Modeling Committee Update
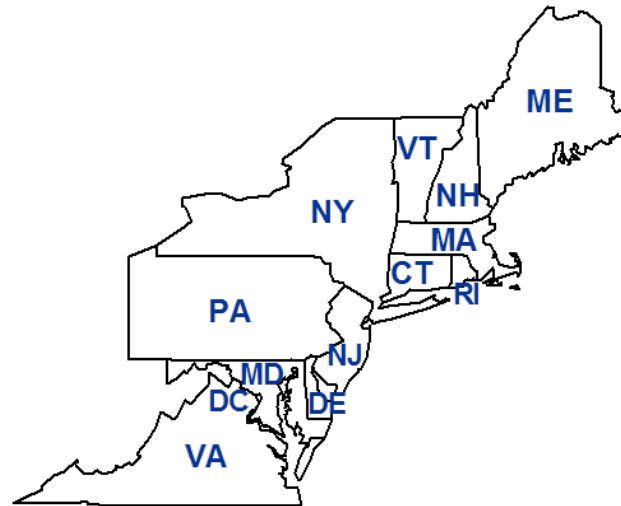
OTC Fall Meeting

Wilmington, DE
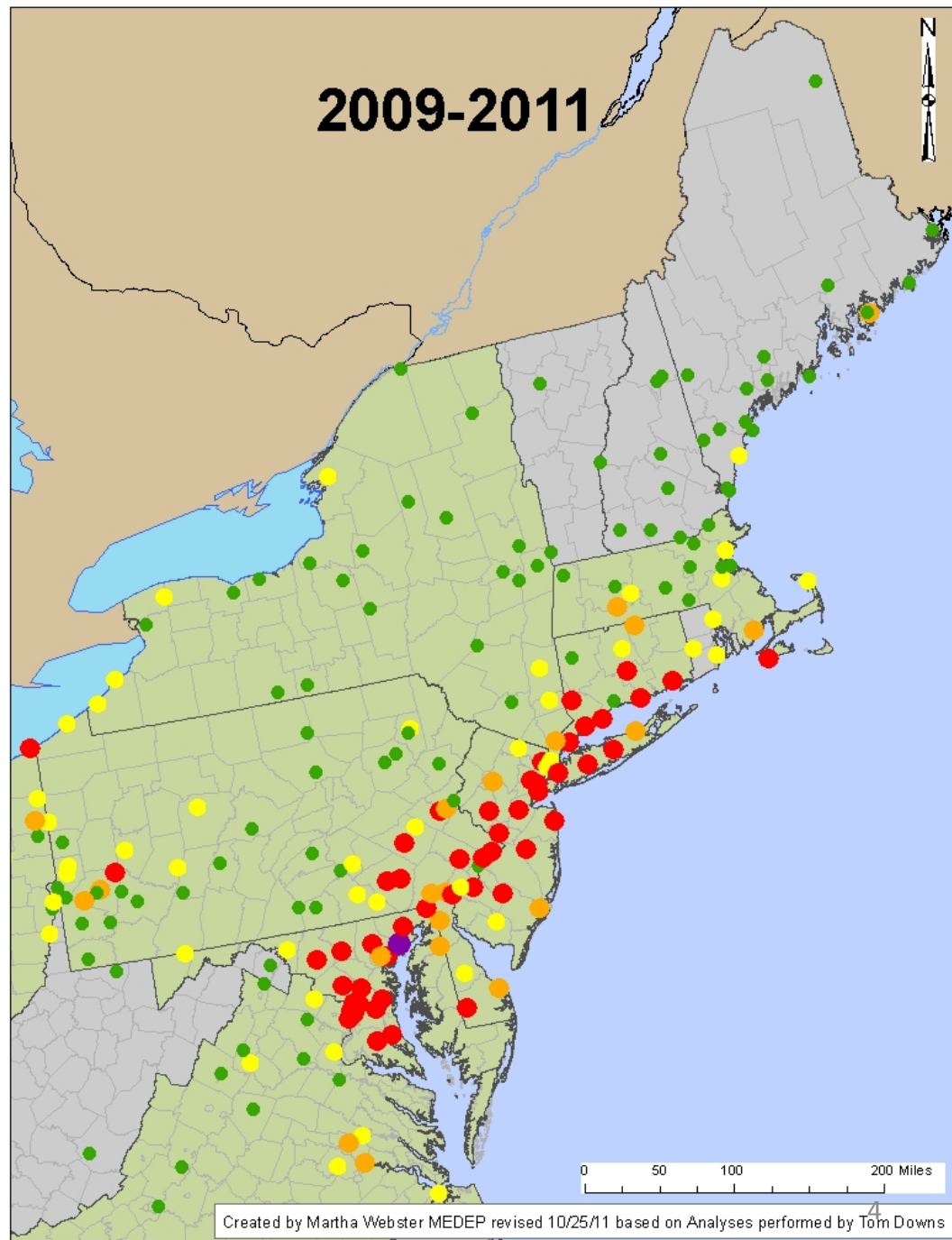## November 10, 2011
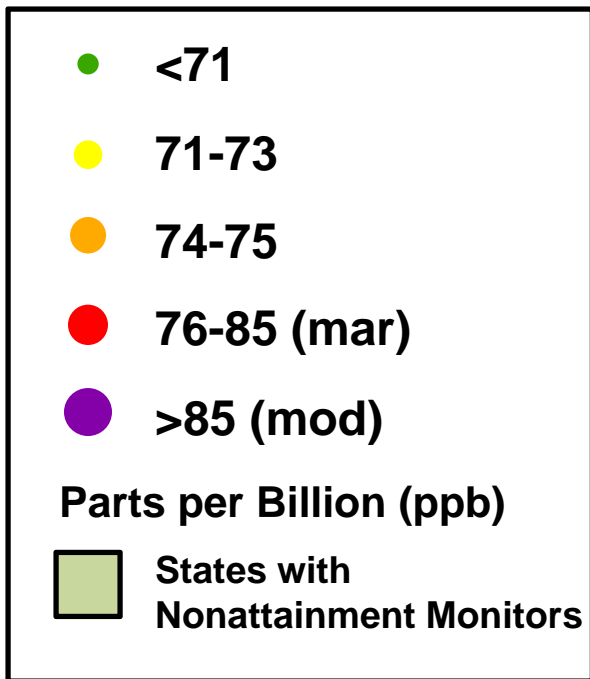
Overview

1. Where are we now?

    ▪ Ozone Season Update

2. Where are we going?

    ▪ Level 2 Screening Results

3. Emission Inventory Projections

    ▪ Update on Emissions Inventory development

4. What we need to do to get there?

    ▪ Projected attainment dates of 2015 and 2018

    ▪ Emissions Inventory Comparison

Where are we now?

1 – OZONE SEASON UPDATE

Preliminary 2011 Design Values in the OTR

2009-2011

Legend:
- 🟢 <71
- 🟡 71-73
- 🟠 74-75
- 🔴 76-85 (mar)
- 🟣 >85 (mod)

Parts per Billion (ppb)

States with Nonattainment Monitors

Created by Martha Webster MEDEP revised 10/25/11 based on Analyses performed by Tom Downs
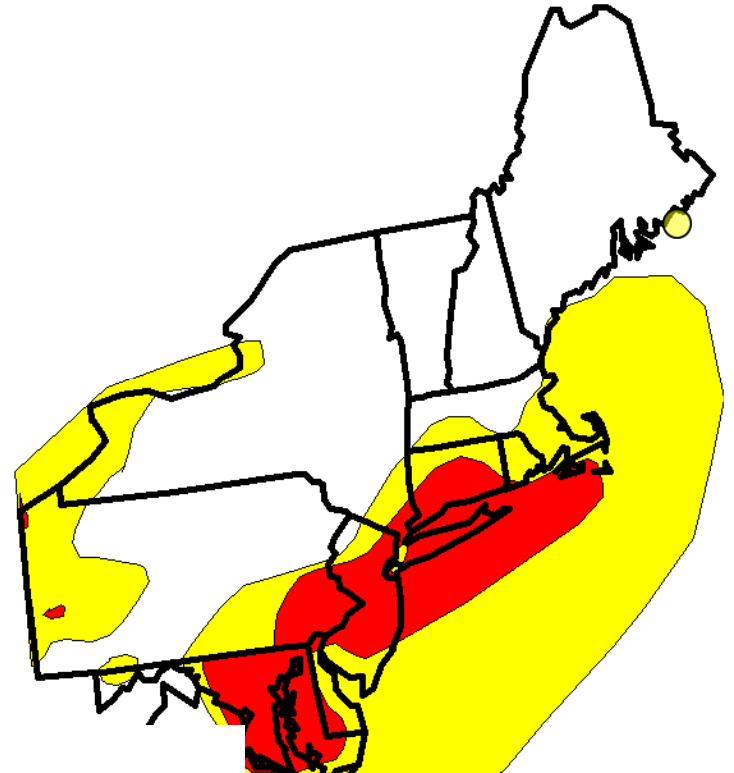
4

Simplified Representation

2010 Design Values
8-Hour Ozone
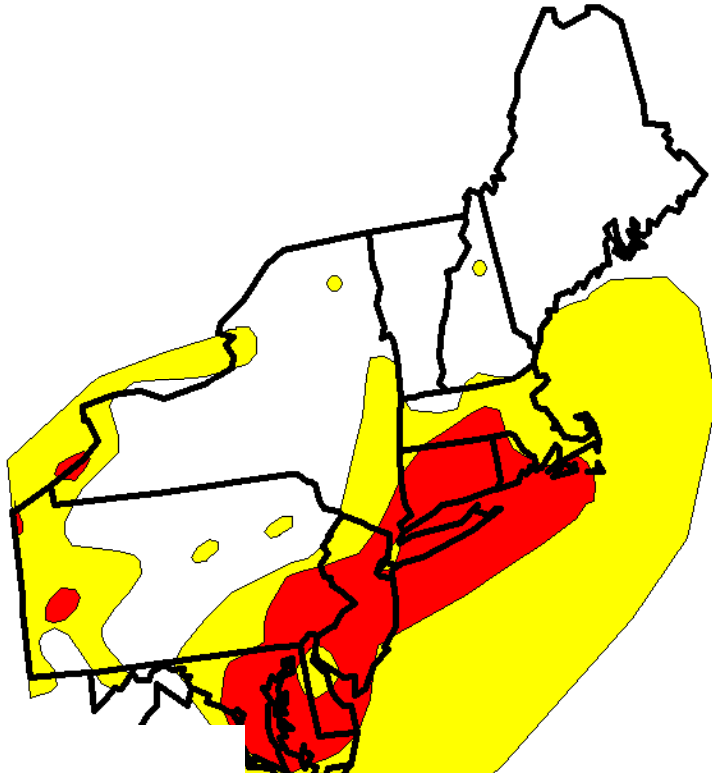
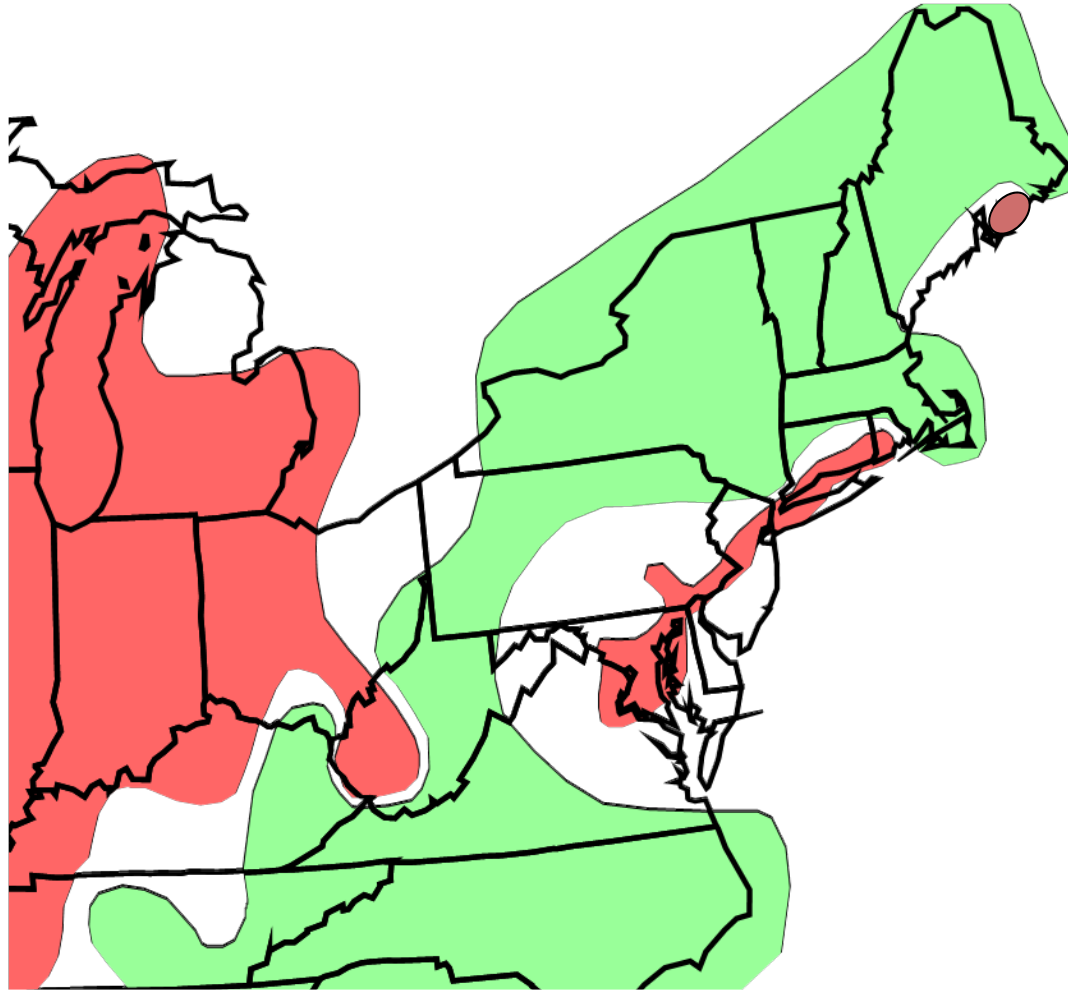**2011 Preliminary Design Values**
8-Hour Ozone
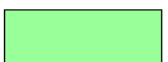
71 to 75 ppb   > 75 ppb

How Design Values Changed

From 2010 to 2011

Of the Past 4 Years
2009 was an Exceptionally Clean Year

Percent of OTR Monitors over Thresholds
By Year and by 3- Year Design Value

Y-axis: Percent of all OTR Monitors > Threshold (%)

Data points:
- 2008: 52.5 (% Sites > 75 ppb), 8.9 (% Sites > 84 ppb)
- 2009: 4.5 (% Sites > 75 ppb), 0 (% Sites > 84 ppb)
- 2010: 49.2 (% Sites > 75 ppb), 10.1 (% Sites > 84 ppb)
- 2011: 37.4 (% Sites > 75 ppb), 12.3 (% Sites > 84 ppb)

3 year averages excluding 2009

Legend:
- % Sites > 75 ppb
- % Sites > 84 ppb
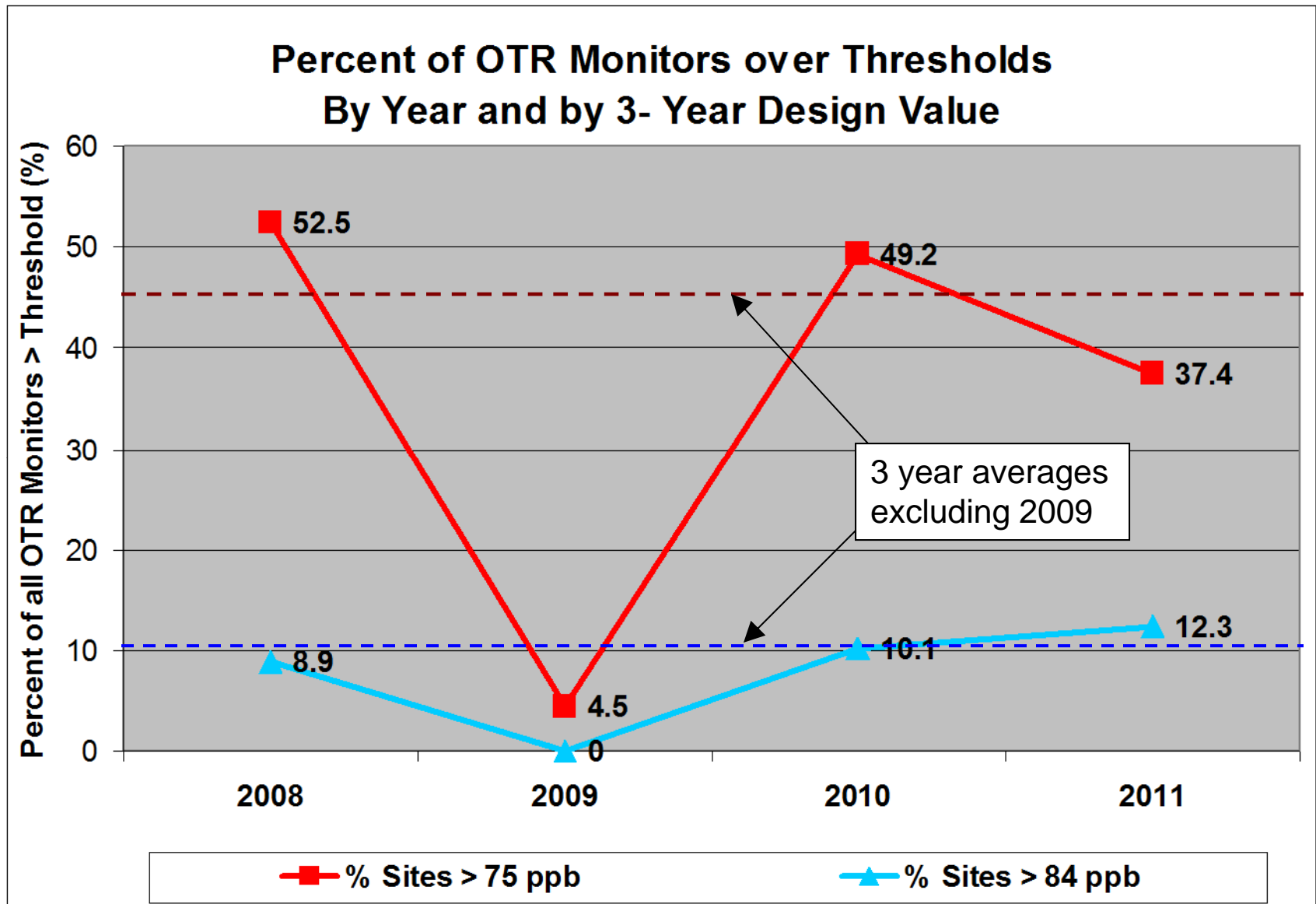
Annual 4ᵗʰ High Ozone Values
for the 3 Design Value Years – 2009, 2010 and 2011
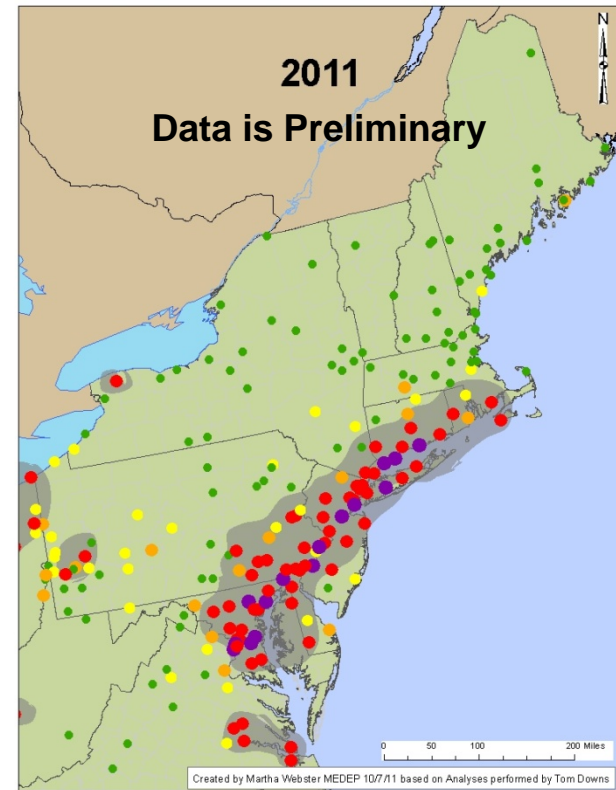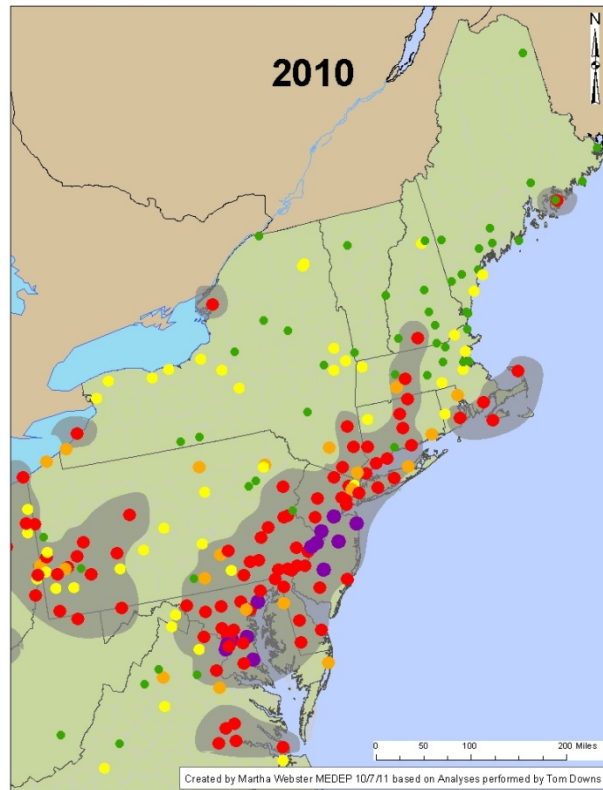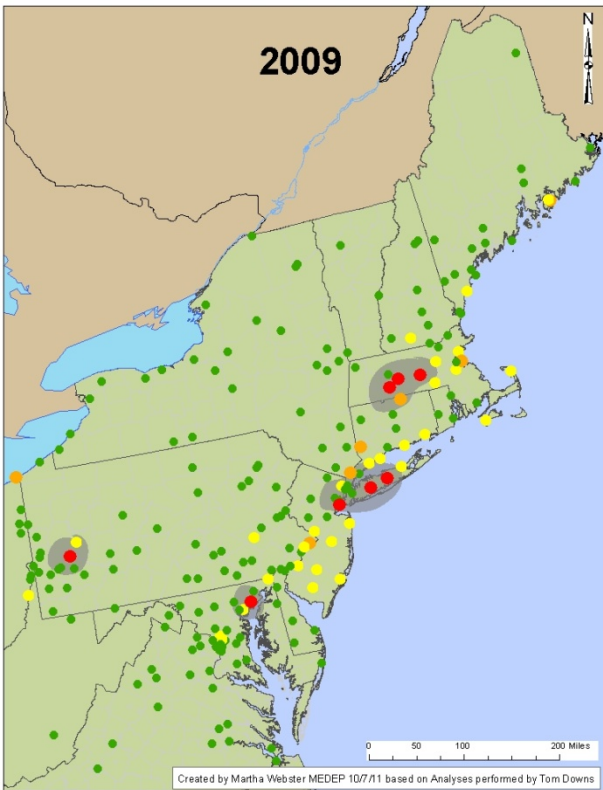
Grey shaded area highlights general areas greater than 75 ppb ozone

Legend:
- <71
- 71-73
- 74-75
- 76-85
- >85

Parts per Billion (ppb)
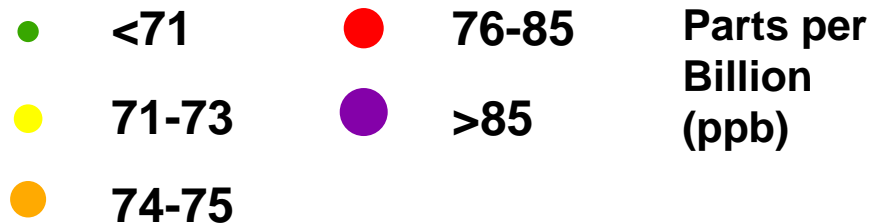
Hypothetical 2012 Design Values

Removing 2009 from Design Value Data
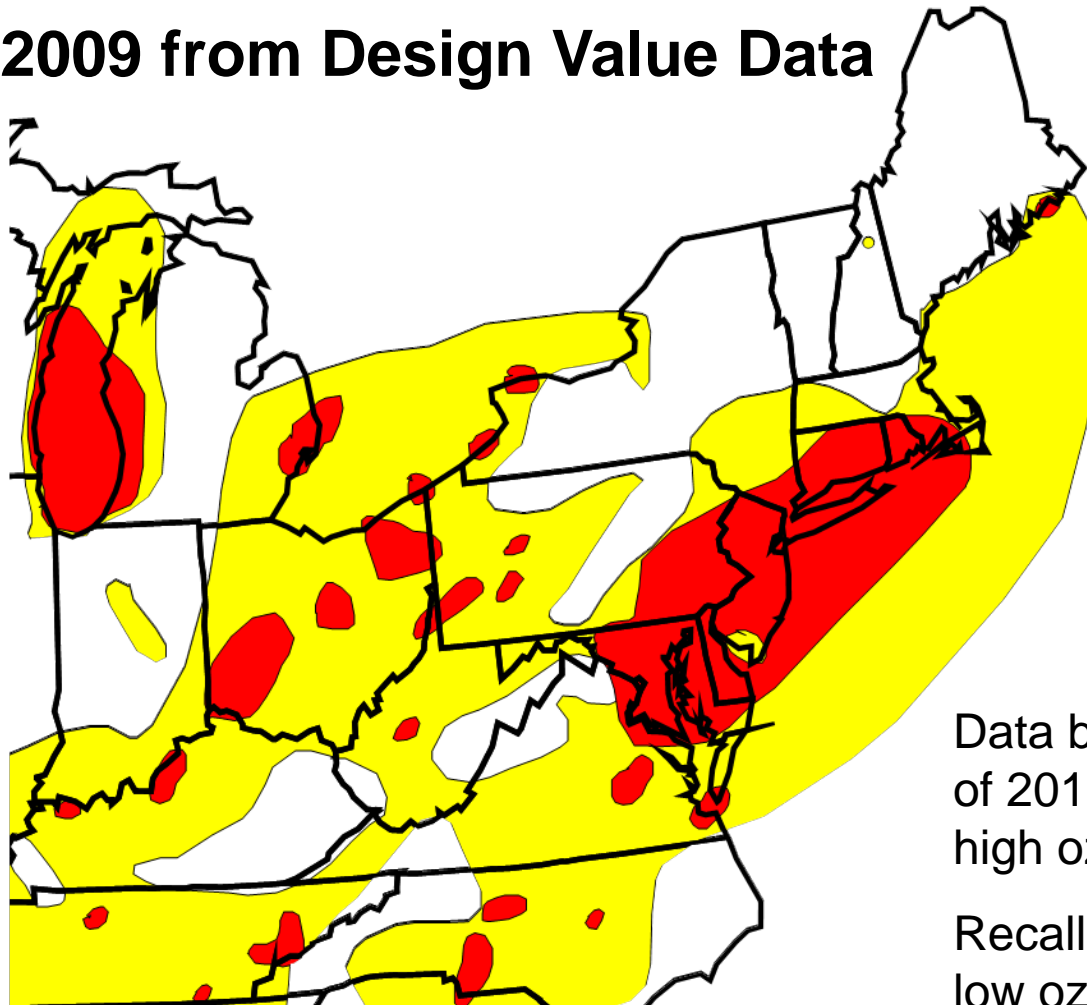
Data based on average of 2010 and 2011 4th high ozone values

Recall: 2009 was a low ozone year

| | 71 to 75 ppb | | > 75 ppb |

Where are we going?

2 – SCREENING MODELING UPDATE

Screening Runs

1. 2007 Base Case
2. 2020 "Scenario 4" Control Case
   (Approximates OTC Recommendations)
3. 2020 Bounding Cases
   A. 10% <u>Less</u> NO_X Reductions Compared to "Scenario 4"
      (N48/V23: 48% NO_X/23% VOC Reduction)
   B. 10% <u>More</u> NO_X Reductions Compared to "Scenario 4"
      (N68/V23: 68% NO_X/23% VOC Reduction)

   ➢ For bounding runs, reductions were applied uniformly to all sectors and entire modeling domain

Caveats:
Not final emission inventories for:
- Mobile & EGU sectors in the OTR
- All sectors outside the OTR
- Modeling domain boundary conditions

Summary of 2020 "Scenario 4"

- Approximates OTC's recommendations for onroad mobile and EGUs

Uses best available 2020 data except where noted

Domain-Wide NO$_X$ Reductions

- EGU: 65% from 2007
  - Estimate of OTC recommended 900,000 ton cap
- Onroad: 70% from 2007
  - Estimate of Tier 2 fleet turnover & LEV3

Domain-Wide VOC Reductions

- 30% EGU & On-road sectors from 2007

OTR Only: Extra 5% NO$_X$

Comparison of Annual NO$_X$ Emissions

2020 Emission Estimates

Legend: Area, Nonroad-MAR, Other Point, Nonroad-NMIM, Onroad Mobile, EGU Point

Y-axis: Thousands of Tons (-, 250, 500, 750, 1,000, 1,250, 1,500)

X-axis categories:
- N48/V23 — 10% Less NO$_X$ Reduction
- Level 2 — "Scenario 4"
- N68/V23 — 10% More NO$_X$ Reduction
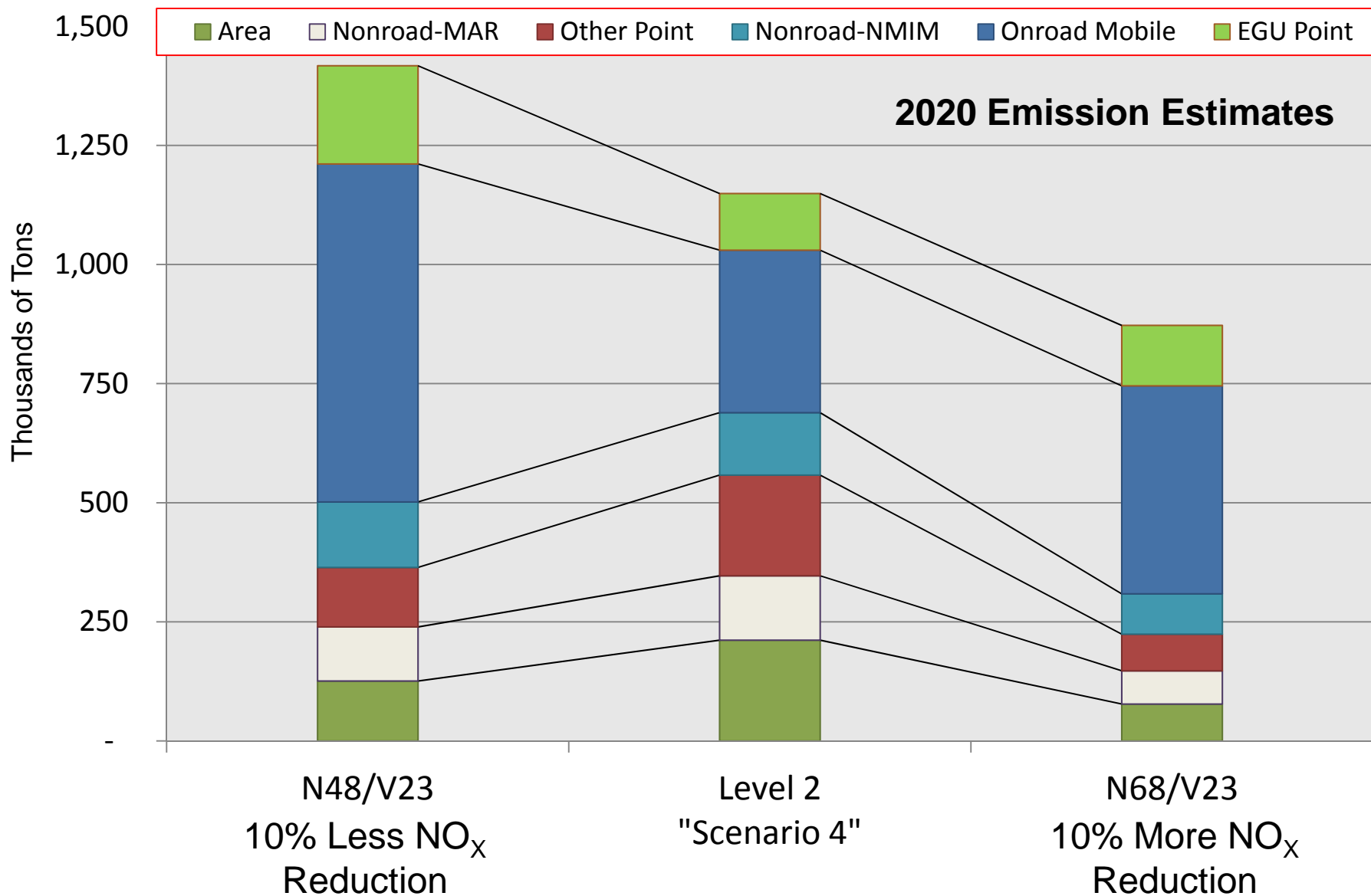
"Scenario 4" Bounding Predicted DVs (2020)

N48/V23 (10% Less)   **"Scenario 4"**   **N68/V23 (10% More)**
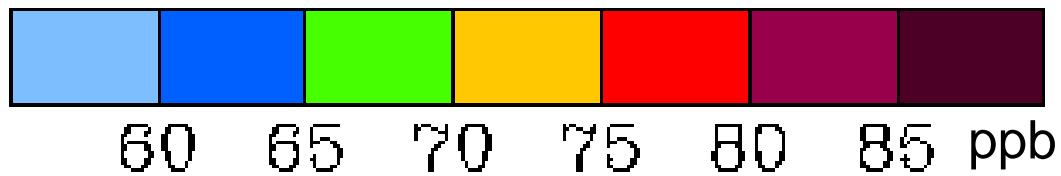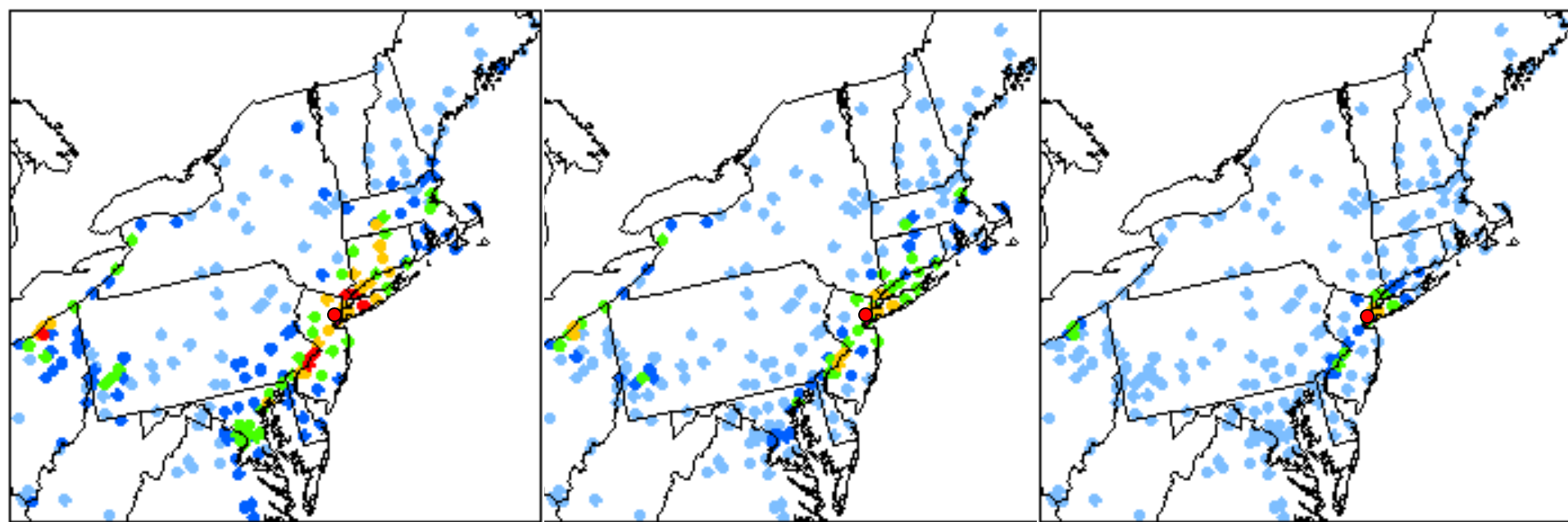
Relative Ozone Reductions (2020)

N48/V23 (10% Less)   **"Scenario 4"**   **N68/V23 (10% More)**

-3%   3%   9%   15%   21%   27%   33%
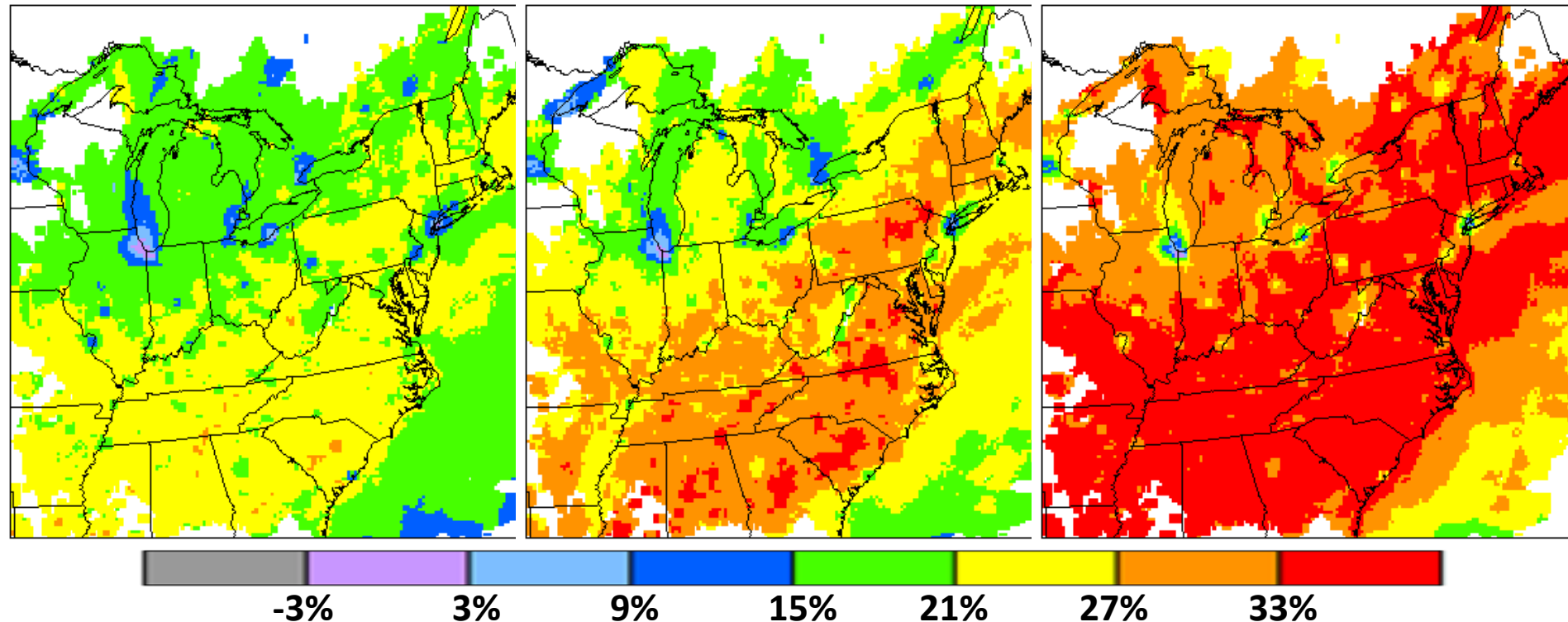
- Ozone reductions from "Scenario 4" run generally between 15 and 25% from the base case
- NO_X focused emission reductions show less benefit for urban core areas

Monitors at Nonattainment Levels - 2020

Number of Monitors in the OTR Predicted to Exceed Varying Thresholds

	Base	N48/V23	Sc. 4	N68/V23
85 ppb (Mod.)	21	0	0	0
75 ppb (Mar.)	120	5	1	1
70 ppb	163	21	8	2
65 ppb	186	61	24	8
Monitors in OTR	194	192	192	192

- Hot spots for "Scenario 4" remain near New York and Philadelphia
  - In N48/V23 (10% less NO_X reductions), more hot spots remain from Philadelphia to Massachusetts
  - N68/V23 (10% more NO_X reductions), hot spots are reduced to just the metro New York City area

Selected Screening Run Design Values

Monitor		2005–09	2020 N48/V23	2020 Sc. 4	2020 N68/V23
Bayonne	NJ	85	82	**80**	76
White Plains	NY	86	77	**73**	69
Camden	NJ	88	77	**73**	67
Bristol	PA	90	77	**72**	66
Greenwich	CT	86	76	**72**	66
Babylon	NY	88	75	**71**	65
NEA	PA	88	75	**70**	64
NYC-Queens	NY	86	74	**72**	71
Clarksboro	NJ	86	74	**69**	63
…					
Edgewood	MD	91	71	**66**	57
Chicopee	MA	88	70	**65**	58

Level 2 Screening Conclusions

- Model Performance: Very good but the model somewhat over-predicts peak observed ozone concentrations
    - Accounted for with relative reduction factor method
- "Scenario 4" sensitivity simulation generally yields reduction factors between 0.75 − 0.85   (15 to 25% ozone reduction)
    - Lower reductions in core urban areas
- Only "Bayonne, NJ" monitor with predicted ozone above 75 ppb

Level 3 Screening Planning

- Updates to:
  - New version of CMAQ and CB05 chemistry
  - ERTAC 2020 EGU Emissions Inventory
  - Updated MOVES Modeling
  - Updated emissions of other regions
  - Improved boundary conditions
- Future screening may include 2017 Scenarios

Calculation of Emission Inventory for SIP Modeling

Top Sources 2007 NO$_X$

Pie chart:
- CAMD EGU 14%
- Area 8%
- Point NonEGU 7%
- CAMD NonEGU 1%
- MAR 8%
- Nonroad 11%
- Mobile 51%

Bar chart (2007 vs 2020), categories top to bottom:
- Stationary Source Fuel Combustion / Comm. & Inst.
- External Combustion Boilers / Industrial
- Industrial Processes / Mineral Products
- NONROAD Mobile / Railroad Equipment
- NONROAD Mobile / Commercial Marine Vessels
- Stationary Source Fuel Combustion / Residential
- NONROAD Mobile / Diesel Vehicles
- External Combustion Boilers / EGU
- ONROAD Mobile / Diesel Vehicles
- ONROAD Mobile / Gasoline Vehicles

Legend: 2007, 2020

Axis: 0, 20, 40, 60, 80

10,000 TPY

MARAMA

Top Sources 2007 Volatile Organic Compounds (VOC)

Pie chart legend:
- CAMD EGU 0%
- Area 12%
- Point NonEGU 1%
- CAMD NonEGU 0%
- MAR 0%
- Nonroad 7%
- Mobile 10%
- Biogenics 70%

Bar chart categories (top to bottom):
- Solvent Use / Degreasing
- Solvent Use / Graphic Arts
- Petroleum Storage and Transport / Storage
- NONROAD Mobile / Gasoline Vehicles, 4-Stroke
- Solvent Use / Surface Coating
- NONROAD Mobile / Gasoline Vehicles, 2-Stroke
- Stationary Source Fuel Combustion / Residential
- NONROAD Mobile / Pleasure Craft
- Solvent Use / Non-industrial Consumer and Comm.
- ONROAD Mobile / Gasoline Vehicles

Legend: 2007, 2020

X-axis: 0, 10, 20, 30, 40, 50, 60, 70

10,000 TPY

MARAMA

Emissions Inventory Work Underway

- ## Model Base 2007/17/20 Inventory Updates
    - Includes current emission reduction programs and those "On the Books"
    - MOVES model bugs have hopefully been corrected and updated modeling now underway
    - Includes emission factors for 2007 for use with ERTAC model inventory projections
- ## Controlled 2020 Inventory Scenario
    - Includes Regional Measures - Adopted by OTC, but not necessarily adopted by the states yet
    - Measures are anticipated but not binding
    - Emissions after application of control measures still need to be generated

ERTAC: Status

- Coding still underway – behind schedule
- Remaining tasks for code development:
  - Input files QA – ERTAC Committee
  - Complete alpha version of code, testing on small scale data sets
  - Run large-scale data sets to test code performance.
  - Fix any discovered bugs
  - Draft and finalize documentation.
- Remaining task next year
  - Run model to obtain projected year emission estimates.

Estimated Inventory Development Status

Sector	2007 Base	2020 Base	2020 Control
EGU Point	Complete (V2)	Complete (V2)	**Early 2012**
Non-EGU Point	Complete (V2)	Complete (V2)	**Early 2012**
On-Road Mobile	Complete (V1)	**Nov 2011**	N/A
Non-Road Mobile	Complete (V2)	Complete (V2)	N/A
Area	Complete (V2)	Complete (V2)	**Early 2012**
LADCO - Midwest	Complete*	Proxy	Proxy
SESARM - Southeast	Proxy	Proxy	Proxy

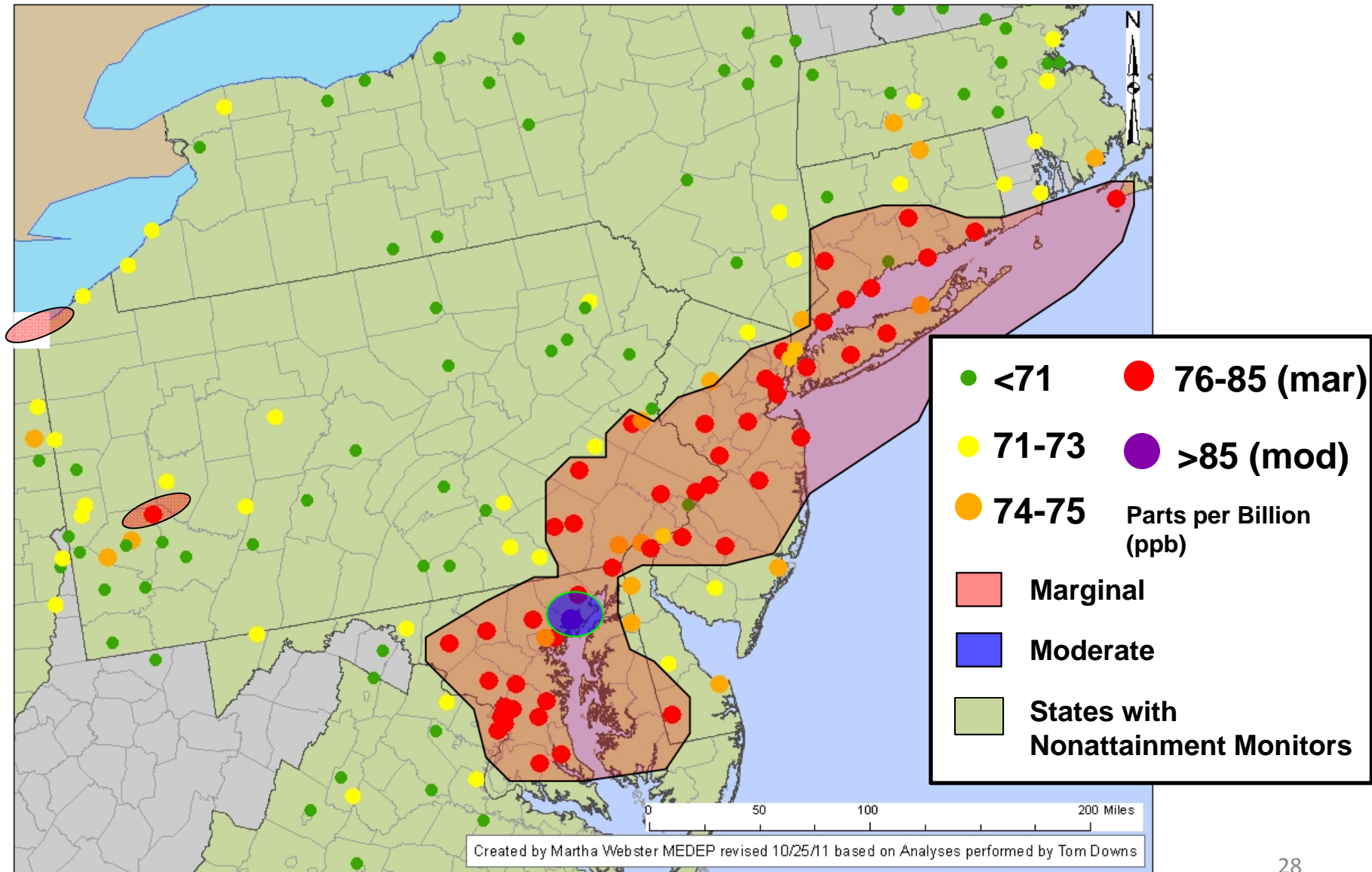* LADCO inventory is complete, but must be converted to CMAQ format to be useable.

What we need to do to get there?

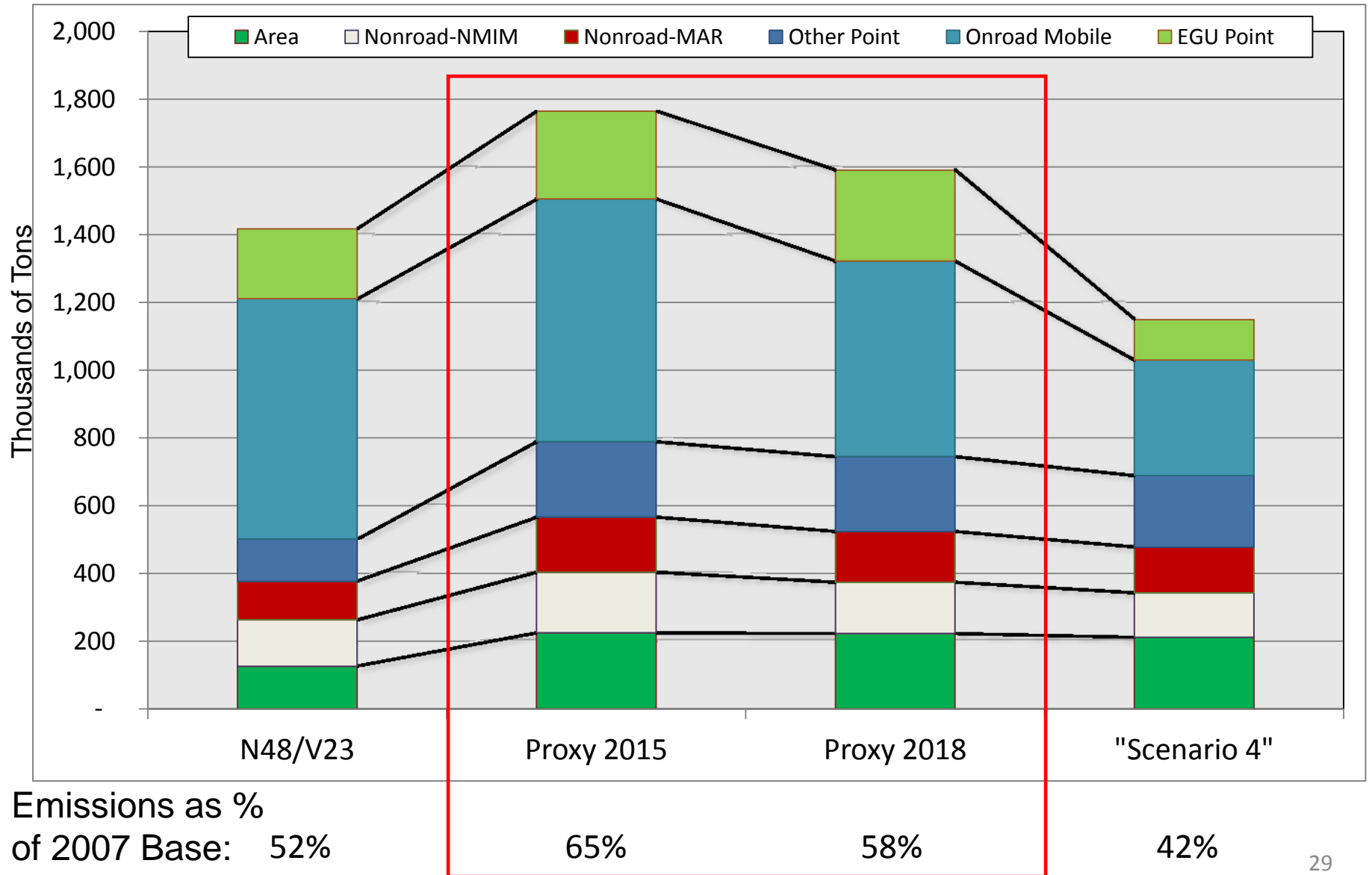# Attainment Options for 2015 and 2018

Why 2015 & 2018?

- EPA is expected to issue final designations for 2008 NAAQS nonattainment areas in the Spring of 2012

- EPA is expected to require clean data for
  - Marginal areas from 2013-2015
  - Moderate areas from 2016-2018

- 2020 modeling for "Scenario 4" shows a potential pathway for ozone attainment for a 75ppb NAAQS

Locations Facing Potential 2015/2018 Attainment Dates (2011 DV)

Legend:
- Green ● <71
- Yellow ● 71-73
- Orange ● 74-75
- Red ● 76-85 (mar)
- Purple ● >85 (mod)

Parts per Billion (ppb)

- Marginal
- Moderate
- States with Nonattainment Monitors

0 — 50 — 100 — 200 Miles

Created by Martha Webster MEDEP revised 10/25/11 based on Analyses performed by Tom Downs

Interpolation of Annual NO$_X$ Emissions

Legend: Area, Nonroad-NMIM, Nonroad-MAR, Other Point, Onroad Mobile, EGU Point

Y-axis: Thousands of Tons (0 to 2,000)

Categories: N48/V23, Proxy 2015, Proxy 2018, "Scenario 4"

Emissions as %
of 2007 Base: 52%   65%   58%   42%

Estimated Areas Above 75ppb

Based on 2020 (N48/V23) Bounding Run
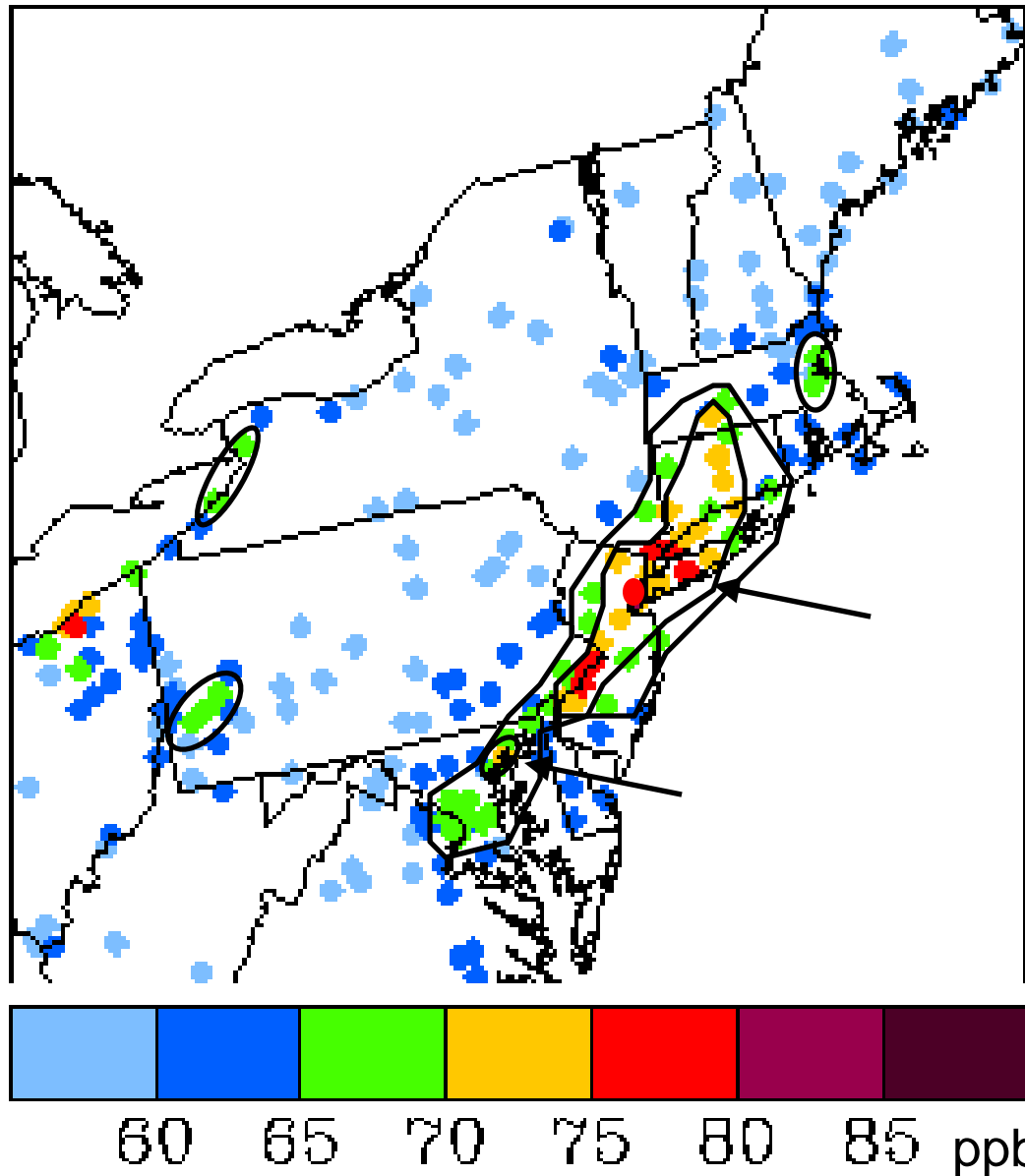
2018

Most red and yellow locations will fail to attain

More locations would likely fail to attain by 2015

(Probably will include all yellow and most green locations)

60 65 70 75 80 85 ppb

Conclusions

- There are not enough projected emission reductions for many potential Marginal or Moderate nonattainment areas to meet their projected attainment dates

- Estimated NO_X Emissions in the OTR exceed Scenario 4 2020 levels by:
  - 23% in 2015
  - 16% in 2018

- Emission reductions may need to "speed up" to get clean data in all OTR locations by this new timeframe

QUESTIONS OR COMMENTS?