Status Report on 8-hr Coalition Modeling: Ensemble Modeling, MPE, and RRF Calculations

Presented by:

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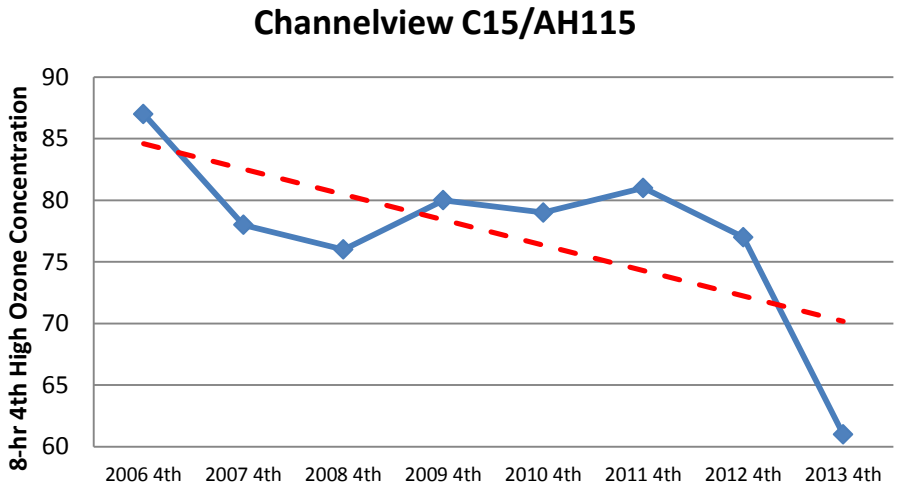


8-hr 4th Highest Ozone Concentration Trend

27 February 2014
Southeast Texas Photochemical Modeling
Technical Committee Meeting

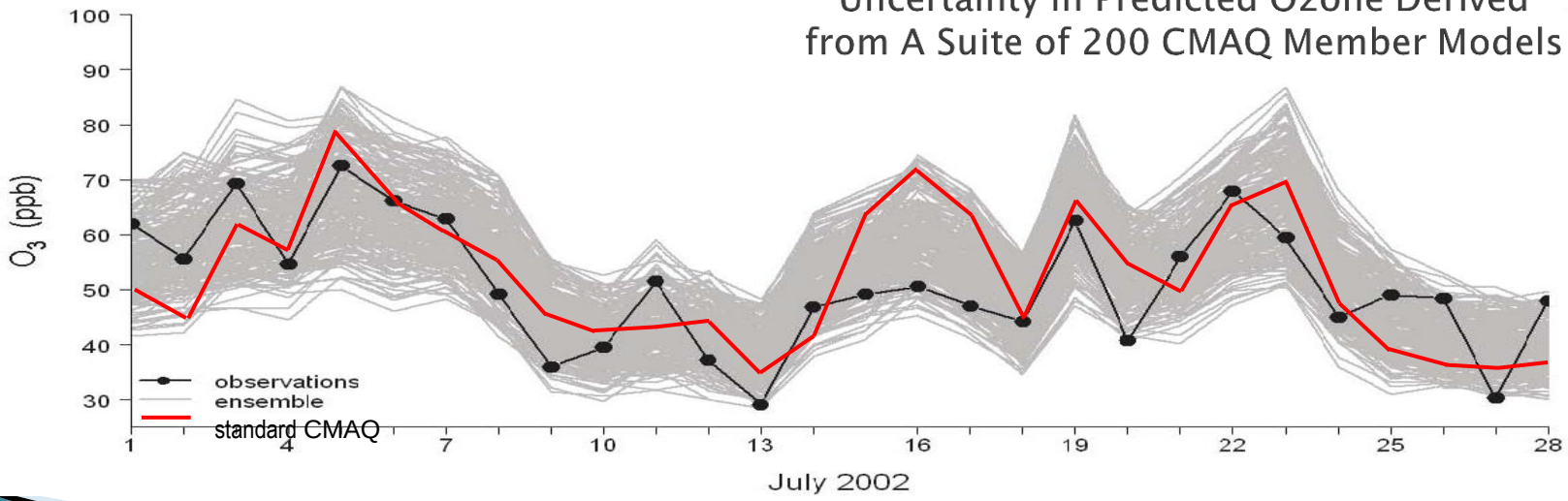
Outline

- Ensemble Modeling
- Monitor 8hr 4th High Concentration Trends
- Relative Response Factor Calculation
- Ensemble Comparisons
- General Summary

Ensemble Configurations

- Four configurations (i.e., ensemble members) used for each of four years analyzed (2008, 2009, 2010, 2011):
  - MM5/SMOKE$_{GLOBEIS}$/CAMx
  - MM5/SMOKE$_{MEGAN}$/CAMx
  - WRF/ SMOKE$_{GLOBEIS}$/CAMx
  - WRF/ SMOKE$_{MEGAN}$/CAMx

Ensemble Member Model 8-hr Ozone Estimates at a Monitor Near Atlanta: Gray Time Series Encompass the Range of Uncertainty in Predicted Ozone Derived from A Suite of 200 CMAQ Member Models



Source: EPA (Rao, 2009)

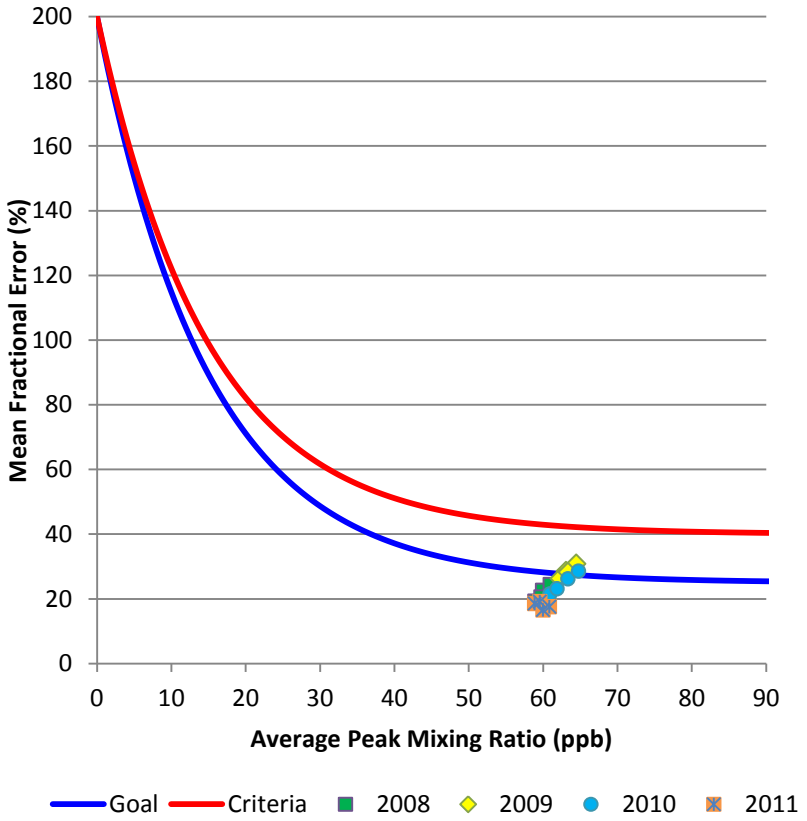
Operational Evaluation Summary

Ensemble Simulation	Summary Statistics		Pred-Obs Paired Statistics			Pred-Obs Unpaired Statistics		
	Avg Obs (ppb)	Avg Pre (ppb)	FB (%)	FE (%)	RMSE (ppb)	FB (%)	FE (%)	RMSE (ppb)
2008 MM5/GloBEIS	54.9	65.0	15.1	22.6	18.3	23.1	23.7	15.7
2008 MM5/MEGAN	54.9	67.1	17.9	24.4	20.3	27.0	27.1	18.5
2008 WRF/GloBEIS	54.9	62.9	12.6	19.2	14.8	18.2	18.9	11.7
2008 WRF/MEGAN	54.9	64.4	14.9	20.5	16.2	21.2	21.4	13.5
2009 MM5/GloBEIS	55.1	71.1	23.7	28.5	23.7	32.4	32.4	21.5
2009 MM5/MEGAN	55.1	73.8	27.1	30.8	26.1	36.6	36.6	24.9
2009 WRF/GloBEIS	55.1	69.4	21.7	26.2	20.7	29.2	29.2	18.9
2009 WRF/MEGAN	55.1	71.6	24.7	28.2	22.8	32.9	32.9	21.7
2010 MM5/GloBEIS	56.3	70.4	19.9	26.1	23.1	28.1	28.2	19.9
2010 MM5/MEGAN	56.3	73.2	23.2	28.5	26.1	33.0	33.0	23.9
2010 WRF/GloBEIS	56.3	65.6	14.5	21.5	16.7	21.4	21.9	13.8
2010 WRF/MEGAN	56.3	67.5	17.1	23.1	18.5	25.1	25.1	16.2
2011 MM5/GloBEIS	57.9	59.8	3.1	18.5	13.3	11.4	12.0	7.5
2011 MM5/MEGAN	57.9	61.2	5.2	19.1	14.1	13.6	14.0	8.7
2011 WRF/GloBEIS	57.9	62.1	7.1	16.5	12.8	14.6	15.2	9.7
2011 WRF/MEGAN	57.9	63.8	9.4	17.5	14.1	17.2	17.6	11.3
	56.0	**66.8**	**16.1**	**23.2**	**18.9**	**24.1**	**24.3**	**16.1**

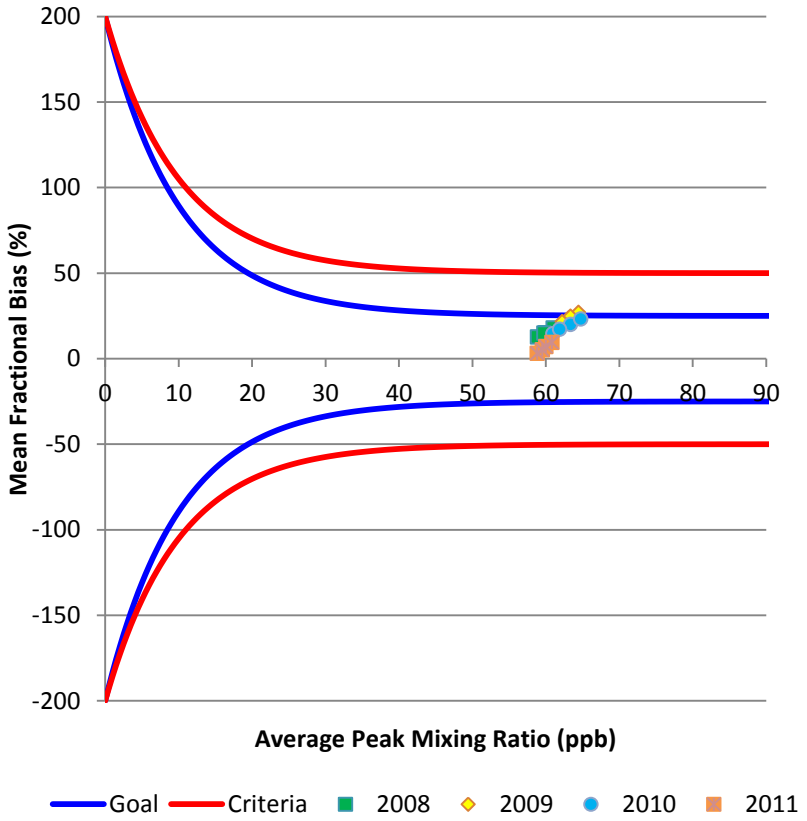
Statistics based on MDA8 ozone, all stations, all days, gross error $\leq$ 35%, bias $\leq$ 10%, 40 ppb cutoff

2011 Ensemble Summary Metrics

Fractional Error in 8hr Ozone

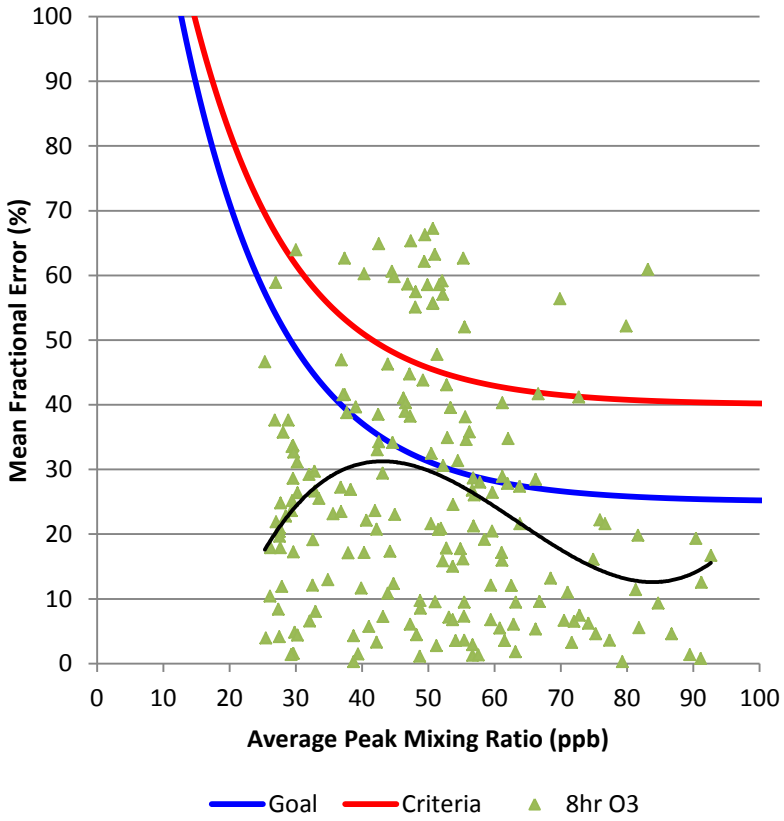


Fractional Bias in 8hr Ozone

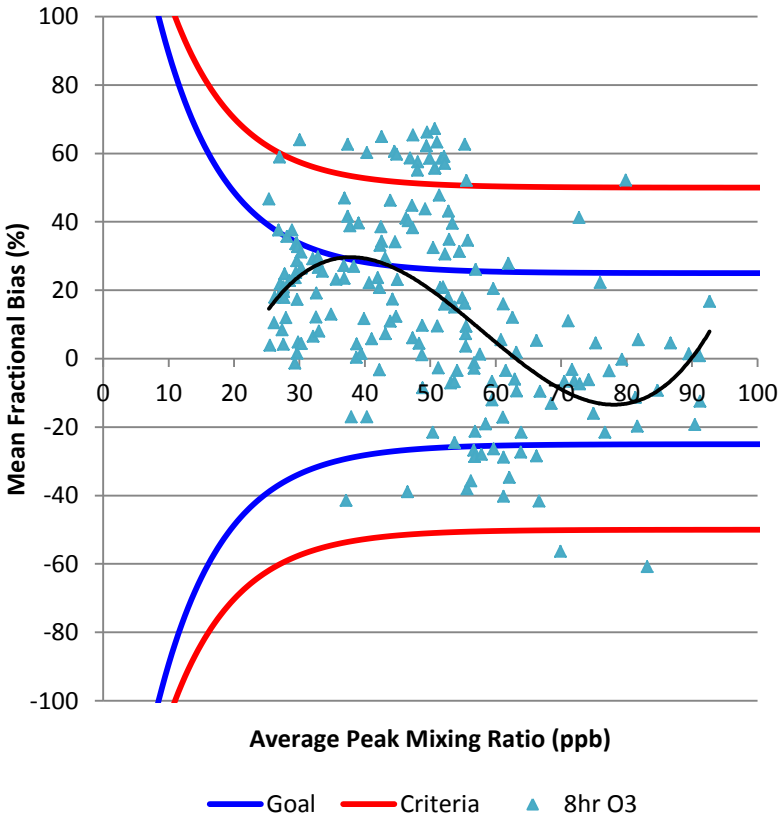


2011 Ensemble MPE Metrics: Manvel Croix Park Monitor (MM5/MEGAN)

Fractional Error in 8-hr Ozone



Fractional Bias in 8-hr Ozone



8-hr 4th Highest Ozone Concentration Trends

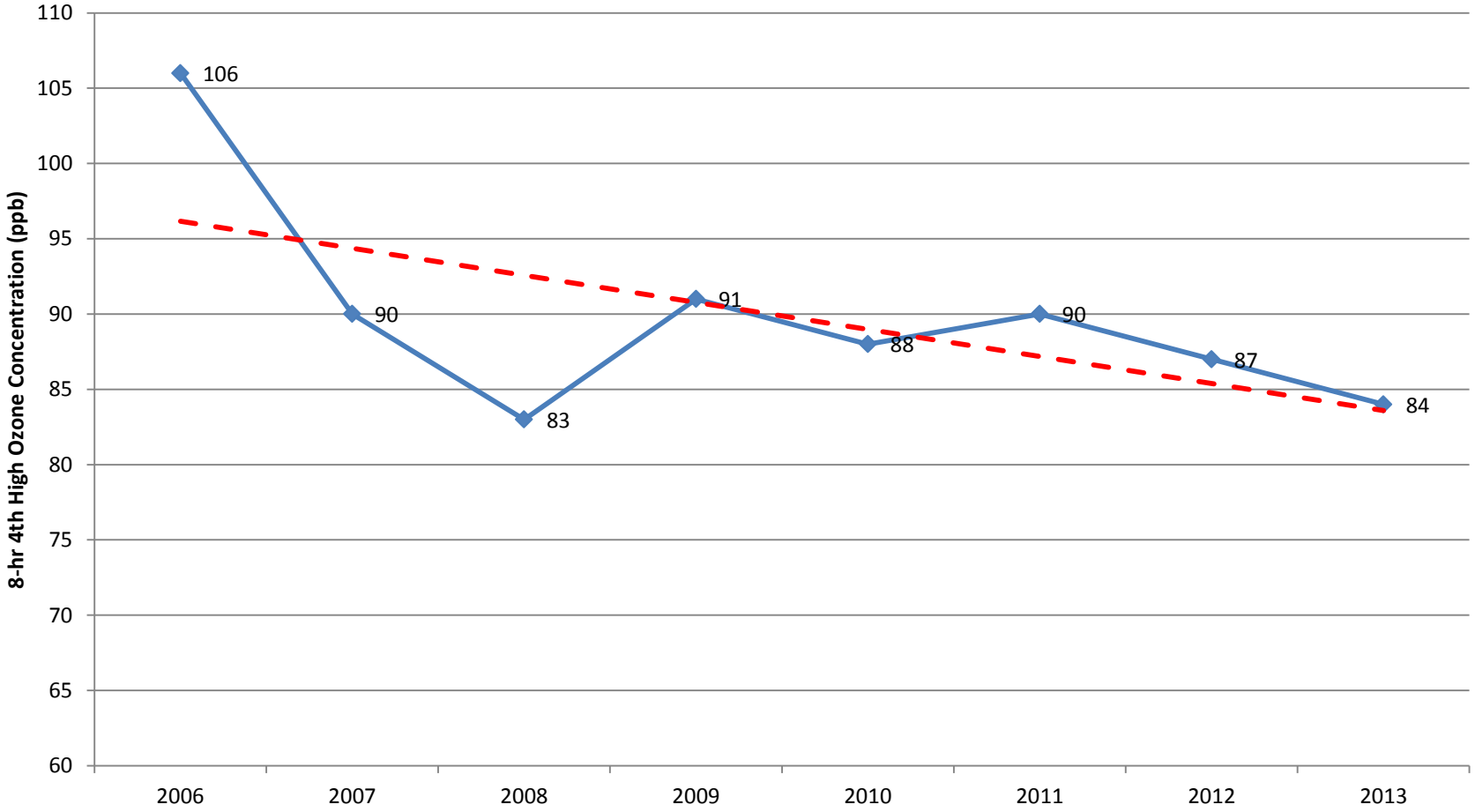
- Review 4th high ozone concentrations from recent history to confirm improvement in air quality
- These are the values used in designation design value calculations
- Calculate slope to see where improvements are best achieved

HGB Monitor 8hr Ozone Concentrations

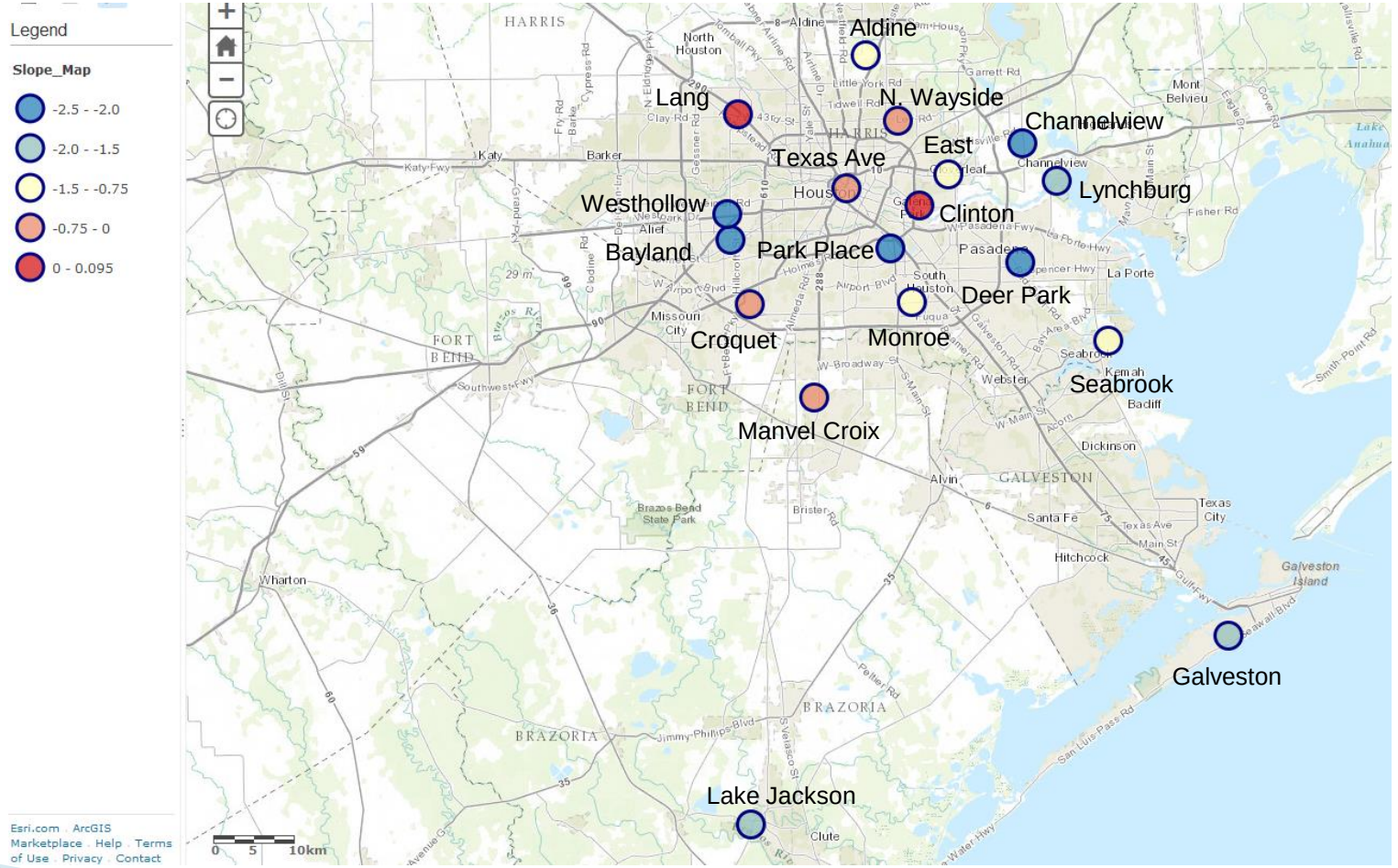
Name	4th High 8hr Ozone Concentration (ppb)								2011-13 8hr DV (ppb)	4th High Conc Slope ppb/yr
	2006	2007	2008	2009	2010	2011	2012	2013		
Park Place C416	106	85	76	73	84	79	77	79	78	-2.488
Houston Bayland Park C53/A146	106	84	83	86	78	87	77	81	81	-2.452
Hou.DeerPrk2 C35/235/1001/AFH139FP239	101	86	76	82	85	83	85	69	79	-2.440
Houston Westhollow C410	103	84	82	71	72	81	81	77	79	-2.369
Channelview C15/AH115	87	78	76	80	79	81	77	61	73	-2.060
Galveston 99th St. C1034/A320/X183		87	69	76	80	79	81	64	74	-1.500
Lake Jackson C1016	80	72	76	76	72	73	71	67	70	-1.298
Lynchburg Ferry C1015/A165	87	71	65	73	83	73	75	64	70	-1.274
Houston Aldine C8/AF108/X150	81	86	83	80	87	83	75	74	77	-1.155
Houston Monroe C406	99	72	72	71	75	76	85	74	78	-1.119
Seabrook Friendship Park C45	83	85	71	79	77	79	86	67	77	-1.012
Northwest Harris Co. C26/A110/X154	90	90	76	86	82	86	82	80	82	-1.000
Houston East C1/G316	91	76	73	79	76	88	83	69	80	-0.917
Conroe Relocated C78/A321	93	76	73	65	77	80	82	75	79	-0.750
Houston Croquet C409	92	74	76	80	77	85	79	79	81	-0.500
Houston North Wayside C405	79	78	70	69	76	80	75	70	75	-0.488
Houston Texas Avenue C411	83	76	71	79	75	79	82	72	77	-0.321
Manvel Croix Park C84	94	86	75	91	88	90	87	84	87	-0.274
Clinton C403/C304/AH113	76	74	71	78	79	80	81	67	76	0.000
Lang C408	86	73	71	81	77	78	81	79	79	0.095
Maximum 4th Highest Monitor	106	90	83	91	88	90	87	84		-1.798

Sorted by increasing slope

Maximum 4th High (All Monitors)



Monitor 4th High Slope Locations



4th High Trend Results

- Greatest improvement in air quality (8-hr ozone) between 2006 and 2013 seen at Park Place monitor
  - 106 ppb -> 79 pbb
  - Slope = -2.488 ppb/yr
- Only monitor with positive slope between 2006 and 2013 is Lang although 4th high concentration decreased during the same period
  - 86 ppb -> 79 ppb
  - Slope = +0.095 pbb/yr
- Slope of maximum 4th high across all monitors shows -1.798 ppb /yr during time period

Relative Response Factor

- The relative response factor (RRF) is the ratio of the future year modeled concentration predicted near a monitor (averaged over multiple days) to the base year modeled concentration predicted near the monitor (averaged over the same days)

- Calculations conducted using EPA's Modeled Attainment Test Software (MATS), v.2.5.1
  - Includes current EPA attainment test guidance methods
  - Results shown include EPA regulatory monitors

8-hr Ozone Attainment Test

RRF is based on modeled data concentration change [future modeled / base modeled]

DV_c is based on observed concentration data

$$DV_f = RRF * DV_c$$

DV_f is resultant future year concentration data based on DV_c and calculated RRF slope

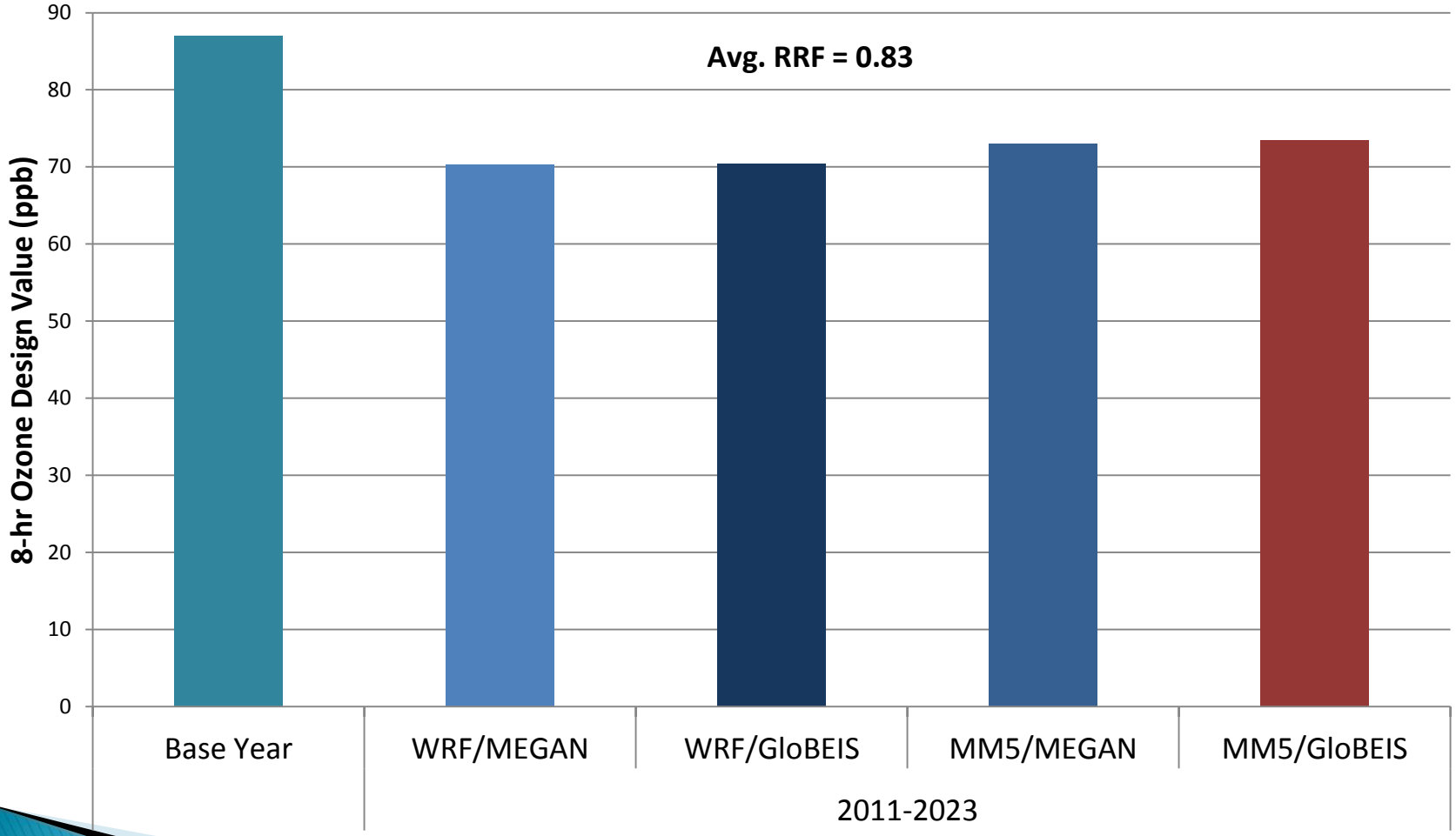
RRF Setup – Selecting Monitors

- If there are fewer than 10 model days at or above 85 ppb in the baseline scenario, then MATS will lower the threshold in increments of 1 ppb, until there are at least 10 days at or above this new, lower threshold
  - This process is continued, if needed, until a threshold of 70 ppb is reached
    - By default, this is the lowest allowable threshold
  - If there are fewer than 5 days at or above this threshold of 70 ppb, then the monitor site will be dropped

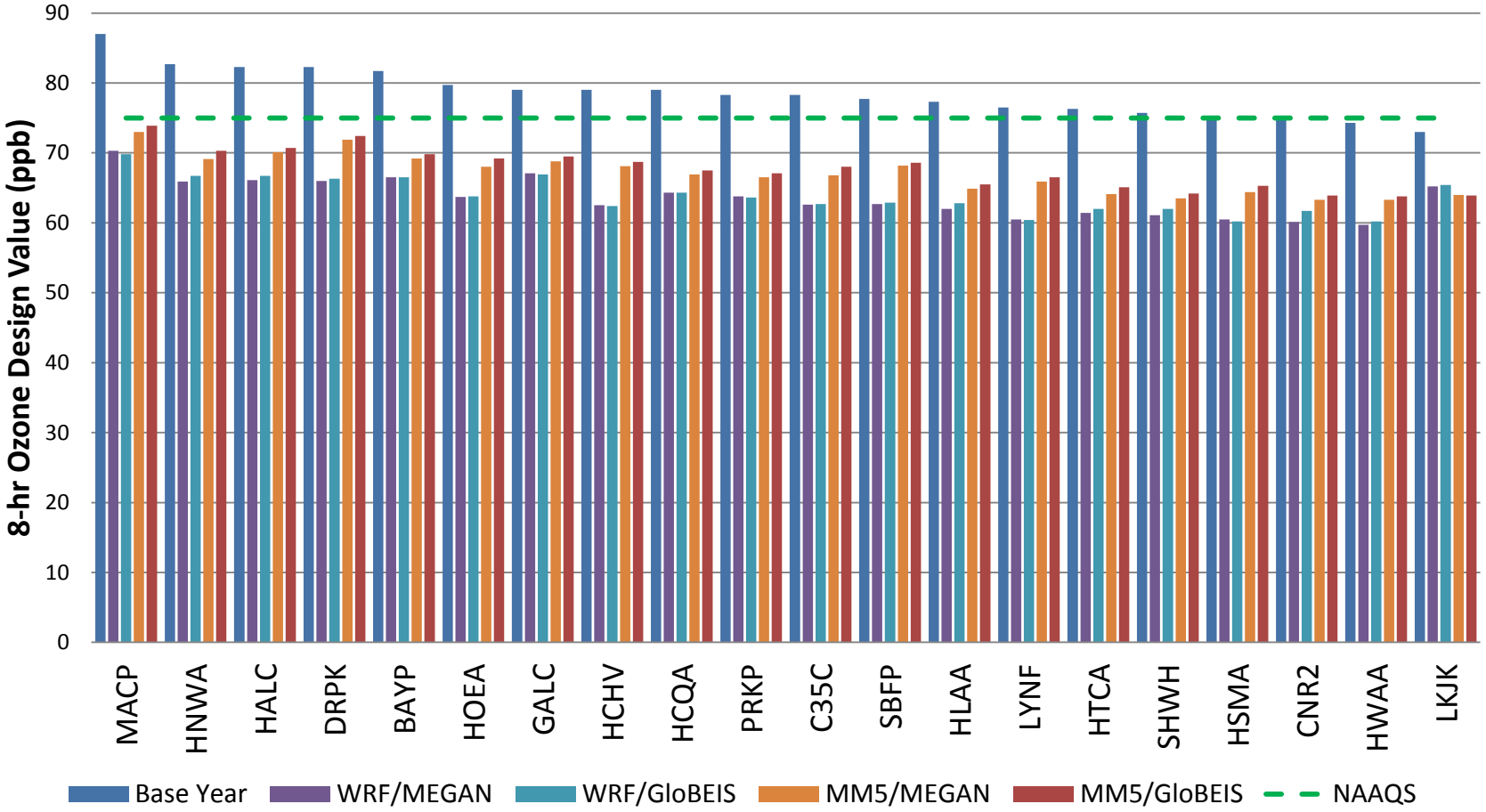
MATS RRF Results : 2011-2023 4km Modeling

	8hr Ozone Design Values (ppb) - MATS					
	DVc	Future Year (DVf)				Ensemble
Name	Base Year	WRF/MEGAN	|WRF/GloBEIS	|MM5/MEGAN	|MM5/GloBEIS	Average
Manvel Croix Park C84	87.0	70.3	70.4	73.0	73.4	71.8
Lake Jackson C1016	73.0	64.1	65.0	64.0	63.9	64.3
Galveston 99th St. C1034/A320/X183	79.0	66.7	66.8	69.1	69.4	68.0
Houston Aldine C8/AF108/X150	82.3	66.6	67.4	70.0	70.6	68.7
Channelview C15/AH115	79.0	62.9	62.5	67.6	68.4	65.4
Northwest Harris Co. C26/A110/X154	82.7	66.0	66.6	68.6	70.1	67.8
Houston North Wayside C405	74.3	60.5	60.8	63.0	64.0	62.1
Lang C408	77.3	62.3	63.1	64.6	65.3	63.8
Houston Croquet C409	79.0	64.3	64.4	66.3	66.7	65.4
Houston Bayland Park C53/A146	81.7	66.5	67.4	68.8	69.7	68.1
Houston Monroe C406	74.7	60.8	60.9	63.0	64.1	62.2
Houston Westhollow C410	75.7	61.3	62.2	63.3	64.3	62.8
Houston Texas Avenue C411	76.3	62.3	63.2	64.0	64.7	63.6
Park Place C416	78.3	64.6	65.1	66.7	66.9	65.8
Lynchburg Ferry C1015/A165	76.5	60.4	60.5	66.3	66.9	63.5
Houston East C1/G316	79.7	64.2	64.4	67.5	68.5	66.2
Clinton C403/C304/AH113	78.3	63.9	64.5	66.1	66.9	65.4
Hou.DeerPrk2 C35/235/1001/AFH139FP239	82.3	66.0	66.3	71.4	72.4	69.0
Seabrook Friendship Park C45	77.7	62.5	62.9	68.2	68.5	65.5
Conroe Relocated C78/A321	74.7	60.3	60.3	63.2	64.0	62.0

480391004 – Manvel Croix Park C84 (4km Results) Ensemble Modeling RRF 8-hr Ozone DV Calculations

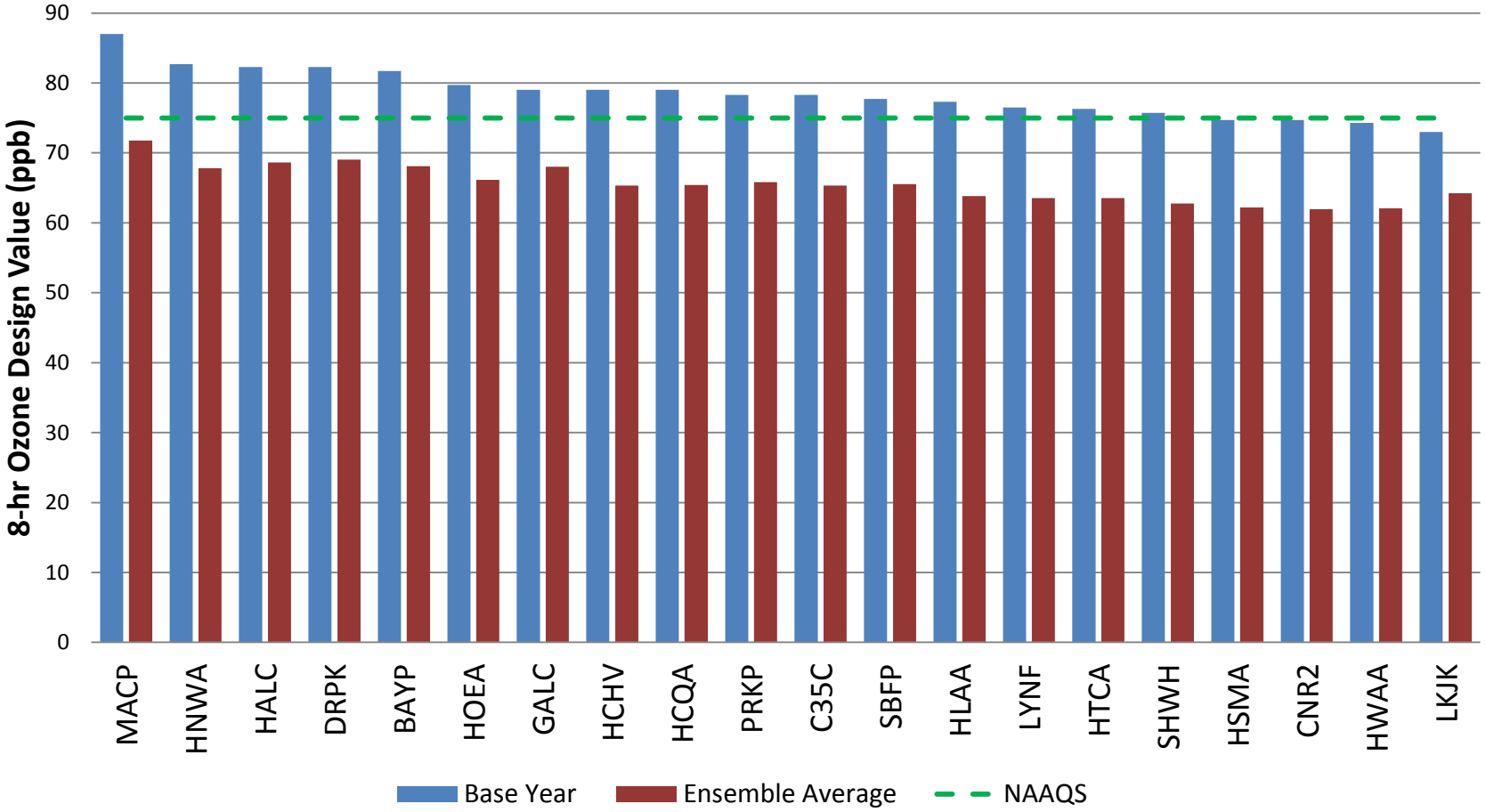


4km Attainment Test Results 2011-2023 Simulation



Sorted by descending base year DV

4km Attainment Test Results
2011-2023 Simulation [Ensemble Average]



8-hr Ozone Attainment Findings

- 4km simulation predicts all investigated monitors attain 75ppb NAAQS in future year using on-the-books controls and current socio-economic growth patterns
- None of the monitors achieve lower than a potential 60 pbb NAAQS level
- Manvel Croix shows highest residual concentration in future (73.4 ppb) with MM5/GloBEIS configuration @ 4km

Summary

- 4th highest ozone concentrations at all monitors has decreased since 2006
- Current 2011 inventory, model, and chemistry configurations provide high confidence DVs
- All reviewed monitors show attainment with 75ppb NAAQS in future year simulations but no monitors would achieve a 60ppb standard