Modeling Committee Update

OTC Spring Meeting

June 7, 2018

Baltimore, MD

2018 8-Hour Ozone Exceedances (preliminary)

12 Days   **12 States**   **151 Site Exceedances**   *(As of June 3, 2018)*

Date	# Sites	States	Date	# Sites	States
April 14:	1	NH (Mt. Washington)	May 24	5	NY, PA, VA
May 1:	29	DE, MD, NJ, PA	May 25	26	CT, MA, NJ, NY, PA, RI, VT
May 2:	51	CT, DE, MA, MD, ME, NJ, NY, PA, RI	May 26	25	CT, MA, NH, NY, PA, RI
May 3:	4	CT, MD, PA, RI	May 27	1	PA
May 4:	1	MD	May 29	6	NJ, NY, PA
May 18:	1	NH (Mt. Washington)	June 1	1	MD

2015-17 8-Hour Ozone Design Values

(excluding exceptional events)

Created by Martha Webster, ME DEP 4/6/2018
based on analysis by Tom Downs with AQS download from 3/31/2018
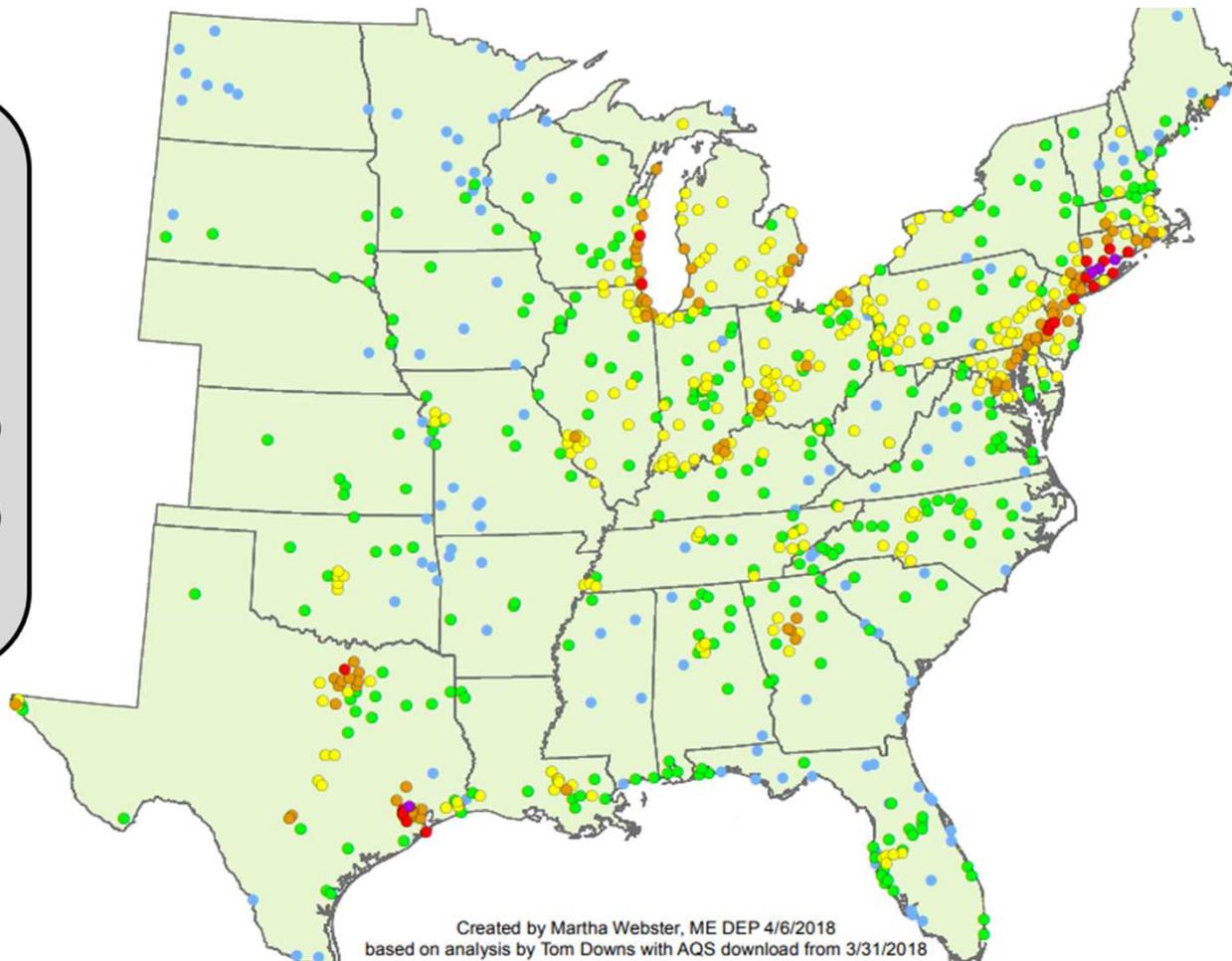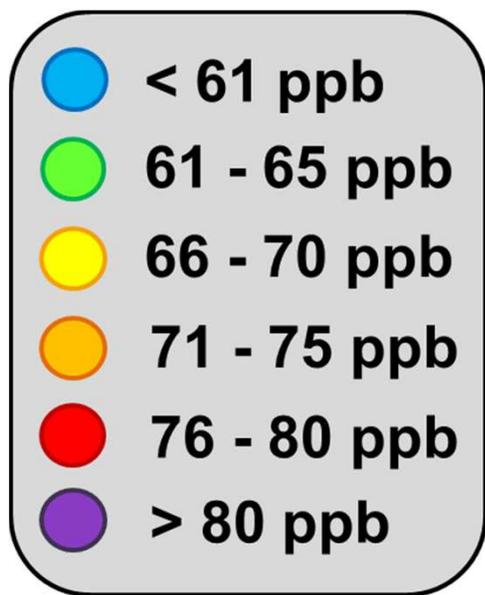
2015-17 Interpolated County Ozone Design Values

Ozone design values by county

Ozone design values by nonattainment area and county

🔵	< 61 ppb
🟢	61 - 65 ppb
🟡	66 - 70 ppb
🟠	71 - 75 ppb
🔴	76 - 80 ppb
🟣	> 80 ppb
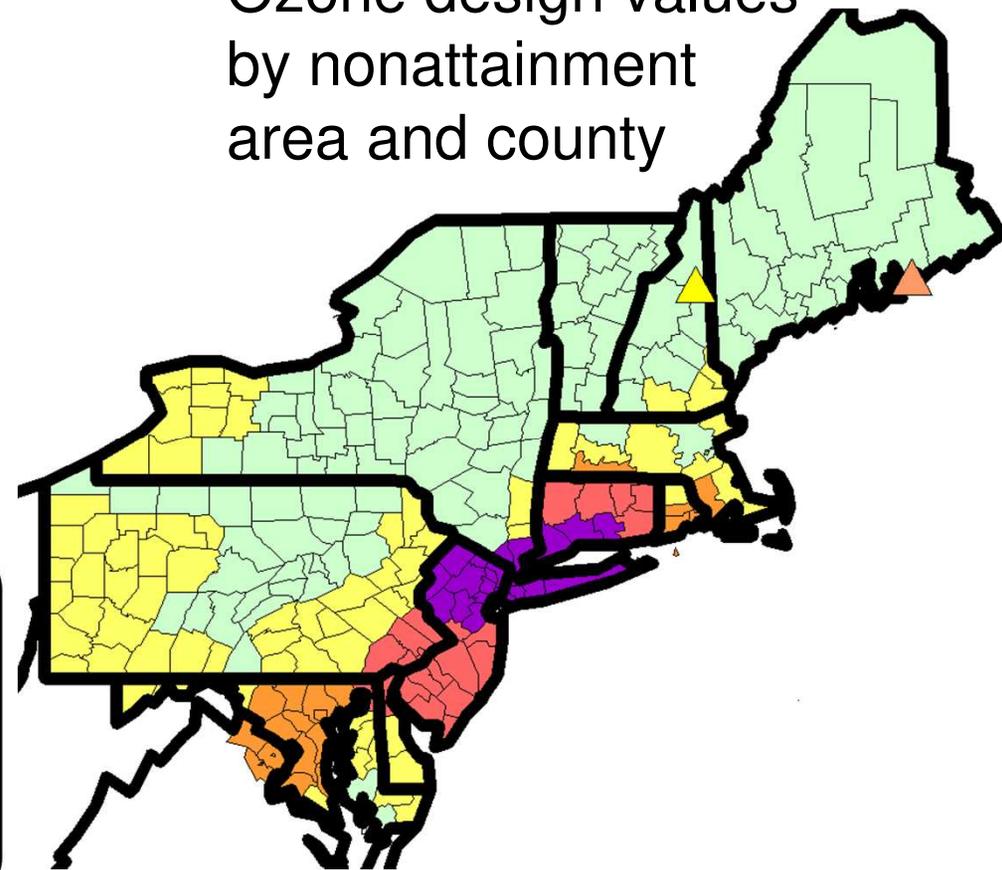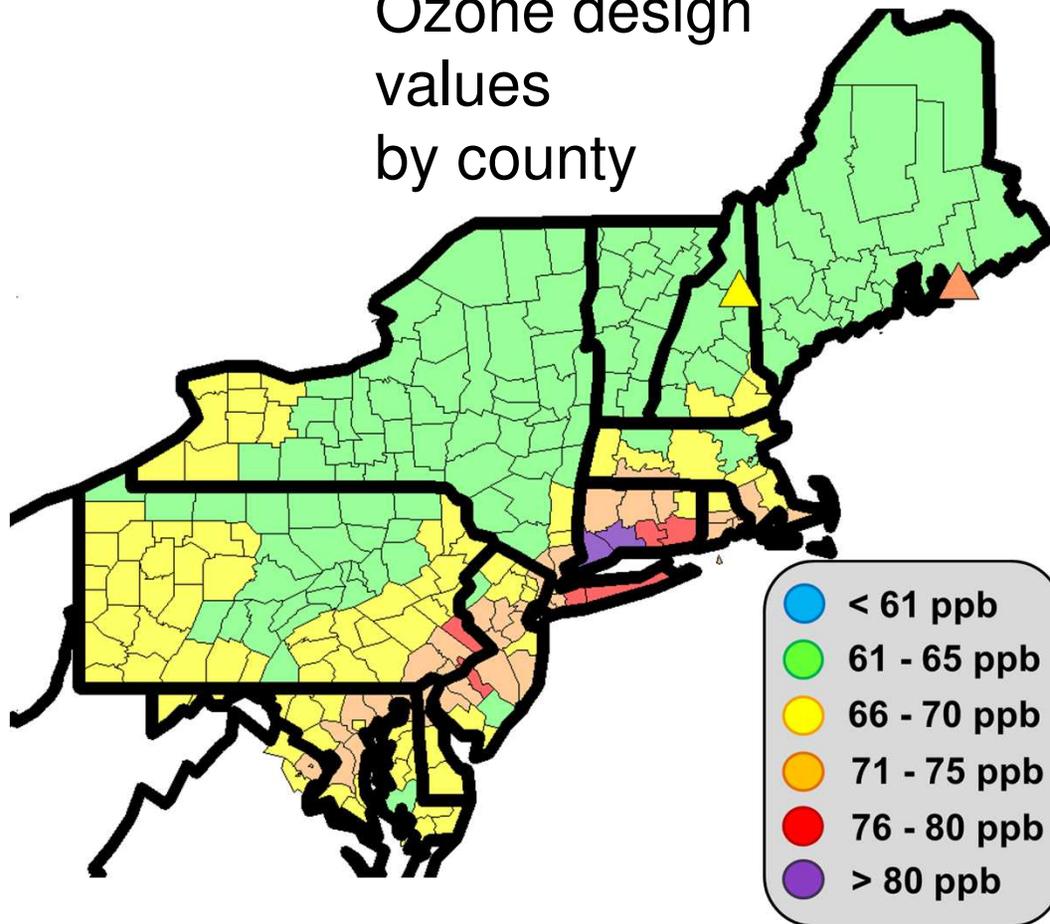
Nearest representative monitor

2015-17 Interpolated County Ozone Design Values

Legend (left map):
- < 61 ppb
- 61 - 65 ppb
- 66 - 70 ppb
- 71 - 75 ppb
- 76 - 80 ppb
- > 80 ppb

Ozone design values by county

3-Year (2015-17) number of exceedance days by county

Legend (right map):
- 0 Days
- 1-3 Days
- 4-7 Days
- 8-11 Days
- 12-15 Days
- 16-19 Days
- 20+ Days

Nearest representative monitor

*Nearest representative monitor*

5
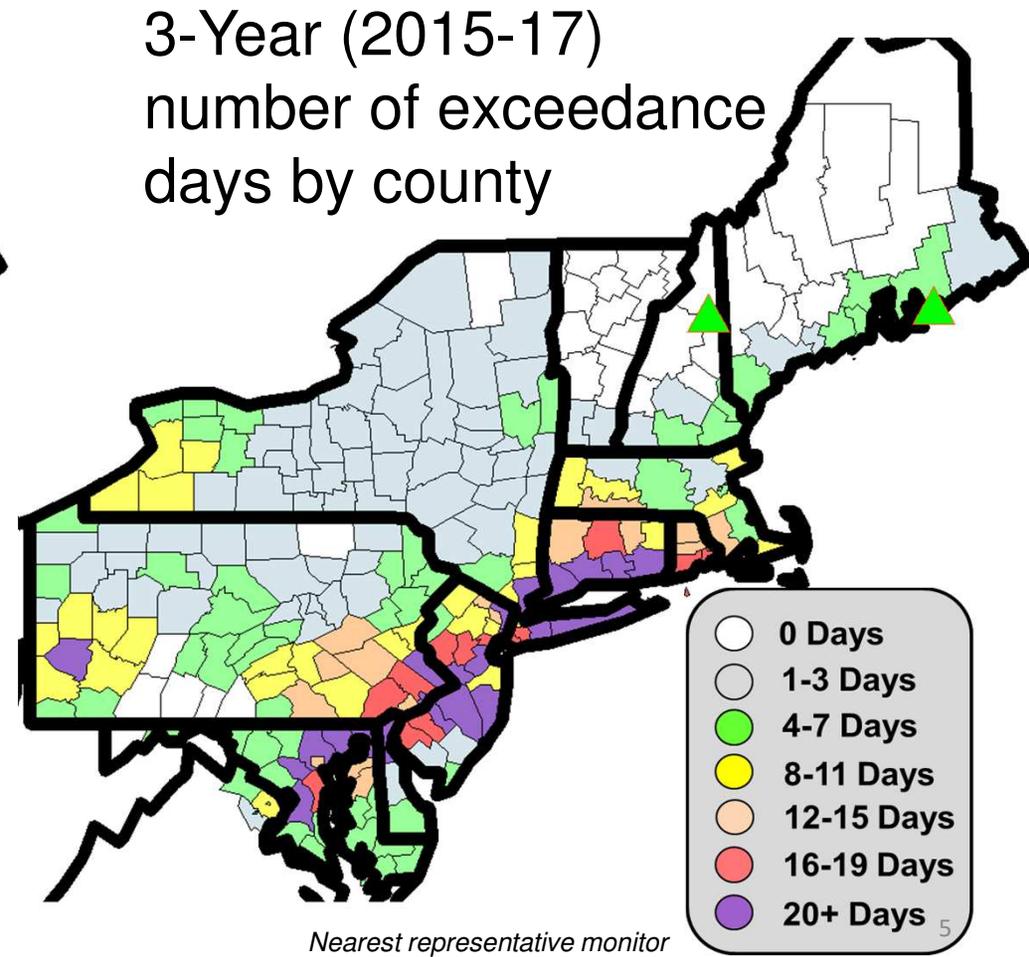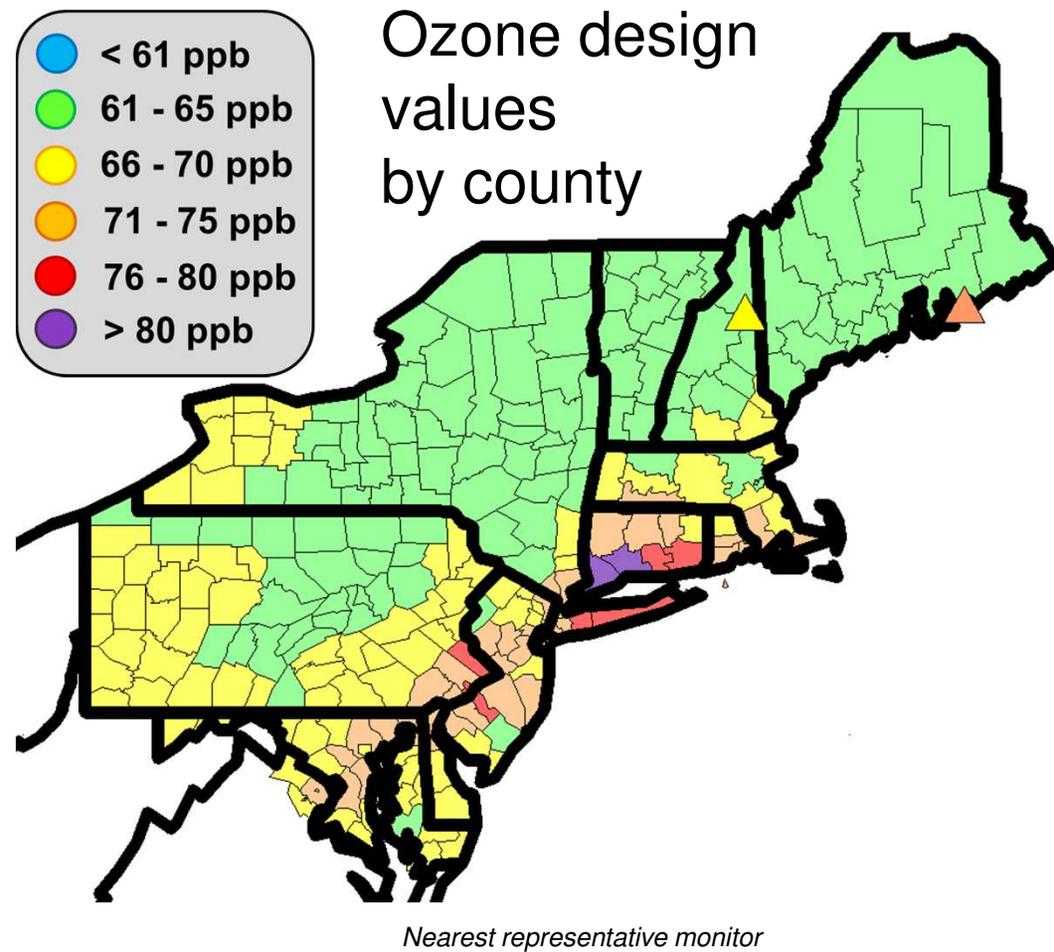
Ozone Transport Region Population Exposure to Ozone
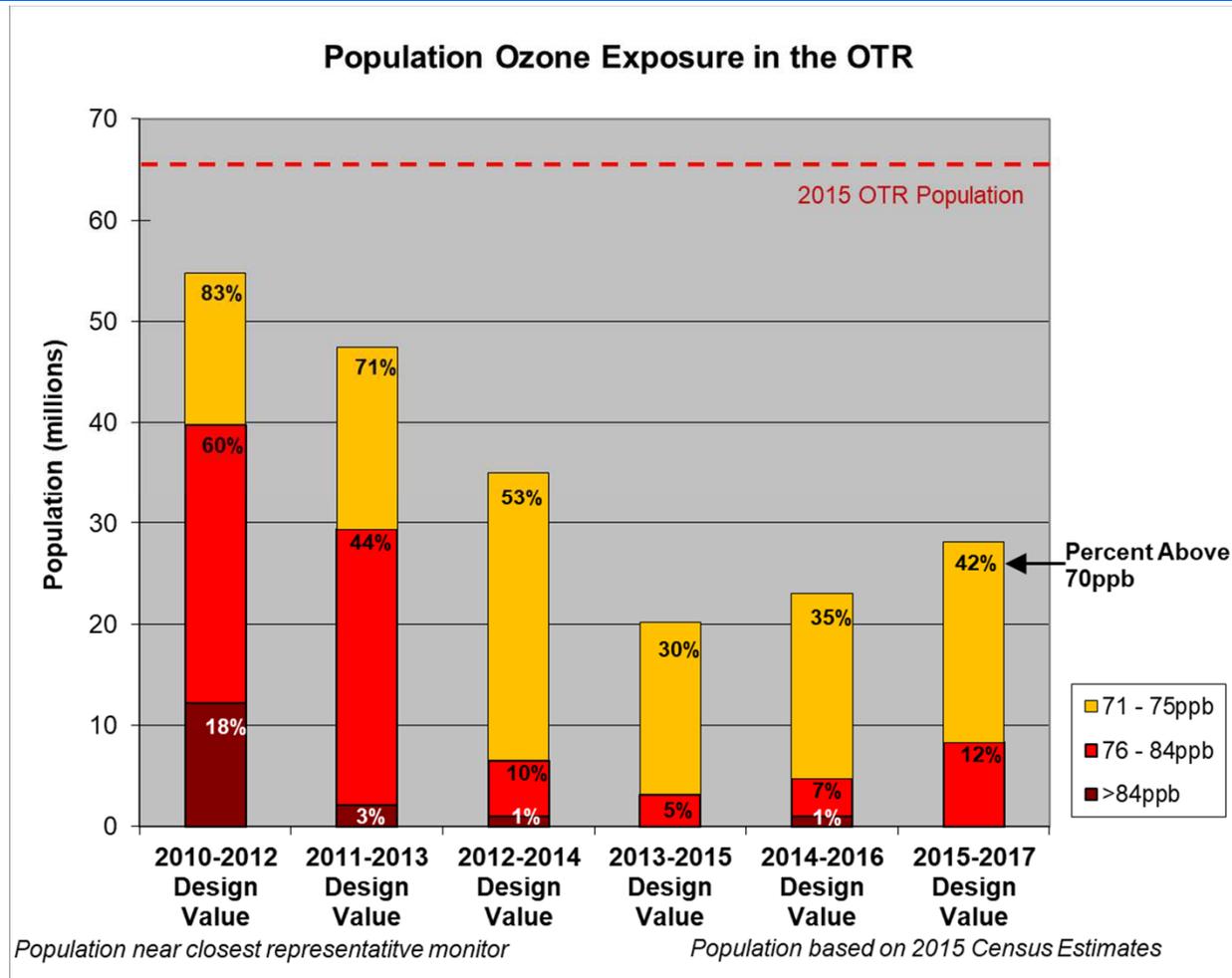
Includes adjustment removing exceptional events

OTR Trends
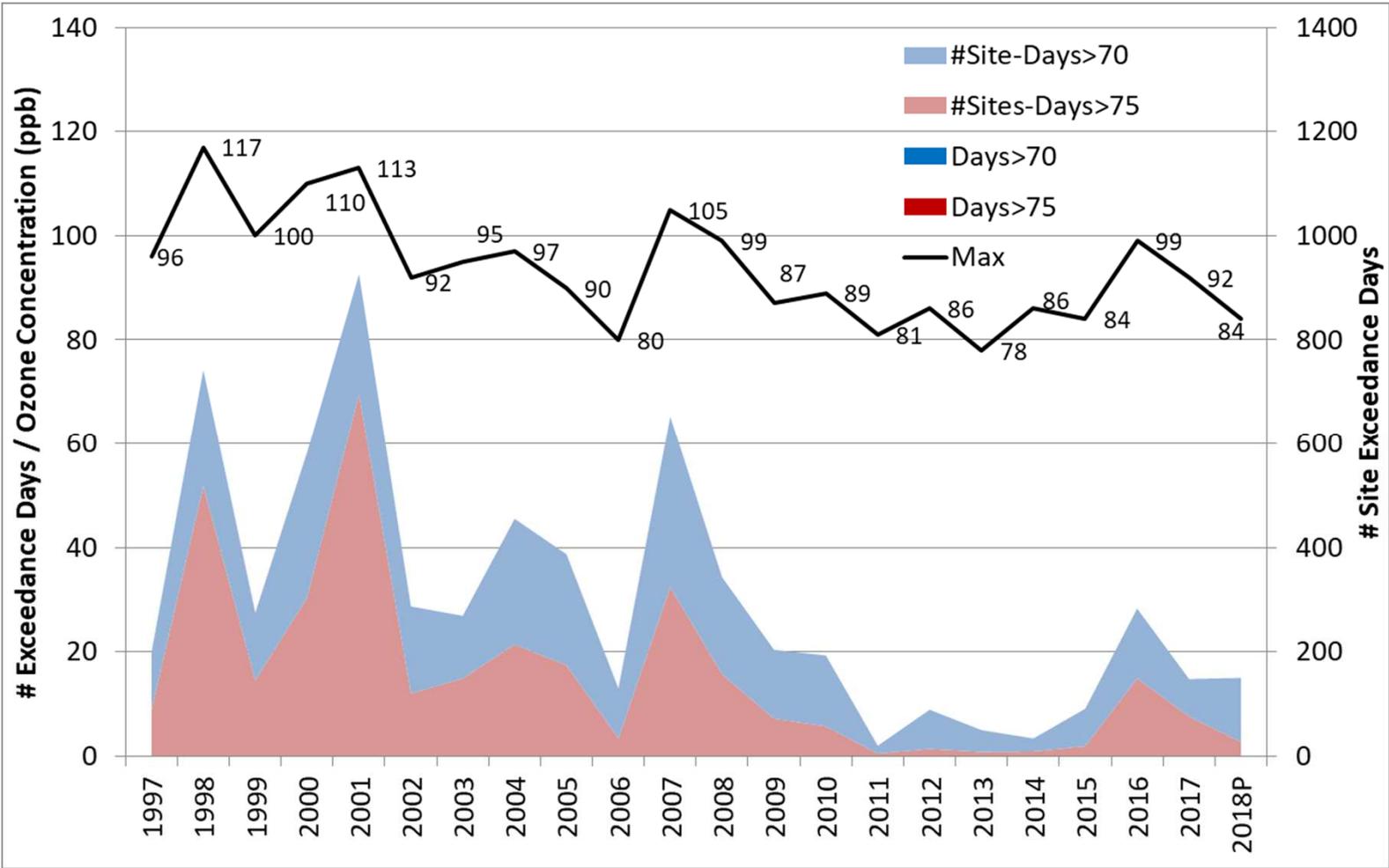
Through May 31, 2018

EPA 2015 Ozone NAAQS nonattainment areas

Legend

Designations

- Delayed
- Marginal NA
- Moderate NA
- P Marg. Rural Trans.
- P Marginal NA
- Unclassifiable

Created by Martha Webster, ME DEP 5/2/2018
based on Tom Downs review 5/1/2018
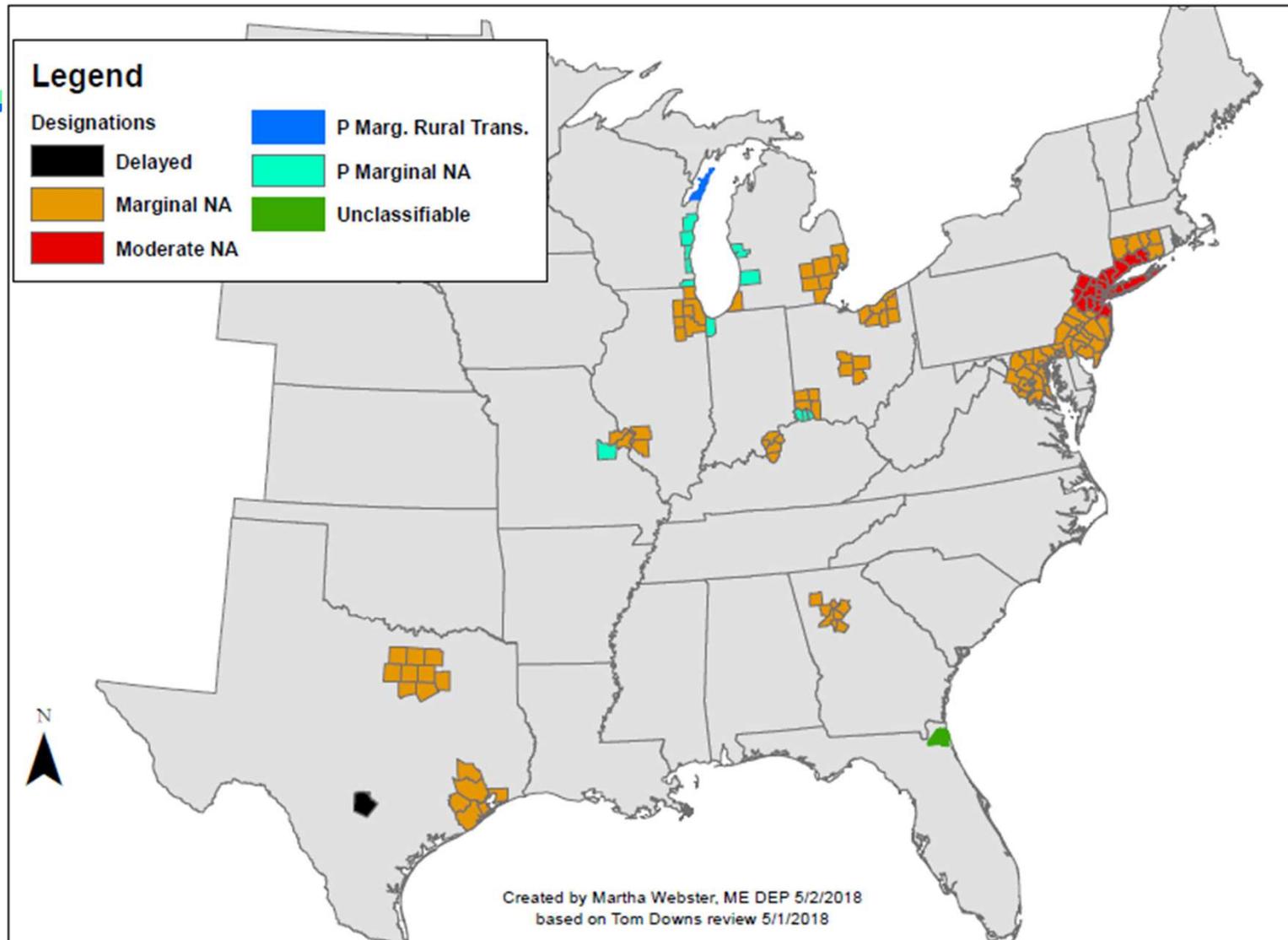
2011 Modeling Platform

- Still the focus of:
  - 2008 Ozone NAAQS SIP Modeling Efforts (primarily CMAQ)
  - 2015 Ozone NAAQS GN SIP Modeling Efforts (primarily CAMx)
  - 2018-21 Regional Haze SIP Modeling for MANE-VU (CMAQ)
  - Contribution assessment modeling (CAMx)
- Emission Inventories have been updated to Gamma for 2011, 2020, 2023, and 2028

OTC CMAQ Modeling – Predicted Design Values

OTC CMAQ Modeling

(2017 Beta)

2017

Legend:
- < 65ppb
- 65 – 70 ppb
- 71 – 75 ppb
- 76 – 80 ppb
- > 80 ppb
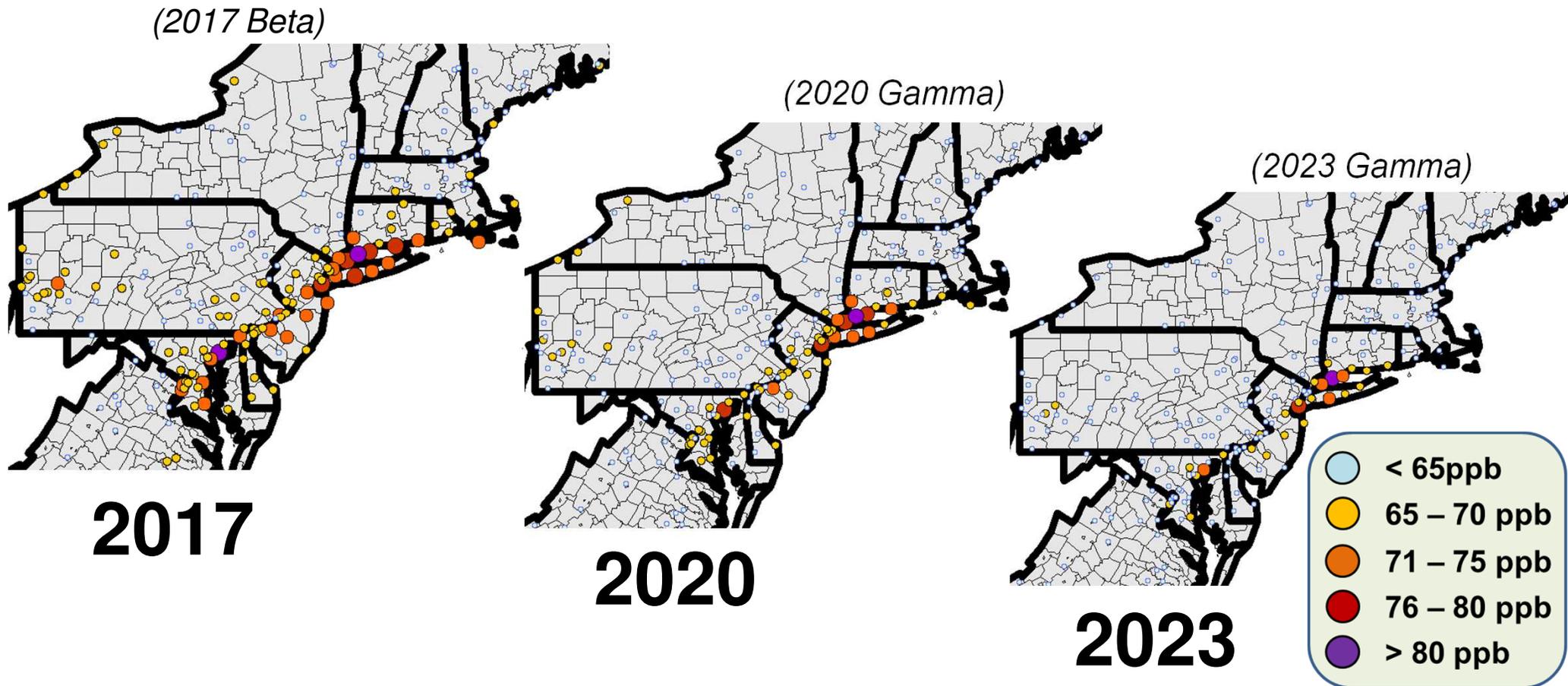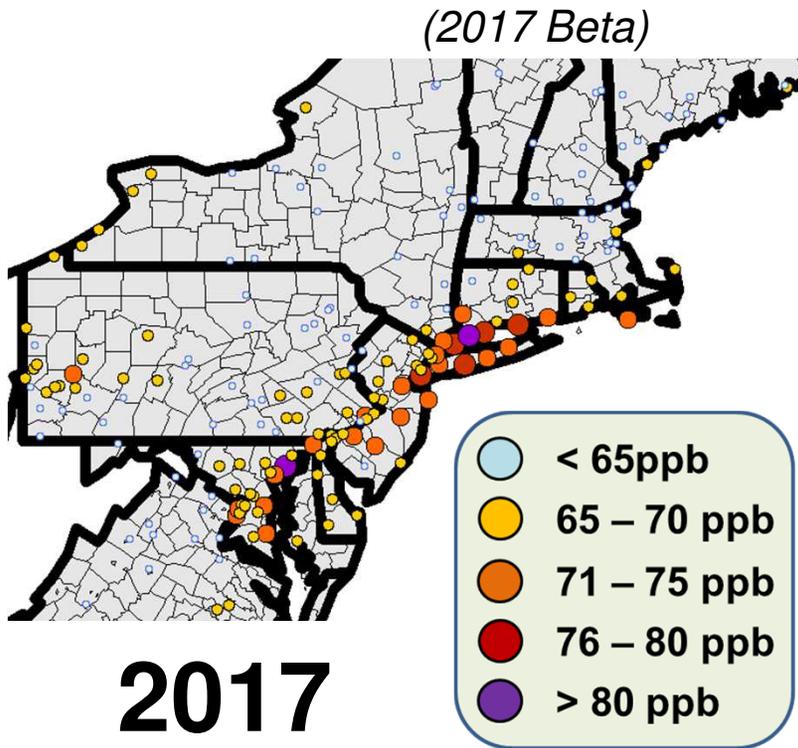
OTC 2017 modeling reasonably predicted actual 2015-17 ozone design values in the OTR

Accurately predicted high ozone in New York City and Connecticut

Edgewood, MD is a notable over-prediction

OTC CMAQ Modeling

(2020 Gamma)

2020

🔵	< 65ppb
🟡	65 – 70 ppb
🟠	71 – 75 ppb
🔴	76 – 80 ppb
🟣	> 80 ppb
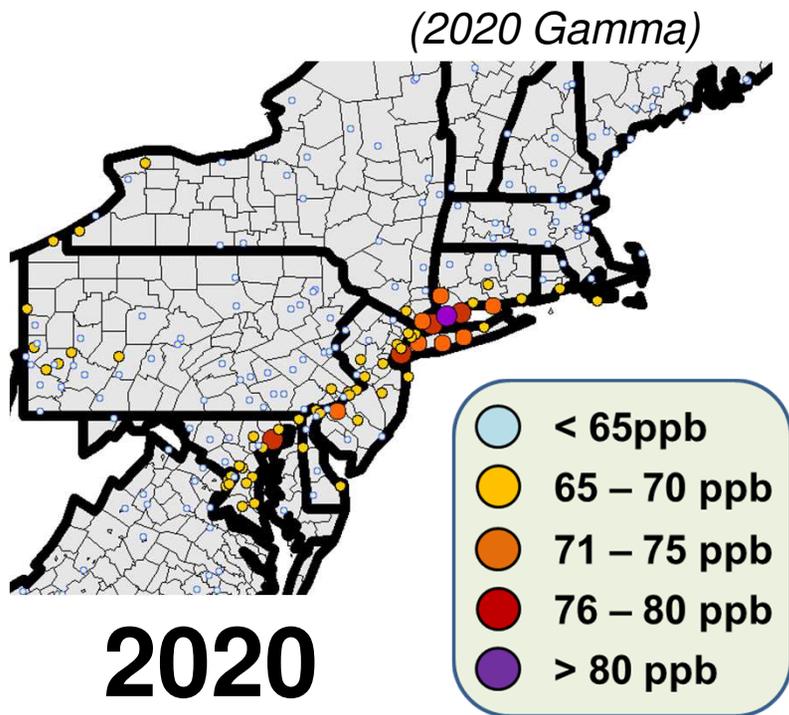
OTC 2020 predicts attainment of 2008 and 2015 ozone NAAQS throughout the OTR except for:

- 2008 and 2015 NAAQS Greater New York City
- 2015 NAAQS Philadelphia area
- 2008 and 2015 NAAQS Edgewood, MD (likely over-prediction)

OTC CMAQ Modeling

(2023 Gamma)

2023

Legend:
- ○ < 65ppb
- ● 65 – 70 ppb
- ● 71 – 75 ppb
- ● 76 – 80 ppb
- ● > 80 ppb
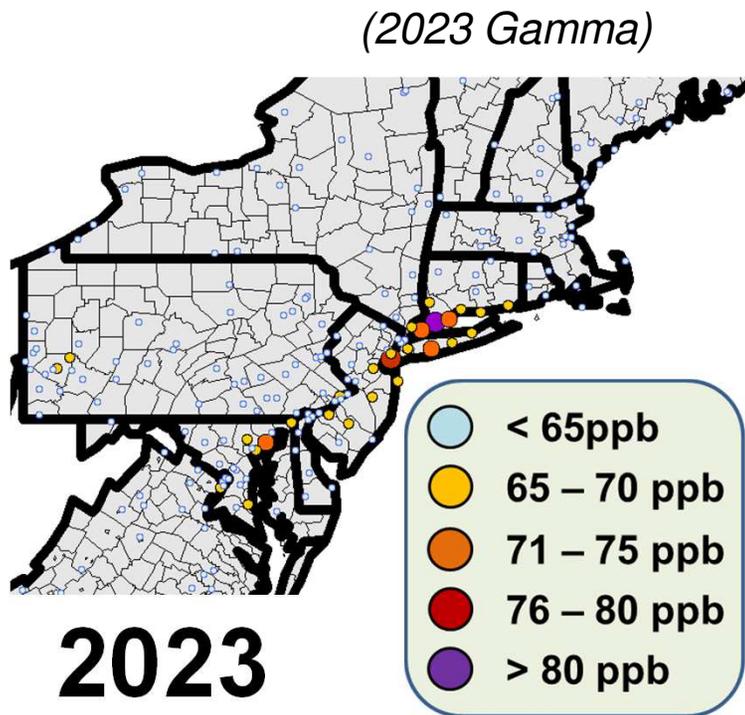
OTC 2023 predicts failure to attain:

- 2008 and 2015 NAAQS in the Greater New York City area
- 2015 NAAQS at Edgewood, MD (likely over-prediction)

Different Futures (OTC CMAQ vs OTC CAMx 2023)

CMAQ
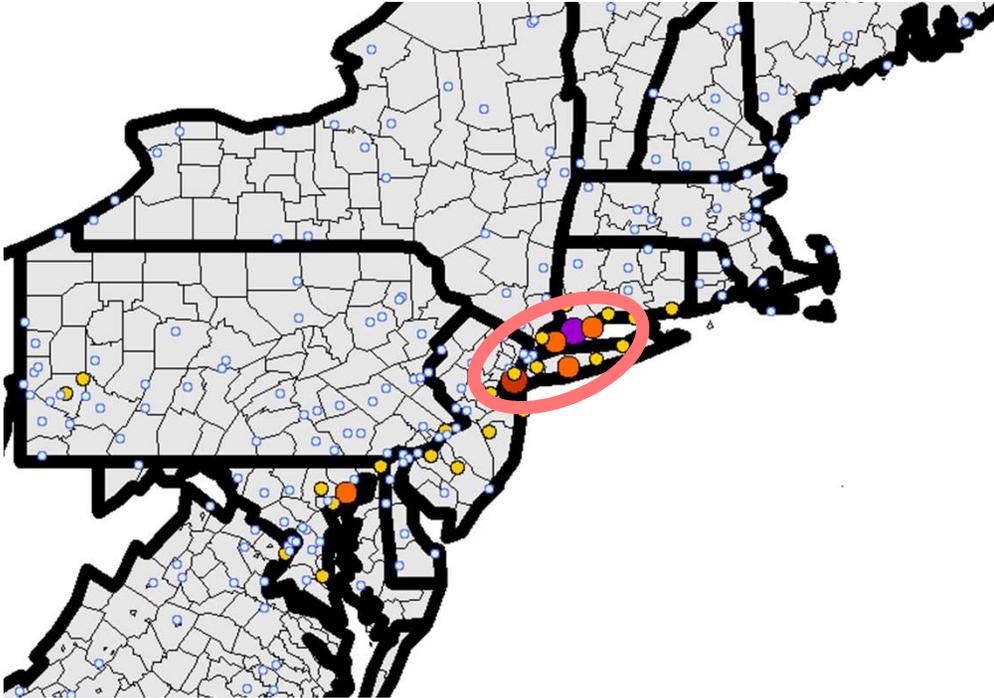
CAMx
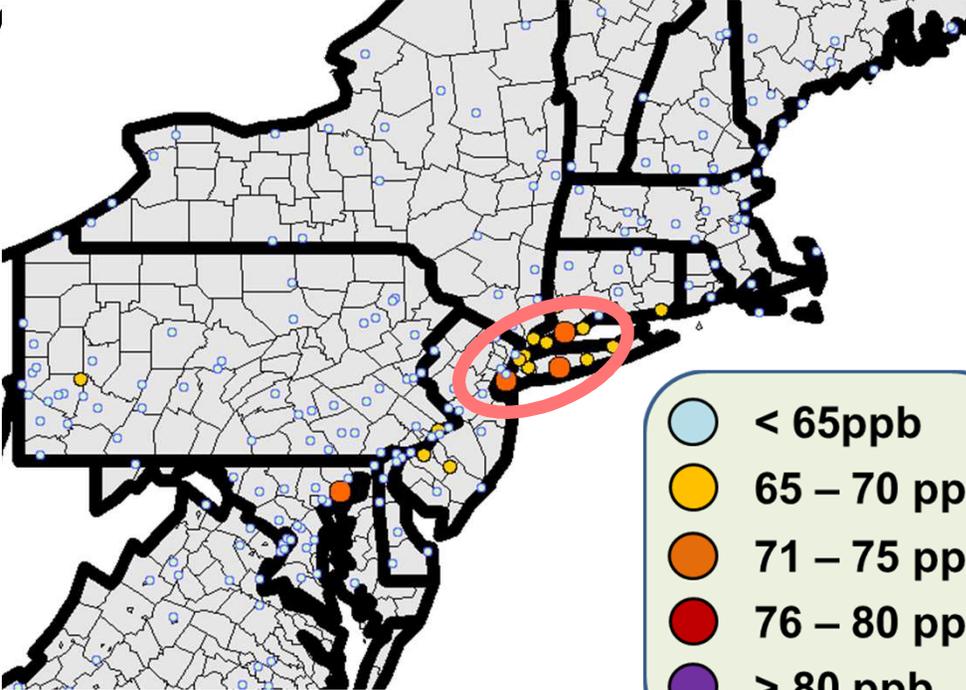
🔵	< 65ppb
🟡	65 – 70 ppb
🟠	71 – 75 ppb
🔴	76 – 80 ppb
🟣	> 80 ppb

Summary of Modeling

AQS Code	County	Site	2015-17 DV	2017 Beta2 CMAQ	2020 Gamma CMAQ	2023 Gamma CMAQ	2023 Beta2 CAMx	2023 EPA 'en' CAMx
090019003	Fairfield	Sherwood Island Westport	83	83.0	83.4	81.1	71.9	72.7
360850067	Richmond	SUSAN WAGNER HS	76	78.0	79.4	76.9	71.1	71.9
240251001	Harford	Edgewood	75	81.0	77.5	74.1	71.8	71.4
090010017	Fairfield	Greenwich Point	79	77.0	76.2	72.3	69.5	69.8
090013007	Fairfield	Lighthouse-Stratford	83	77.0	76.8	73.7	70.6	71.2
361030002	Suffolk	BABYLON	76	77.0	75.2	71.4	72.0	72.5
090099002	New Haven	Hammonasset State Park-Madison	82	77.0	73.9	69.7	69.9	71.2
360810124	Queens	QUEENS COLLEGE 2	74	74.0	72.0	68.8	69.4	70.1
361192004	Westchester	WHITE PLAINS	73	73.0	72.7	69.5	68.1	68.1
340150002	Gloucester	Clarksboro	74	74.0	72.3	69.1	67.5	67.8
090011123	Fairfield	Danbury	77	74.0	71.1	68.0	66.3	66.5
090110124	New London	Fort Griswold Park-Groton	76	73.0	70.3	66.2	65.2	66.4

15

2023 Contribution Modeling Emission Tags

Full States

- CT
- DC
- DE
- IL
- IN
- KY
- MA
- MD
- ME
- MI
- NC
- NH
- NJ
- NY
- OH
- PA
- RI
- SC
- TN
- VA
- VT
- WI
- WV

Partial States

- AL
- AR
- GA
- IA
- LA
- MN
- MO
- MS
- TX

Sectors

- AreaNonpt
- Biogenic
- cmvc1c2c3
- EGUertac
- NonEGUcement
- NonEGUmwc
- NonEGUother
- Nonroad
- OilandGasNonpt
- OilandGasPt
- OnroadDiesel
- OnroadNondiesel
- Afdust
- Agfire
- Agriculture
- Cl2
- OffshoreCMV
- OffshoreNonEGU
- Offshoreptnonipm
- PrescFire
- Rail
- Wildfire
- Residential Wood Combustion

Other: Boundary, Canada, and Offshore

2023 Gamma NO$_X$ Emissions (May 31 – September 1, Draft)
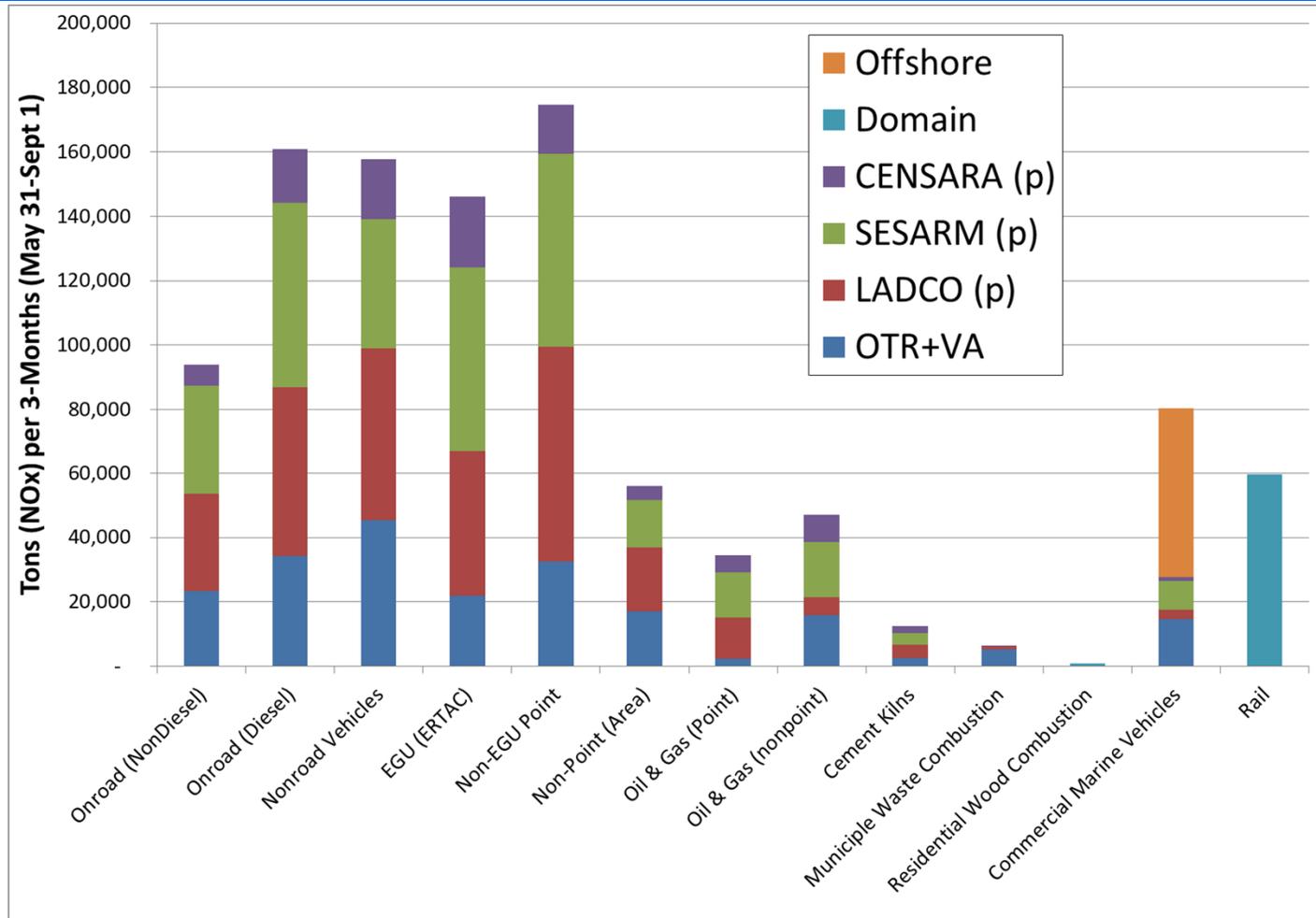
p: Partial region. Includes only inside domain emissions

2023 Gamma NO$_X$ Emissions (May 31 – September 1, Draft)

p: Partial region.

Includes only inside domain emissions
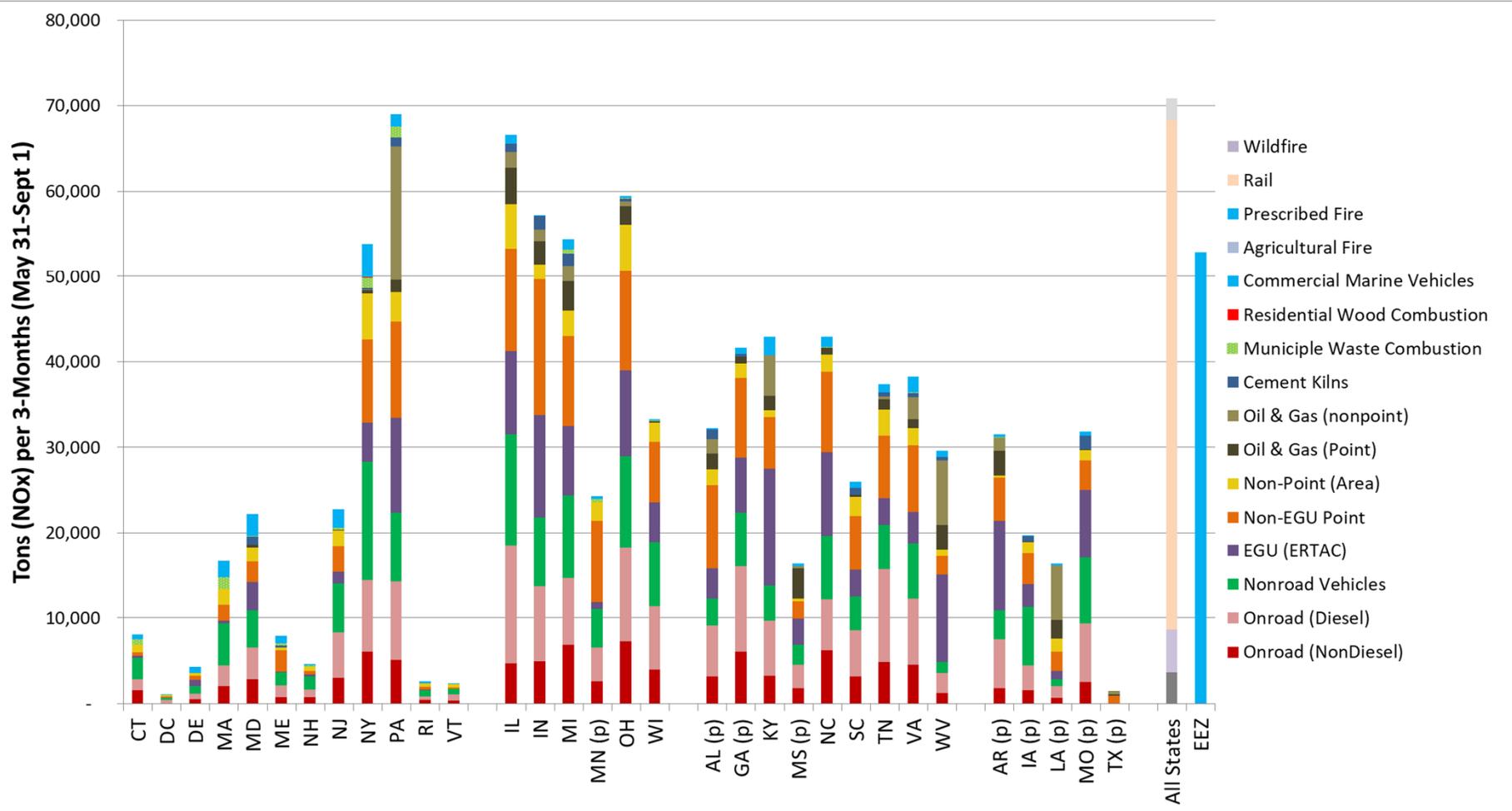
Each Page Has Two Plots (1ˢᵗ slide of each set)

Left Side

- Shows all days exceeding threshold (usually 70ppb)
- Shows contributions by sector for each day

Right Side

- Specific to days exceeding threshold (usually 70ppb)
- Shows the number of days that each state/sector significantly contributes to the site's exceedances
- Colors indicate the highest contributing emission sector from that state
- Dotted red line indicates the total number of modeled exceedances

Modeled Ozone Greenwich Point Park, CT - 2023

Connecticut - 090010017

Ozone Contribution (ppb) by Sector on NAAQS Exceedance Days
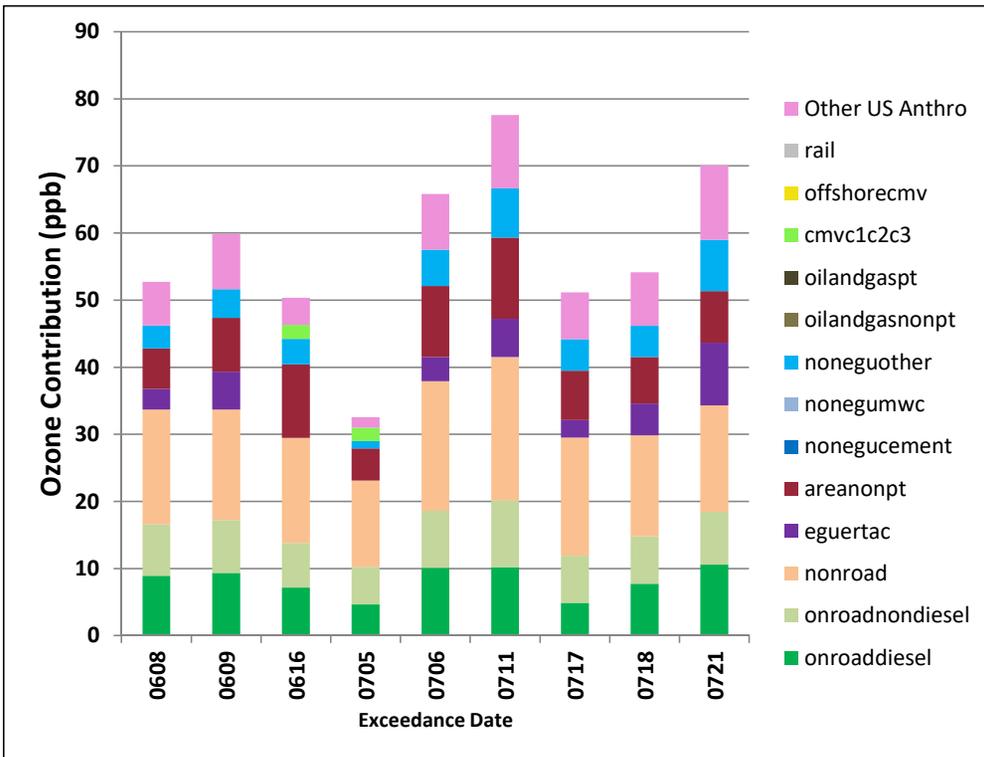
Number of Days >1% NAAQS by Sector
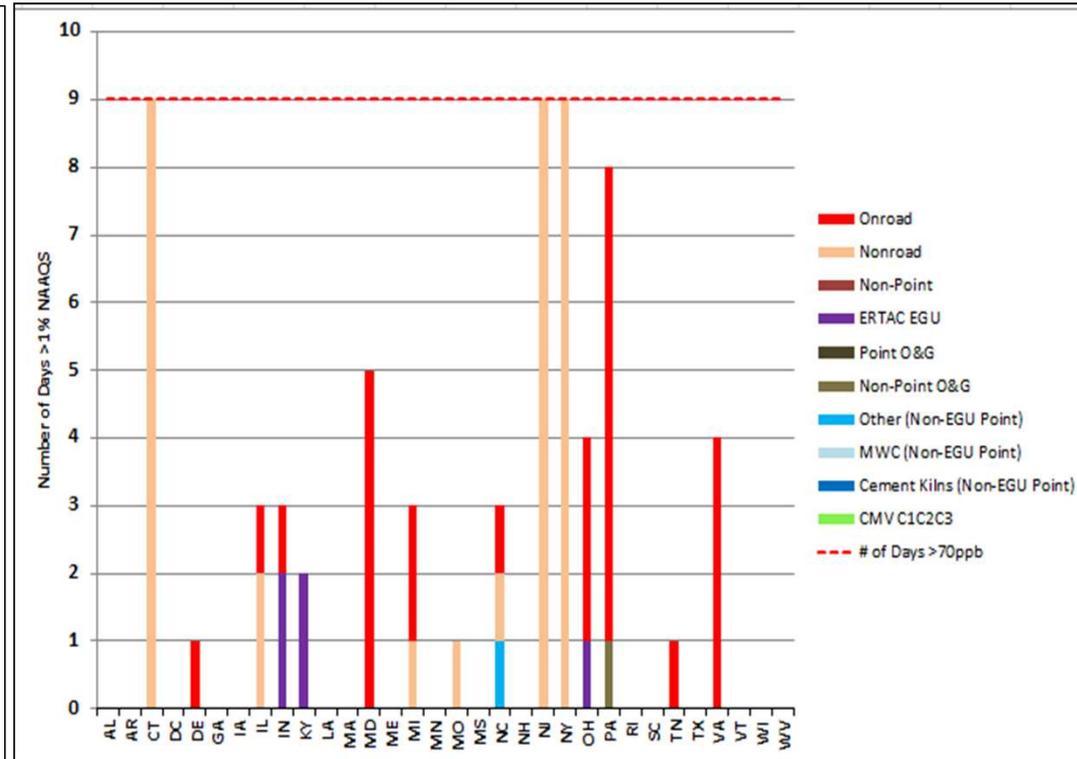
2023 Ozone Contributions to 090010017
Connecticut - Greenwich

### By State
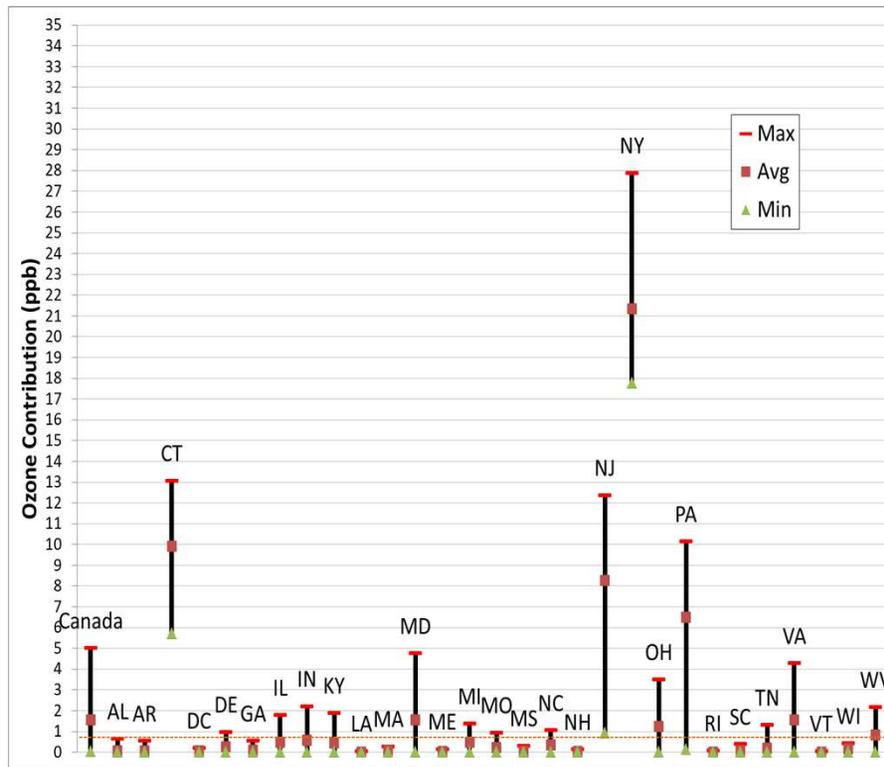
By Sector
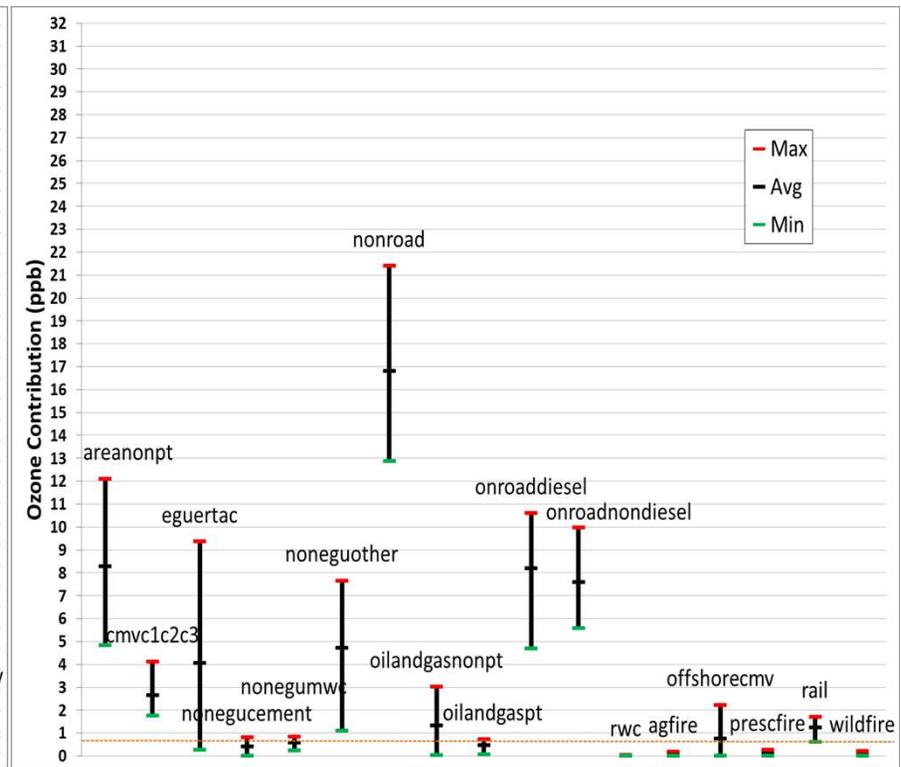
*On days with Modeling Exceeding 70ppb*

Modeled Ozone Susan Wagner High School (NYC)- 2023

New York - 360850067

Ozone Contribution (ppb) by Sector on NAAQS Exceedance Days
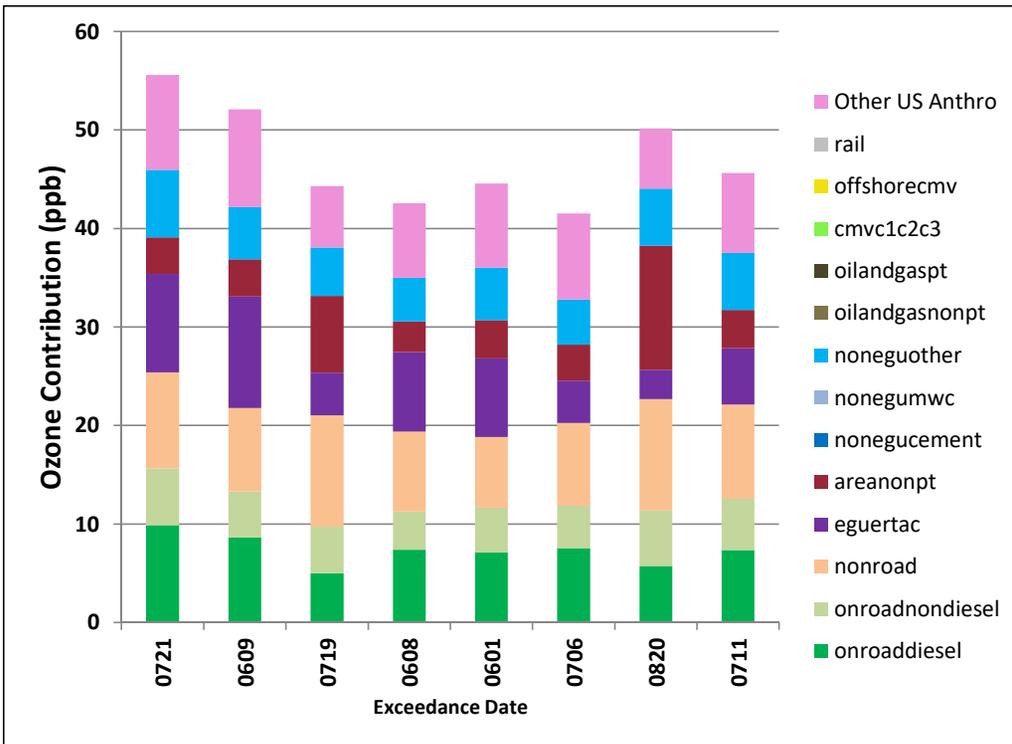
Number of Days >1% NAAQS by Sector
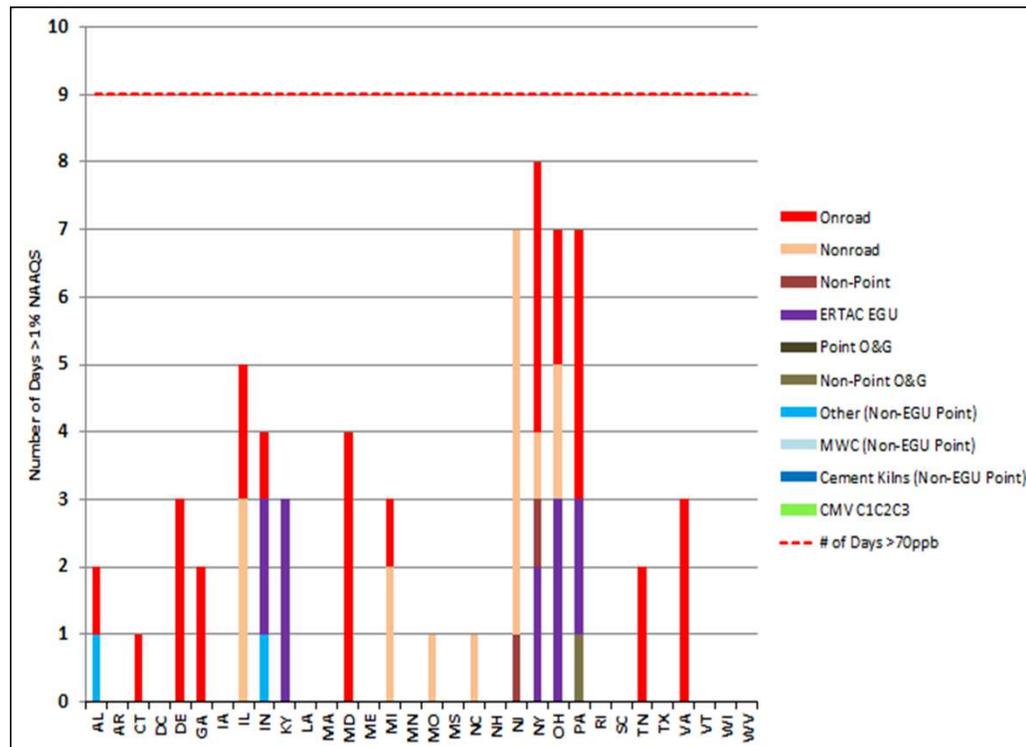
Modeled Ozone Edgewood, MD - 2023

Maryland - 240251001

Ozone Contribution (ppb) by Sector on NAAQS Exceedance Days
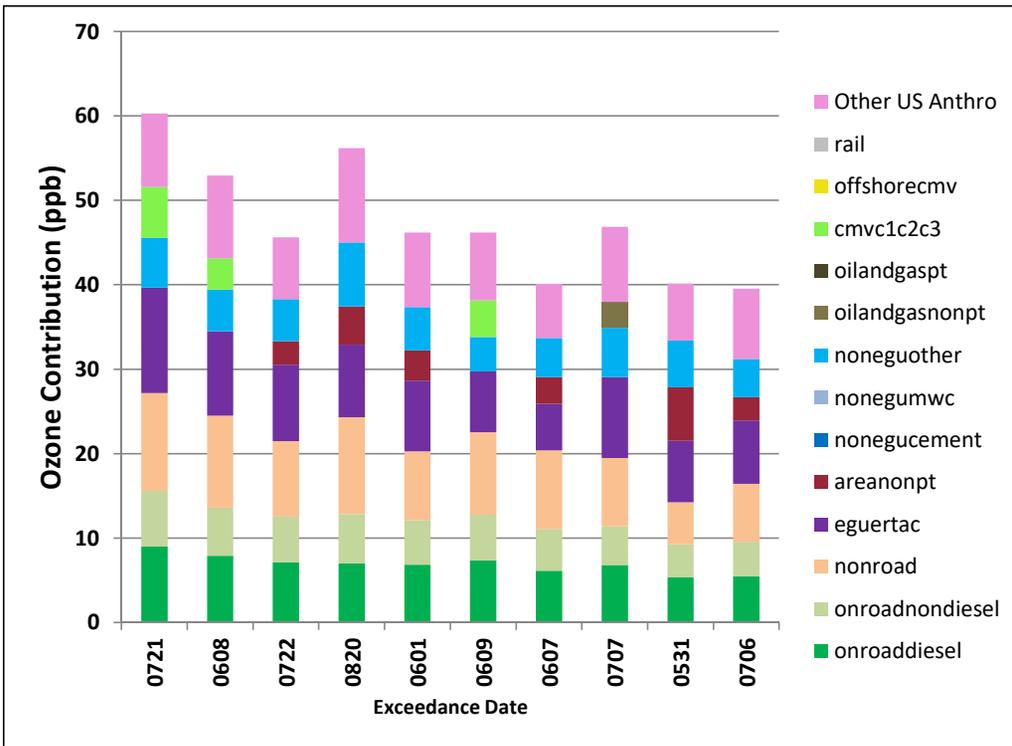
Number of Days >1% NAAQS by Sector
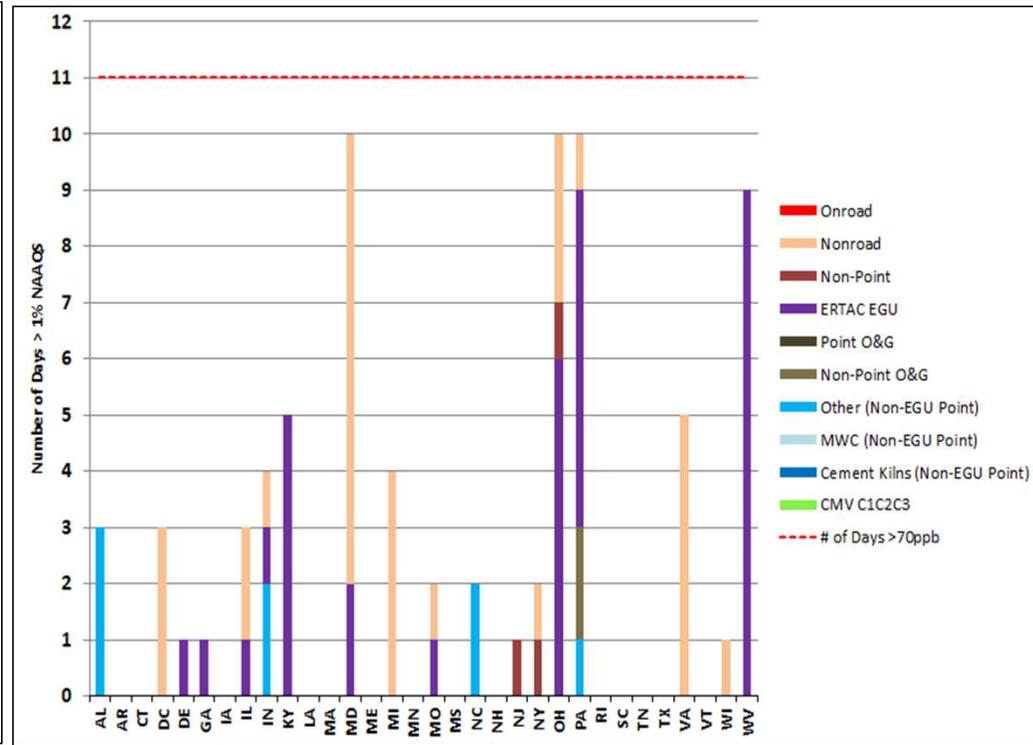
2023 Contribution Modeling Preliminary Conclusions

Onroad and Nonroad are Heavy Contributors

- Nearly every day/monitor has onroad and nonroad contributions as a primary or secondary contributor

EGU and NonEGU Contributions are Still Significant

- Nearly every day/monitor has EGU and NonEGU contributions as a primary or secondary contributor

Importance of Oil and Gas is Growing

The Weather Matters

- Oil & Gas, EGUs, or Other Point Sources can be primary contributors at some monitors on certain days
- Nearby states might contribute to all exceedances, but other contributing states may vary depending on wind patterns

The Day of Week Matters

- Ozone is higher during weekdays due to higher on-road emissions

Other Points

- EGU contributions may be underestimated – CSAPR Update Strategy may be too optimistic
- Onroad and Nonroad contributions may be overestimated – evidence points toward both inventories being high

2023 GN SIP Control Case – Under Review

- Modeling done in two phases, screening and SIP quality

- Screening measures modeled include:

  1. Reference 2023 that includes optimized SCR operations

  2. Scenario where facilities with no post-combustion NOx emission controls add SCRs (domain-wide)

  3. Scenario that adds aftermarket catalyst program NOx emission reductions (~5.2% reduction from OnRoad gasoline vehicle emissions domain-wide)

OTC EGU AMC – OTC Ref   O3 (ppb)
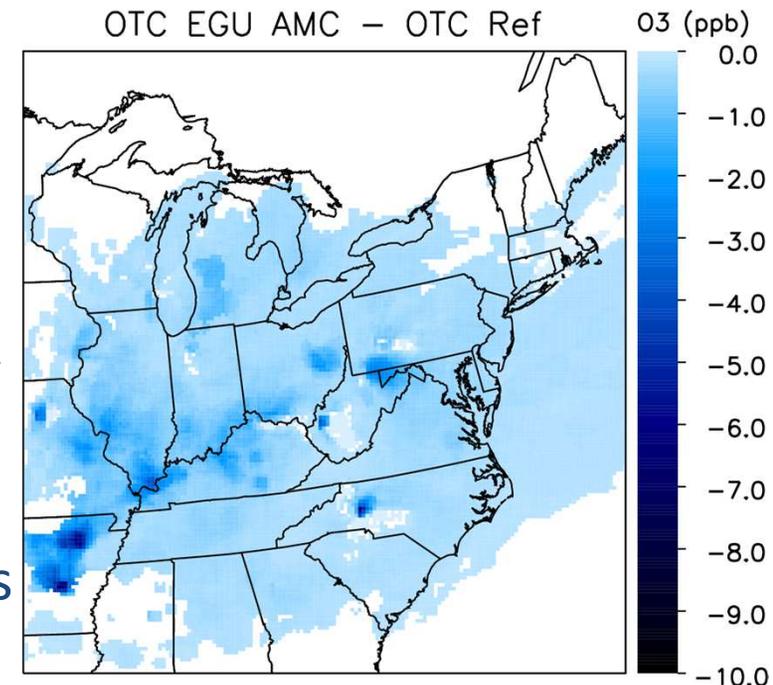
2016 Based OTC Modeling Platform Development

- In partnership with EPA and other regions nationally for 2015 Ozone NAAQS and for Regional Haze 2021 submittals

- Likely to use a unified domain

  - OTC likely to utilize a larger portion of the national domain than in the past (i.e., east of the Rocky Mountains)

  - Common emission inventories where possible

    - 2014 NEI represents update to 2011
    - 2017 NEI will not be available until 2019

  - 2016 meteorology focus, possibly supplemented with 2015 episodes

  - Projected years, TBD, probably 2023 & 2028
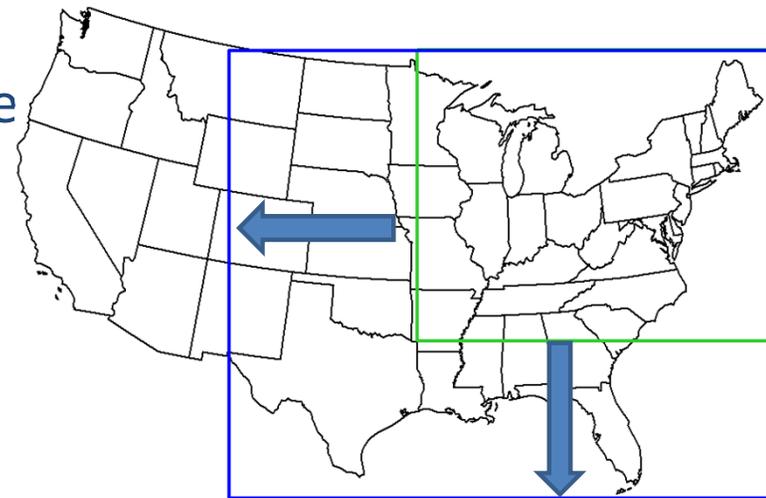
Enhanced Monitoring Plans (EMP)

- Required for all OTR states as part of 2015 Ozone NAAQS process
  - State plans are due October 2019, although EPA is encouraging early submittal by July 2018.
  - OTR states have been exploring options and coordinating.

May 2018 Update
- Required and Supplemental PAMS (10-13 locations)
- Partnerships with EPA/NASA for up to 12 Pandora Spectrometers
- Up to 6 upper air profilers, 2-3 lidars, potential coordinated O_3 sondes
- Additional formaldehyde and trace level CO monitoring, upgraded equipment
- LISTOS Study: Long Island Sound Monitoring Intensive
- MDE OWLETS2: Monitoring intensive focused on Chesapeake Bay area

LISTOS

- Investigate the evolving nature of ozone formation and transport in the NYC region and downwind.

- Involves a large group of researchers with state and federal agencies and academia that bring a diverse set of resources, expertise, and instrumentation skills.
  - These encompass satellite, aircraft, balloon (ozone sondes), marine, and ground-based data collection and analysis methods to probe the New York City pollution plume and its evolution over and around Long Island Sound.

- Initial aircraft studies began in May 2017, with expanded activities and planning efforts underway for 2018 and beyond.

OWLETS2 Monitoring Campaign

Ozone Water –Land Environmental Transition Study (OWLETS2)

• Monitoring Period: June 6 – July 6, 2018

• Will involve MDE and scientists from NASA, NOAA and several local universities.

• Measurements will provide a much needed 3-D look at air pollution over and surrounding the Chesapeake Bay to help answer land water interface questions

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• Measurements will provide a much needed 3-D look at air pollution over and surrounding the Chesapeake Bay to help answer land water interface questions

Ceilometer – Measures cloud height , aerosol content , atmospheric depth

MDE Surface Air Pollution Trailer – Can measure an assortment of pollutants, such as ozone, and meteorology

MDE Radar Wind Profiler – Measures aloft wind speed/direction and temperature

Ozonesonde – Measures vertical profile of ozone concentrations via balloon

Airplane – Retrofitted Cessna aircraft capable of obtaining vertical profiles of ozone and sampling the aloft atmosphere over wide areas.

WINDCUBE

Wind Cube - Measures aloft wind speed/direction; portable
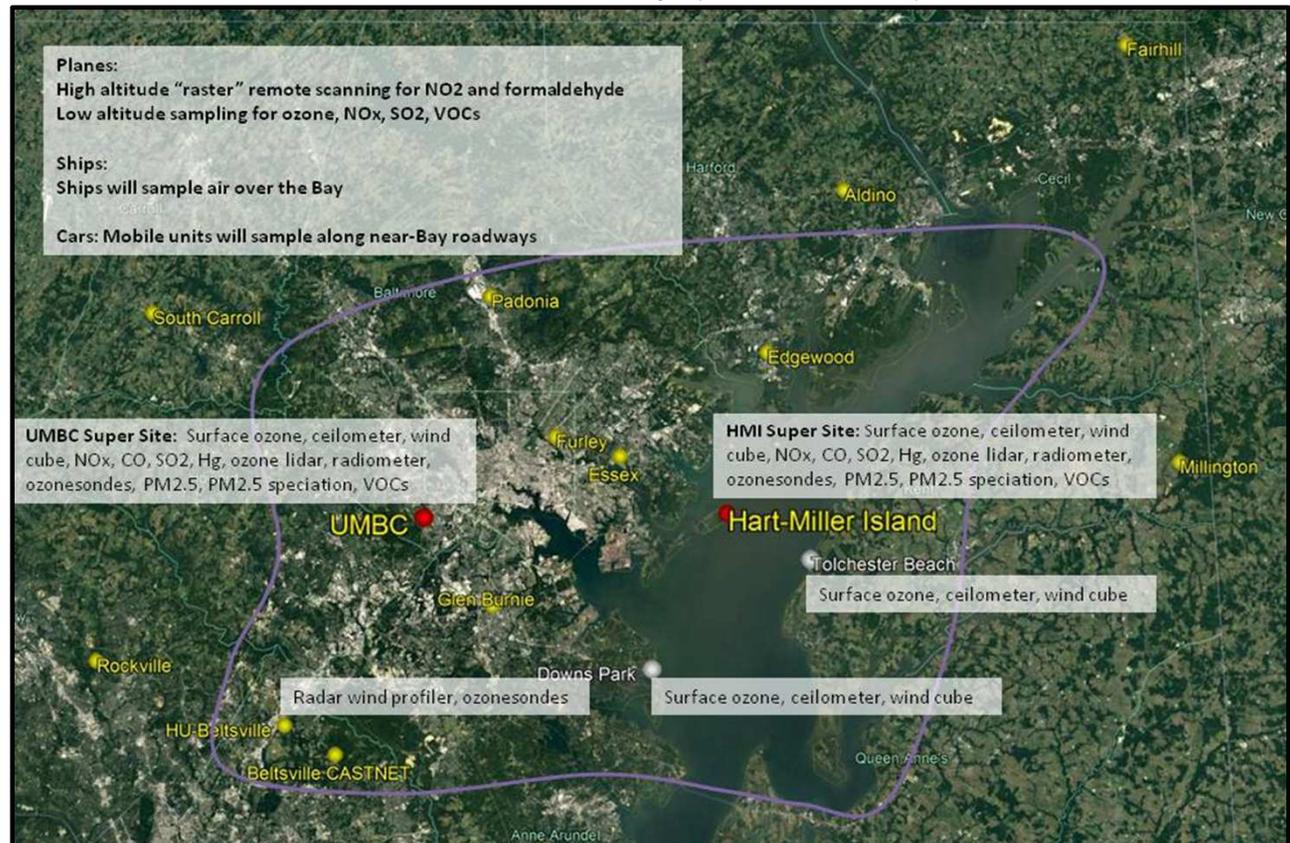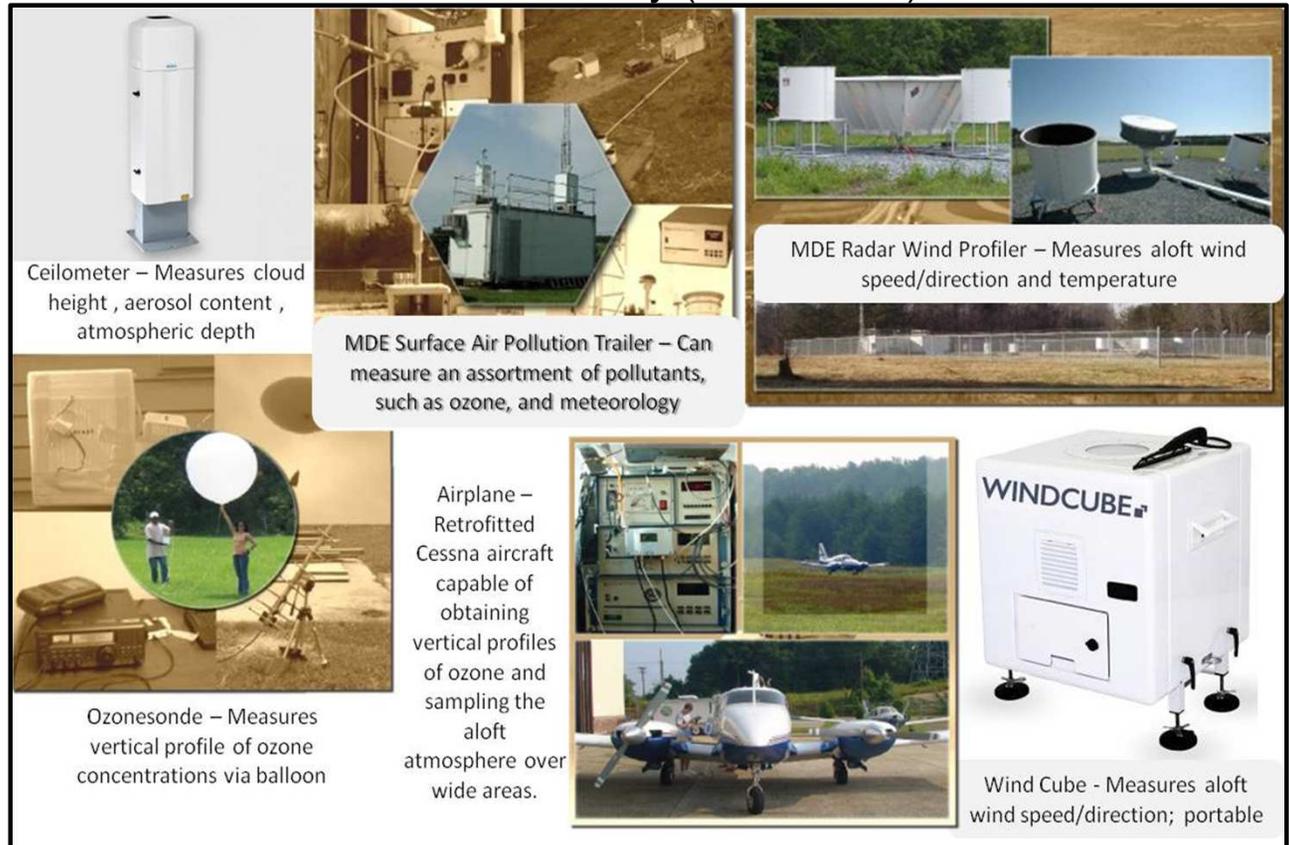
Conclusions & Next Steps

- 2018 ozone season off to eventful start
- OTC modeling for 2020 and 2023 is mostly complete
  - Good progress is noted
  - Continued nonattainment is predicted in some areas through at least 2023
- OTC contribution modeling indicates that dominant ozone producing emission category sectors include:
  - CT: OnRoad, NonRoad, and EGU
  - NYC: OnRoad, NonRoad, and EGU
  - MD: NonRoad, OnRoad, EGU, NonPoint (area), Oil&Gas
- Underway:
  - Good Neighbor screening modeling
  - 2016 modeling platform development
  - Enhanced monitoring studies
  - Conceptual model documentation

Questions

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Emissions Inventory Lead:

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OTC Committee Lead:

Shyamala Rajan

srajan@otcair.org (202) 508-3839

Ozone Design Values

- Ozone concentrations collected at monitor locations
- The highest 8-hour average concentration for a continuous period for each day is recorded.
- The 4th highest 8-hour concentration recorded over the ozone season for each monitor is determined and averaged with 4th highest concentrations for the two previous years.
  - The resulting value is referred to as the **ozone design value** and this value is compared directly to the NAAQS for compliance

Near-Term OTC/MARAMA Base Case Emission Inventories
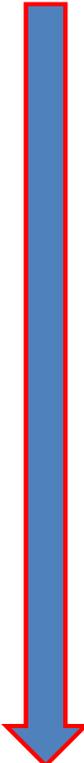
Alpha
- 2011
- 2018 ✓
- 2028

Beta
- 2011
- 2017 ✓

Gamma
- 2011
- 2020 ✓
- 2023
- 2028

	2020	2023	2028
EGUs	ERTAC v2.7 w/ C-SAPR Optimization		
Small EGUs & Non-EGU Point	MARAMA EMF Growth	MARAMA EMF Growth	EPA 'el' re-split
Onroad/Nonroad	2017-> 2023 Interpolation	EPA 'en'	EPA 'el'
Other Sectors		EPA 'en' or 'el'	

OTC Photochemical Modeling Plan

2011 Gamma Emission Inventory Base Case

- To ensure consistent inventories and update chemistry

2020 Gamma Emission Inventory Base Case – CMAQ

- For use in Serious 2008 NAAQS Nonattainment Ozone SIPs

2023 Gamma Emission Inventory Base Case – CAMx Emission Tags

- For use in Transport SIP Planning
- Guidance information for 2015 Ozone NAAQS

2023 Gamma Emission Inventory Screening Control Case – CAMx

- For use in Good Neighbor SIP (Transport SIP) Planning

2028 Gamma Emission Inventory Base & Control Case – CMAQ (regional haze)

- For use in Regional Haze SIPs

2016 Modeling Platform Development

Model Comparison Summary

2008 NAAQS

- CAMx predicts full attainment by 2023

- CMAQ predicts two locations (CT and NY) will fail to attain by 2023

- CMAQ predicts that 5 locations in three states (CT, MD, NY) will fail to attain by 2020

2015 NAAQS

- Both models predict that six (but differing) locations in three states (CT, MD, and NY) will fail to attain by 2023

- CMAQ predicts that 12 locations in four states (CT, MD, NJ, NY) will fail to attain by 2020

2023 Ozone Contributions to 360850067

## New York – NYC – Susan Wagner High School

By State
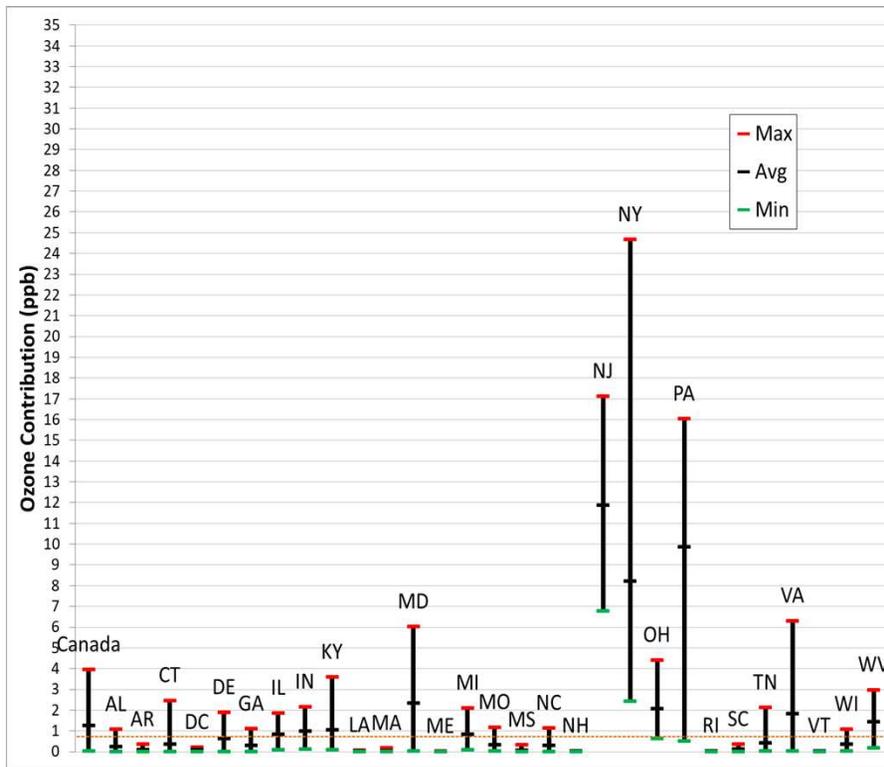
By Sector
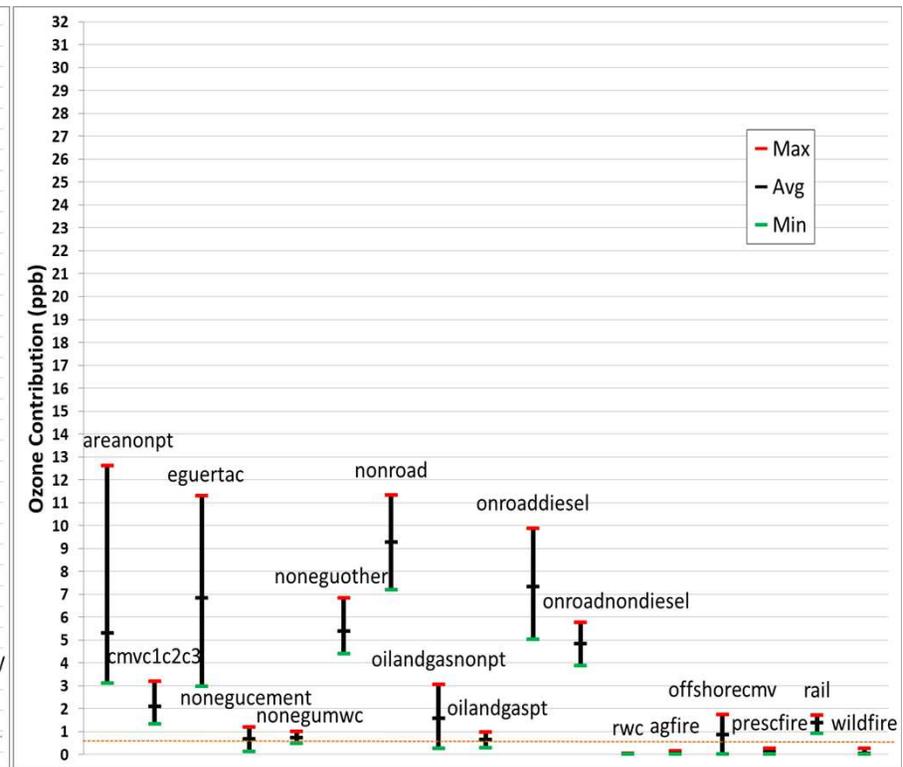
On days with Modeling Exceeding 70ppb

2023 Ozone Contributions to 240251001

Maryland - Edgewood

By State
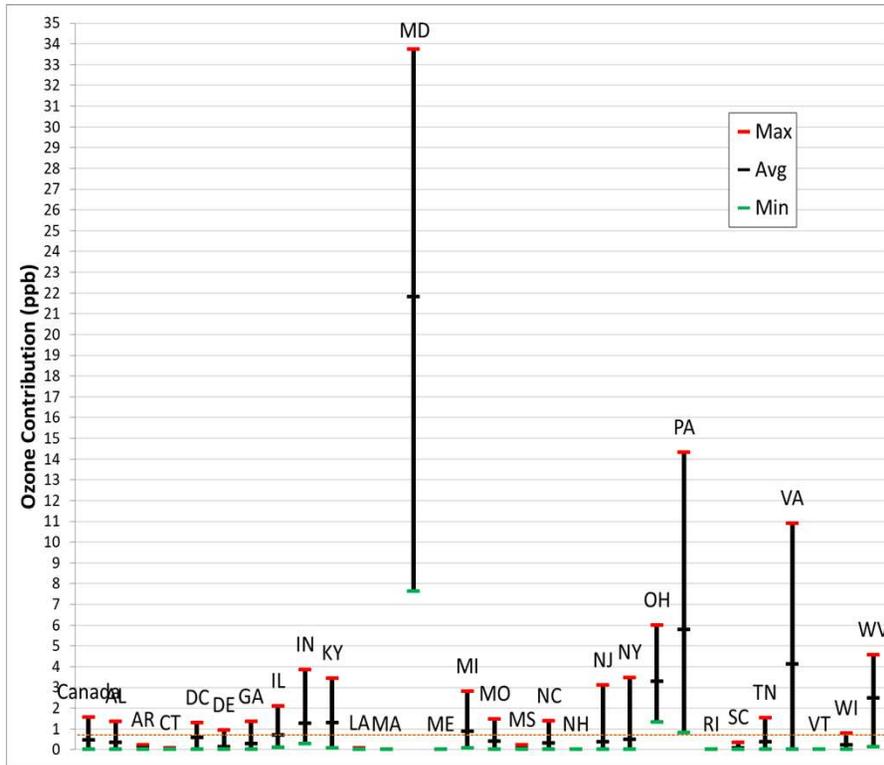
By Sector
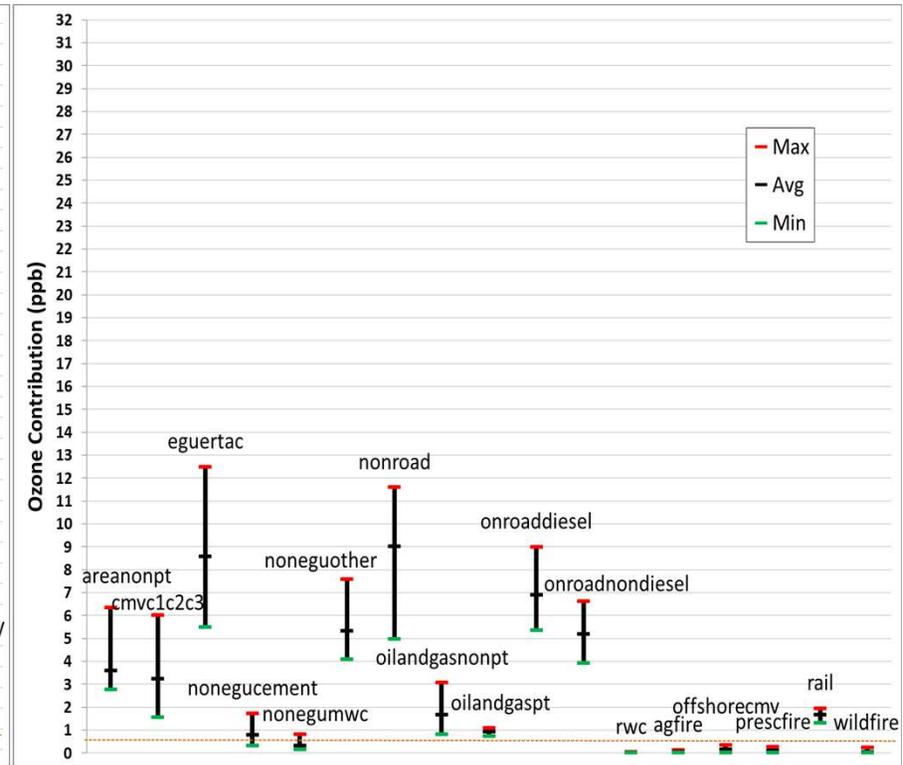
On days with Modeling Exceeding 70ppb

OTC Report: Conceptual Model

- Conceptual Model last updated August 2010

- Slide deck updated last cycle, currently updating written report

- Have been advances in our understanding of ozone since then

  - DISCOVER-AQ Campaign

  - Land-Water Interface

  - NO_X Tipping Point

  - Changing Weather Patterns

  - More Advanced Inventories