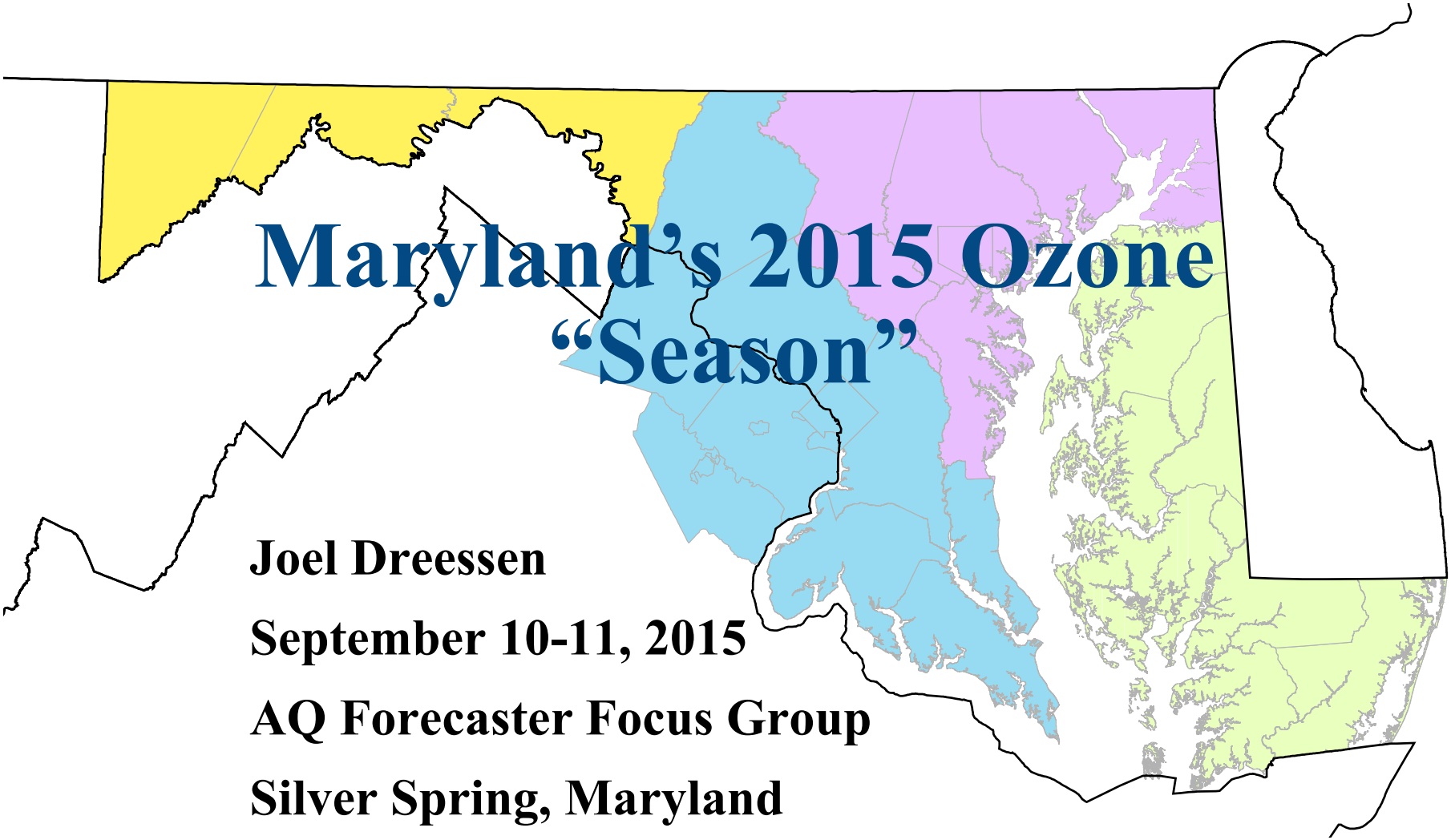
MARYLAND
DEPARTMENT OF THE ENVIRONMENT



Maryland's 2015 Ozone "Season"

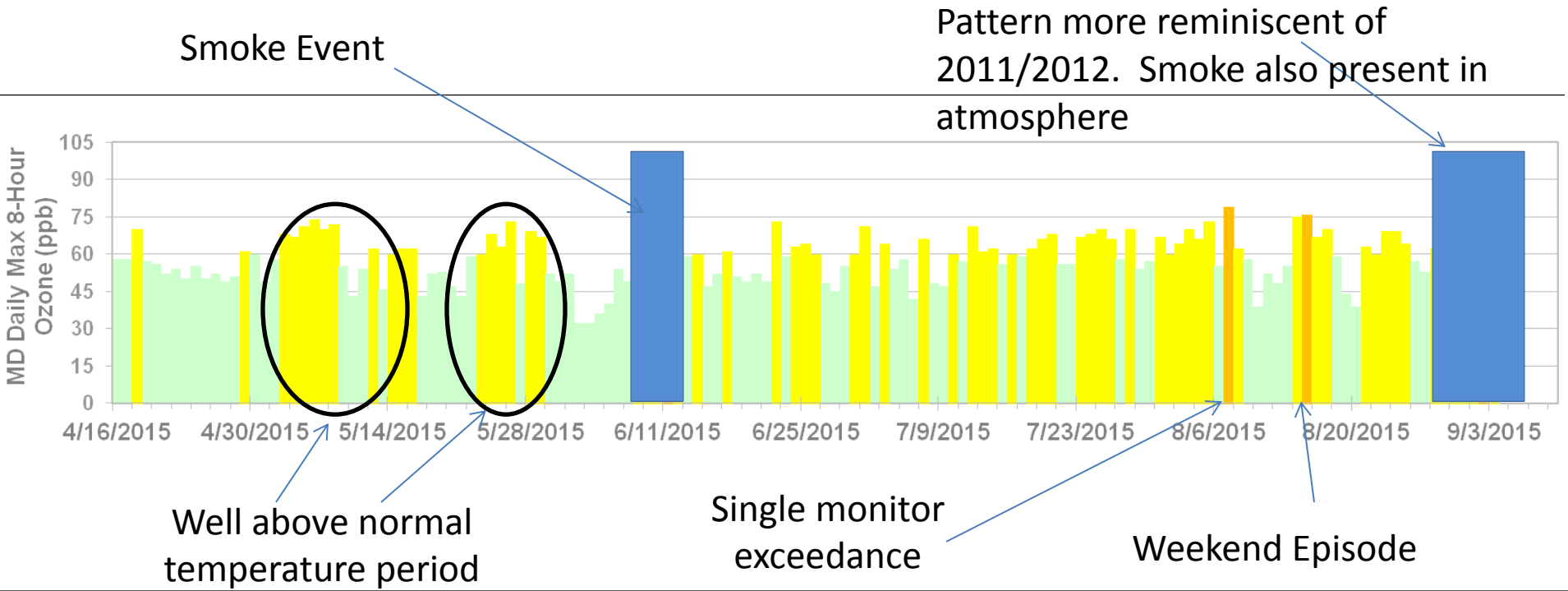
Joel Dreessen

September 10-11, 2015

AQ Forecaster Focus Group

Silver Spring, Maryland

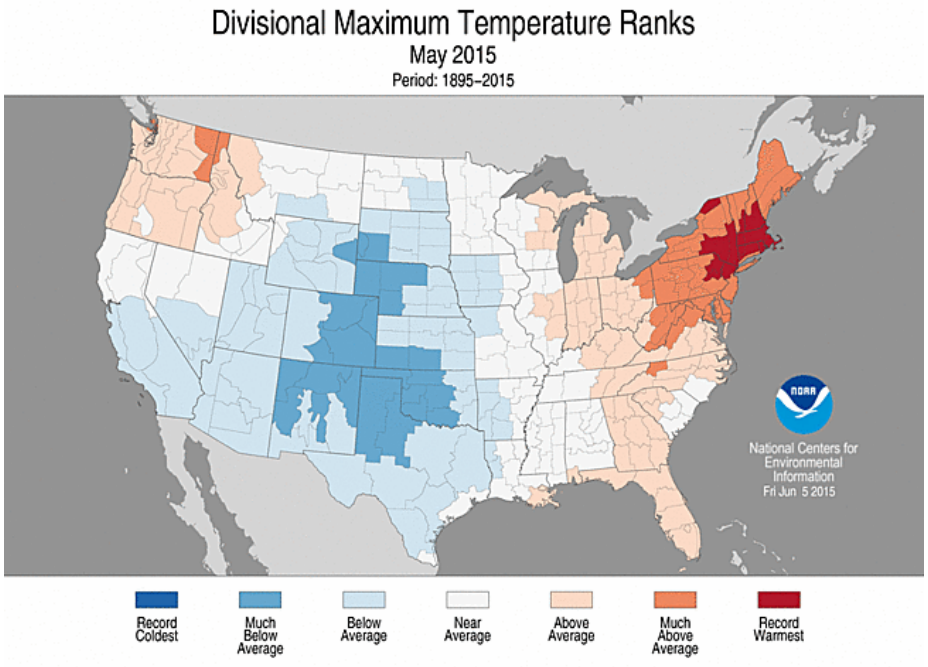
2015 SEASON AT A GLANCE

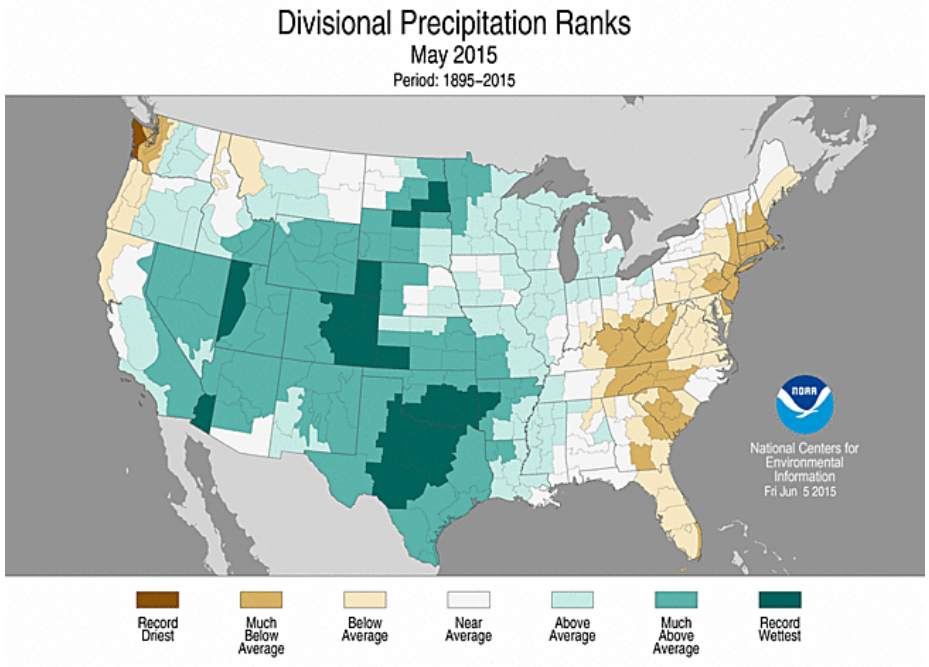


	Aldino	Davidsonville	Edgewood	Essex	Furley	Padonia	South Carroll	Calvert	PG Equest. Ctr.	Frederick Airport	Howard U.	Beltsville*	Rockville	So. Maryland	Fair Hill	Blackwater NWR*	Millington	Horn Point	Hagerstown	Piney Run
2014 Design Value	73	74	75	72	64	72	69	73	76	70	70	75	68	71	77	70	74	73	67	68
06/11/2015	83					81					88	86	83		100					
08/07/2015															79					
08/15/2015						76														
09/02/2015			88											77						

Day 5: 09/04/2015 Baltimore

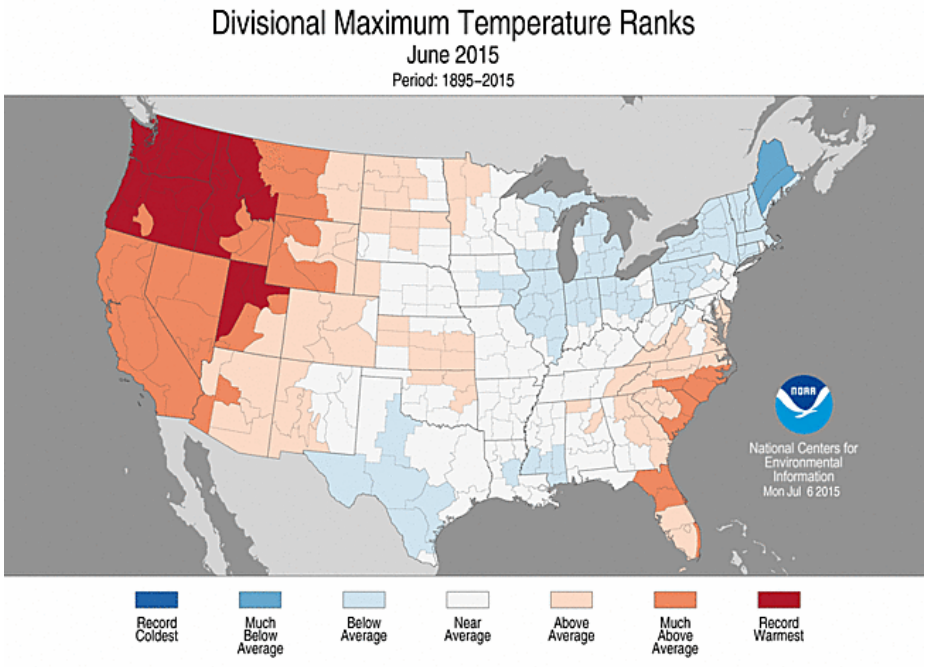
MAY

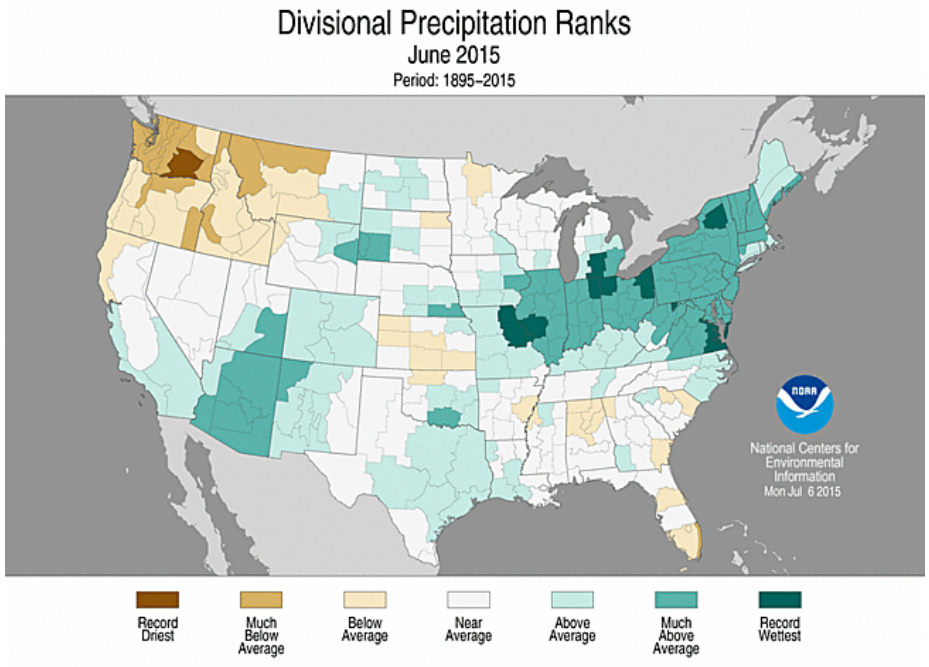




Source: [NCDC Temperature and Precipitaiton Maps]

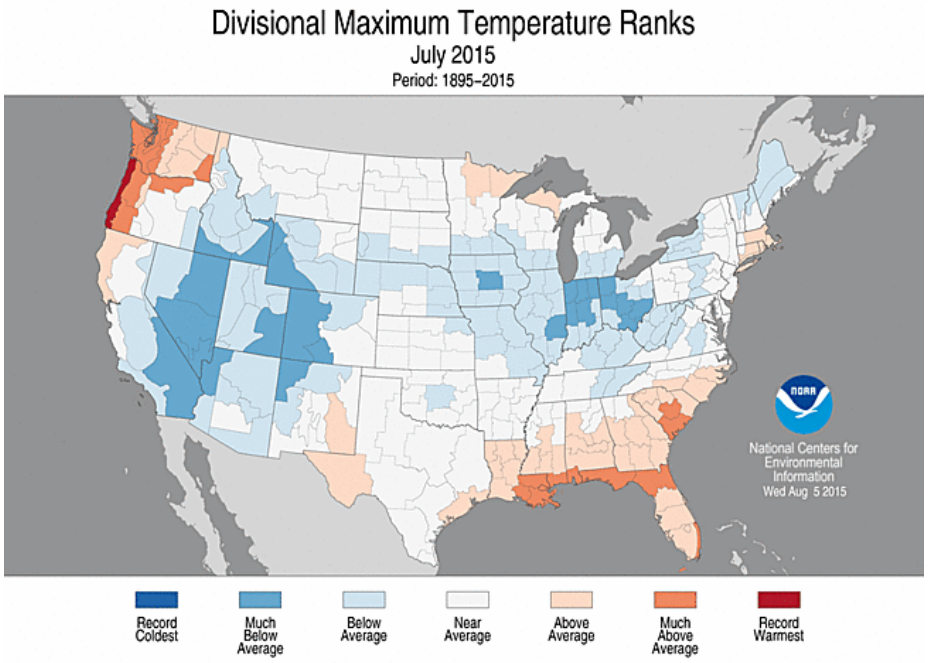
JUNE

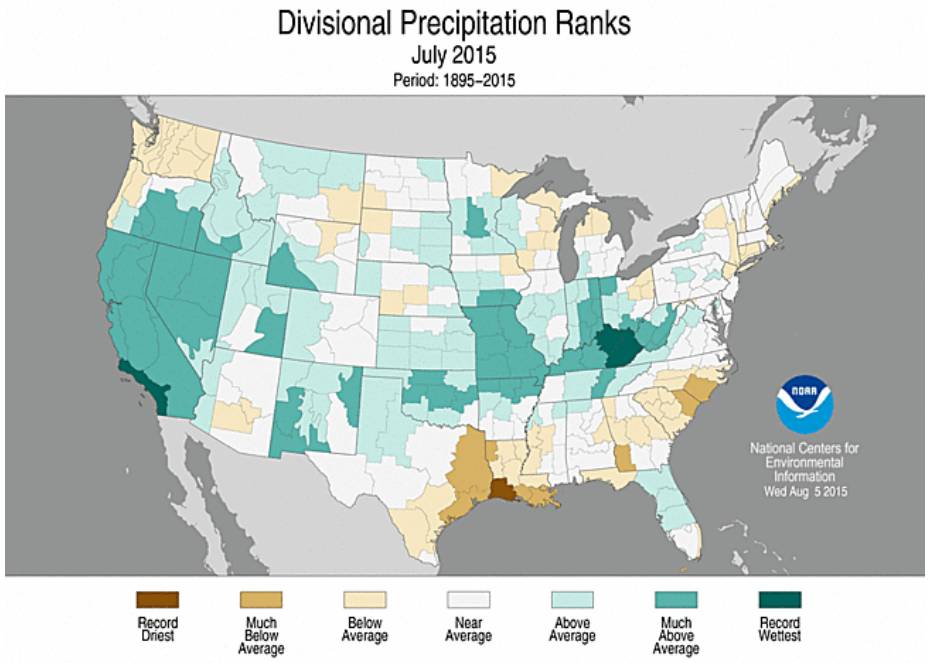




Source: [NCDC Temperature and Precipitaiton Maps]

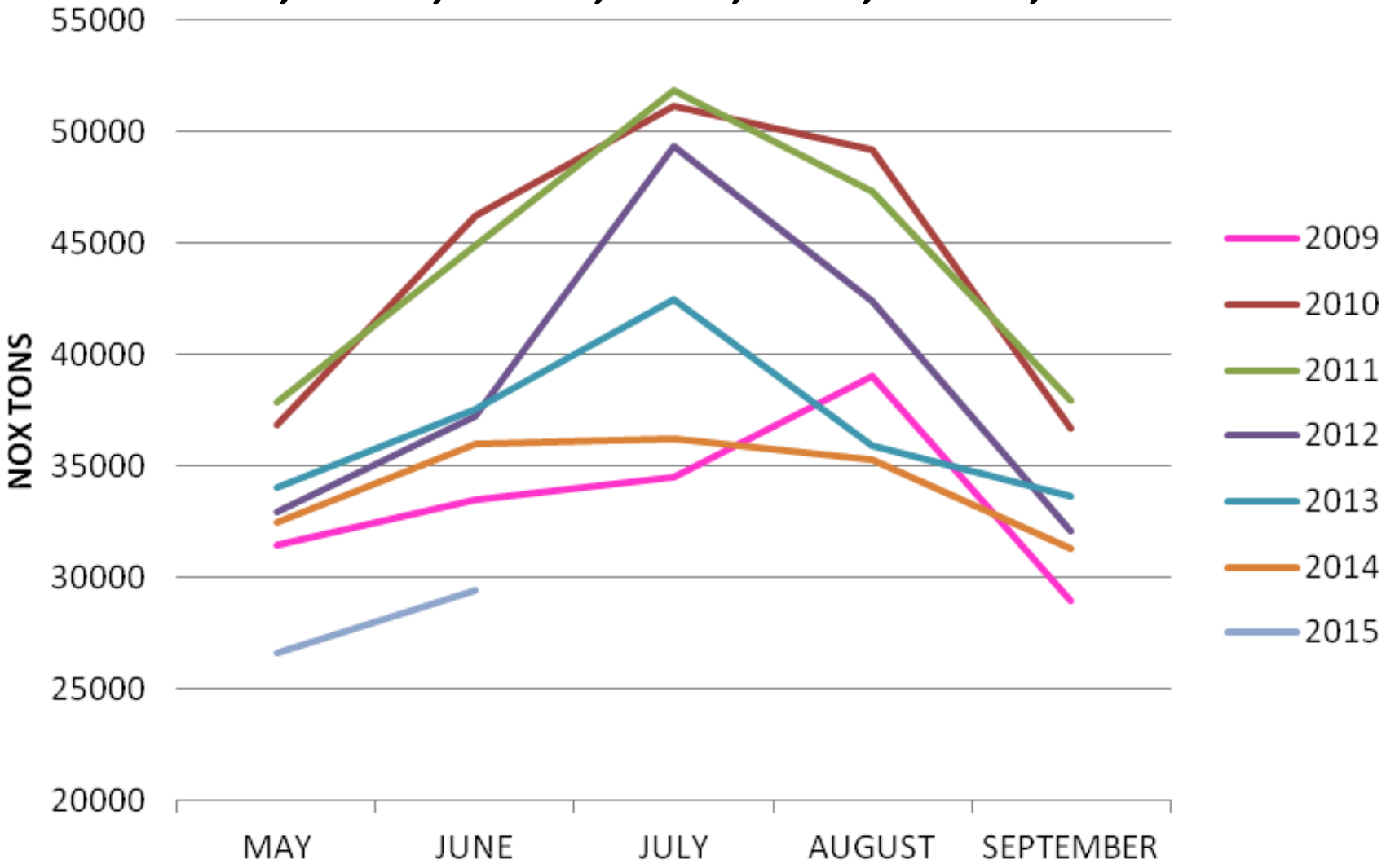
JULY





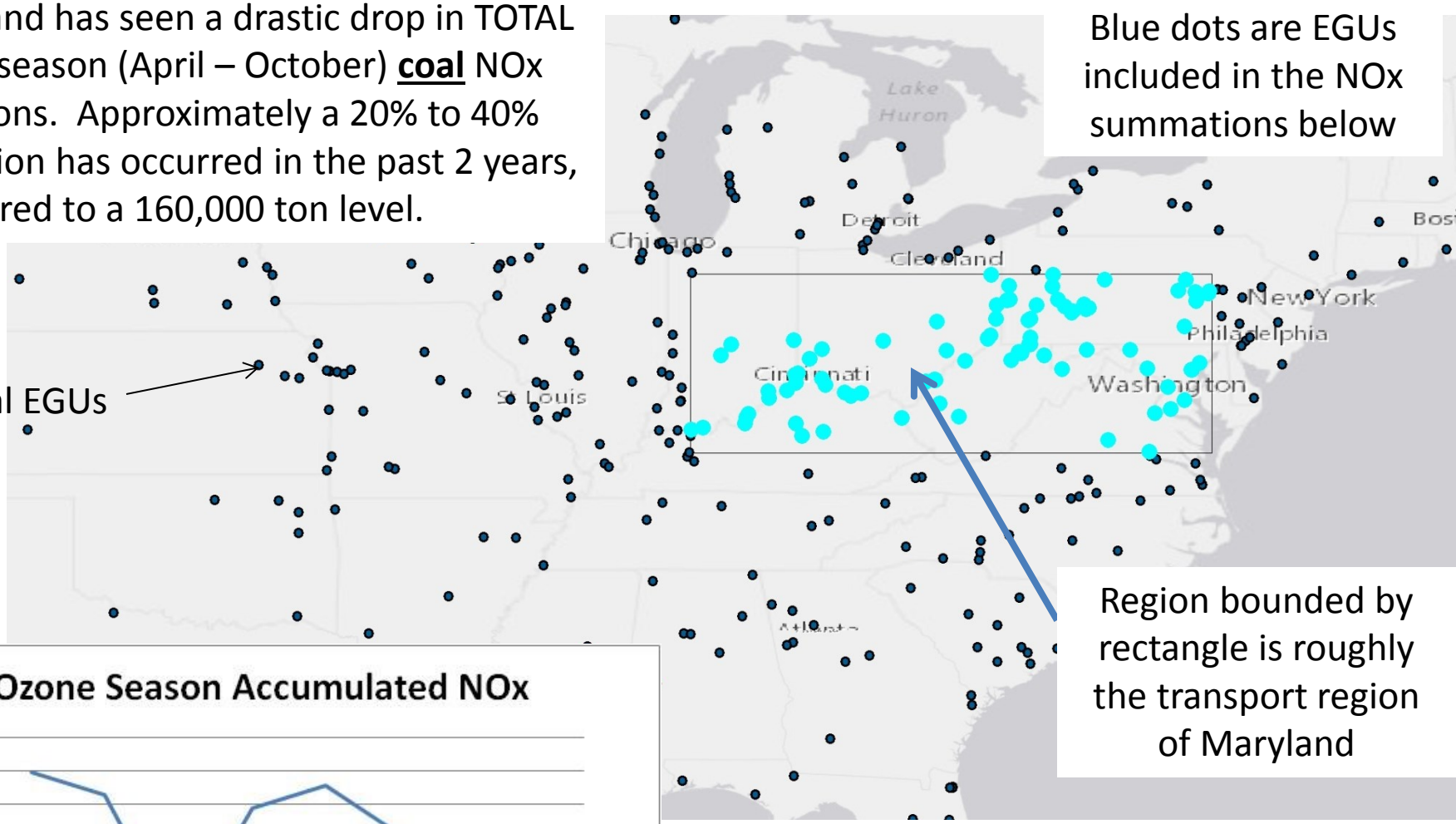
Source: [NCDC Temperature and Precipitaiton Maps]

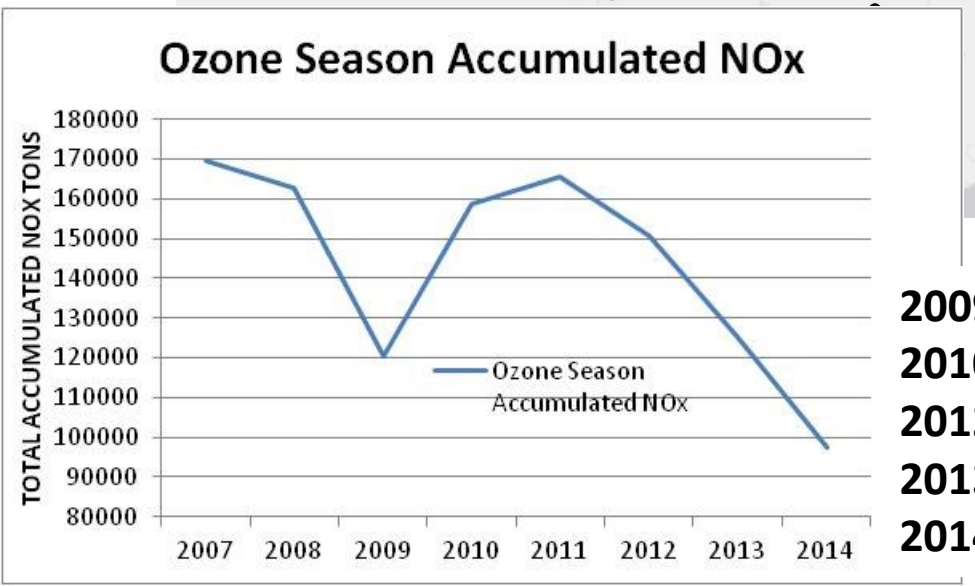
Monthly CAMD Emissions from: IN, OH, WV, VA, PA, MD, DC



Emissions of Indiana, Ohio, West Virginia, Virginia, Pennsylvania, Maryland and the District of Columbia were summed together on a monthly basis

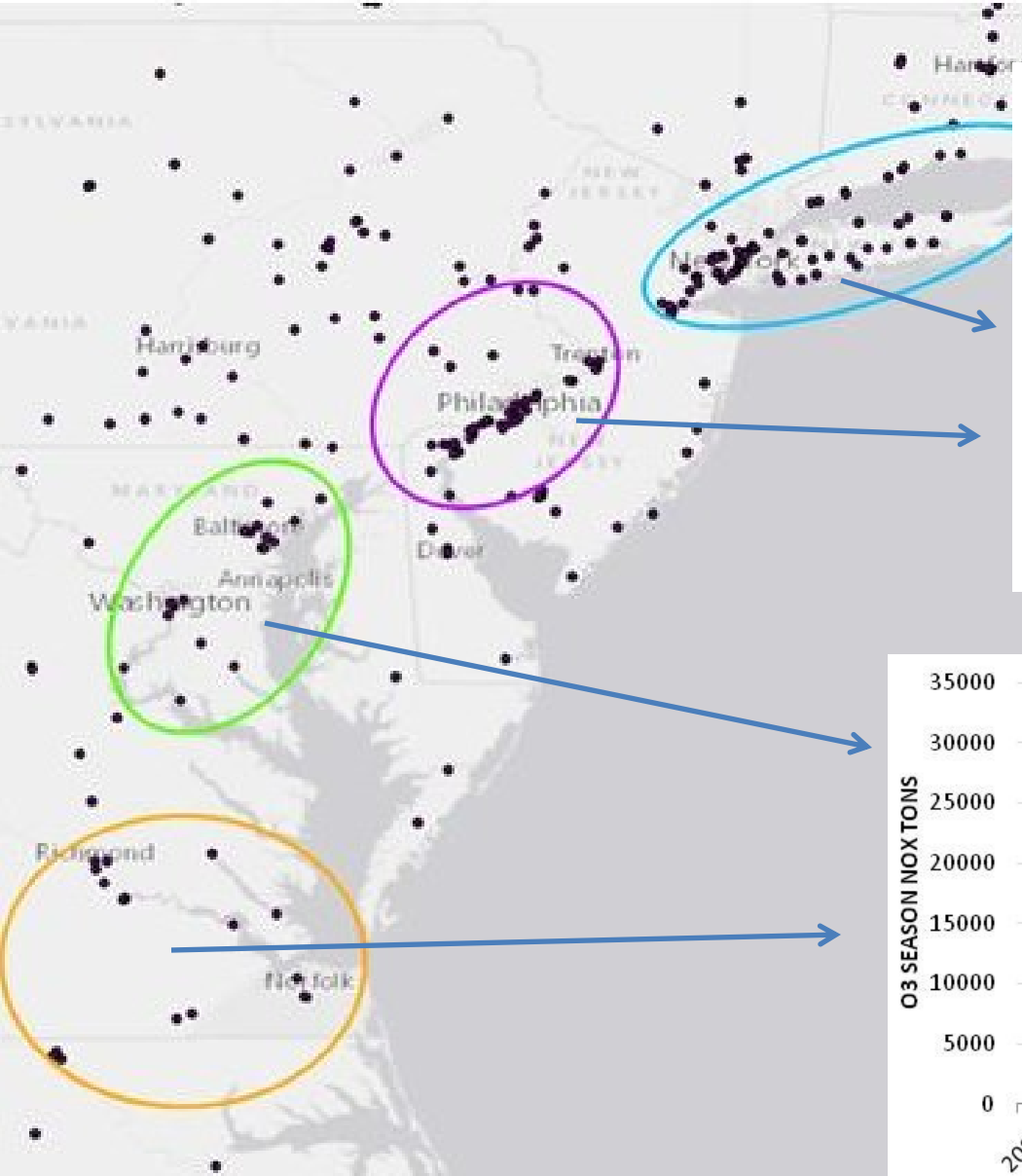
Source region for NOx transport in to Maryland has seen a drastic drop in TOTAL ozone season (April – October) **coal** NOx emissions. Approximately a 20% to 40% reduction has occurred in the past 2 years, compared to a 160,000 ton level.

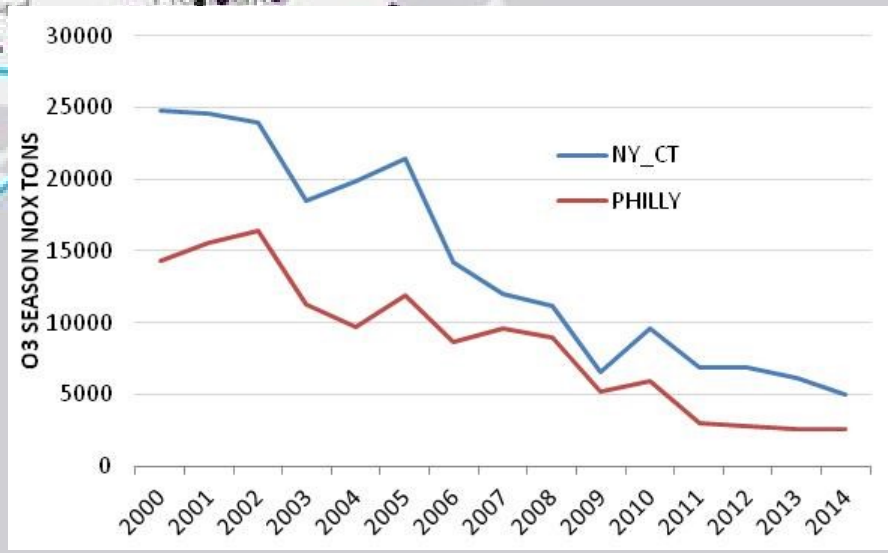


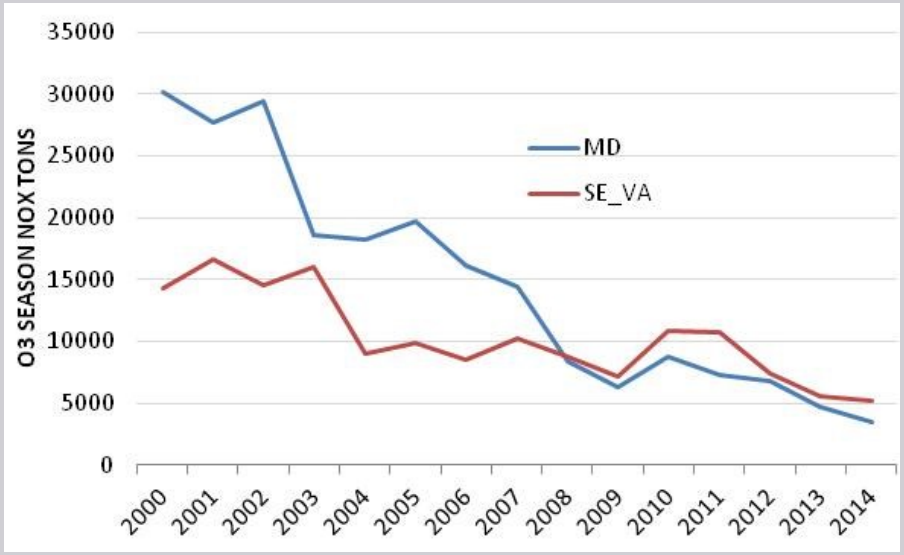


2009: 45135 fewer NOx tons emitted than in 2011
2010: 7011 fewer NOx tons emitted than in 2011
2012: 14830 fewer NOx tons emitted than in 2011
2013: 40462 fewer NOx tons emitted than in 2011
2014: 67983 fewer NOx tons emitted than in 2011

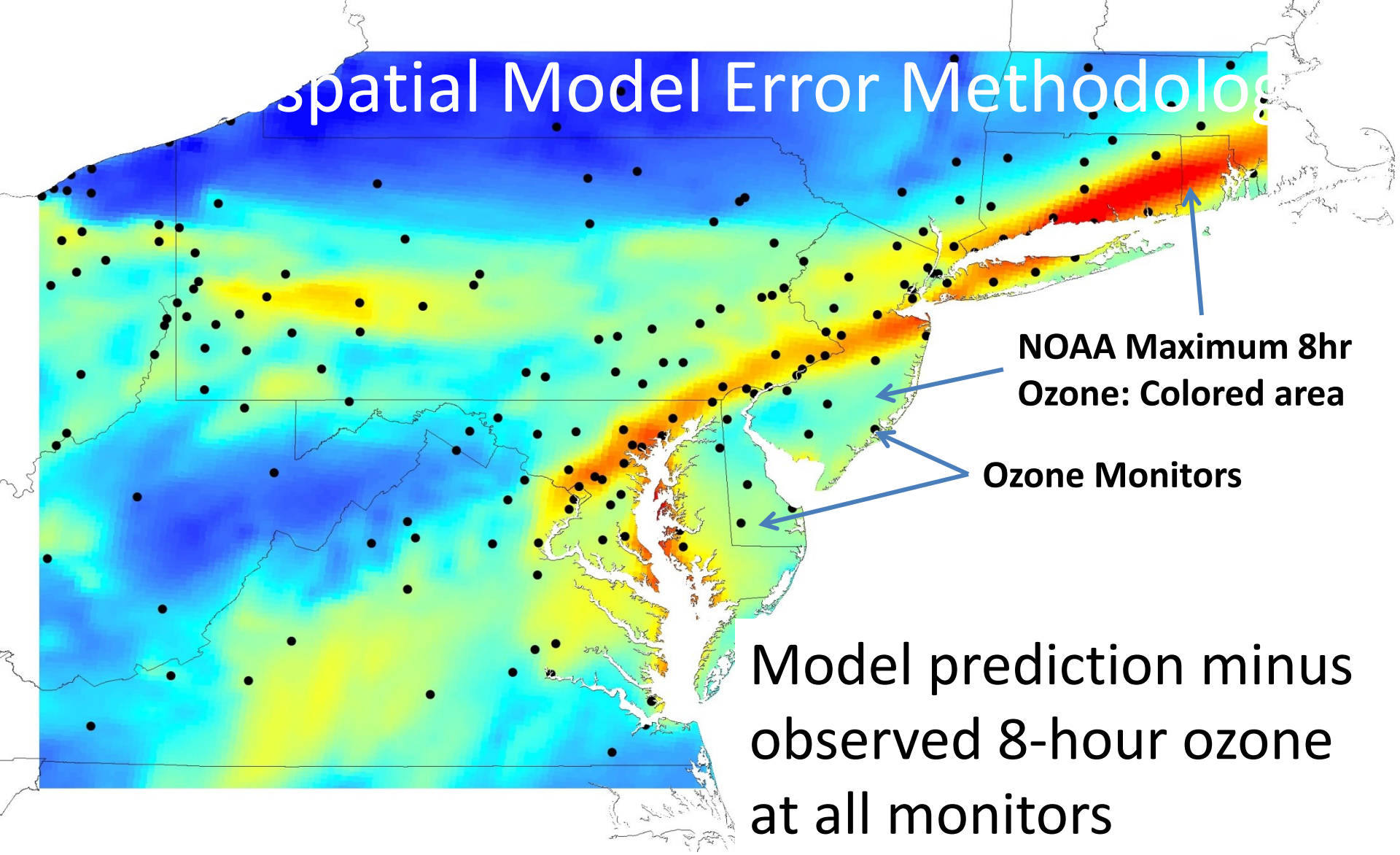
ALL CAMD EGUs (>25MW) NOx Emissions



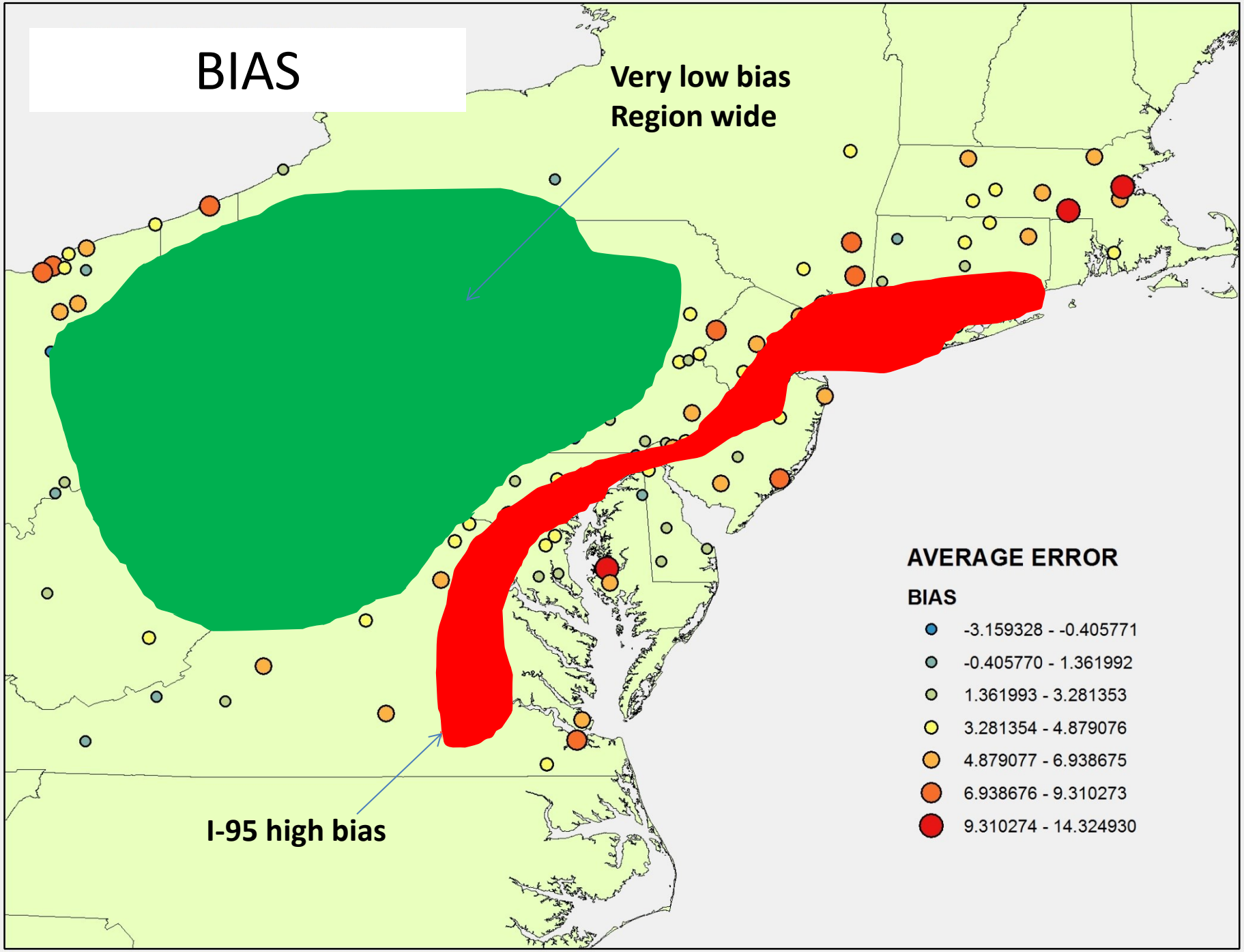


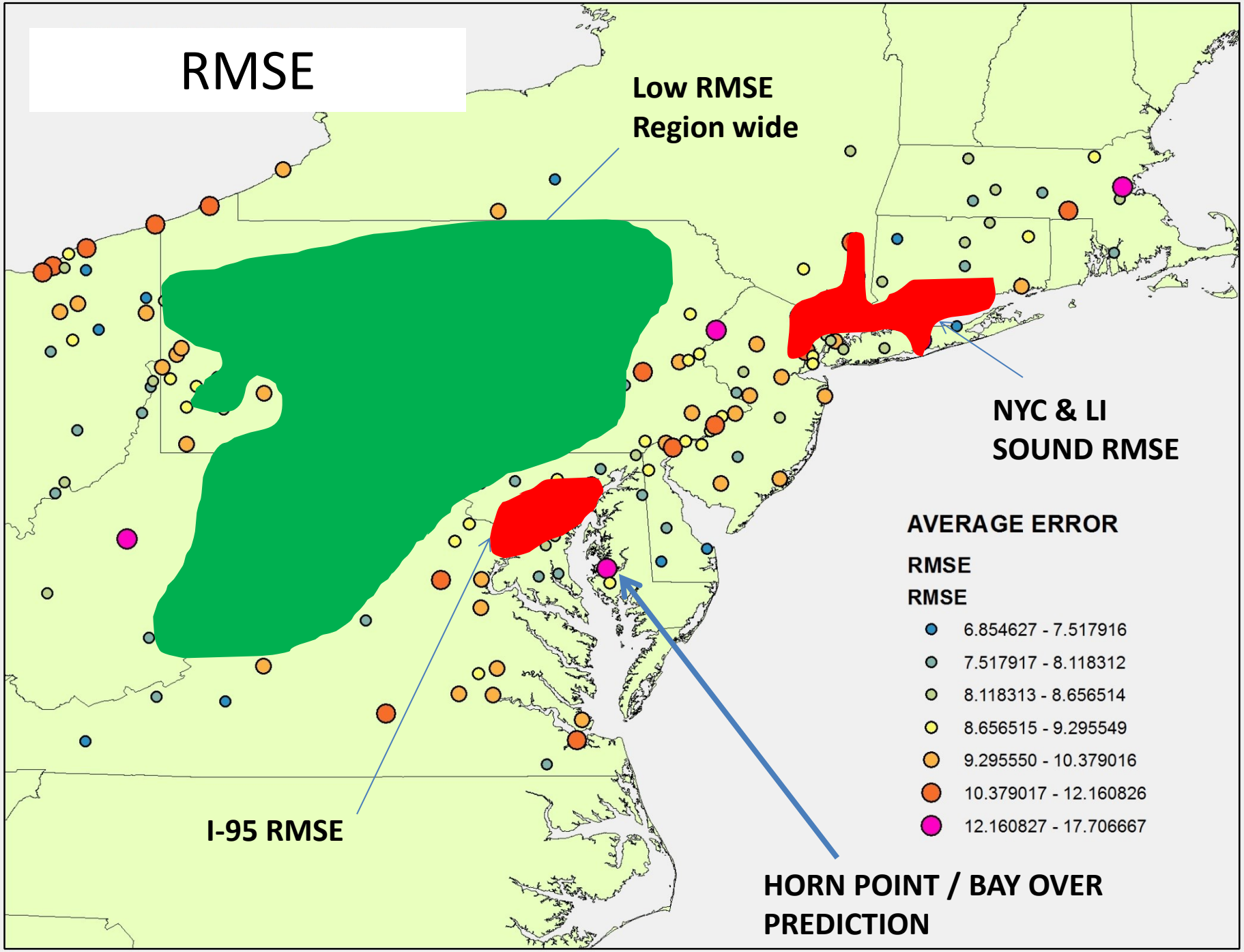


Spatial Model Error Methodolog

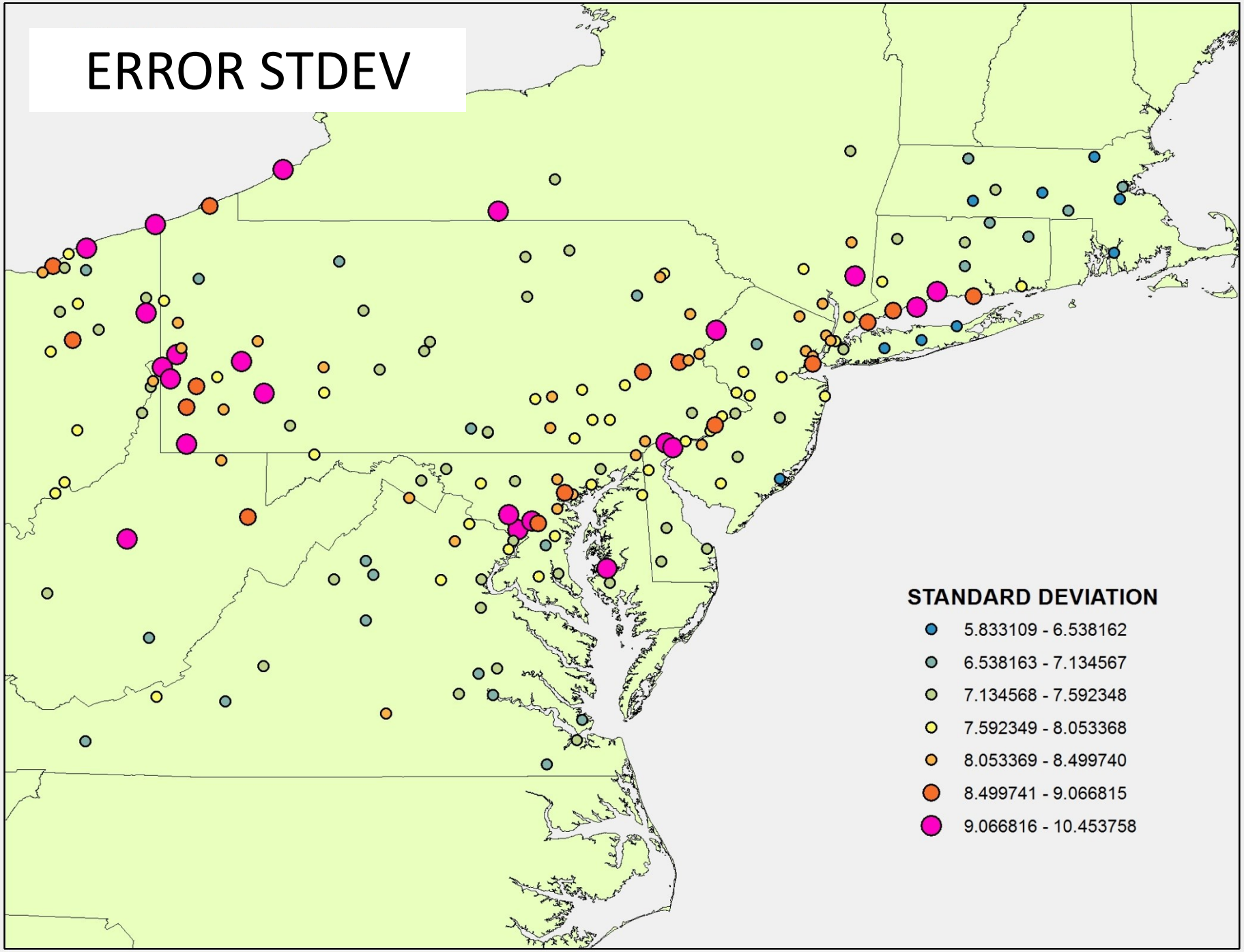


Model prediction minus observed 8-hour ozone at all monitors (preliminary data from AirnowTech)


BIAS
Very low bias
Region wide
I-95 high bias
AVERAGE ERROR
BIAS
-3.159328 - -0.405771
-0.405770 - 1.361992
1.361993 - 3.281353
3.281354 - 4.879076
4.879077 - 6.938675
6.938676 - 9.310273
9.310274 - 14.324930

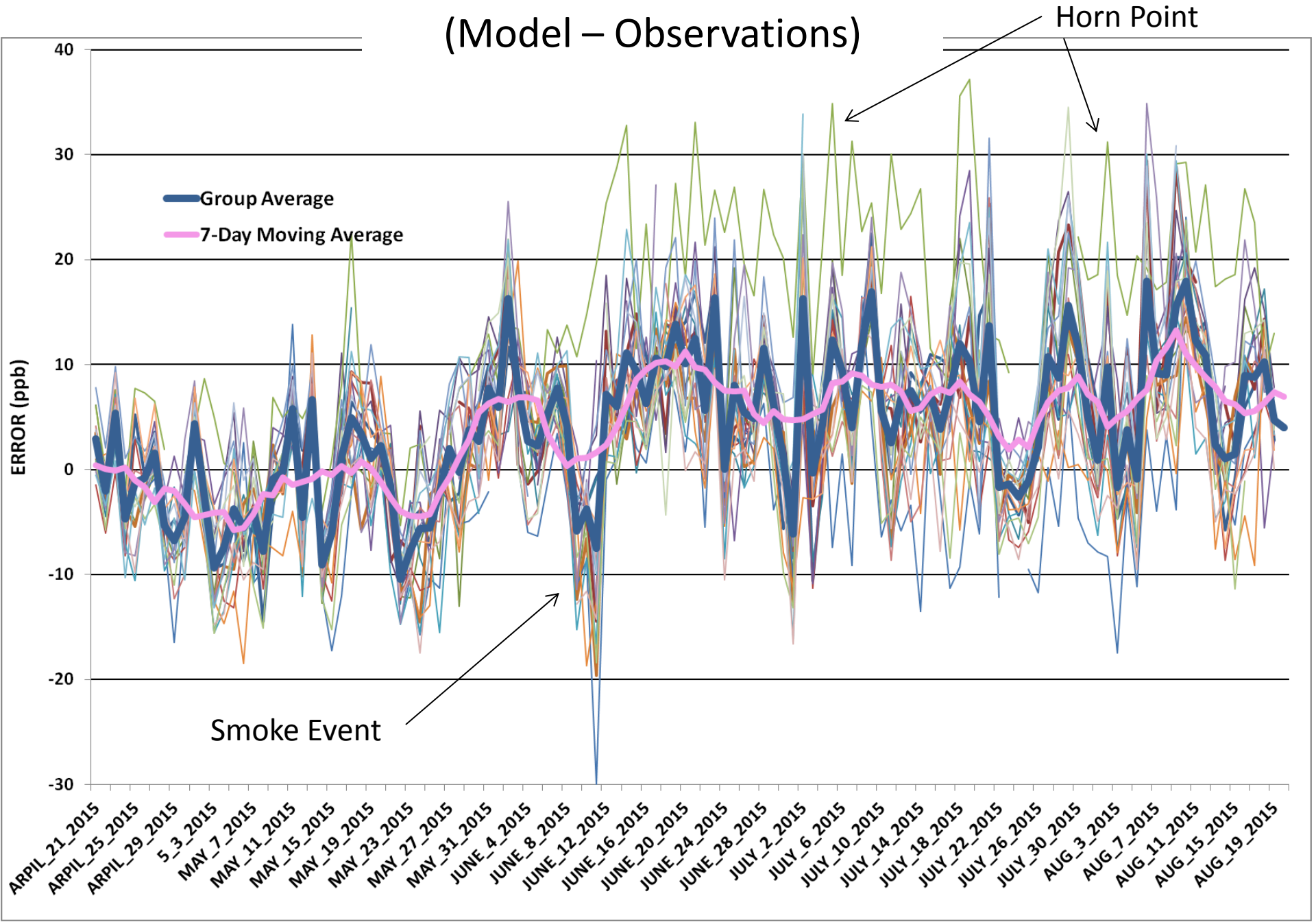

RMSE
Low RMSE
Region wide
NYC & LI
SOUND RMSE
AVERAGE ERROR
RMSE
RMSE
6.854627 - 7.517916
7.517917 - 8.118312
8.118313 - 8.656514
8.656515 - 9.295549
9.295550 - 10.379016
10.379017 - 12.160826
12.160827 - 17.706667
I-95 RMSE
HORN POINT / BAY OVER
PREDICTION

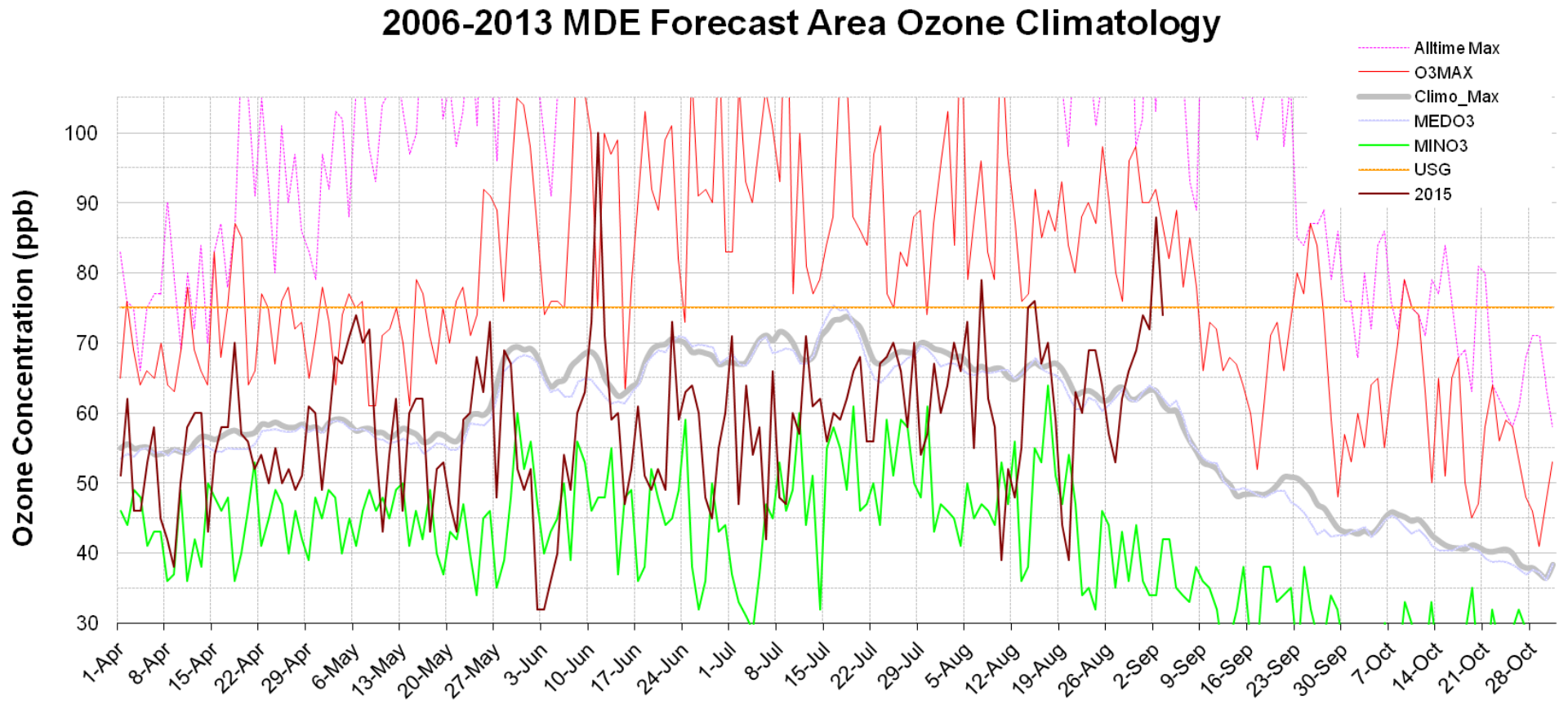
ERROR STDEV


STANDARD DEVIATION
5.833109 - 6.538162
6.538163 - 7.134567
7.134568 - 7.592348
7.592349 - 8.053368
8.053369 - 8.499740
8.499741 - 9.066815
9.066816 - 10.453758

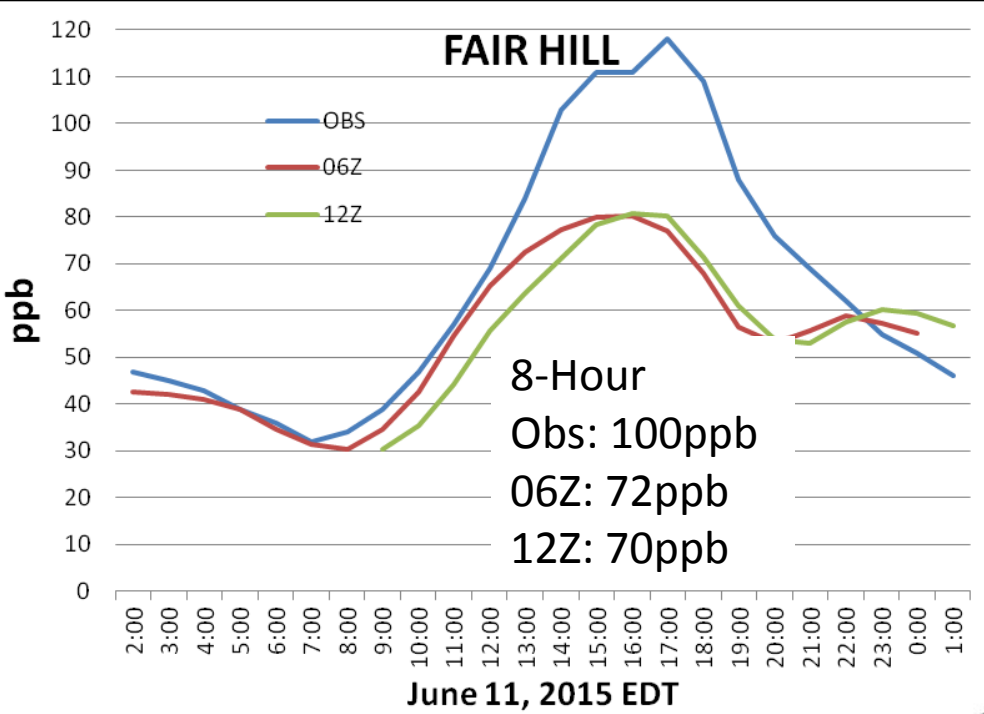
MARLAND ERRORS

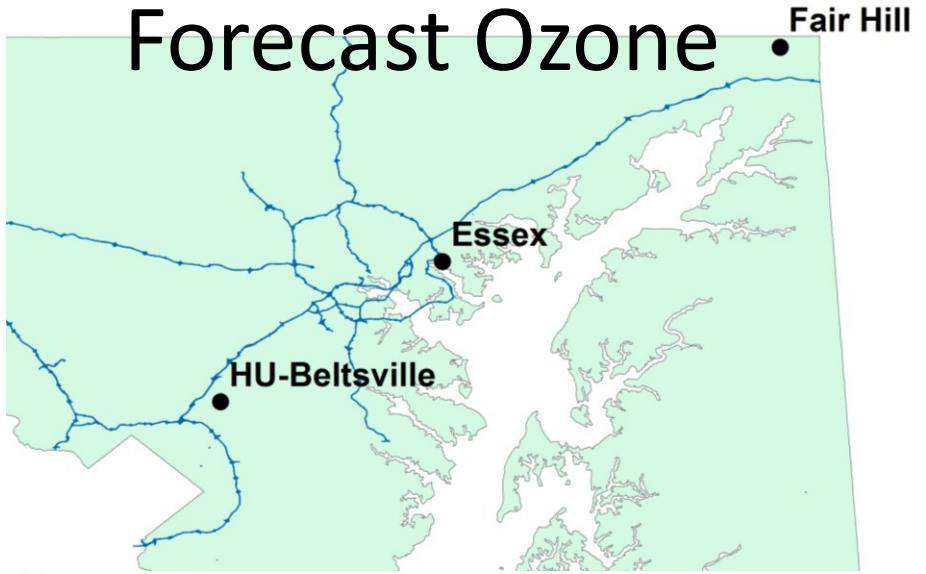
(Model – Observations)

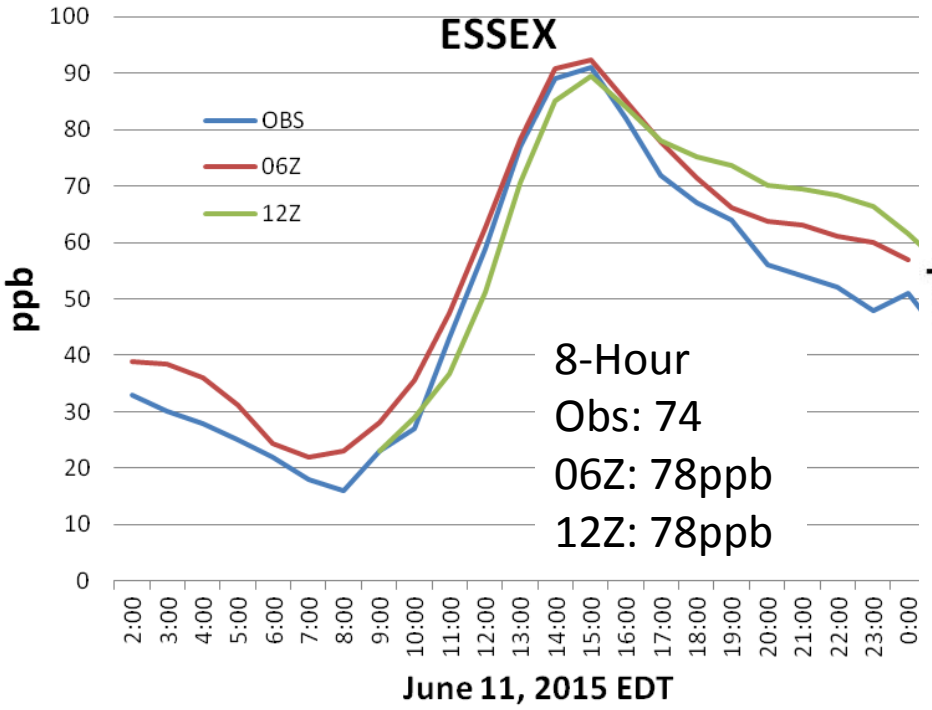


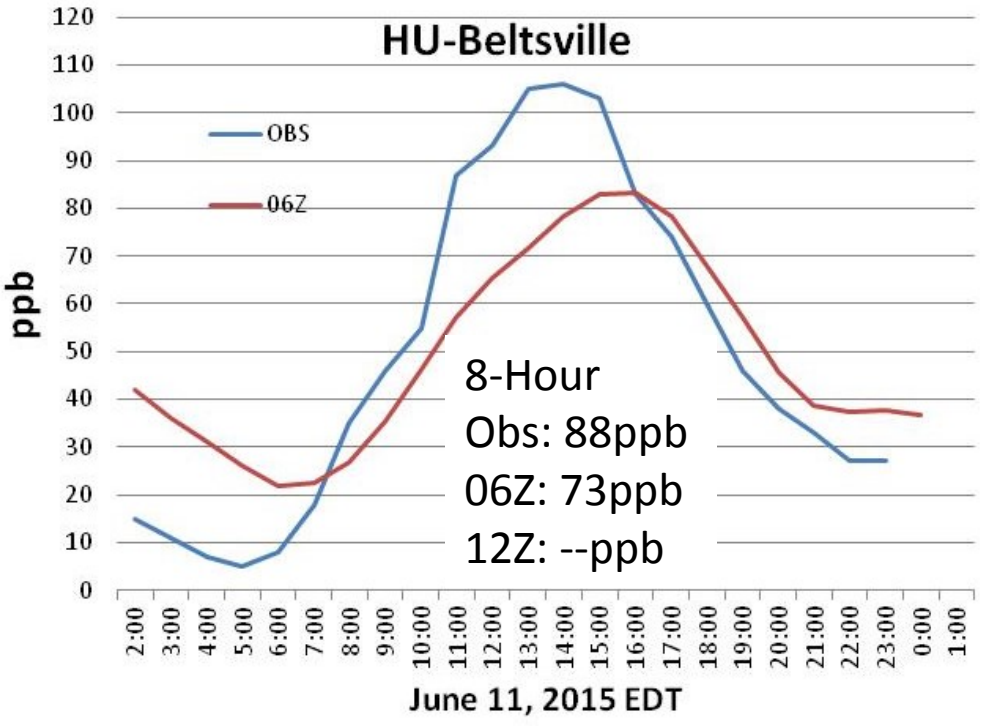

2006-2013 MDE Forecast Area Ozone Climatology
Ozone Concentration (ppb)
100
90
80
70
60
50
40
30
1-Apr
8-Apr
15-Apr
22-Apr
29-Apr
6-May
13-May
20-May
27-May
3-Jun
10-Jun
17-Jun
24-Jun
1-Jul
8-Jul
15-Jul
22-Jul
29-Jul
5-Aug
12-Aug
19-Aug
26-Aug
2-Sep
9-Sep
16-Sep
23-Sep
30-Sep
7-Oct
14-Oct
21-Oct
28-Oct
Alltime Max
O3MAX
Climo_Max
MEDO3
MINO3
USG
2015

NOAA: Hourly Forecast Ozone

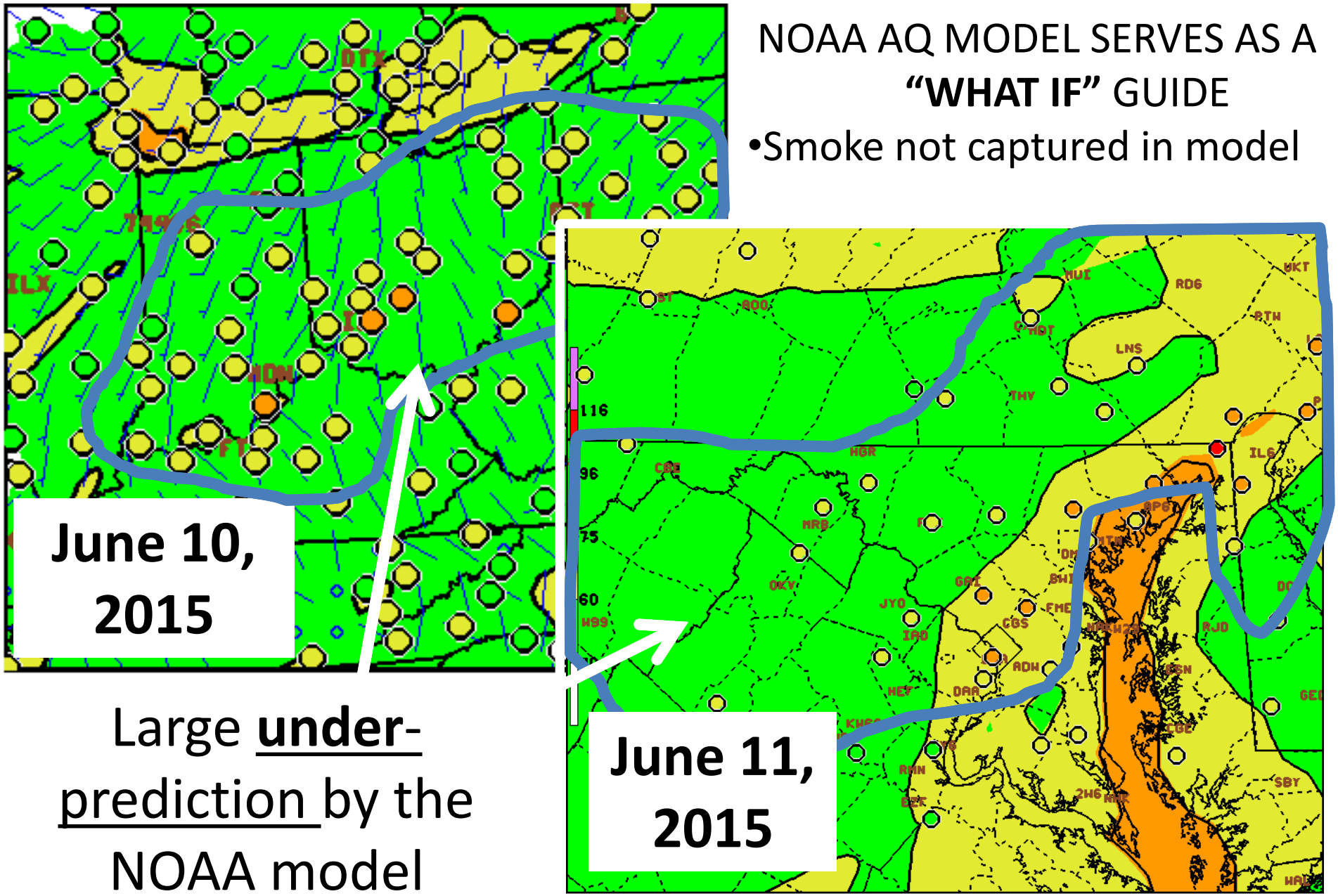








How Much Ozone from Smoke?

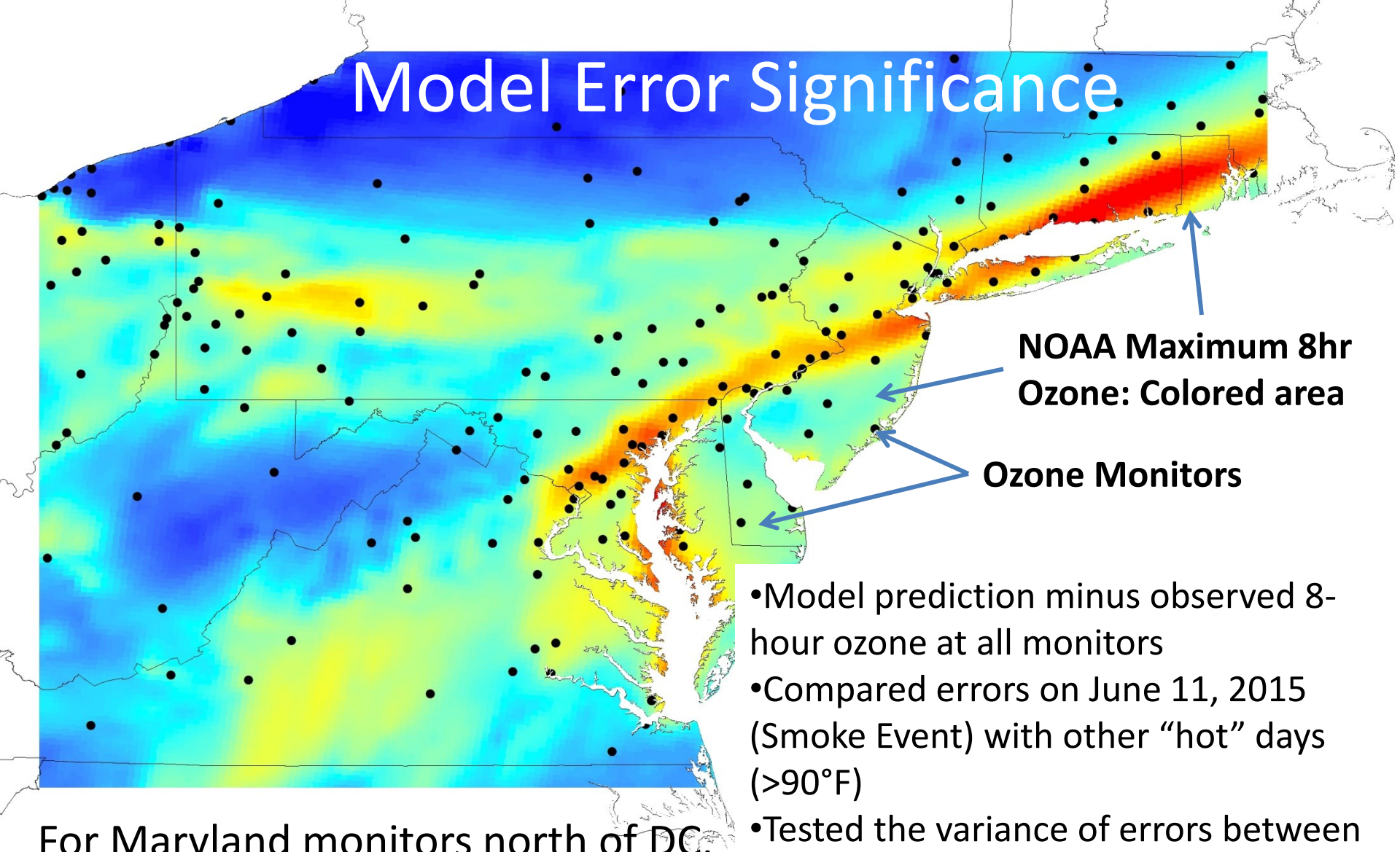


NOAA AQ MODEL SERVES AS A **"WHAT IF"** GUIDE

- Smoke not captured in model

Large **under**-prediction by the NOAA model

Model Error Significance



- Model prediction minus observed 8-hour ozone at all monitors
- Compared errors on June 11, 2015 (Smoke Event) with other "hot" days (>90°F)
- Tested the variance of errors between smoke day and non-smoke day
- F-test shows the variances are different with statistical significance at the 95% confidence level

For Maryland monitors north of DC, ozone contribution from smoke is approximately **14ppb**.
Range: 7.6ppb – 30ppb

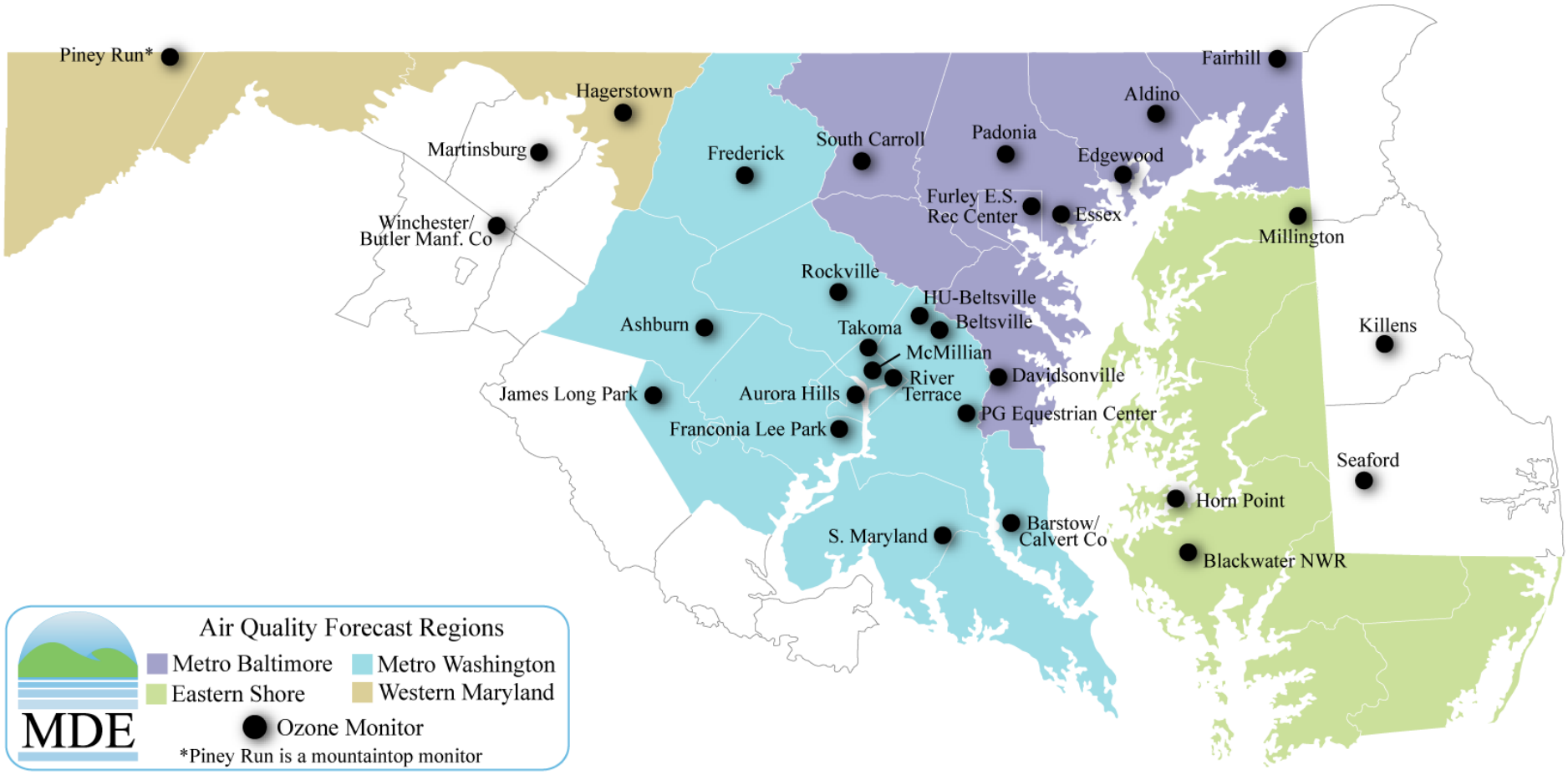
Ohio Error: 18-21ppb

DIRECT FROM THE DIRECTOR

- "..like to use science for policy"… Is the Chesapeake Bay high ozone prediction real or not? Model artifact? Marine vessels? Meteorology?
- MDE is pursuing putting an ozone monitor in the Bay
- The same issues which face the operational model are facing the SIP modelers; (4km on the Bay?)
- Ability to modify the model online and rerun – does Maryland exceed or not with new settings?
- Inventory: are smaller generators being modeled? (distributed generation)

APPENDIX

Forecast Regions & Monitors



Essex and Howard University Beltsville

June 11	Max 8hr O3	24hr PAMs (ppbc)	24hr Avg NOX
Essex	75 (74)	89.6	13.5
HU-BLT	88	77.4	10.1

Why did Essex (and Edgewood) not exceed the 76ppb ozone NAAQS standard?