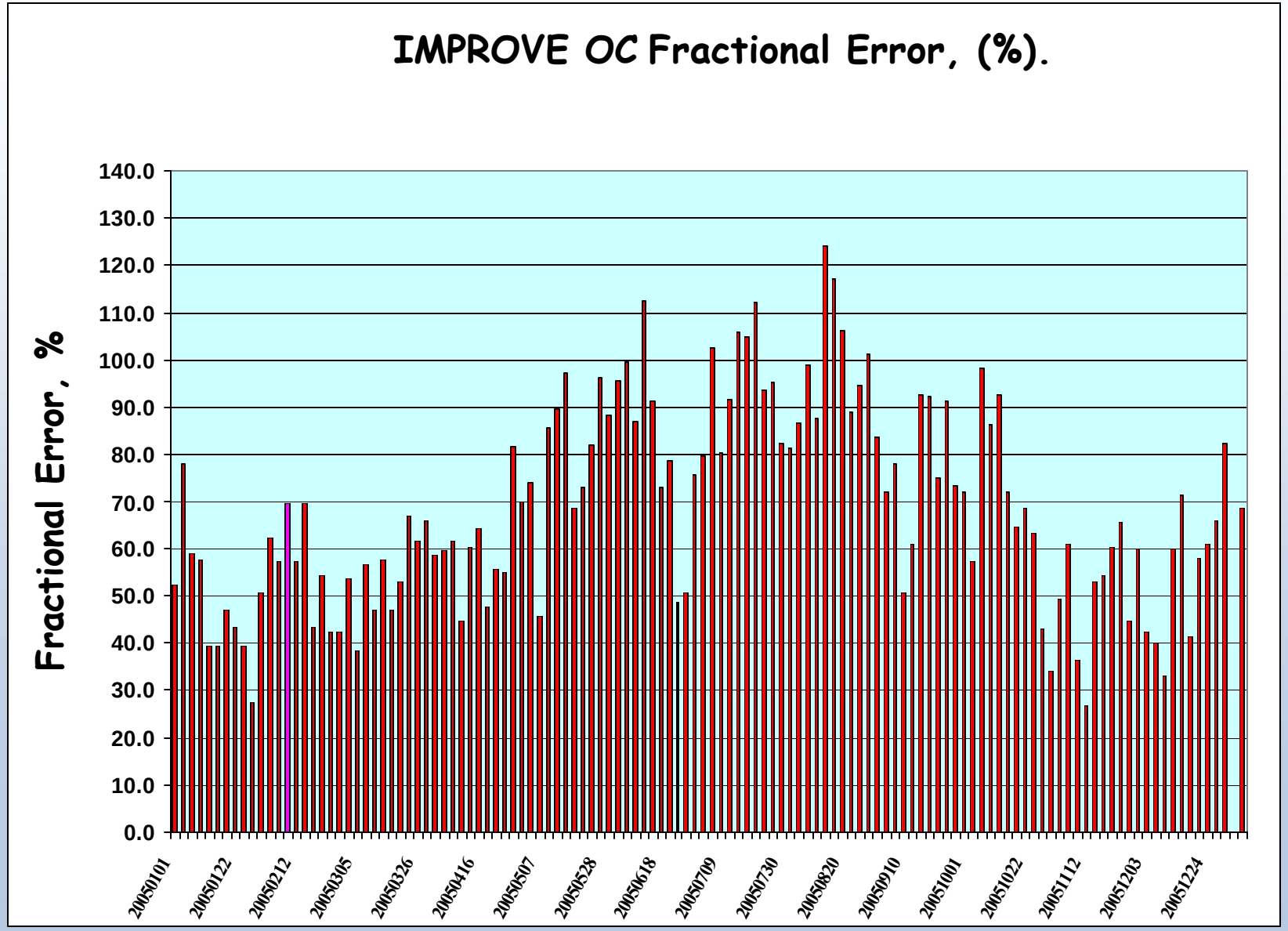
Daily SO_4 Fractional Error



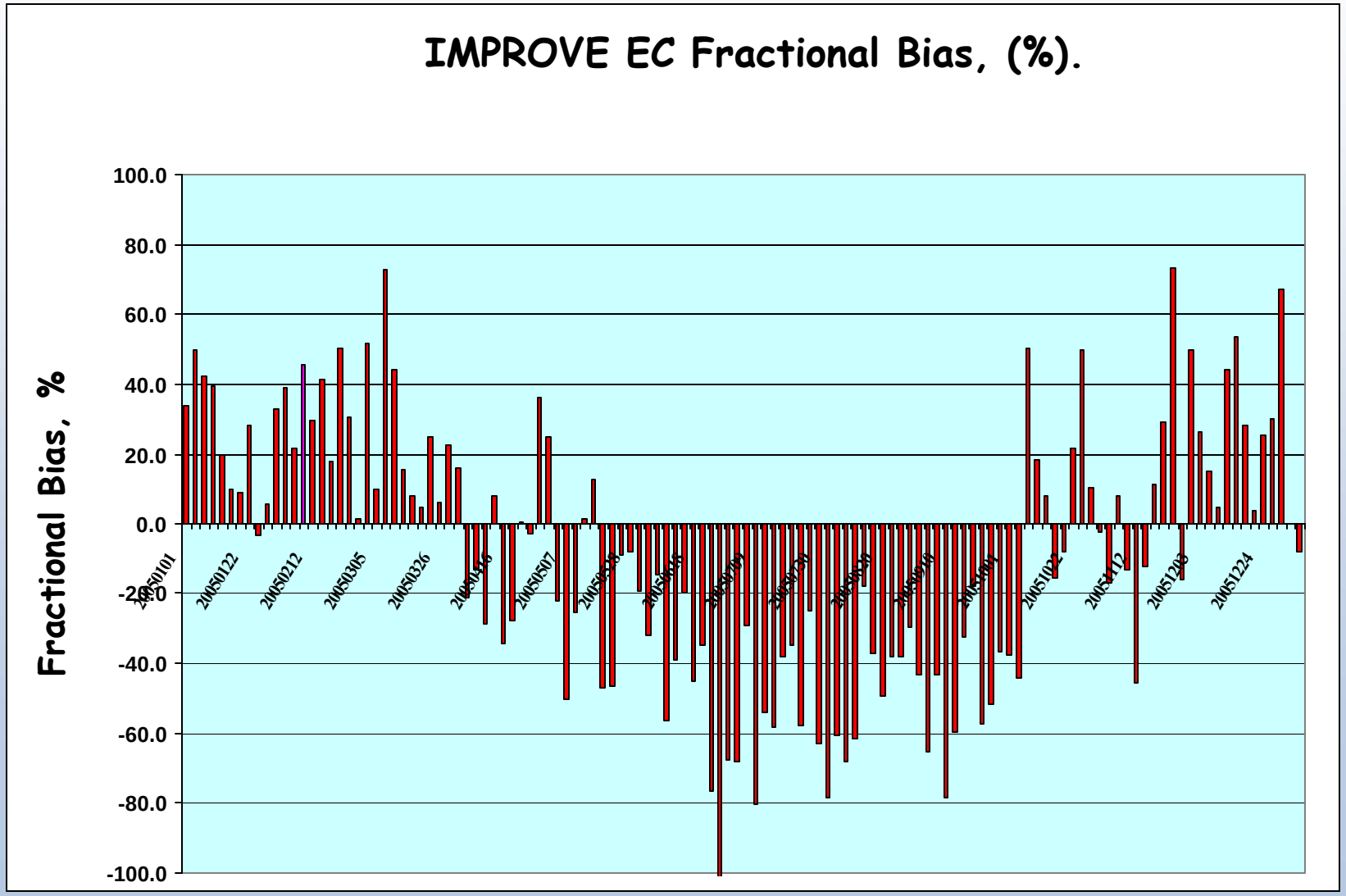
Daily OC Fractional Bias



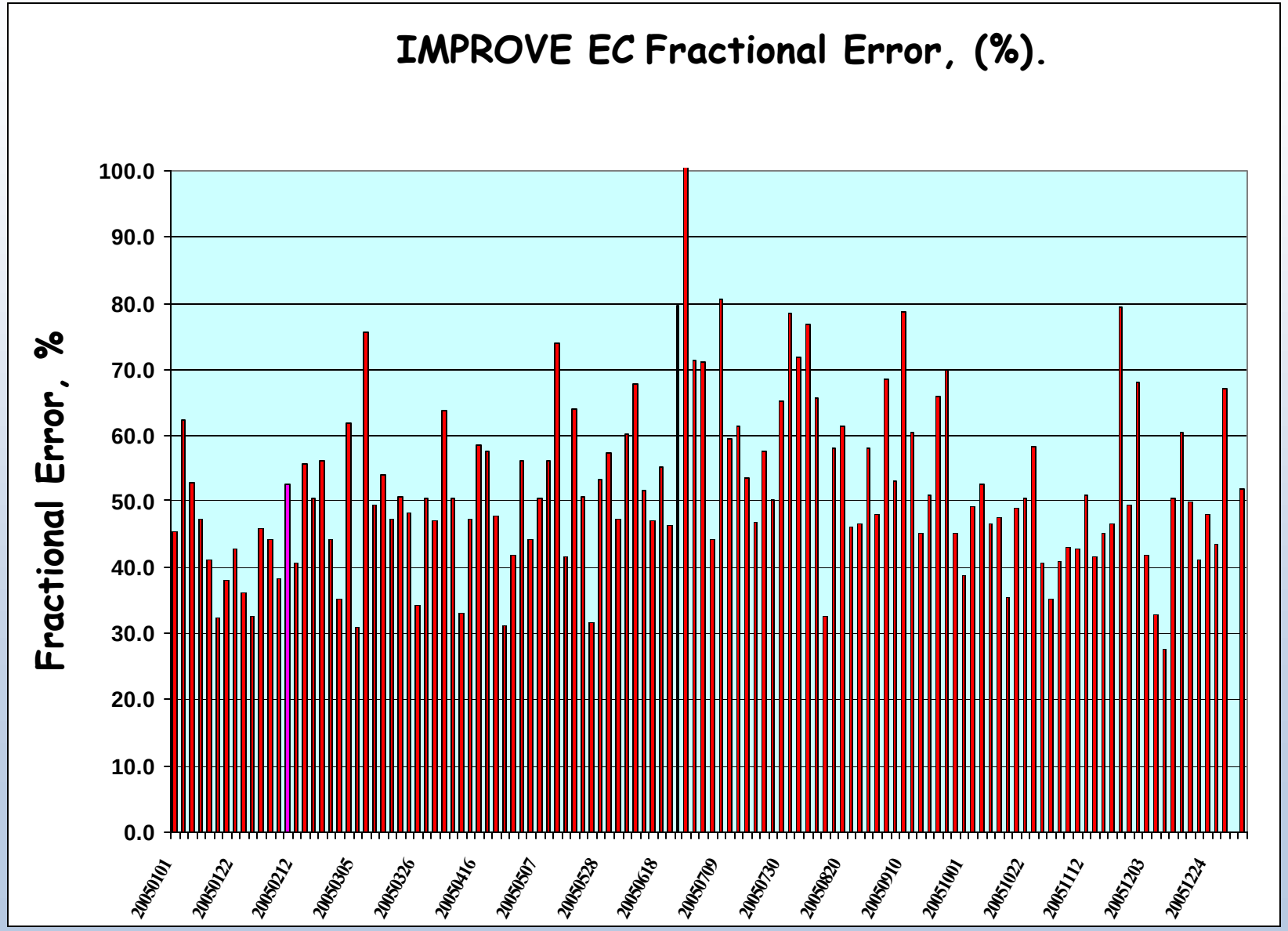
Daily OC Fractional Error



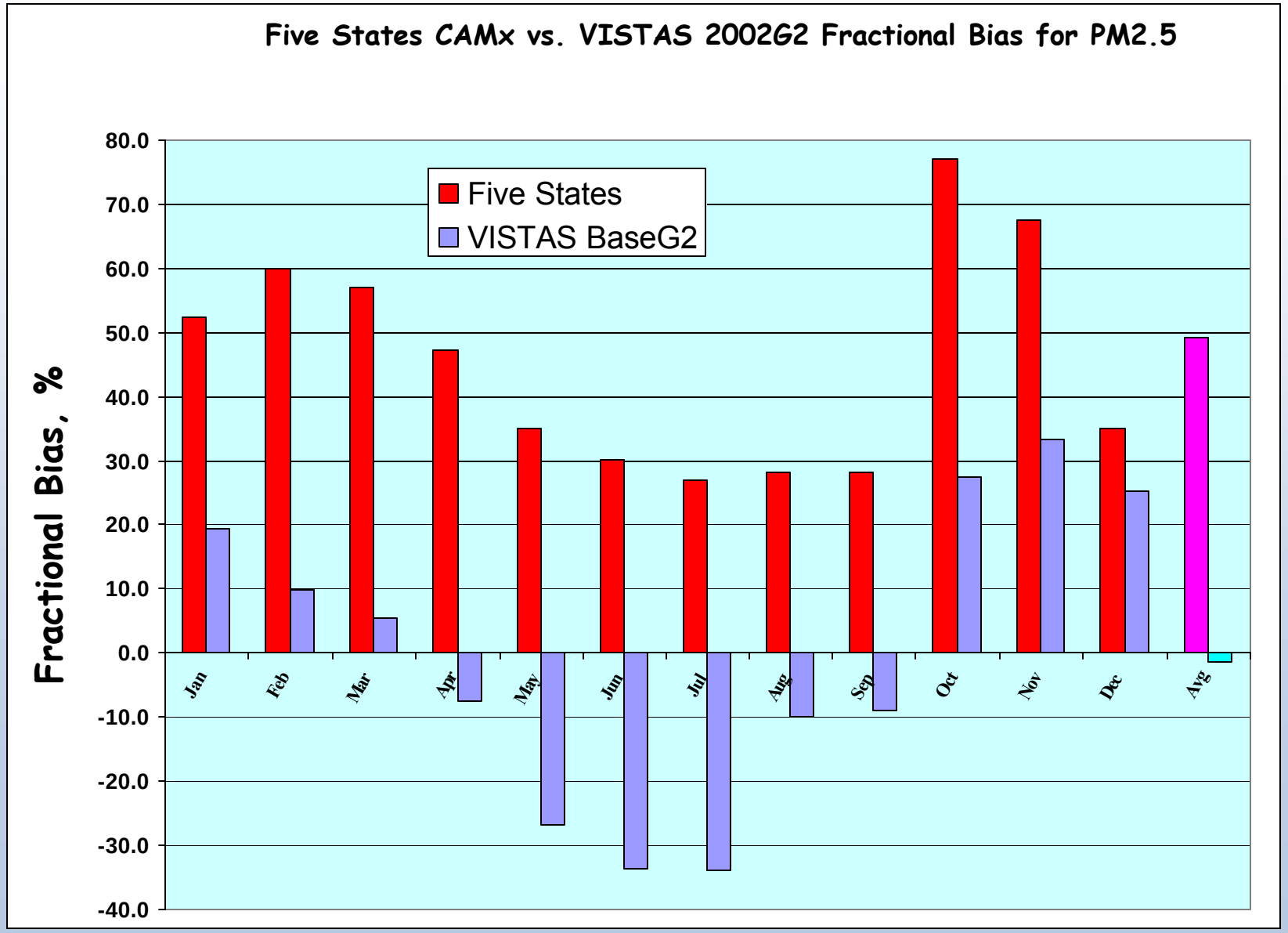
Daily EC Fractional Bias



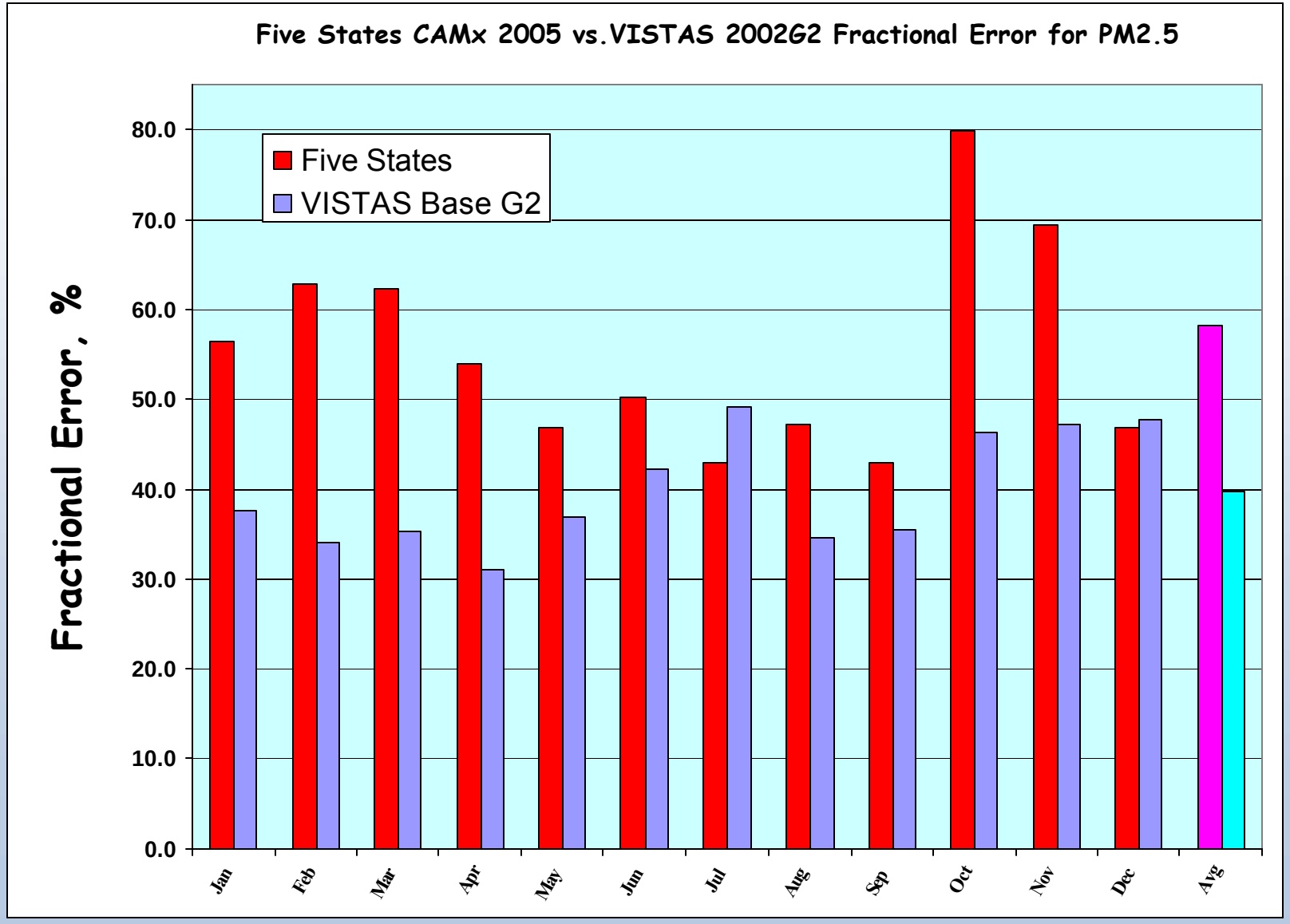
Daily EC Fractional Error



CAMx $PM_{2.5}$ Intercomparison with VISTAS CMAQ Base G2



CAMx $PM_{2.5}$ Intercomparison with VISTAS CMAQ Base G2



8-hr Ozone Attainment Demonstration for 2008 and 2015 on the 4 km and 12 km Grids

8-hr Ozone Attainment Test

RRF is based on modeled data [2015/2005]

DV_C is based on observed data

$$DV_F = \mathbf{RRF} * DV_C$$

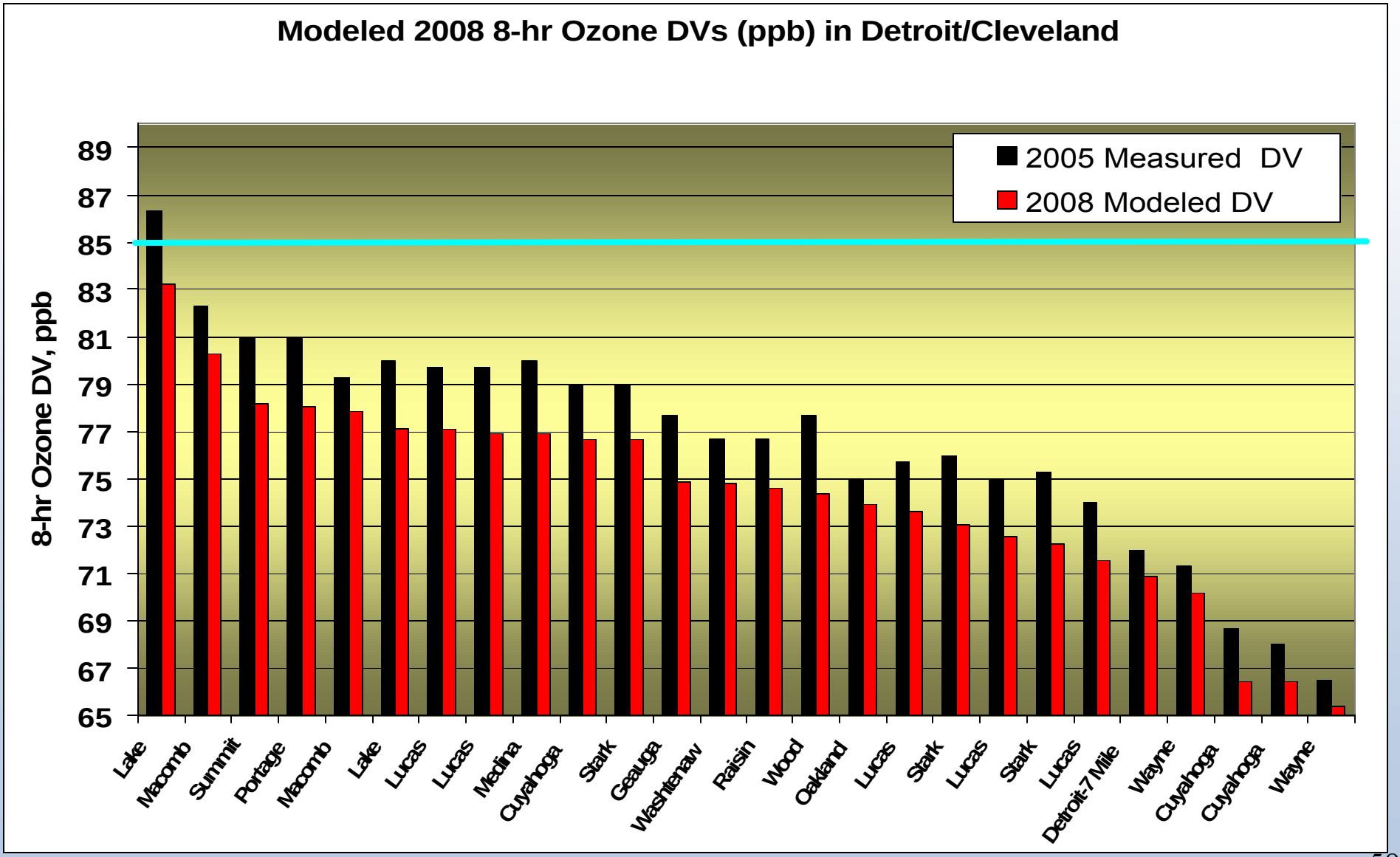
$$\frac{\textit{Future (2015) modeled values}}{\textit{Baseline(2005) modeled values}}$$

If DVf £ 84 ppb, the test is passed.

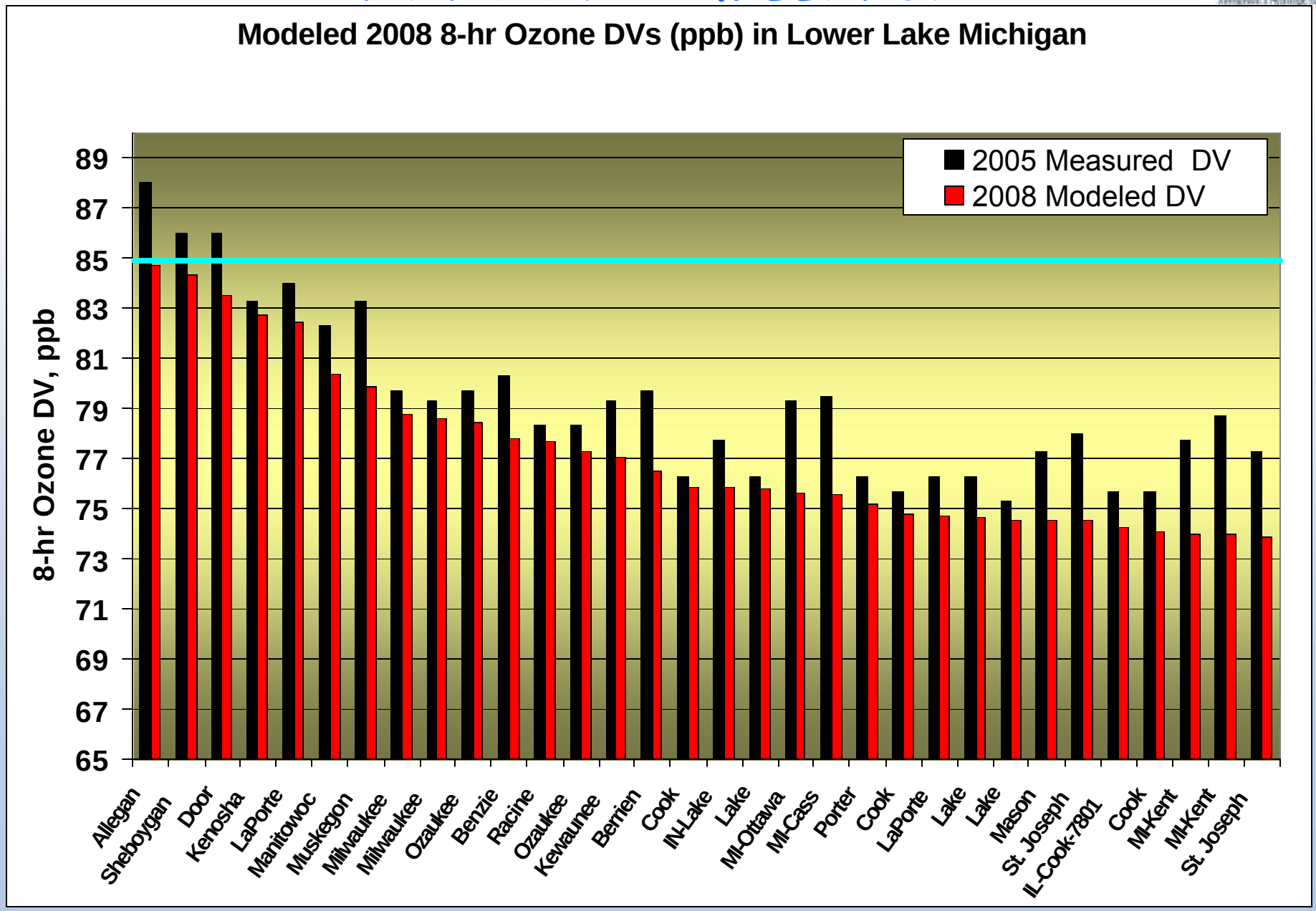
8-hr Ozone Attainment Modeling on 12/4 km Grids

- 8-hr Ozone DVs obtained from MRPO (10 May ’07)
- Formal EPA 8-hr Attainment Test applied on
  - Detroit/Cleveland and Lower Lake Michigan 4 km grids
  - Five States region on 12 km grid

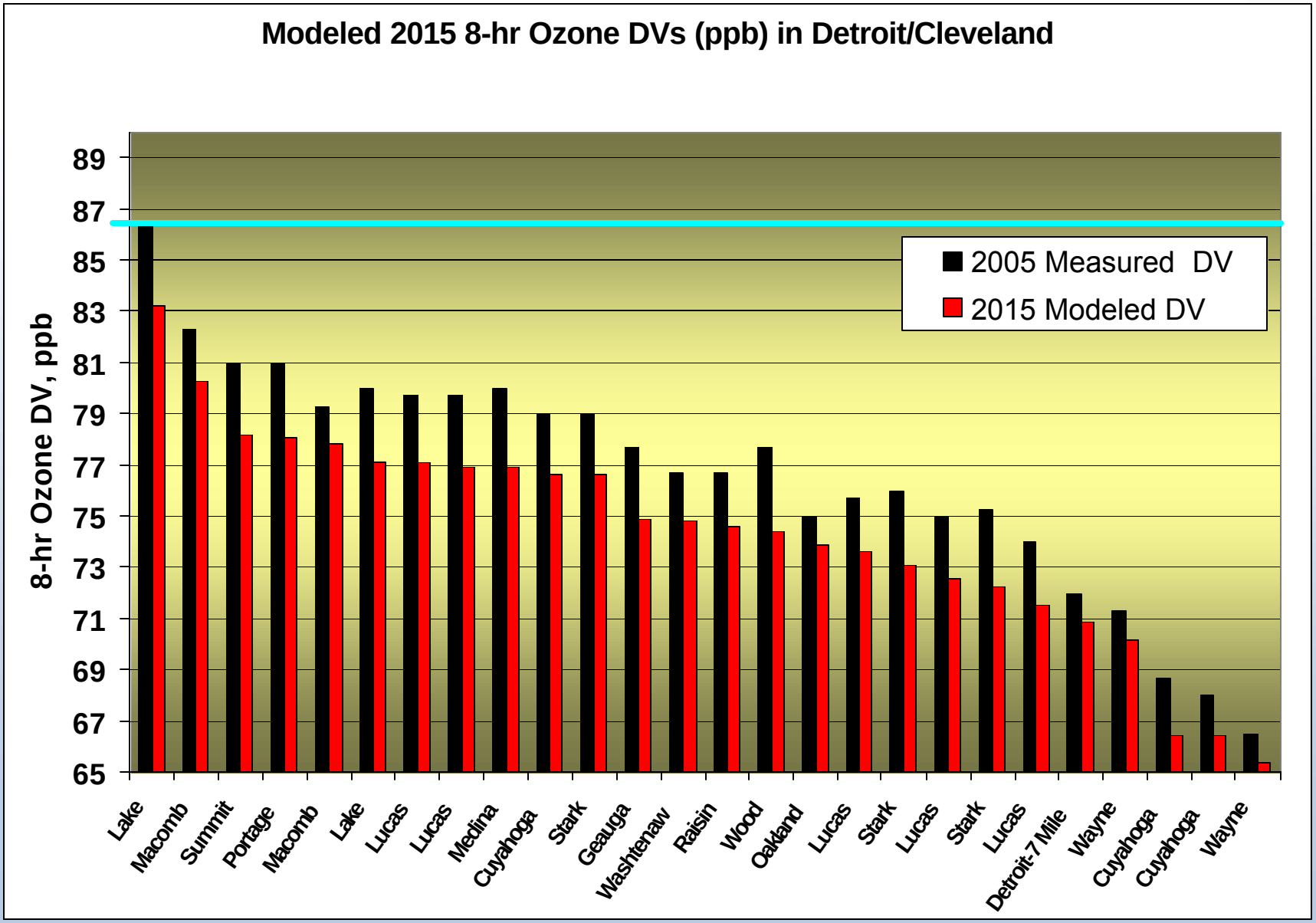
Modeled 2008 8-hr Ozone Design Values on 4 km D/C Grid



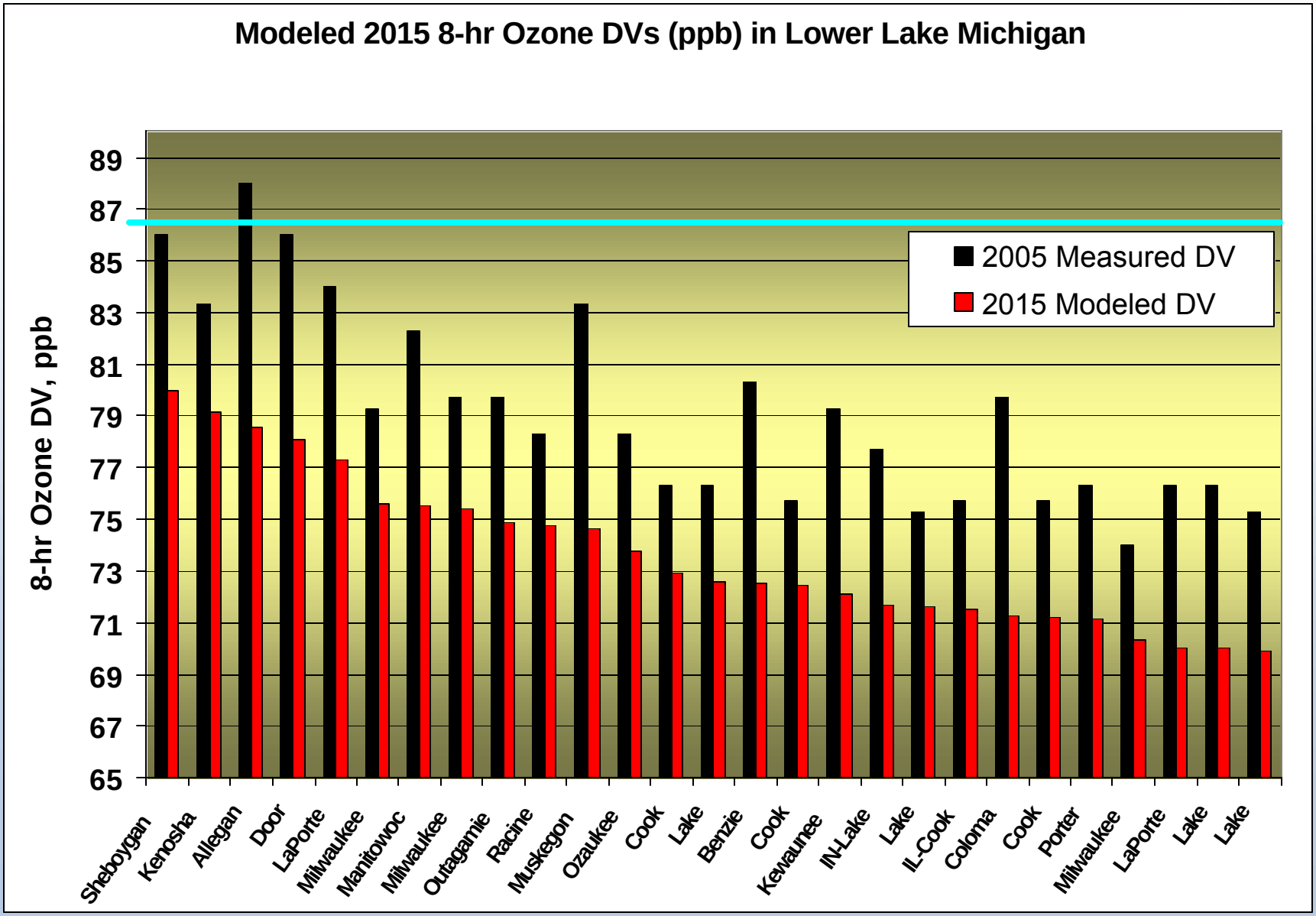
Modeled 2008 8-hr Ozone Design Values on 4 km LLM Grid



Modeled 2015 8-hr Ozone Design Values on 4 km D/C Grid



Modeled 2015 8-hr Ozone Design Values on 4 km LLM Grid



2008 8-hr Ozone Design Values for Detroit/Cleveland 4 km Domain

				MRPO '05					2008	2008
Long Name	County	City or Monitor	MSA	DVC	THRESH -1ppb	AYS >Thr	DVBM	DVFM	RRF	FDV
390850003	Lake	Eastlake	Cleveland-Lorair	86.3	85	34	95.62	92.24	0.960	83.24
260990009	Macomb	New Haven	Detroit MI	82.3	85	15	92.58	90.31	0.980	80.28
391530020	Summit	Akron-Patterson	Akron OH	81.0	85	12	92.86	89.62	0.970	78.17
391331001	Portage	Akron-Revenna	Akron OH	81.0	85	14	90.76	87.46	0.960	78.05
260991003	Macomb	Warren Fire Sta	Detroit MI	79.3	85	22	91.25	89.56	0.980	77.83
390853002	Lake	Painesville	Cleveland-Lorair	80.0	85	31	96.01	92.58	0.960	77.14
390950034	Lucas	Jerusalem Twp	Toledo OH	79.7	85	20	95.73	92.62	0.970	77.11
390950081	Lucas	Toledo-Shelter	Toledo OH	79.7	85	15	98.60	95.17	0.970	76.93
391030003	Medina	Lafayette Twp	Cleveland-Lorair	80.0	82	11	91.88	88.33	0.960	76.91
390355002	Cuyahoga	Mayfield	Cleveland-Lorair	79.0	85	32	92.53	89.78	0.970	76.66
391514005	Stark	Alliance	Canton-Massillo	79.0	84	11	89.71	87.02	0.970	76.64
390550004	Geauga	Geauga	Cleveland-Lorair	77.7	85	21	90.69	87.42	0.960	74.90
261610008	Washtenaw	Ypsilanti	Ann Arbor MI	76.7	82	11	91.59	89.33	0.980	74.81
260910007	Raisin	Raisin Center	Raisin Center	76.7	79	10	85.76	83.4	0.970	74.59
391730003	Wood	Bowling Green	Toledo OH	77.7	77	10	80.39	76.95	0.960	74.37
261250001	Oakland	Oak Park	Detroit MI	75.0	85	15	93.66	92.27	0.990	73.88
390950027	Lucas	Waterville	Toledo OH	75.7	80	10	84.07	81.79	0.970	73.65
391510016	Stark	Canton	Canton-Massillo	76.0	84	11	89.95	86.49	0.960	73.07
390930018	Lucas	Toledo-Erie St	Toledo OH	75.0	85	21	95.38	92.29	0.970	72.57
391510021	Stark	Brewster	Canton-Massillo	75.3	83	12	87.56	84.05	0.960	72.28
390950024	Lucas	Toledo-Erie St	Toledo OH	74.0	85	16	95.44	92.26	0.970	71.54
261630019	Detroit-7 Mile		Detroit-7 Mile	72.0	85	17	90.87	89.44	0.980	70.87
261630016	Wayne	Detroit-Linwood	Detroit MI	71.3	85	13	90.60	89.2	0.980	70.19
390350034	Cuyahoga	Cleveland	Cleveland-Lorair	68.7	85	34	94.82	91.65	0.970	66.41
390350064	Cuyahoga	Berea	Cleveland-Lorair	68.0	84	11	97.12	94.84	0.980	66.41
261630001	Wayne	Allen Park	Detroit MI	66.5	85	12	90.37	88.83	0.980	65.37

2015 8-hr Ozone Design Values for the Detroit/Cleveland 4 km Domain

				MRPO '05					2015	2015
Long Name	County	City or Monitor	MSA	DVC	THRESH -1ppb	AYS >Thr	DVBM	DVFM	RRF	FDV
390850003	Lake	Eastlake	Cleveland-Lorair	86.3	85	34	95.62	83.40	0.870	75.27
260990009	Macomb	New Haven	Detroit MI	82.3	85	15	92.58	84.18	0.910	74.83
260991003	Macomb	Warren Fire Sta	Detroit MI	79.3	85	22	91.25	83.84	0.920	72.86
390950034	Lucas	Jerusalem Twp	Toledo OH	79.7	85	20	95.73	85.64	0.890	71.30
390950081	Lucas	Toledo-Shelter	Toledo OH	79.7	85	15	98.60	87.69	0.890	70.88
391530020	Summit	Akron-Patterson	Akron OH	81.0	85	12	92.86	81.11	0.870	70.75
261610008	Washtenaw	Ypsilanti	Ann Arbor MI	76.7	82	11	91.59	84.05	0.920	70.39
391331001	Portage	Akron-Revenna	Akron OH	81.0	85	14	90.76	78.31	0.860	69.89
390355002	Cuyahoga	Mayfield	Cleveland-Lorair	79.0	85	32	92.53	81.44	0.880	69.54
261250001	Oakland	Oak Park	Detroit MI	75.0	85	15	93.66	86.73	0.930	69.45
390853002	Lake	Painesville	Cleveland-Lorair	80.0	85	31	96.01	83.35	0.870	69.45
391030003	Medina	Lafayette Twp	Cleveland-Lorair	80.0	82	11	91.88	79.02	0.860	68.81
391730003	Wood	Bowling Green	Toledo OH	77.7	77	10	80.39	70.74	0.880	68.37
390950027	Lucas	Waterville	Toledo OH	75.7	80	10	84.07	75.79	0.900	68.25
391514005	Stark	Alliance	Canton-Massillor	79.0	84	11	89.71	77.28	0.860	68.05
261630019	7 Mile		Detroit-7 Mile	72.0	85	17	90.87	84.33	0.930	66.82
390930018	Lucas	Toledo-Erie St	Toledo OH	75.0	85	21	95.38	84.75	0.890	66.64
390550004	Geauga	Geauga	Cleveland-Lorair	77.7	85	21	90.69	77.69	0.860	66.56
261630016	Wayne	Detroit-Linwood	Detroit MI	71.3	85	13	90.60	84.55	0.930	66.54
390950024	Lucas	Toledo-Erie St	Toledo OH	74.0	85	16	95.44	85.44	0.900	66.25
391510021	Stark	Brewster	Canton-Massillor	75.3	83	12	87.56	76.88	0.880	66.12
391510016	Stark	Canton	Canton-Massillor	76.0	84	11	89.95	77.57	0.860	65.54
261630001	Wayne	Allen Park	Detroit MI	66.5	85	12	90.37	84.00	0.930	61.82
390350064	Cuyahoga	Berea	Cleveland-Lorair	68.0	84	11	97.12	87.38	0.900	61.18
390350034	Cuyahoga	Cleveland	Cleveland-Lorair	68.7	85	34	94.82	83.19	0.880	60.28

2008 8-hr Ozone Design Values for the Lower Lake Michigan 4 km Domain

				MRPO '05					2008	2008
Long Name	County	City or Monitor	MSA	DVC	THRESH -1ppb	AYS >Thr	DVBM	DVFM	RRF	FDV
Long Name					DVBM	DVFM	RRF	FDV		
260050003	Allegan	Holland	Grand Rapids-M	88.0	85	19	99.22	95.55	0.960	84.74
551170006	Sheboygan	Kohler Andre Pk	Sheboygan WI	86.0	85	19	100.29	98.34	0.980	84.33
550290004	Door	Door County		86.0	85	14	96.43	93.64	0.970	83.51
550590019	Kenosha	Pleasant Prairie	Kenosha WI	83.3	85	21	95.73	95.05	0.990	82.71
180910010	LaPorte	La Porte	La Porte	84.0	85	12	96.82	95.06	0.980	82.47
550710007	Manitowoc	Manitowoc		82.3	85	18	98.42	96.10	0.980	80.36
261210039	Muskegon	Muskegon	Grand Rapids-M	83.3	85	24	97.11	93.10	0.960	79.86
550790085	Milwaukee	Bayside	Milwaukee-Wauk	79.7	85	20	96.93	95.82	0.990	78.78
550790041	Milwaukee	Milwaukee-UWM	Milwaukee-Wauk	79.3	85	19	97.74	96.88	0.990	78.60
550890009	Ozaukee	Harrington Park	Milwaukee-Wauk	79.7	85	21	98.26	96.71	0.980	78.44
260190003	Benzie	Benzonia		80.3	85	14	97.85	94.75	0.970	77.76
551010017	Racine	Racine	Racine WI	78.3	85	23	95.29	94.51	0.990	77.66
550890008	Ozaukee	Grafton	Milwaukee-Wauk	78.3	85	19	96.52	95.28	0.990	77.30
550610002	Kewaunee	Kewaunee		79.3	85	20	95.85	93.15	0.970	77.06
260210014	Berrien	Coloma	Benton Harbor M	79.7	85	24	98.54	94.58	0.960	76.49
170317002	Cook	Chi-E. Lincoln	Chicago IL	76.3	85	18	94.41	93.86	0.990	75.86
180890030	IN-Lake	WHITING	Whiting, IN	77.7	85	15	95.16	92.87	0.980	75.83
170971007	Lake	Illinois Beach	Chicago IL	76.3	85	23	94.89	94.24	0.990	75.78
261390005	MI-Ottawa	6981		79.3	84	11	93.10	88.78	0.950	75.62
260270003	MI-Cass	ROSS		79.5	79	11	86.51	82.21	0.950	75.55
181270024	Porter	Gary- Water Plnt	Gary IN	76.3	85	16	100.21	98.71	0.990	75.16
170311003	Cook	Chi-Hurlbut	Chicago IL	75.7	85	18	91.63	90.54	0.990	74.80
180910005	LaPorte	Michigan City		76.3	85	27	98.79	96.72	0.980	74.70
180892008	Lake	Hammond	Gary IN	76.3	85	14	95.26	93.16	0.980	74.62
170971002	Lake	Waukegan	Chicago IL	75.3	85	21	94.69	93.71	0.990	74.52
261050007	Mason	W. US 10		77.3	85	11	97.17	93.68	0.960	74.52
181411008	St. Joseph	South Bend	South Bend IN	78.0	78	12	84.41	80.63	0.960	74.50
170310076	IL-Cook-7801	7801	IL-Cook	75.7	85	19	91.41	89.66	0.980	74.25
170310001	Cook	Alsip	Chicago IL	75.7	85	17	90.60	88.68	0.980	74.10
260810020	MI-Kent	1179		77.7	85	14	91.85	87.47	0.950	73.99
260810022	MI-Kent	10300		78.7	85	10	91.21	85.74	0.940	73.98
181411007	St. Joseph	Harris Fire Sta	South Bend IN	77.3	79	11	84.61	80.87	0.960	73.89
180890022	Lake	Gary-Iitri Bunker	Gary IN	75.3	85	13	100.35	98.44	0.980	73.87

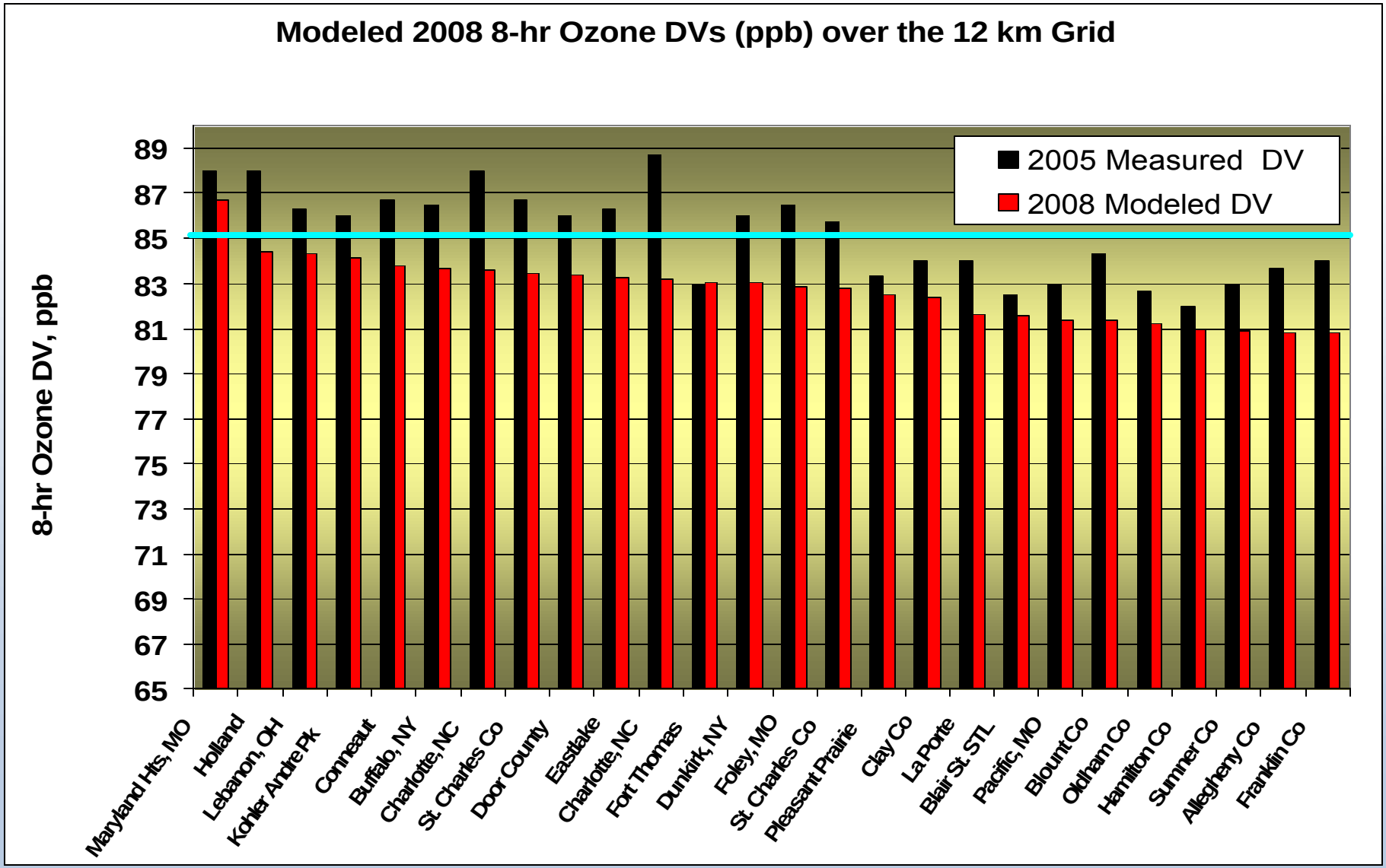
2015 8-hr Ozone Design Values for the Lower Lake Michigan 4 km Domain

				MRPO '05					2015	2015
Long Name	County	City or Monitor	MSA	DVC	THRESH -1ppb	AYS >Thr	DVBM	DVFM	RRF	FDV
551170006	Sheboygan	Kohler Andre Pk	Sheboygan WI	86.0	85	19	100.3	93.3	0.930	79.96
550590019	Kenosha	Pleasant Prairie	Kenosha WI	83.3	85	21	95.7	91.0	0.950	79.17
260050003	Allegan	Holland	Grand Rapids-M	88.0	85	19	99.2	88.6	0.890	78.58
550290004	Door	Door County		86.0	85	14	96.4	87.6	0.910	78.09
180910010	LaPorte	La Porte	La Porte	84.0	85	12	96.8	89.1	0.920	77.29
550790041	Milwaukee	Milwaukee-UWM	Milwaukee-Wauk	79.3	85	19	97.7	93.2	0.950	75.63
550710007	Manitowoc	Manitowoc		82.3	85	18	98.4	90.3	0.920	75.48
550790085	Milwaukee	Bayside	Milwaukee-Wauk	79.7	85	20	96.9	91.7	0.950	75.39
550870009	Outagamie	Appleton	Appleton-Oshko	79.7	85	21	98.3	92.3	0.940	74.86
551010017	Racine	Racine	Racine WI	78.3	85	23	95.3	91.0	0.950	74.77
261210039	Muskegon	Muskegon	Grand Rapids-M	83.3	85	24	97.1	87.0	0.900	74.63
550890008	Ozaukee	Grafton	Milwaukee-Wauk	78.3	85	19	96.5	90.9	0.940	73.76
170317002	Cook	Chi-E. Lincoln	Chicago IL	76.3	85	18	94.4	90.3	0.960	72.94
170971007	Lake	Illinois Beach	Chicago IL	76.3	85	23	94.9	90.3	0.950	72.62
260190003	Benzie	Benzonia		80.3	85	14	97.9	88.4	0.900	72.52
170311003	Cook	Chi-Hurlbut	Chicago IL	75.7	85	18	91.6	87.7	0.960	72.42
550610002	Kewaunee	Kewaunee		79.3	85	20	95.9	87.2	0.910	72.11
180890030	IN-Lake	WHITING	Whiting, IN	77.7	85	15	95.2	87.8	0.920	71.67
170971002	Lake	Waukegan	Chicago IL	75.3	85	21	94.7	90.1	0.950	71.65
170310076	IL-Cook	7801		75.7	85	19	91.4	86.4	0.940	71.52
260210014	Coloma	Coloma	Coloma	79.7	85	24	98.5	88.1	0.890	71.23
170310001	Cook	Alsip	Chicago IL	75.7	85	17	90.6	85.2	0.940	71.22
181270024	Porter	Gary- Water Plnt	Gary IN	76.3	85	16	100.2	93.5	0.930	71.15
550790026	Milwaukee	Milwaukee-Hdqrts	Milwaukee-Wauk	74.0	85	19	96.1	91.3	0.950	70.33
180910005	LaPorte	Michigan City		76.3	85	27	98.8	90.7	0.920	70.03
180892008	Lake	Hammond	Gary IN	76.3	85	14	95.3	87.4	0.920	69.99
180890022	Lake	Gary-Iitri Bunker	Gary IN	75.3	85	13	100.4	93.2	0.930	69.90

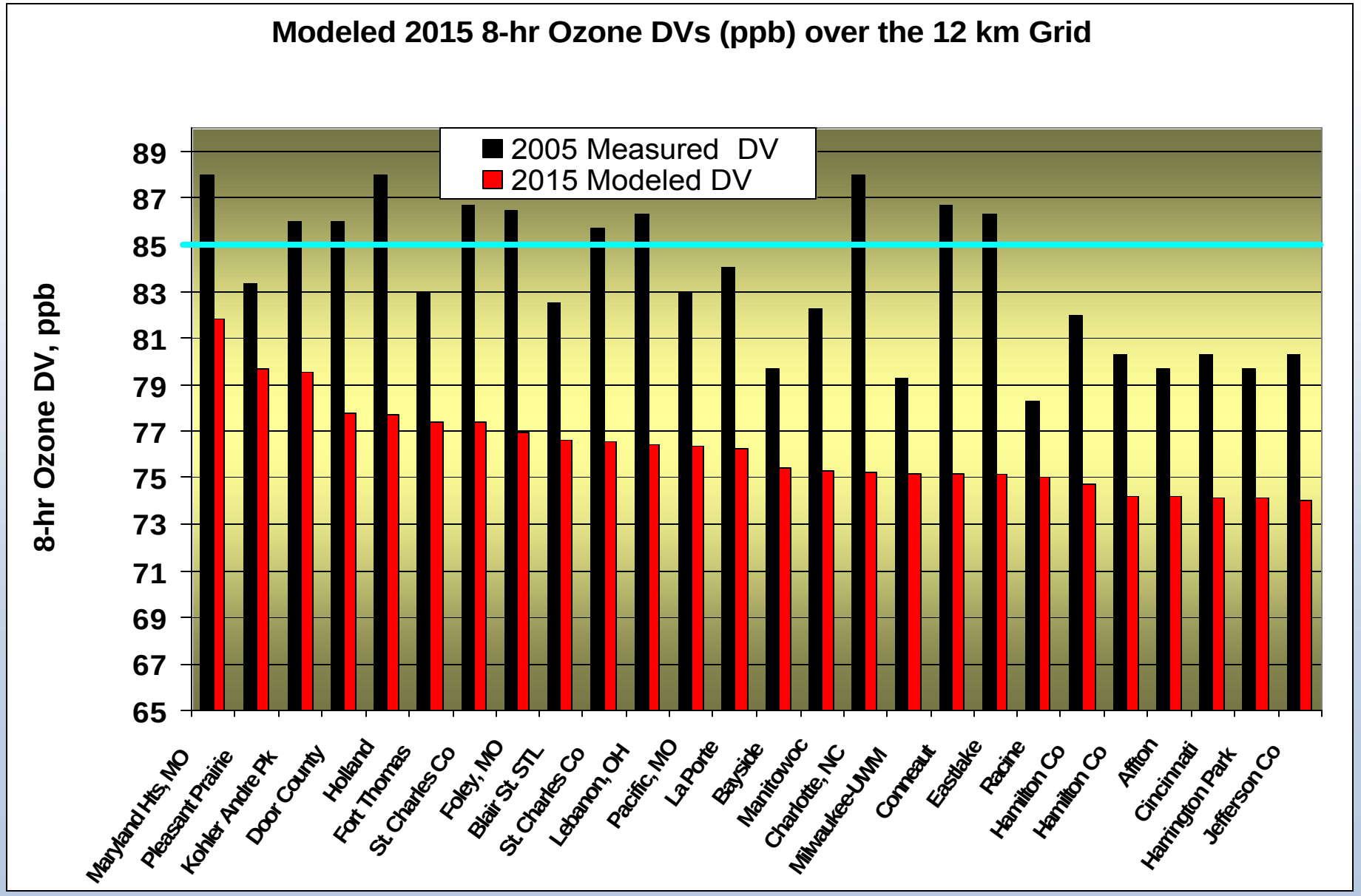
8-hr Ozone Attainment Modeling on 12 km Grid Domain

- 8-hr Ozone DVs obtained from MRPO on 10 May '07
- Formal EPA 8-hr Attainment Test applied on 12 km Grid Domain
- For 8-hr ozone SIPs, EPA guidance seems to favor 4 km rather than 12 km resolution for the attainment demonstration (EPA, 2007, pg 166.) That is, EPA states… "*For urban and fine scale portions of nested regional grids, it may be desirable to use grid cells about 4 km, but not larger than 12 km".*

Modeled 2008 8-hr Ozone Design Values over 5 States on 12 km Grid



Modeled 2015 8-hr Ozone Design Values over 5 States for 12 km Grid



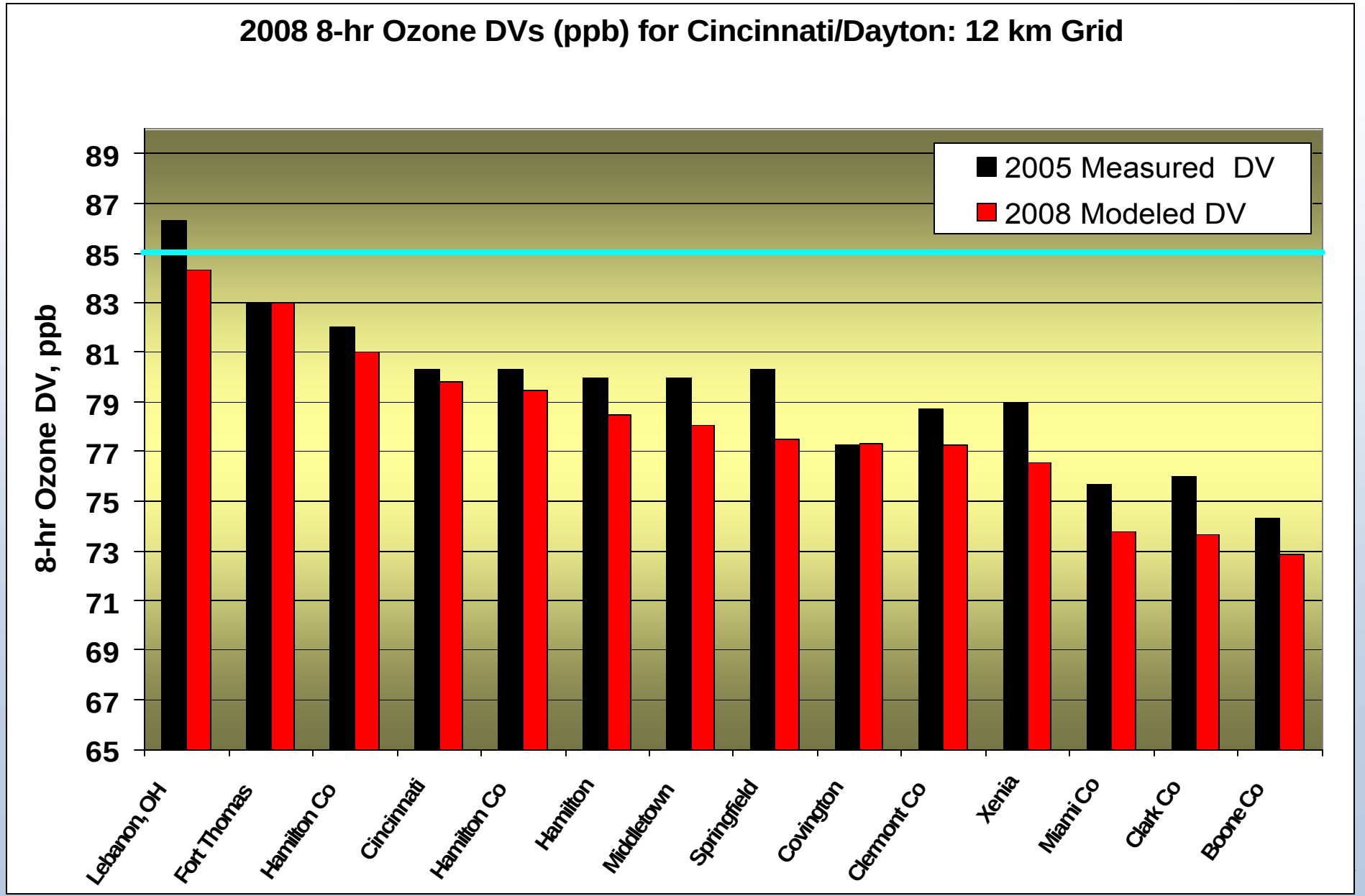
2008 8-hr Ozone Design Values for 12 km Domain

Table 1. 12 km Grid Region 8-hr DVs (ppm) for 2008												
						MRPO '05					2008	2008
		Long Name	County	City or Monit	MSA	DVC	THRESH -1ppb	AYS >Thr	DVBM	DVFM	RRF	FDV
291890014	Maryland Hts	Maryland Hts	Maryland Hts	Maryland Hts	Maryland Hts	88.0	85	30	96.24	94.84	0.990	86.71
260050003	260050003	Allegan	Holland	Grand Rapids-Muskegon-		88.0	85	10	100.11	96.04	0.960	84.42
391650007	Lebanon, OH	Lebanon, OH	Lebanon, OH	Lebanon, OH	Lebanon, OH	86.3	85	26	94.52	92.34	0.980	84.31
551170006	551170006	Sheboygan	Kohler Andr	Sheboygan WI		86.0	85	21	98.43	96.29	0.980	84.13
390071001	390071001	Jq Conneaut	Conneaut	Ashtabula C	Cleveland-L	86.7	85	35	99.54	96.21	0.970	83.80
360290002	Buffalo, NY	Buffalo, NY	Buffalo, NY	Buffalo, NY	Buffalo, NY	86.5	85	11	92.73	89.68	0.970	83.65
371190041	Charlotte, NC	Charlotte, NC	Charlotte, NC	Charlotte, NC	Charlotte, NC	88.0	85	35	99.98	95.03	0.950	83.64
291831004	291831004	Orchard Farr	St. Charles C	St. Charles C	St Louis MO	86.7	85	28	95.63	92.05	0.960	83.46
550290004	550290004	Door	Door County			86.0	85	15	95.56	92.66	0.970	83.39
390850003	390850003	Lake	Eastlake	Cleveland-Lorain-Elyria C		86.3	85	34	94.78	91.43	0.960	83.25
371191009	Charlotte, NC	Charlotte, NC	Charlotte, NC	Charlotte, NC	Charlotte, NC	88.7	85	25	97.83	91.74	0.940	83.18
210370003	210370003	700 Alexand	Fort Thomas	Campbell Co	Cincinnati O	83.0	85	33	95.42	95.45	1.000	83.03
360130006	Dunkirk, NY	Dunkirk, NY	Dunkirk, NY	Dunkirk, NY	Dunkirk, NY	86.0	85	33	97.11	93.76	0.970	83.03
291130003	Foley, MO	Foley, MO	Foley, MO	Foley, MO	Foley, MO	86.5	83	10	90.25	86.43	0.960	82.83
291831002	291831002	General Elec	St. Charles C	St. Charles C	St Louis MO	85.7	85	31	97.37	94.05	0.970	82.78
550590019	550590019	Kenosha	Pleasant Pra	Kenosha WI		83.3	85	22	95.55	94.64	0.990	82.51
290470005	290470005	Hwy33 & Co	Clay Co	Clay Co	Kansas City	84.0	85	15	92.63	90.85	0.980	82.38
180910010	180910010	LaPorte	La Porte	La Porte		84.0	85	21	99.17	96.38	0.970	81.64
295100085	Blair St. STL	Blair St. STL	Blair St. STL	Blair St. STL	Blair St. STL	82.5	85	29	96.51	95.39	0.990	81.54
291890005	Pacific, MO	Pacific, MO	Pacific, MO	Pacific, MO	Pacific, MO	83.0	85	19	95.64	93.78	0.980	81.39
470090101	470090101	Great Smoky	Blount Co	Blount Co	Knoxville TN	84.3	85	12	91.40	88.23	0.970	81.38
211850004	211850004	3995 Morgar	Oldham Co	Oldham Co	Louisville KY	82.7	85	24	92.11	90.43	0.980	81.19
390610006	390610006	11590 Groon	Hamilton Co	Hamilton Co	Cincinnati O	82.0	85	33	96.15	94.97	0.990	81.00
471650007	471650007	Rockland Re	Sumner Co	Sumner Co	Nashville TN	83.0	85	27	93.16	90.83	0.980	80.93
420031005	420031005	California &	Allegheny C	Allegheny C	Pittsburgh P	83.7	85	25	93.36	90.17	0.970	80.83
390490029	390490029	7600 Fodor F	Franklin Co	Franklin Co	Columbus O	84.0	85	12	89.91	86.46	0.960	80.78

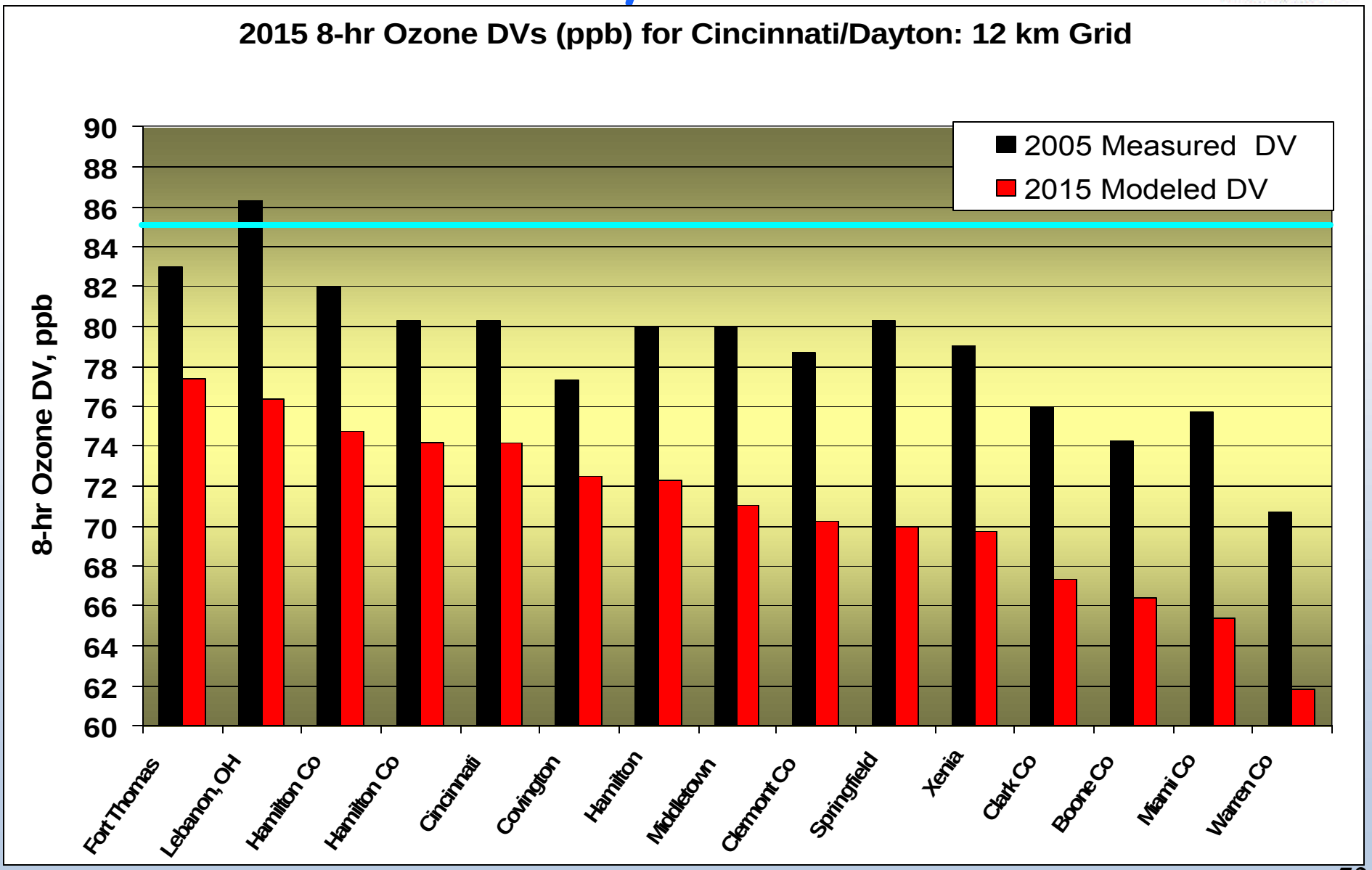
2015 8-hr Ozone Design Values for the 12 Km Domain

Table 2. 12 Km Grid Region 8-hr DVs (ppm) for 2015												
						MRPO '05					2015	2015
		Long Name	County	City or Monit	MSA	DVC	THRESH -1ppb	AYS >Thre	DVBM	DVFM	RRF	FDV
291890014	Maryland Hts	Maryland Hts	Maryland Hts	Maryland Hts	Maryland Hts	88.0	85	30	96.24	89.48	0.930	81.81
550590019	550590019	Kenosha	Pleasant Pra	Kenosha WI		83.3	85	22	95.55	91.41	0.960	79.69
551170006	551170006	Sheboygan	Kohler Andr	Sheboygan WI		86.0	85	21	98.43	91.00	0.920	79.50
550290004	550290004	Door	Door County			86.0	85	15	95.56	86.42	0.900	77.78
260050003	260050003	Allegan	Holland	Grand Rapids-Muskegon-		88.0	85	10	100.11	88.39	0.880	77.70
210370003	210370003	700 Alexand	Fort Thomas	Campbell Co	Cincinnati O	83.0	85	33	95.42	88.97	0.930	77.39
291831004	291831004	Orchard Farr	St. Charles (	St. Charles C	St Louis MO	86.7	85	28	95.63	85.37	0.890	77.39
291130003	Foley, MO	Foley, MO	Foley, MO	Foley, MO	Foley, MO	86.5	83	10	90.25	80.30	0.890	76.96
295100085	Blair St. STL	Blair St. STL	Blair St. STL	Blair St. STL	Blair St. STL	82.5	85	29	96.51	89.57	0.930	76.57
291831002	291831002	General Elec	St. Charles (	St. Charles C	St Louis MO	85.7	85	31	97.37	86.98	0.890	76.55
391650007	Lebanon, OH	Lebanon, OH	Lebanon, OH	Lebanon, OH	Lebanon, OH	86.3	85	26	94.52	83.68	0.890	76.41
291890005	Pacific, MO	Pacific, MO	Pacific, MO	Pacific, MO	Pacific, MO	83.0	85	19	95.64	87.99	0.920	76.36
180910010	180910010	LaPorte	La Porte	La Porte		84.0	85	21	99.17	90.00	0.910	76.23
550790085	550790085	Milwaukee	Bayside	Milwaukee-Waukesha WI		79.7	85	19	100.70	95.32	0.950	75.44
550710007	550710007	Manitowoc	Manitowoc			82.3	85	19	98.12	89.78	0.920	75.31
371190041	Charlotte, NC	Charlotte, NC	Charlotte, NC	Charlotte, NC	Charlotte, NC	88.0	85	35	99.98	85.48	0.850	75.23
550790041	550790041	Milwaukee	Milwaukee-U	Milwaukee-Waukesha WI		79.3	85	20	99.24	94.12	0.950	75.21
390071001	390071001	Jq Conneaut	Conneaut	Ashtabula C	Cleveland-Lo	86.7	85	35	99.54	86.32	0.870	75.18
390850003	390850003	Lake	Eastlake	Cleveland-Lorain-Elyria O		86.3	85	34	94.78	82.48	0.870	75.10
551010017	551010017	Racine	Racine	Racine WI		78.3	85	22	96.93	92.88	0.960	75.02
390610006	390610006	11590 Groon	Hamilton Co	Hamilton Co	Cincinnati O	82.0	85	33	96.15	87.62	0.910	74.73
390610010	390610010	6950 Ripple	Hamilton Co	Hamilton Co	Cincinnati O	80.3	85	24	96.06	88.78	0.920	74.22
291890004	291890004	4580 South L	Affton	St. Louis Co	St Louis MO	79.7	85	21	98.14	91.35	0.930	74.18
390610040	390610040	250 Wm. Hov	Cincinnati	Hamilton Co	Cincinnati O	80.3	85	34	95.89	88.54	0.920	74.14
550890009	550890009	Ozaukee	Harrington F	Milwaukee-Waukesha WI		79.7	85	20	100.14	93.12	0.930	74.11
290990012	290990012	Arnold Tenb	Jefferson Co	Jefferson Co	St Louis MO	80.3	85	18	98.80	91.09	0.920	74.04

2008 8-hr Ozone Design Values in Cincinnati/Dayton: 12 km Grid



2015 8-hr Ozone Design Values for Cincinnati/Dayton: 12 km Grid



2008 8-hr Ozone Design Values for Cincinnati/Dayton on 12 km Domain

Table 1. Cincinnati/Dayton 12 km Grid 8-hr DVs (ppm) for 2008

		Long Name	County	City or Moni	MSA	MRPO '05 DVC	THRESH -1ppb	AYS >Thre	DVBM	DVFM	2008 RRF	2008 FDV
391650007	391650007	Lebanon, O	Lebanon, Ol	Lebanon, Ol	Lebanon, OH	86.3	85	26	94.52	92.34	0.980	84.31
210370003	210370003	700 Alexand	Fort Thoma	Campbell C	Cincinnati OH-K	83.0	85	33	95.42	95.45	1.000	83.03
390610006	390610006	11590 Groo	Hamilton Co	Hamilton Co	Cincinnati OH-K	82.0	85	33	96.15	94.97	0.990	81.00
390610040	390610040	250 Wm. Ho	Cincinnati	Hamilton Co	Cincinnati OH-K	80.3	85	34	95.89	95.27	0.990	79.79
390610010	390610010	6950 Ripple	Hamilton Co	Hamilton Co	Cincinnati OH-K	80.3	85	24	96.06	95.08	0.990	79.48
390170004	390170004	Schuler Anc	Hamilton	Butler Co	Hamilton-Midd	80.0	85	27	96.09	94.29	0.980	78.50
390171004	390171004	Hook Field I	Middletown	Butler Co	Hamilton-Midd	80.0	85	27	95.51	93.18	0.980	78.05
390230001	390230001	5171 Urbana	Springfield	Clark Co	Dayton-Springf	80.3	85	10	89.53	86.40	0.970	77.49
211170007	211170007	1401 Dixie H	Covington	Kenton Co	Cincinnati OH-K	77.3	85	33	95.32	95.36	1.000	77.33
390250022	390250022	2400 Clermo	Clermont Co	Clermont Co	Cincinnati OH-K	78.7	85	28	93.41	91.72	0.980	77.28
390570006	390570006	541 Ledbett	Xenia	Greene Co	Dayton-Springf	79.0	85	13	89.97	87.21	0.970	76.58
391090005	391090005	3825 North S	Miami Co	Miami Co	Dayton-Springf	75.7	85	10	89.27	87.00	0.970	73.78
390230003	390230003	5400 Spang	Clark Co	Clark Co	Dayton-Springf	76.0	85	10	90.78	87.97	0.970	73.65
210150003	210150003	Ky 338 & 53(	Boone Co	Boone Co	Cincinnati OH-K	74.3	85	20	91.71	89.95	0.980	72.87
212270008	212270008	Oakland Ele	Warren Co	Warren Co		70.7	77	11	81.20	79.53	0.980	69.25

2015 8-hr Ozone Design Values for Cincinnati/Dayton on the 12 Km Domain

Table 2. Cincinnati/Dayton 12 Km Grid Region 8-hr DVs (ppm) for 2015

		Long Name	County	City or Moni	MSA	MRPO '05 DVC	THRESH -1ppb	AYS >Thr	DVBM	DVFM	2015 RRF	2015 FDV
210370003	210370003	700 Alexand	Fort Thomas	Campbell Co	Cincinnati OH-KY-IN	83.0	85	33	95.42	88.97	0.930	77.39
391650007	391650007	Lebanon, OH	Lebanon, OH	Lebanon, OH	Lebanon, OH	86.3	85	26	94.52	83.68	0.890	76.41
390610006	390610006	11590 Groon	Hamilton Co	Hamilton Co	Cincinnati OH-KY-IN	82.0	85	33	96.15	87.62	0.910	74.73
390610010	390610010	6950 Ripple	Hamilton Co	Hamilton Co	Cincinnati OH-KY-IN	80.3	85	24	96.06	88.78	0.920	74.22
390610040	390610040	250 Wm. Ho	Cincinnati	Hamilton Co	Cincinnati OH-KY-IN	80.3	85	34	95.89	88.54	0.920	74.14
211170007	211170007	1401 Dixie H	Covington	Kenton Co	Cincinnati OH-KY-IN	77.3	85	33	95.32	89.41	0.940	72.51
390170004	390170004	Schuler And	Hamilton	Butler Co	Hamilton-Middletow	80.0	85	27	96.09	86.79	0.900	72.26
390171004	390171004	Hook Field M	Middletown	Butler Co	Hamilton-Middletow	80.0	85	27	95.51	84.83	0.890	71.05
390250022	390250022	2400 Clermo	Clermont Co	Clermont Co	Cincinnati OH-KY-IN	78.7	85	28	93.41	83.39	0.890	70.26
390230001	390230001	5171 Urbana	Springfield	Clark Co	Dayton-Springfield C	80.3	85	10	89.53	78.00	0.870	69.96
390570006	390570006	541 Ledbette	Xenia	Greene Co	Dayton-Springfield C	79.0	85	13	89.97	79.39	0.880	69.71
390230003	390230003	5400 Spangl	Clark Co	Clark Co	Dayton-Springfield C	76.0	85	10	90.78	80.41	0.890	67.32
210150003	210150003	Ky 338 & 53(	Boone Co	Boone Co	Cincinnati OH-KY-IN	74.3	85	20	91.71	81.95	0.890	66.39
391090005	391090005	3825 North S	Miami Co	Miami Co	Dayton-Springfield C	75.7	85	10	89.27	77.12	0.860	65.40
212270008	212270008	Oakland Ele	Warren Co	Warren Co		70.7	77	11	81.20	71.07	0.880	61.88

$PM_{2.5}$ Attainment Demonstration for 2008 and 2015 on the 36 km Grid

$PM_{2.5}$ Projection Procedures

- Speciated Model Attainment Test (SMAT)
  - Project observed Quarterly Average $PM_{2.5}$ "Design Values" (DVs) of each component of $PM_{2.5}$ using model derived Relative Reduction Factors (RRFs)
    - SO4, NO3, NH4, EC, OC, IP (Soil)
  - Combine species to obtained projected quarter averages and average four quarters to obtain annual average for comparison with NAAQS
  - Only $PM_{2.5}$ measured using the Federal Reference Method (FRM) can be used to determine attainment/nonattainment
    - FRM measures total $PM_{2.5}$ mass and has measurement artifacts, therefore need way to speciate FRM into PM components

$PM_{2.5}$ Projection Procedures (cont.)

- Speciated Model Attainment Test (SMAT)
  - SMAT can be applied directly where co-located FRM and speciated $PM_{2.5}$ measurements are available
  - There are ~1200 FRM $PM_{2.5}$ measurements in USA
  - There are ~250 STN and ~165 IMPROVE speciated $PM_{2.5}$ monitors in USA
  - ~75% of the FRM sites do not have co-located speciation
  - SMAT must include procedures for interpolating speciated $PM_{2.5}$ observations onto FRM monitor locations
    - EPA has used the Voronoi Neighbor Averaging (VNA) [from BenMAP Software] to interpolate speciated PM onto FRM sites

$PM_{2.5}$ Projection Procedures (cont.)

- Speciated Model Attainment Test (SMAT)
  - FRM vs. STN vs. IMPROVE $PM_{2.5}$ measurements
    - FRM does not retain all $PM_{2.5}$ mass on filter, negative and positive artifacts (e.g., nitrate loss due to volatility)
    - STN has several artifacts such that speciation can not be used directly
      - Water bound to PM
      - Not blank corrected
      - Carbon measurement bias (EC/OC)
      - Unidentified component of $PM_{2.5}$
    - IMPROVE does not include ammonium
  - Need to account for these measurement artifacts when mapping speciated $PM_{2.5}$ to FRM measurements

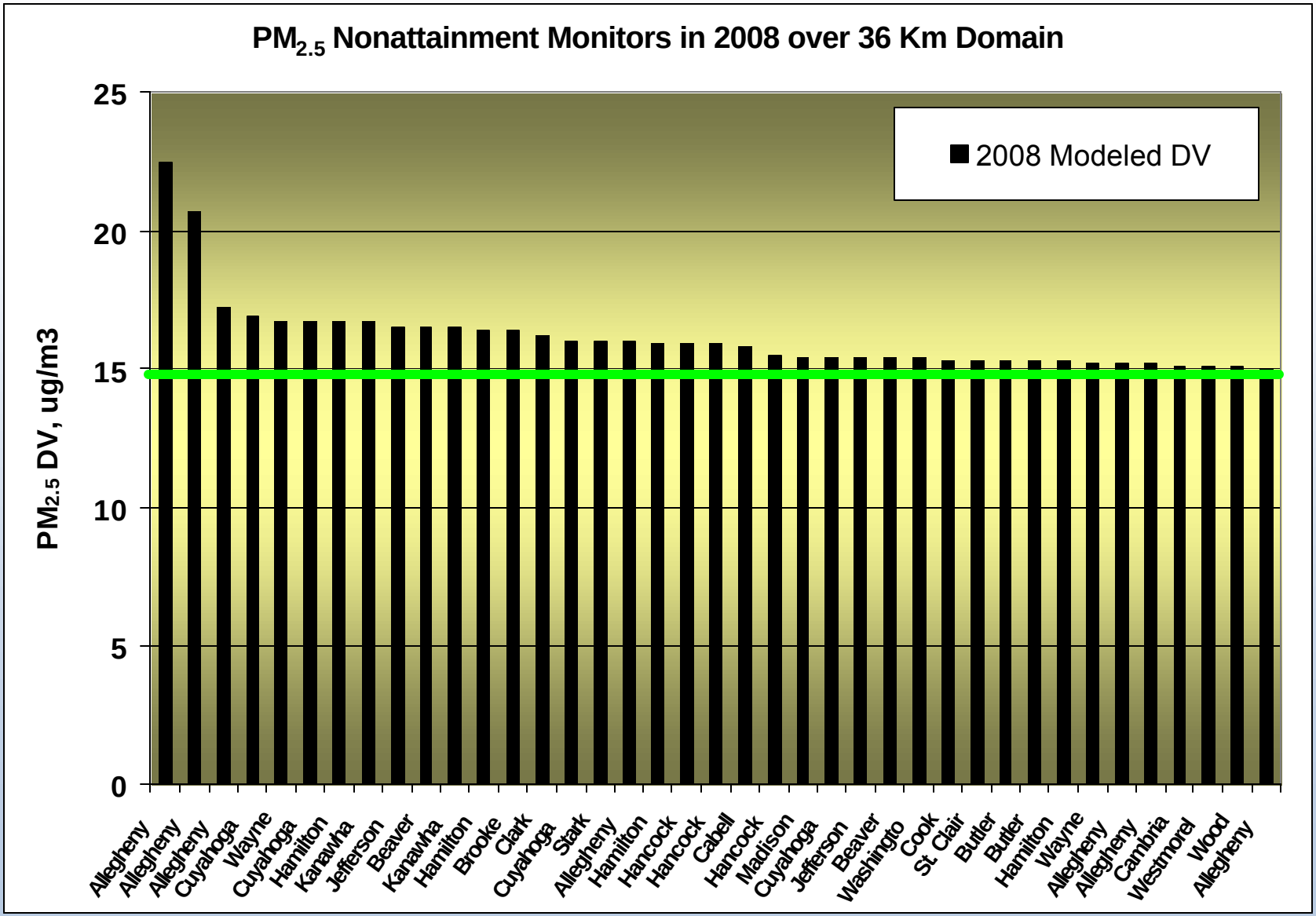
$PM_{2.5}$ Projection Procedures (cont.)

- Speciated Model Attainment Test (SMAT)
  - Interpolate STN/IMPROVE speciated $PM_{2.5}$ measurements to FRM monitors on Quarterly basis using BenMap
    - Retained water associated with $PM_{2.5}$
    - Sulfate
    - Nitrate (adjusted)
    - Ammonium
    - Elemental Carbon (EC)
    - Crustal Inorganic Particles (crustal/other -- Soil)
    - Degree of Neutralization of Sulfate (DON)
      - Ammonium (NH4) calculated from DON and NO3

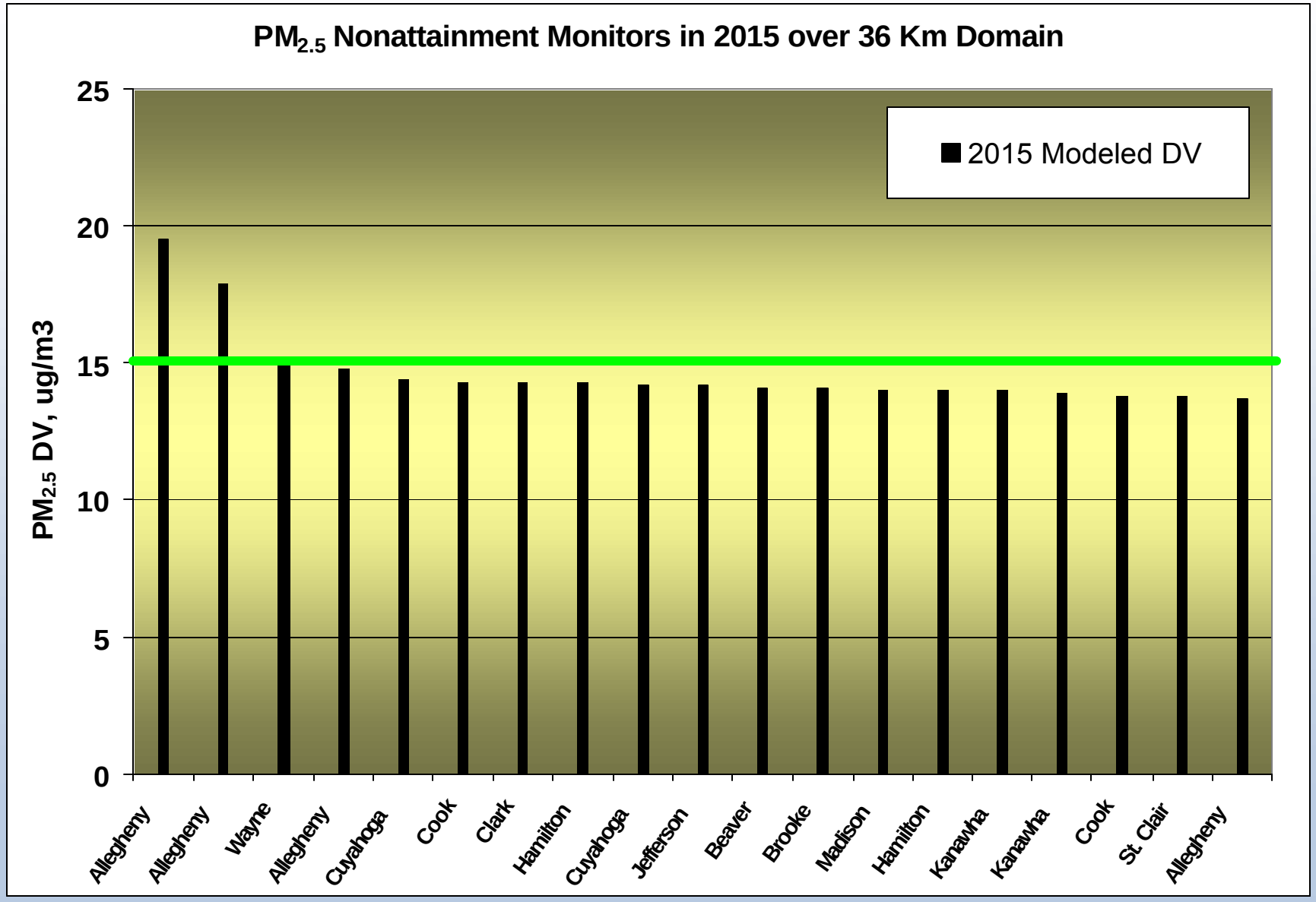
$PM_{2.5}$ Projection Procedures (concluded)

- EPA has Developed SMAT $PM_{2.5}$ Projection Tool that was used in CAIR Projections
  - Includes I/O API, SAS, Fortran codes
  - Several steps of data transferring among SMAT Tool components with assumptions on precision of data
  - Original EPA SMAT Tool was inelegant and used software that is expensive and not typically available (SAS)
  - EPA has now released a new SMAT Tool that is easier to use and more widely applicable
  - **AG used new SMAT tool and associated data bases provided by LADCo/MRPO**

Modeled 2008 $PM_{2.5}$ Nonattainment and Attainment Monitors on 36 km Grid



Modeled 2015 $PM_{2.5}$ Nonattainment and Attainment Monitors on 36 km Grid



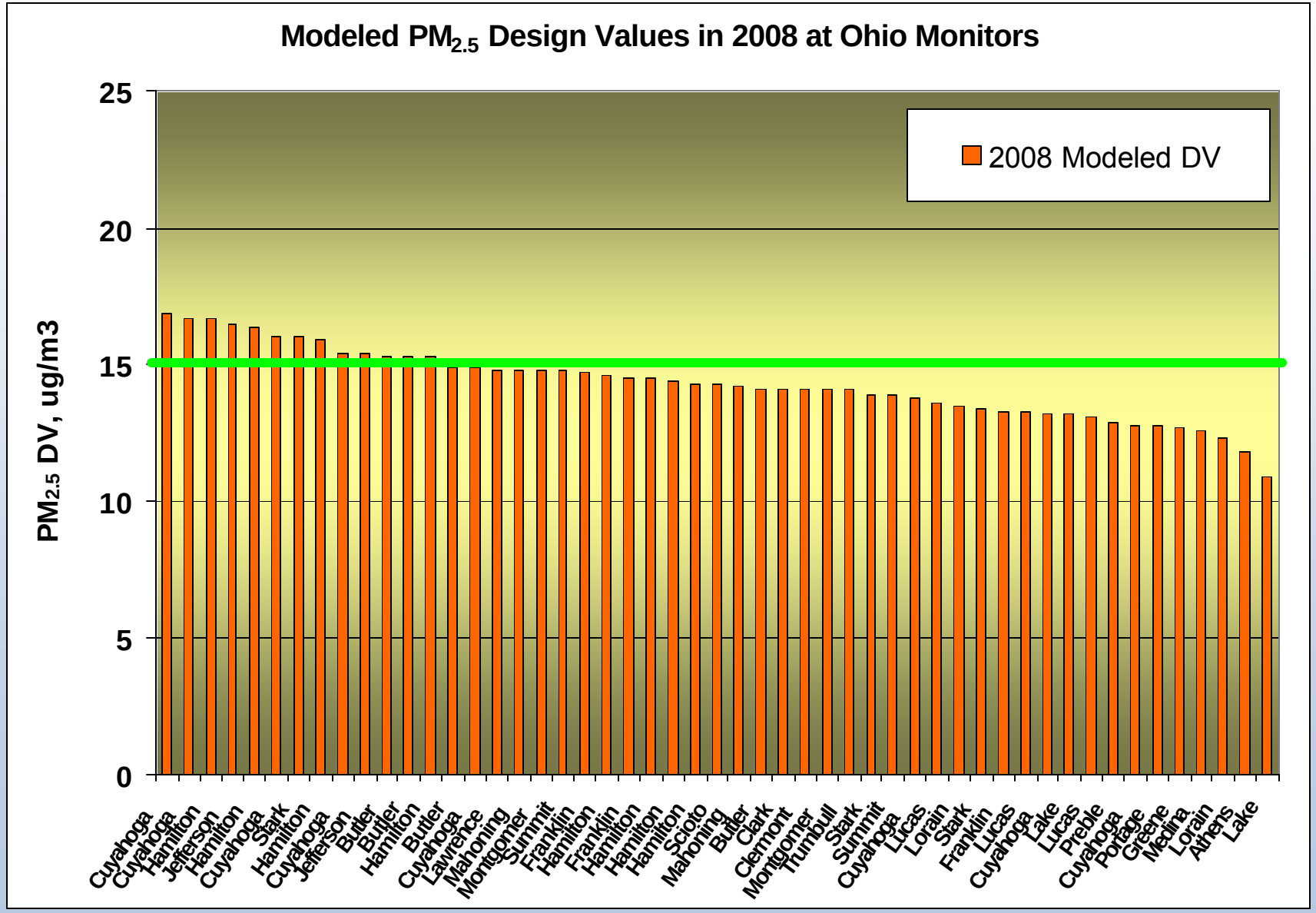
Modeled $PM_{2.5}$ Nonattainment Monitors in 2008 on 36 km Grid

			Average Seasonal DVs									Attain
AIRS ID	State	County	Winter	Spring	Summer	Fall	03_05	04_06	05_06	BYDV	FYDV	in 2008?
4200300642	PA	Allegheny	16.5	15.5	29.3	27.3	23.2	20.5	20.5	22.2	22.5	FAIL
4200300641	PA	Allegheny	16.1	20.4	24.7	20.5	20.8	20.2	19.9	20.4	20.7	FAIL
4200313012	PA	Allegheny	15.1	14.2	25.6	15.1	18.2	17.3	17.3	17.5	17.2	FAIL
3903500381	OH	Cuyahoga	16.7	16.5	20.1	16.5	18.1	17.2	17.1	17.5	16.9	FAIL
2616300331	MI	Wayne	20.0	15.7	17.3	17.3	18.2	17.0	17.1	17.6	16.7	FAIL
3903500601	OH	Cuyahoga	17.9	16.7	20.1	14.4	17.7	16.9	17.2	17.3	16.7	FAIL
3906180011	OH	Hamilton	16.9	16.6	22.3	15.3	17.9	17.4	17.9	17.8	16.7	FAIL
5403910052	WV	Kanawha	13.3	16.4	24.0	13.1	16.7	16.5	16.8	16.7	16.7	FAIL
3908110011	OH	Jefferson	15.3	16.3	21.4	13.4	17.2	16.3	16.3	16.6	16.5	FAIL
4200700141	PA	Beaver	14.1	16.0	20.8	15.1	16.5	16.2	16.6	16.5	16.5	FAIL
5403910051	WV	Kanawha	13.2	16.0	23.9	12.9	16.5	16.4	16.6	16.5	16.5	FAIL
3906100141	OH	Hamilton	16.7	16.5	20.9	15.5	17.5	17.1	17.6	17.4	16.4	FAIL
5400900051	WV	Brooke	14.3	16.5	21.4	13.9	16.8	16.4	16.3	16.5	16.4	FAIL
1801900061	IN	Clark	14.9	16.7	21.1	15.2	17.6	16.5	17.2	17.0	16.2	FAIL
3903500451	OH	Cuyahoga	17.0	15.8	19.8	13.9	17.0	16.2	16.7	16.6	16.0	FAIL
3915100171	OH	Stark	16.0	15.0	20.9	14.4	16.9	16.2	16.5	16.5	16.0	FAIL
4200313011	PA	Allegheny	13.5	15.9	22.1	13.6	16.6	16.3	16.5	16.3	16.0	FAIL
3906100421	OH	Hamilton	15.4	16.0	22.1	14.4	17.3	16.7	17.0	17.0	15.9	FAIL
5402900111	WV	Hancock	12.9	16.1	21.1	14.0	16.4	15.7	16.0	16.0	15.9	FAIL
5402900112	WV	Hancock	13.1	16.1	21.1	14.1	16.4	15.8	16.0	16.1	15.9	FAIL
5401100061	WV	Cabell	13.0	16.2	22.3	13.7	16.3	16.1	16.6	16.3	15.8	FAIL
5402910041	WV	Hancock	12.9	16.5	21.0	12.4	16.6	15.4	15.0	15.7	15.5	FAIL
1711910071	IL	Madison	16.3	16.0	20.4	15.2	17.0	16.6	17.2	17.0	15.4	FAIL
3903500651	OH	Cuyahoga	17.2	15.3	18.9	12.6	16.4	15.6	15.9	16.0	15.4	FAIL
3908100171	OH	Jefferson	13.1	13.8	22.4	13.2	15.8	15.4	15.1	15.6	15.4	FAIL
4200700142	PA	Beaver	15.0	15.3	17.4	14.1	15.4	14.7	15.6	15.5	15.4	FAIL
4212500052	PA	Washingto	12.0	13.4	24.2	13.2	13.0	14.5	16.0	15.7	15.4	FAIL
1703131031	IL	Cook	19.3	14.0	16.6	15.6	16.8	16.1	16.2	16.4	15.3	FAIL
2614700052	MI	St. Clair	18.5	16.0	14.5	13.7	15.7	0.0	0.0	15.7	15.3	FAIL
3901700031	OH	Butler	15.1	14.7	21.2	13.4	16.0	15.7	16.5	16.1	15.3	FAIL
3901700171	OH	Butler	15.5	14.5	20.3	14.1	15.4	15.7	17.2	16.1	15.3	FAIL
3906170011	OH	Hamilton	15.0	15.2	21.5	13.5	16.6	16.0	16.4	16.3	15.3	FAIL
2616300151	MI	Wayne	17.8	14.2	17.2	15.1	16.4	15.8	16.0	16.1	15.2	FAIL
4200301161	PA	Allegheny	13.5	15.4	21.5	12.1	15.4	15.4	16.1	15.6	15.2	FAIL
4200330071	PA	Allegheny	13.4	14.2	21.1	12.8	15.7	15.1	15.8	15.4	15.2	FAIL
4202100111	PA	Cambria	13.3	14.6	22.0	12.2	15.6	15.5	16.1	15.5	15.1	FAIL
4212900081	PA	Westmore	12.8	15.5	21.9	12.2	15.7	15.6	16.0	15.6	15.1	FAIL
5410710021	WV	Wood	12.8	15.3	21.3	12.3	15.4	15.3	15.5	15.4	15.1	FAIL
4200300082	PA	Allegheny	13.6	14.1	21.1	13.0	16.2	15.2	15.2	15.5	15.0	FAIL

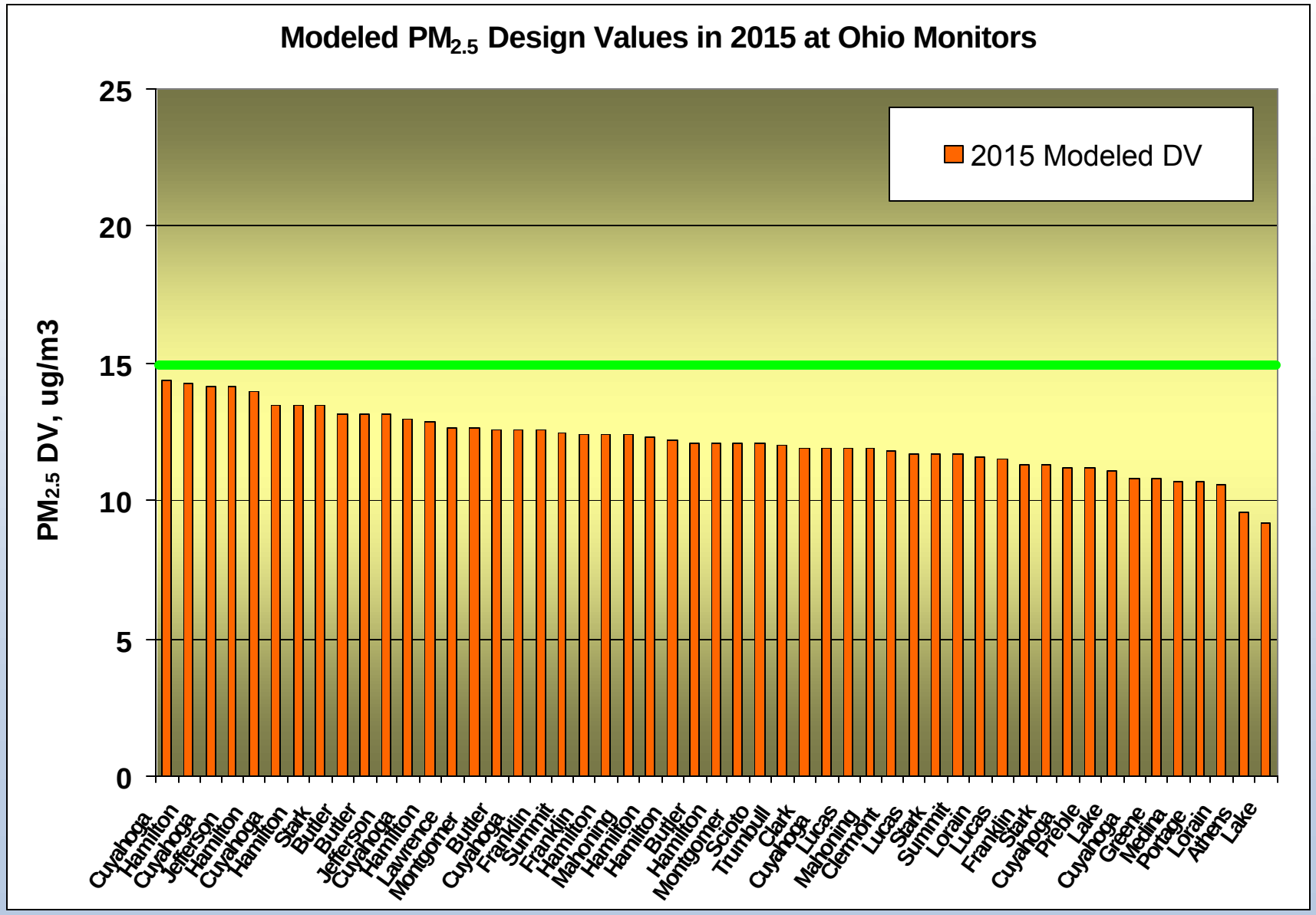
Modeled $PM_{2.5}$ Nonattainment Monitors in 2015 on 36 km Grid

			Average Seasonal DVs									Attain
AIRS ID	State	County	Winter	Spring	Summer	Fall	03_05	04_06	05_06	BYDV	FYDV	in 2015?
4200300642	PA	Allegheny	16.5	15.5	29.3	27.3	23.2	20.5	20.5	22.2	19.5	FAIL
4200300641	PA	Allegheny	16.1	20.4	24.7	20.5	20.8	20.2	19.9	20.4	17.9	FAIL
2616300331	MI	Wayne	20.0	15.7	17.3	17.3	18.2	17.0	17.1	17.6	15.0	PASS
4200313012	PA	Allegheny	15.1	14.2	25.6	15.1	18.2	17.3	17.3	17.5	14.8	PASS
3903500381	OH	Cuyahoga	16.7	16.5	20.1	16.5	18.1	17.2	17.1	17.5	14.4	PASS
1703131031	IL	Cook	19.3	14.0	16.6	15.6	16.8	16.1	16.2	16.4	14.3	PASS
1801900061	IN	Clark	14.9	16.7	21.1	15.2	17.6	16.5	17.2	17.0	14.3	PASS
3906180011	OH	Hamilton	16.9	16.6	22.3	15.3	17.9	17.4	17.9	17.8	14.3	PASS
3903500601	OH	Cuyahoga	17.9	16.7	20.1	14.4	17.7	16.9	17.2	17.3	14.2	PASS
3908110011	OH	Jefferson	15.3	16.3	21.4	13.4	17.2	16.3	16.3	16.6	14.2	PASS
4200700141	PA	Beaver	14.1	16.0	20.8	15.1	16.5	16.2	16.6	16.5	14.1	PASS
5400900051	WV	Brooke	14.3	16.5	21.4	13.9	16.8	16.4	16.3	16.5	14.1	PASS
1711910071	IL	Madison	16.3	16.0	20.4	15.2	17.0	16.6	17.2	17.0	14.0	PASS
3906100141	OH	Hamilton	16.7	16.5	20.9	15.5	17.5	17.1	17.6	17.4	14.0	PASS
5403910052	WV	Kanawha	13.3	16.4	24.0	13.1	16.7	16.5	16.8	16.7	14.0	PASS
5403910051	WV	Kanawha	13.2	16.0	23.9	12.9	16.5	16.4	16.6	16.5	13.9	PASS
1703100521	IL	Cook	17.9	12.9	16.4	16.0	16.0	15.6	15.7	15.8	13.8	PASS
2614700052	MI	St. Clair	18.5	16.0	14.5	13.7	15.7	0.0	0.0	15.7	13.8	PASS
4200313011	PA	Allegheny	13.5	15.9	22.1	13.6	16.6	16.3	16.5	16.3	13.7	PASS

2008 $PM_{2.5}$ Modeled DVs in Ohio on 36 km Grid



2015 $PM_{2.5}$ Modeled DVs in Ohio on 36 km Grid



Modeled $PM_{2.5}$ Design Values for 2008 in Ohio on 36 km Grid

			Average Seasonal DVs									
AIRS ID	State	County	Winter	Spring	Summer	Fall	03_05	04_06	05_06	BYDV	FYDV	Attain in 2008?
3903500381	OH	Cuyahoga	16.7	16.5	20.1	16.5	18.1	17.2	17.1	17.5	16.9	FAIL
3903500601	OH	Cuyahoga	17.9	16.7	20.1	14.4	17.7	16.9	17.2	17.3	16.7	FAIL
3906180011	OH	Hamilton	16.9	16.6	22.3	15.3	17.9	17.4	17.9	17.8	16.7	FAIL
3908110011	OH	Jefferson	15.3	16.3	21.4	13.4	17.2	16.3	16.3	16.6	16.5	FAIL
3906100141	OH	Hamilton	16.7	16.5	20.9	15.5	17.5	17.1	17.6	17.4	16.4	FAIL
3903500451	OH	Cuyahoga	17.0	15.8	19.8	13.9	17.0	16.2	16.7	16.6	16.0	FAIL
3915100171	OH	Stark	16.0	15.0	20.9	14.4	16.9	16.2	16.5	16.5	16.0	FAIL
3906100421	OH	Hamilton	15.4	16.0	22.1	14.4	17.3	16.7	17.0	17.0	15.9	FAIL
3903500651	OH	Cuyahoga	17.2	15.3	18.9	12.6	16.4	15.6	15.9	16.0	15.4	FAIL
3908100171	OH	Jefferson	13.1	13.8	22.4	13.2	15.8	15.4	15.1	15.6	15.4	FAIL
3901700031	OH	Butler	15.1	14.7	21.2	13.4	16.0	15.7	16.5	16.1	15.3	FAIL
3901700171	OH	Butler	15.5	14.5	20.3	14.1	15.4	15.7	17.2	16.1	15.3	FAIL
3906170011	OH	Hamilton	15.0	15.2	21.5	13.5	16.6	16.0	16.4	16.3	15.3	FAIL
3901700161	OH	Butler	14.9	14.7	20.1	13.7	16.1	15.5	15.9	15.9	14.9	PASS
3903500271	OH	Cuyahoga	15.4	15.5	18.1	13.3	16.1	15.3	15.2	15.5	14.9	PASS
3908700101	OH	Lawrence	11.8	15.7	20.9	12.5	15.0	15.0	15.7	15.2	14.8	PASS
3909900141	OH	Mahoning	14.0	14.7	19.5	12.7	15.5	15.0	15.2	15.2	14.8	PASS
3911300321	OH	Montgome	15.5	14.0	19.3	13.2	15.9	15.2	15.5	15.5	14.8	PASS
3915300171	OH	Summit	13.7	14.7	19.0	13.4	15.6	15.0	15.0	15.2	14.8	PASS
3904900241	OH	Franklin	15.4	13.0	19.3	13.5	16.0	15.0	15.0	15.3	14.7	PASS
3906100431	OH	Hamilton	14.3	14.1	20.6	13.6	15.8	15.4	15.7	15.6	14.6	PASS
3904900251	OH	Franklin	15.3	13.1	19.3	12.7	15.5	14.8	14.9	15.1	14.5	PASS
3906100401	OH	Hamilton	14.3	14.5	20.8	12.6	15.9	15.2	15.5	15.6	14.5	PASS
3906100061	OH	Hamilton	14.8	13.3	21.2	12.8	16.6	14.9	14.9	15.5	14.4	PASS
3906100411	OH	Hamilton	15.0	14.2	19.0	12.8	15.2	15.2	15.8	15.2	14.3	PASS
3914500131	OH	Scioto	12.2	14.7	20.4	11.9	14.6	14.5	15.3	14.8	14.3	PASS
3909900051	OH	Mahoning	13.7	14.4	18.7	12.1	15.0	14.5	14.7	14.7	14.2	PASS
3901710041	OH	Butler	13.7	14.0	19.4	12.8	15.1	14.6	15.1	15.0	14.1	PASS
3902300051	OH	Clark	14.3	14.1	18.2	12.0	14.7	14.4	14.9	14.7	14.1	PASS
3902500221	OH	Clermont	13.2	13.8	20.2	11.7	15.7	14.2	14.2	14.7	14.1	PASS
3911300311	OH	Montgome	14.5	13.8	18.5	12.6	15.0	14.6	14.9	14.8	14.1	PASS
3915500071	OH	Trumbull	13.4	13.8	18.2	12.9	14.7	14.4	14.7	14.6	14.1	PASS
3915100201	OH	Stark	14.0	13.5	17.4	13.0	15.1	14.1	14.1	14.5	13.9	PASS
3915300231	OH	Summit	12.8	13.5	18.5	12.4	14.6	14.1	14.3	14.3	13.9	PASS
3903510021	OH	Cuyahoga	14.1	14.4	17.7	10.8	14.6	13.9	14.2	14.2	13.8	PASS
3909500241	OH	Lucas	15.5	12.8	15.6	13.5	14.7	14.1	14.2	14.3	13.6	PASS
3909300161	OH	Lorain	13.9	13.0	17.5	11.3	14.1	13.6	14.0	13.9	13.5	PASS
3915100172	OH	Stark	13.4	14.4	18.3	10.1	12.6	13.2	14.3	14.1	13.4	PASS
3904900811	OH	Franklin	13.9	11.7	17.9	12.2	14.3	13.7	13.7	13.9	13.3	PASS
3909500261	OH	Lucas	14.9	12.7	15.4	13.2	14.3	13.8	14.2	14.1	13.3	PASS
3903500341	OH	Cuyahoga	13.8	13.4	17.3	10.6	14.1	13.4	13.9	13.8	13.2	PASS
3908510011	OH	Lake	12.2	14.7	16.6	11.4	13.1	12.6	13.2	13.7	13.2	PASS
3909500251	OH	Lucas	14.4	12.7	15.7	12.7	14.4	13.6	13.7	13.9	13.1	PASS
3913510011	OH	Preble	13.3	13.1	17.6	11.3	13.9	13.5	14.0	13.8	12.9	PASS
3903500661	OH	Cuyahoga	14.4	11.7	16.0	10.9	12.8	11.7	0.0	13.3	12.8	PASS
3913300021	OH	Portage	11.9	12.8	17.4	11.3	13.4	13.2	13.5	13.4	12.8	PASS
3905700051	OH	Greene	13.4	12.7	17.3	10.6	12.4	13.2	13.7	13.5	12.7	PASS
3910300031	OH	Medina	10.6	12.9	16.7	11.7	15.2	13.6	13.6	13.0	12.6	PASS
3909330021	OH	Lorain	12.0	12.2	15.8	11.1	12.8	12.6	13.0	12.8	12.3	PASS
3900900031	OH	Athens	9.3	12.4	17.8	9.8	12.3	12.2	12.5	12.3	11.8	PASS
3908530021	OH	Lake	11.1	10.2	14.8	8.7	0.0	11.2	11.2	11.2	10.9	PASS

Modeled $PM_{2.5}$ Design Values for 2015 in Ohio on 36 km Grid

			Average Seasonal DVs									
AIRS ID	State	County	Winter	Spring	Summer	Fall	03_05	04_06	05_06	BYDV	FYDV	Attain in 2015?
3903500381	OH	Cuyahoga	16.7	16.5	20.1	16.5	18.1	17.2	17.1	17.5	14.4	PASS
3906180011	OH	Hamilton	16.9	16.6	22.3	15.3	17.9	17.4	17.9	17.8	14.3	PASS
3903500601	OH	Cuyahoga	17.9	16.7	20.1	14.4	17.7	16.9	17.2	17.3	14.2	PASS
3908110011	OH	Jefferson	15.3	16.3	21.4	13.4	17.2	16.3	16.3	16.6	14.2	PASS
3906100141	OH	Hamilton	16.7	16.5	20.9	15.5	17.5	17.1	17.6	17.4	14.0	PASS
3903500451	OH	Cuyahoga	17.0	15.8	19.8	13.9	17.0	16.2	16.7	16.6	13.5	PASS
3906100421	OH	Hamilton	15.4	16.0	22.1	14.4	17.3	16.7	17.0	17.0	13.5	PASS
3915100171	OH	Stark	16.0	15.0	20.9	14.4	16.9	16.2	16.5	16.5	13.5	PASS
3901700031	OH	Butler	15.1	14.7	21.2	13.4	16.0	15.7	16.5	16.1	13.2	PASS
3901700171	OH	Butler	15.5	14.5	20.3	14.1	15.4	15.7	17.2	16.1	13.2	PASS
3908100171	OH	Jefferson	13.1	13.8	22.4	13.2	15.8	15.4	15.1	15.6	13.2	PASS
3903500651	OH	Cuyahoga	17.2	15.3	18.9	12.6	16.4	15.6	15.9	16.0	13.0	PASS
3906170011	OH	Hamilton	15.0	15.2	21.5	13.5	16.6	16.0	16.4	16.3	12.9	PASS
3908700101	OH	Lawrence	11.8	15.7	20.9	12.5	15.0	15.0	15.7	15.2	12.7	PASS
3911300321	OH	Montgome	15.5	14.0	19.3	13.2	15.9	15.2	15.5	15.5	12.7	PASS
3901700161	OH	Butler	14.9	14.7	20.1	13.7	16.1	15.5	15.9	15.9	12.6	PASS
3903500271	OH	Cuyahoga	15.4	15.5	18.1	13.3	16.1	15.3	15.2	15.5	12.6	PASS
3904900241	OH	Franklin	15.4	13.0	19.3	13.5	16.0	15.0	15.0	15.3	12.6	PASS
3915300171	OH	Summit	13.7	14.7	19.0	13.4	15.6	15.0	15.0	15.2	12.5	PASS
3904900251	OH	Franklin	15.3	13.1	19.3	12.7	15.5	14.8	14.9	15.1	12.4	PASS
3906100431	OH	Hamilton	14.3	14.1	20.6	13.6	15.8	15.4	15.7	15.6	12.4	PASS
3909900141	OH	Mahoning	14.0	14.7	19.5	12.7	15.5	15.0	15.2	15.2	12.4	PASS
3906100401	OH	Hamilton	14.3	14.5	20.8	12.6	15.9	15.2	15.5	15.6	12.3	PASS
3906100061	OH	Hamilton	14.8	13.3	21.2	12.8	16.6	14.9	14.9	15.5	12.2	PASS
3901710041	OH	Butler	13.7	14.0	19.4	12.8	15.1	14.6	15.1	15.0	12.1	PASS
3906100411	OH	Hamilton	15.0	14.2	19.0	12.8	15.2	15.2	15.8	15.2	12.1	PASS
3911300311	OH	Montgome	14.5	13.8	18.5	12.6	15.0	14.6	14.9	14.8	12.1	PASS
3914500131	OH	Scioto	12.2	14.7	20.4	11.9	14.6	14.5	15.3	14.8	12.1	PASS
3915500071	OH	Trumbull	13.4	13.8	18.2	12.9	14.7	14.4	14.7	14.6	12.0	PASS
3902300051	OH	Clark	14.3	14.1	18.2	12.0	14.7	14.4	14.9	14.7	11.9	PASS
3903510021	OH	Cuyahoga	14.1	14.4	17.7	10.8	14.6	13.9	14.2	14.2	11.9	PASS
3909500241	OH	Lucas	15.5	12.8	15.6	13.5	14.7	14.1	14.2	14.3	11.9	PASS
3909900051	OH	Mahoning	13.7	14.4	18.7	12.1	15.0	14.5	14.7	14.7	11.9	PASS
3902500221	OH	Clermont	13.2	13.8	20.2	11.7	15.7	14.2	14.2	14.7	11.8	PASS
3909500261	OH	Lucas	14.9	12.7	15.4	13.2	14.3	13.8	14.2	14.1	11.7	PASS
3915100201	OH	Stark	14.0	13.5	17.4	13.0	15.1	14.1	14.1	14.5	11.7	PASS
3915300231	OH	Summit	12.8	13.5	18.5	12.4	14.6	14.1	14.3	14.3	11.7	PASS
3909300161	OH	Lorain	13.9	13.0	17.5	11.3	14.1	13.6	14.0	13.9	11.6	PASS
3909500251	OH	Lucas	14.4	12.7	15.7	12.7	14.4	13.6	13.7	13.9	11.5	PASS
3904900811	OH	Franklin	13.9	11.7	17.9	12.2	14.3	13.7	13.7	13.9	11.3	PASS
3915100172	OH	Stark	13.4	14.4	18.3	10.1	12.6	13.2	14.3	14.1	11.3	PASS
3903500341	OH	Cuyahoga	13.8	13.4	17.3	10.6	14.1	13.4	13.9	13.8	11.2	PASS
3913510011	OH	Preble	13.3	13.1	17.6	11.3	13.9	13.5	14.0	13.8	11.2	PASS
3908510011	OH	Lake	12.2	14.7	16.6	11.4	13.1	12.6	13.2	13.7	11.1	PASS
3903500661	OH	Cuyahoga	14.4	11.7	16.0	10.9	12.8	11.7	0.0	13.3	10.8	PASS
3905700051	OH	Greene	13.4	12.7	17.3	10.6	12.4	13.2	13.7	13.5	10.8	PASS
3910300031	OH	Medina	10.6	12.9	16.7	11.7	15.2	13.6	13.6	13.0	10.7	PASS
3913300021	OH	Portage	11.9	12.8	17.4	11.3	13.4	13.2	13.5	13.4	10.7	PASS
3909330021	OH	Lorain	12.0	12.2	15.8	11.1	12.8	12.6	13.0	12.8	10.6	PASS
3900900031	OH	Athens	9.3	12.4	17.8	9.8	12.3	12.2	12.5	12.3	9.6	PASS
3908530021	OH	Lake	11.1	10.2	14.8	8.7	0.0	11.2	11.2	11.2	9.2	PASS