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Solving the Ozone Transport Problem

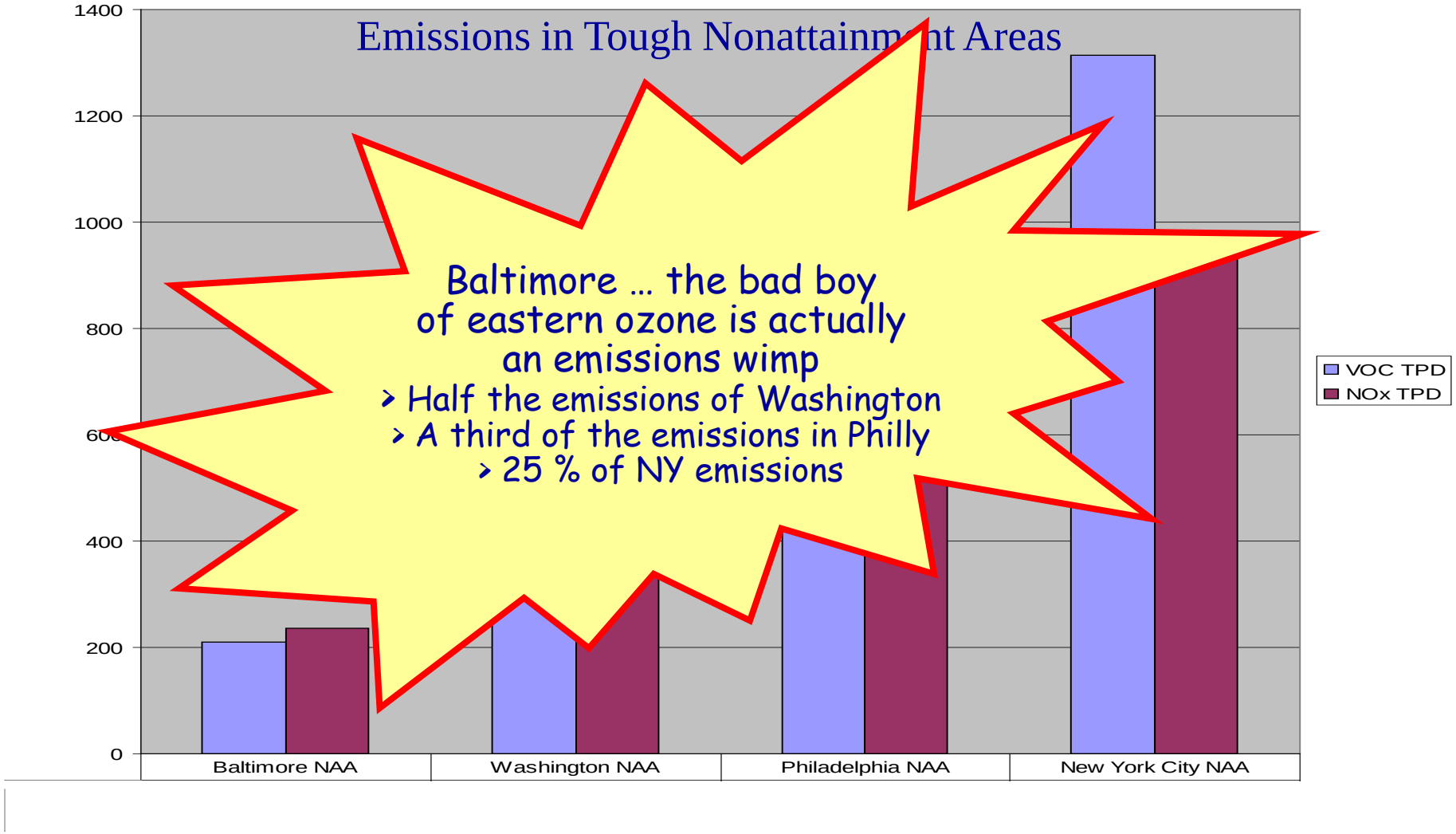
An Update on Ozone Transport and "Good Neighbor "SIPs

Tad Aburn, Air Director, MDE

AQCAC Meeting - September 21, 2015

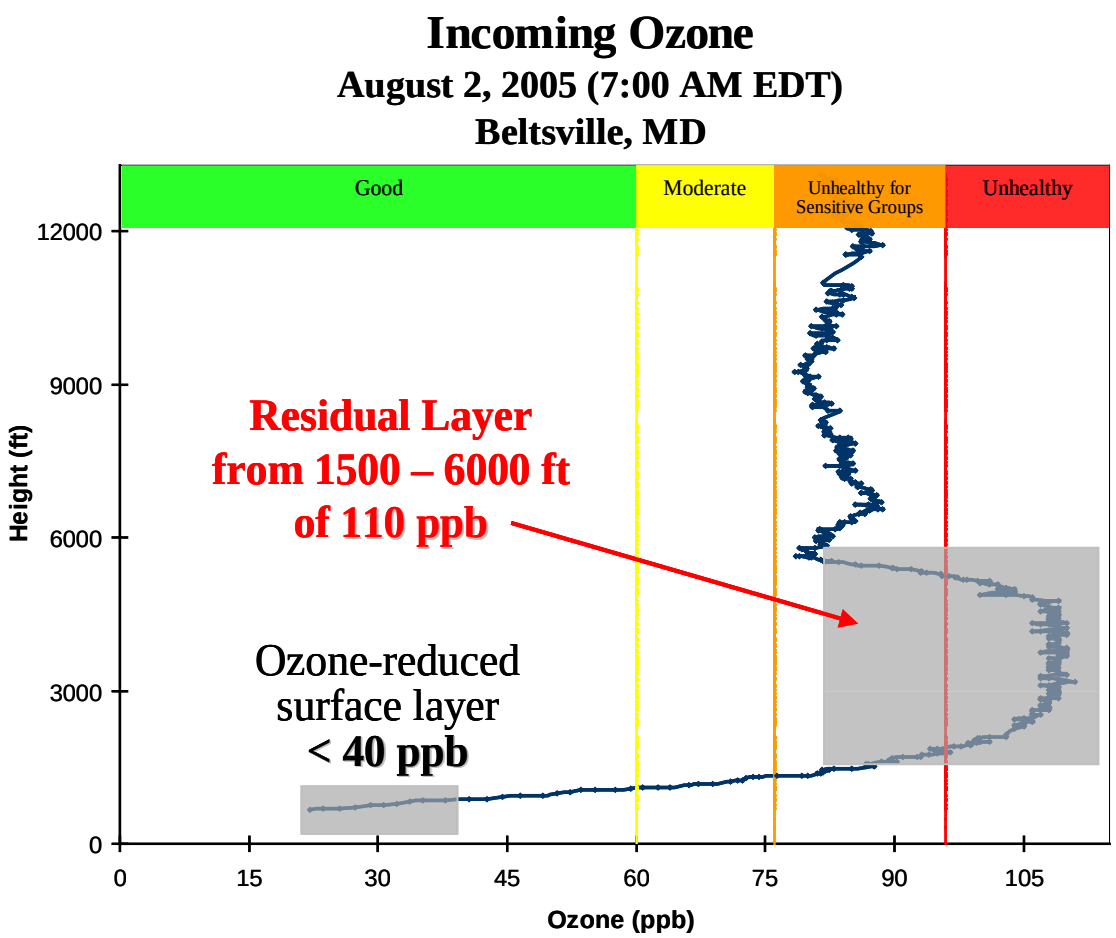
MARYLAND
DEPARTMENT OF THE ENVIRONMENT

Baltimore – Worst Ozone in the East?



So What the Heck is Going On?

Why has Baltimore historically measured some of the worst ozone in the East?



Source: Maryland Department of the Environment & Howard University

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Topics

- What does the Maryland Ozone Research Program tell us about the significance of ozone transport?
- What is happening to reduce ozone transport into Maryland and across the East?
- Why are power plants in upwind states not running their controls?
- What happens next?

Background – Ozone Transport

- Many, many balls in the air
  - Supreme Court has acted
    - Several times over the past two years
  - "Expand the Ozone Transport Commission (OTC)" Petition under Section 176A of the Clean Air Act (CAA)
  - Challenges to EPA over large nonattainment areas (CAA Section 107)
  - Challenges to EPA over "Good Neighbor" SIPs (CAA Section 110A2D)
  - EPA's new (1/22/15) transport guidance and "Failure to Submit" action (6/30/15)
  - A collaborative effort between upwind and downwind states with a power plant focus
  - New - lower ozone standard all but here

Maryland's Ozone Research Effort

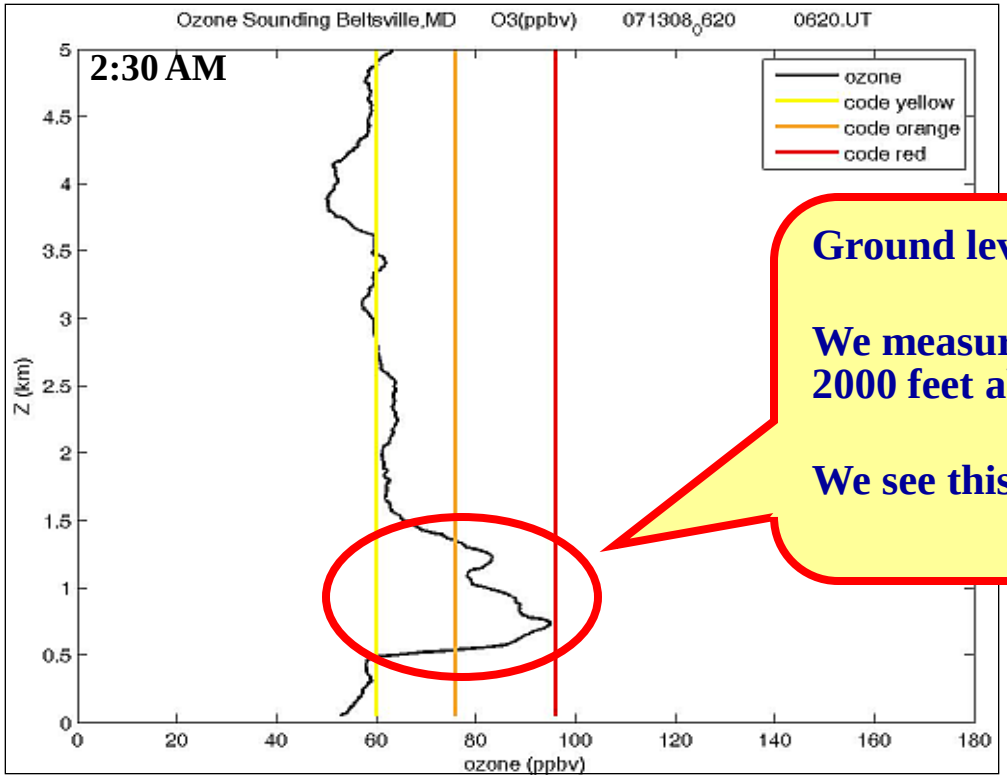
- MDE works in partnership with local universities (UMD at College Park, UMBC, Penn State and Howard University) to study Maryland's air pollution problems
  - Airplanes
  - Balloons
  - Lidar
  - Profilers
  - Satellites
  - Special monitors
  - Modeling
  - More

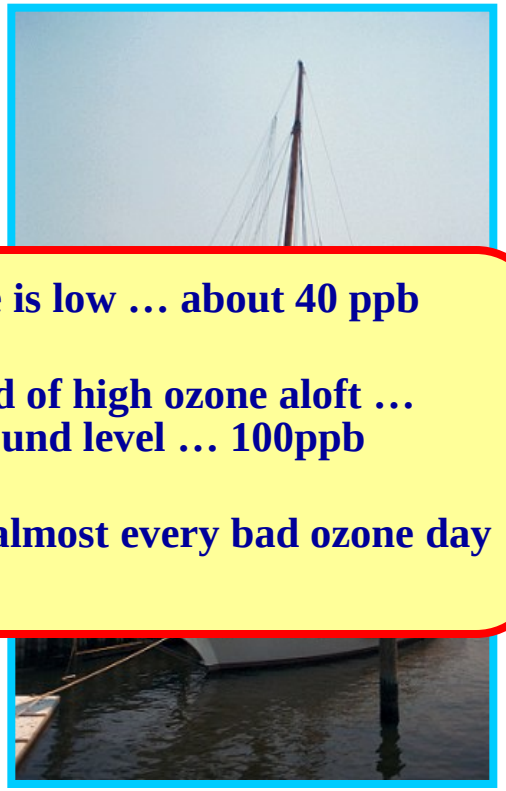
Understanding Ozone Transport

- It's complicated … but not that complicated … some key concepts
- An "elevated reservoir" of ozone
  - A transport cloud
  - An elevated ocean of ozone
  - The residual layer
- Three different types of transport
  - Westerly Transport – Power plants are a contributor
  - Night-time, Southerly Transport – Vehicles, power plants, more
  - City to City – An urban soup … Washington to Baltimore … Baltimore to Philly … Philly to NYC … etc. etc. etc

What is This Reservoir?

A balloon launch at 2:30 am south of Baltimore … north of Washington





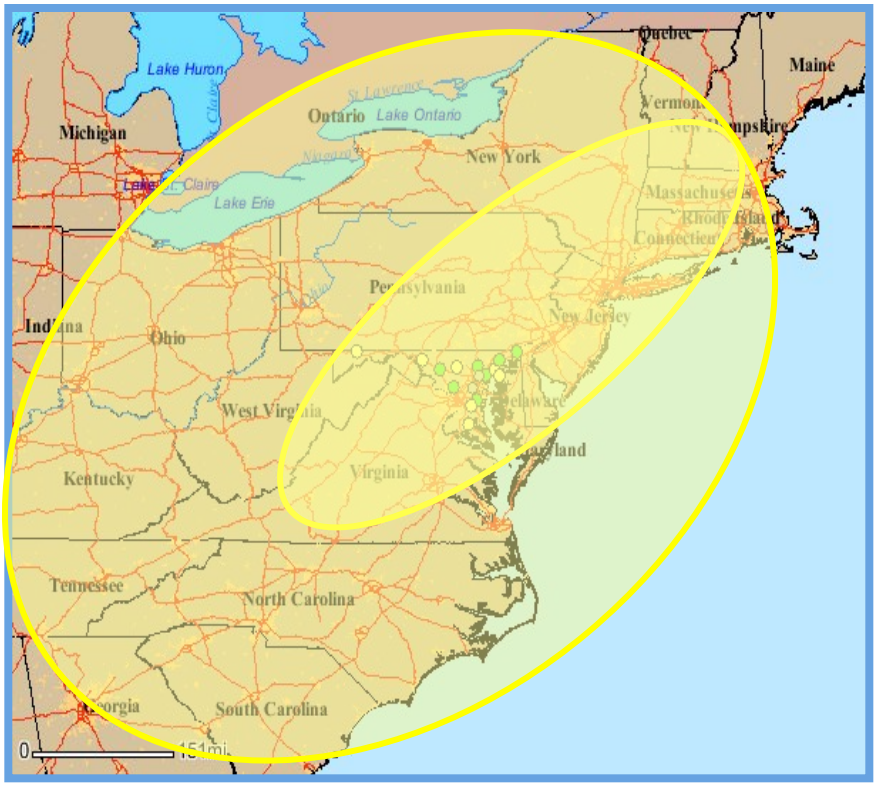
Ground level ozone is low … about 40 ppb

We measure a cloud of high ozone aloft … 2000 feet above ground level … 100ppb

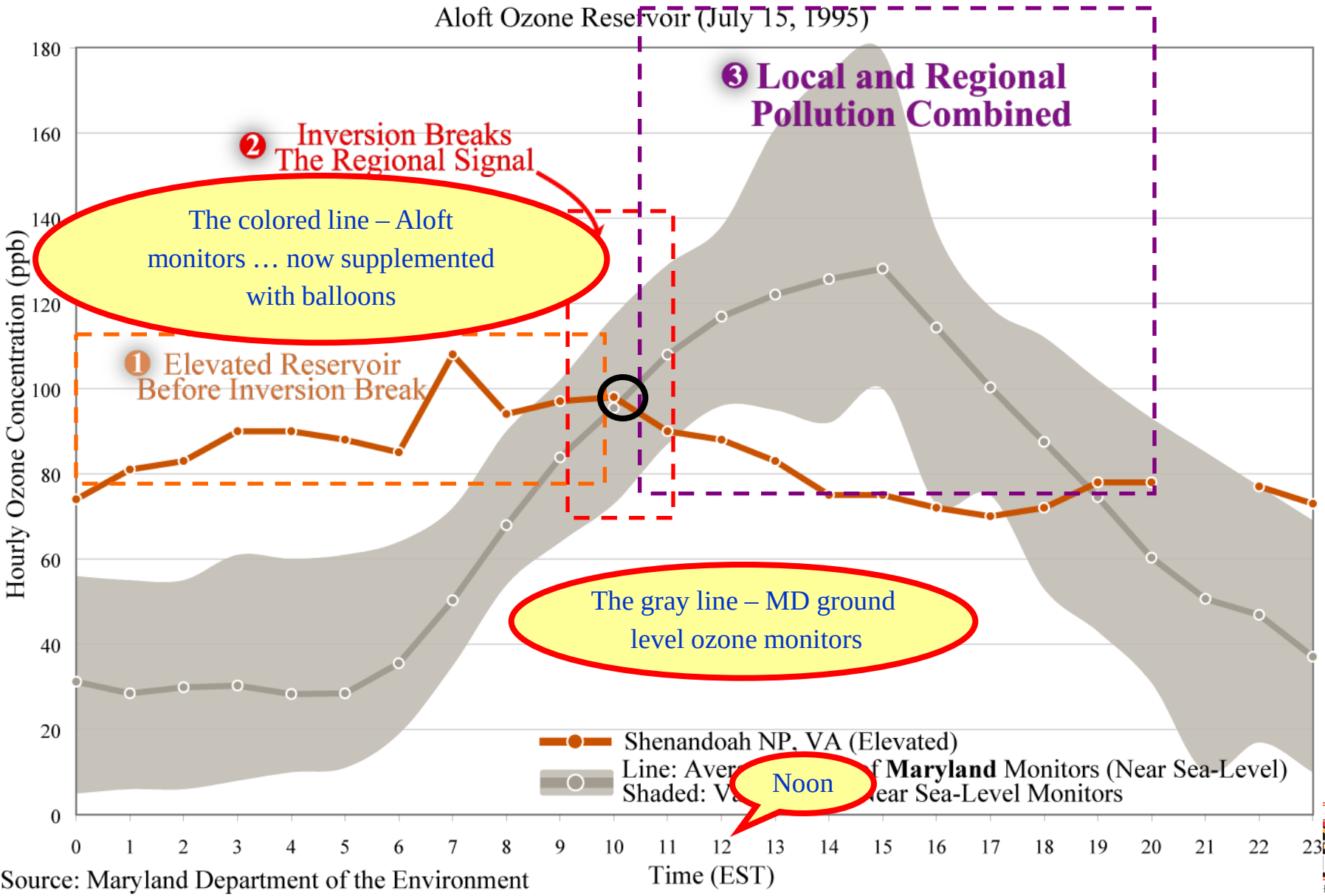
We see this before almost every bad ozone day

The Elevated Ozone Reservoir

- Every bad ozone day, in the morning hours, a large reservoir of ozone sits above Maryland and the Mid-Atlantic waiting to mix down
  - Ozone levels in the reservoir can routinely reach 60 to 100 ppb
  - In the morning, ozone levels at the surface are very low
- Around 10:00 or 11:00 … the "nocturnal inversion" breaks down … and
  - Ozone in the elevated reservoir mixes down to the surface and degrades air quality

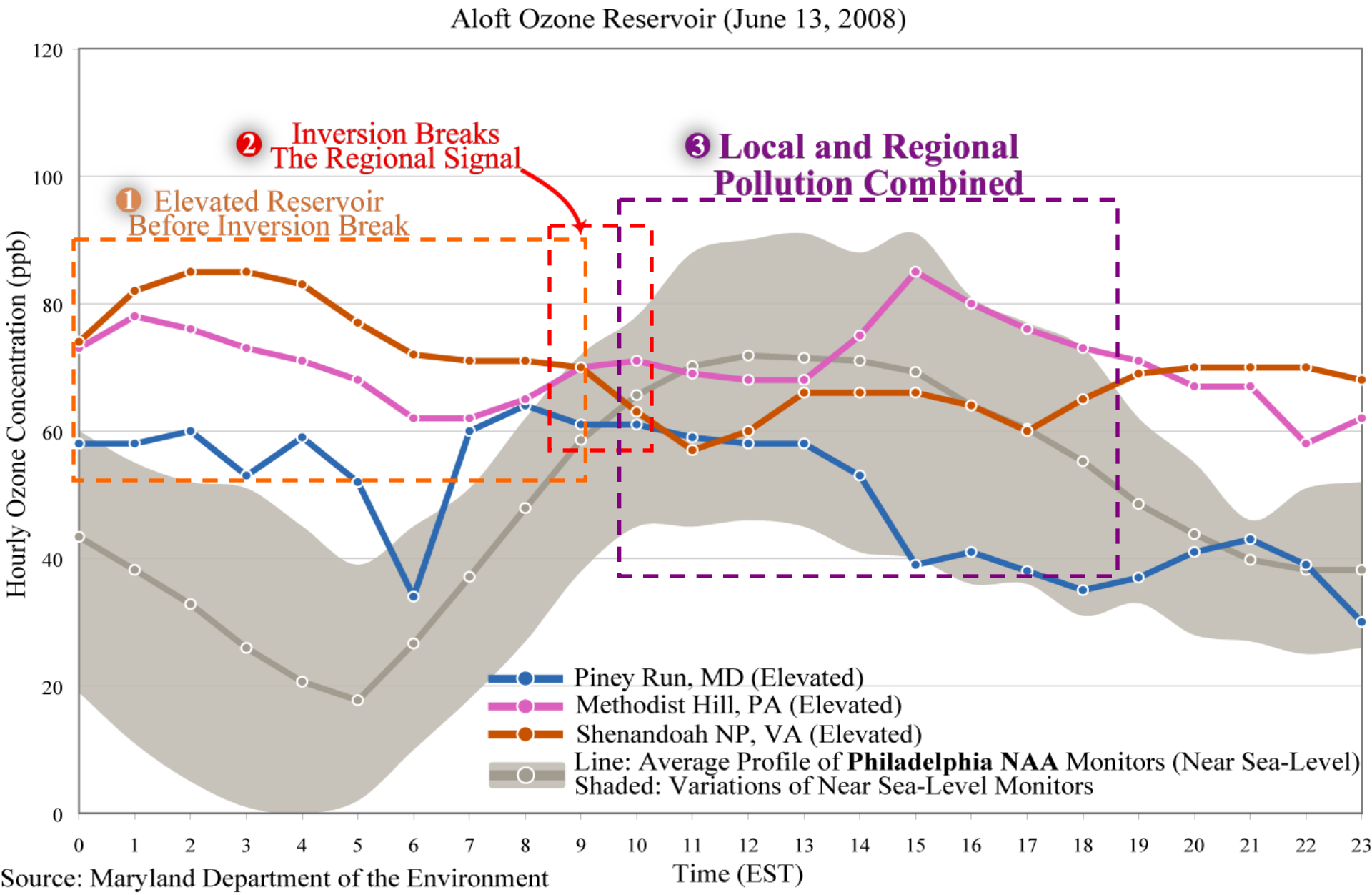


The Elevated Reservoir – The 90's



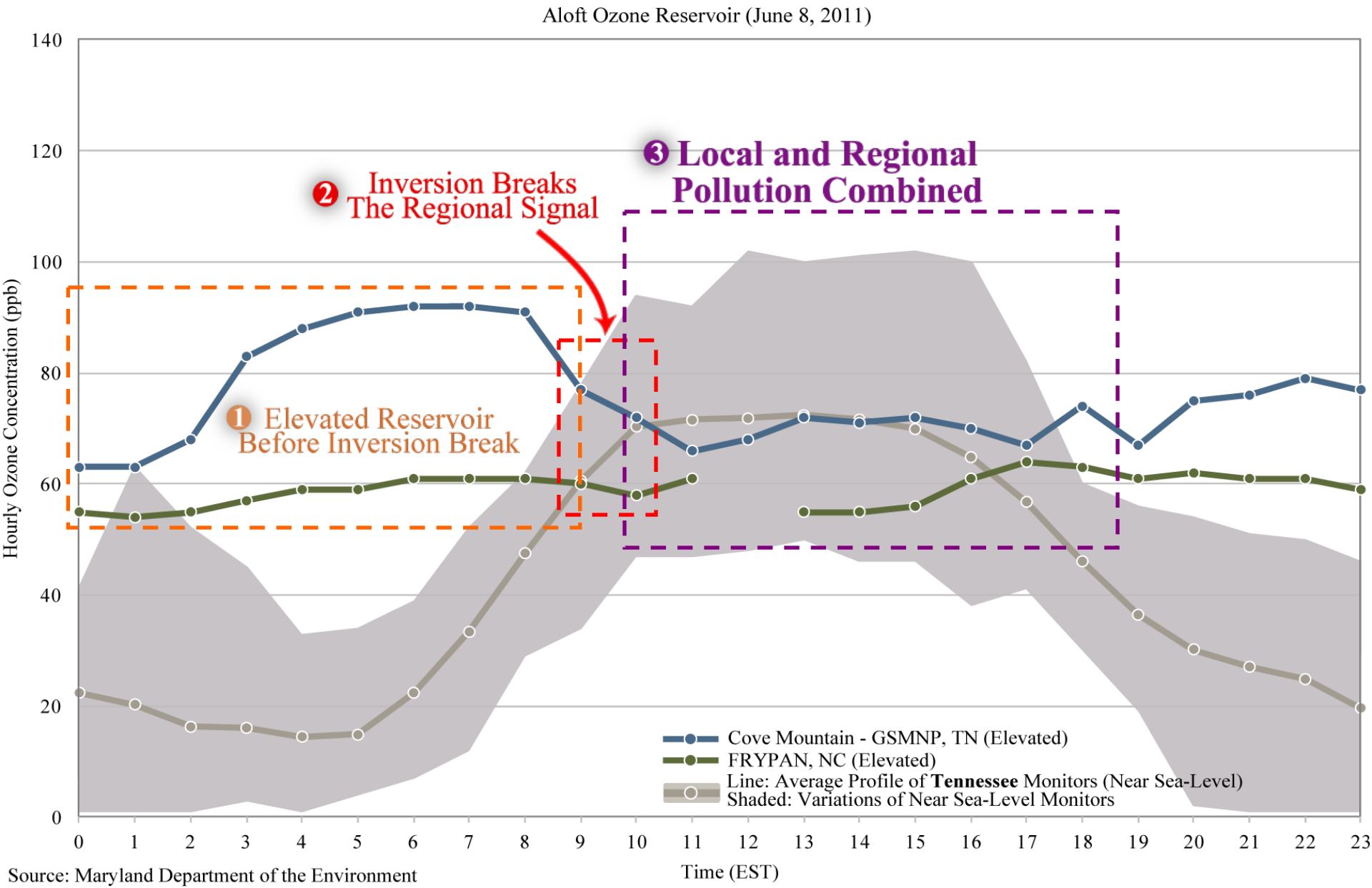
Source: Maryland Department of the Environment

Same Signal – Philly/NJ 2008



Source: Maryland Department of the Environment

Same Signal – Tennessee 2011



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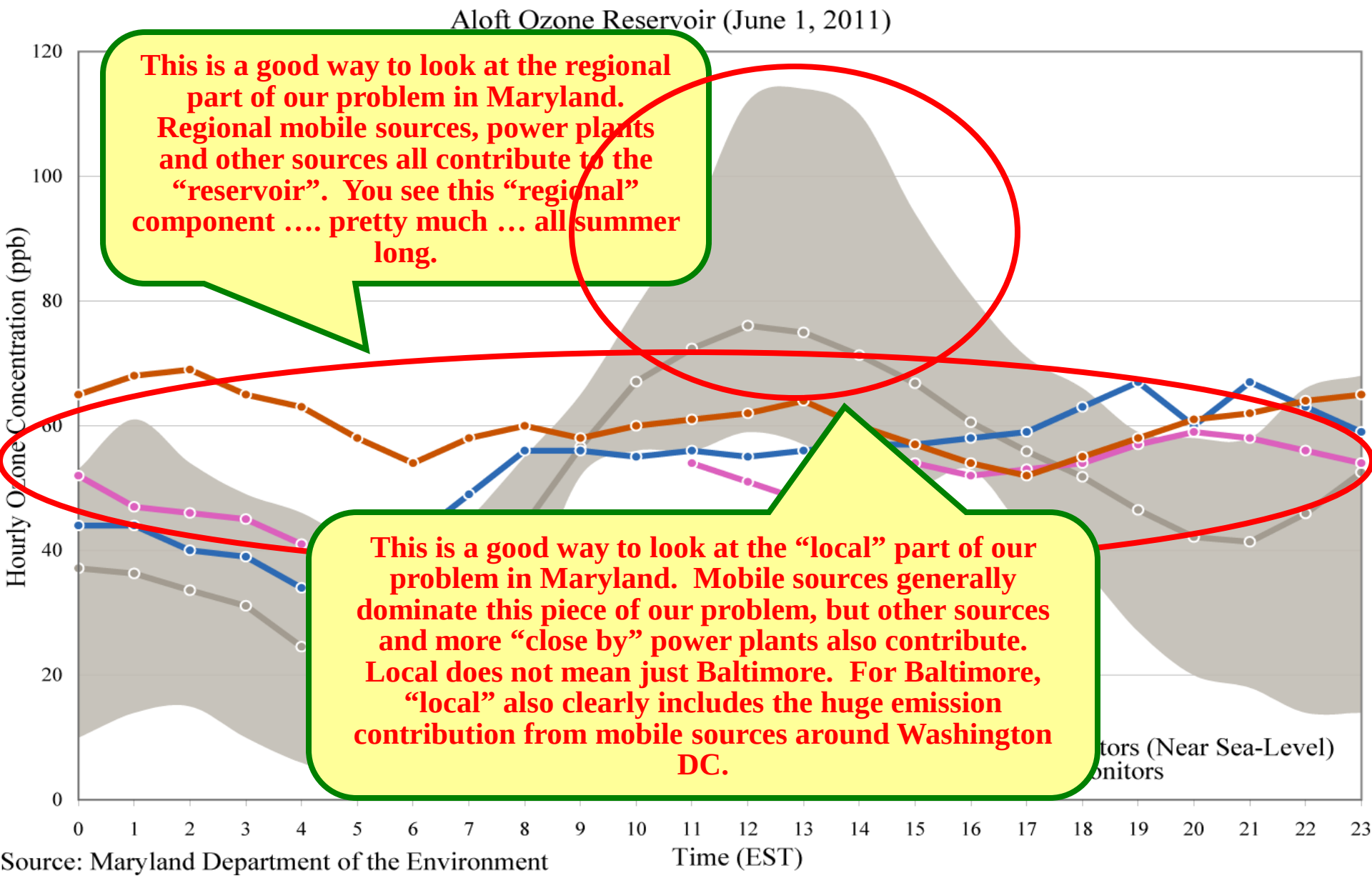
Same Signal – Maryland 2011



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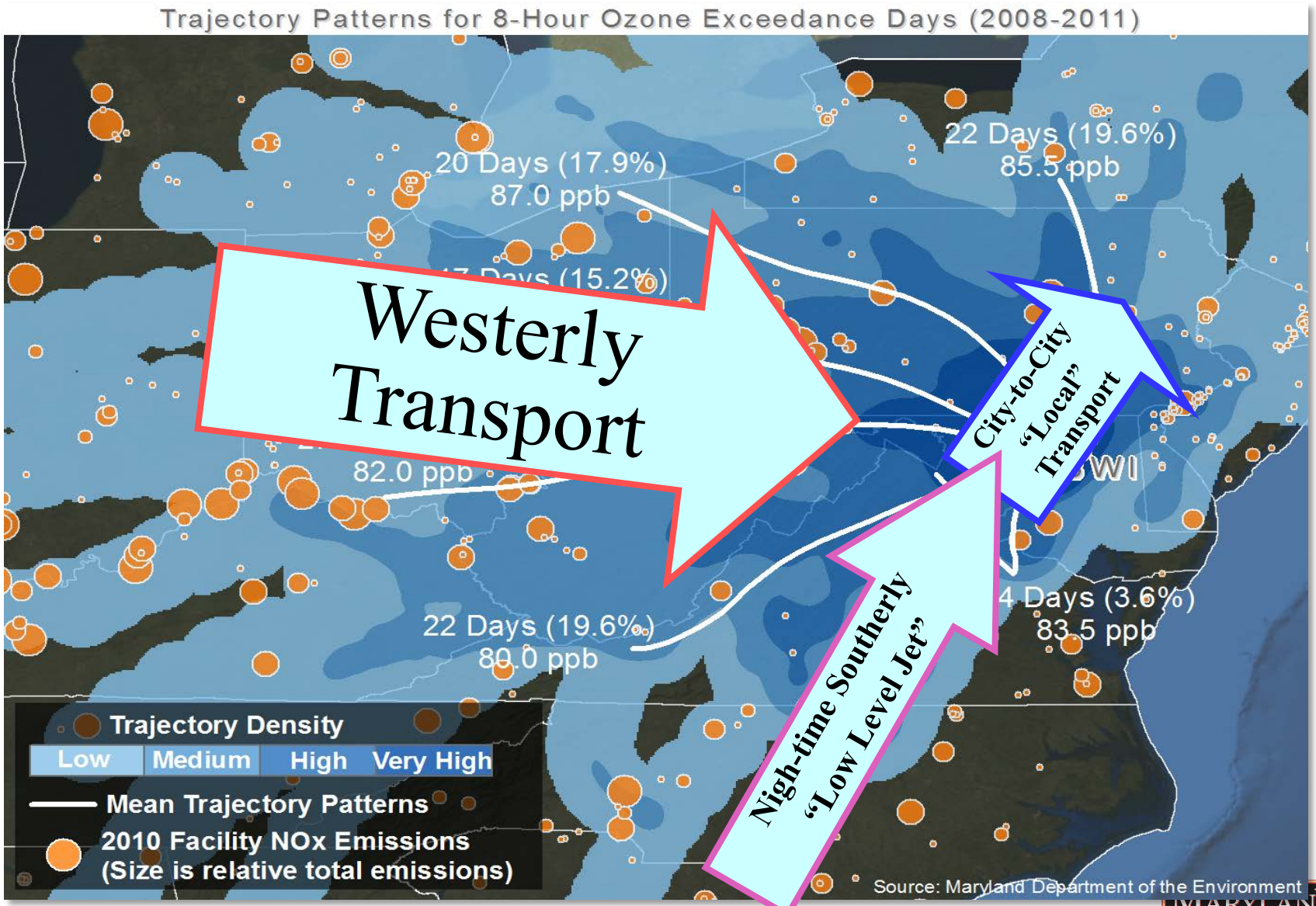
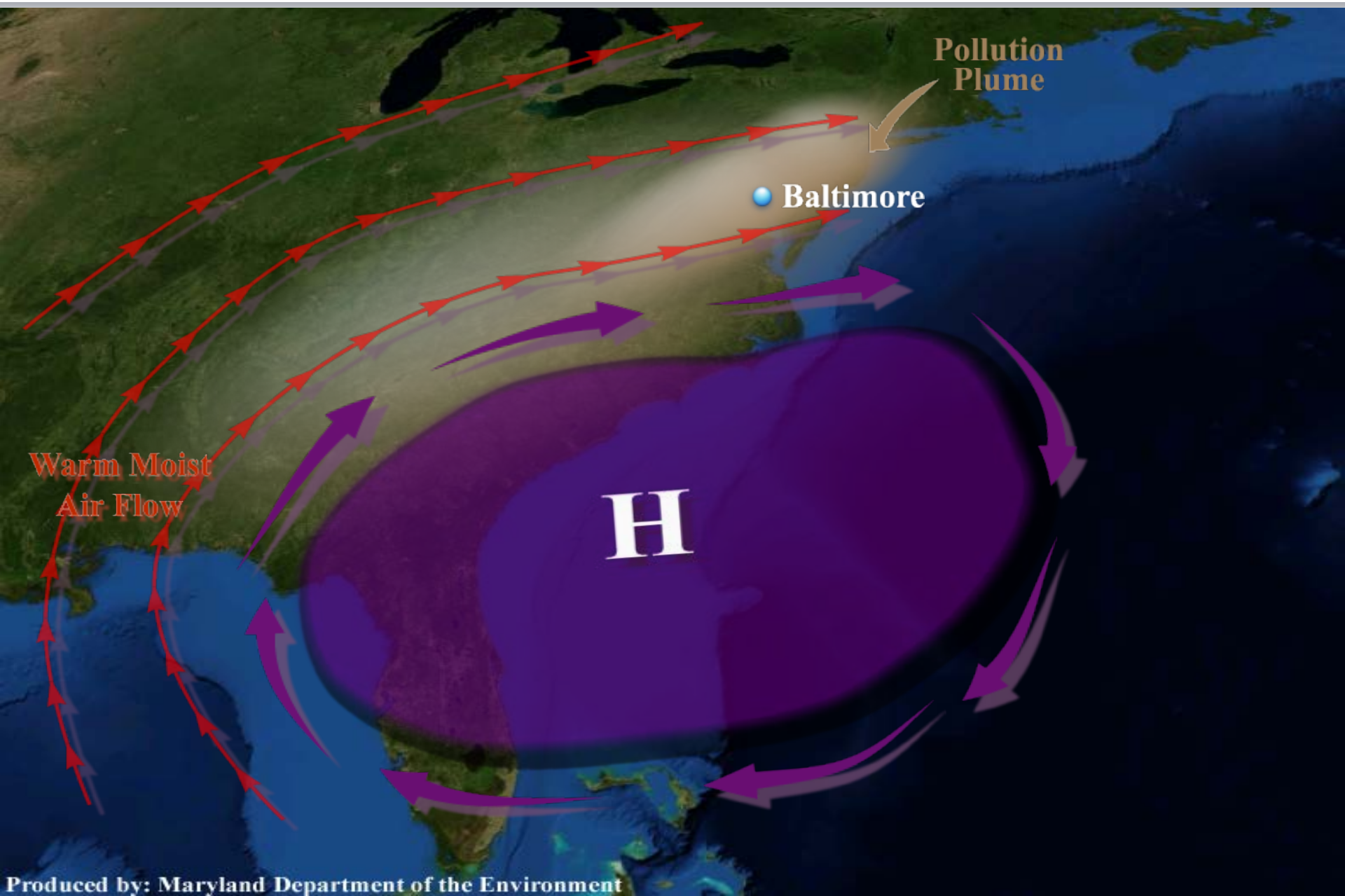
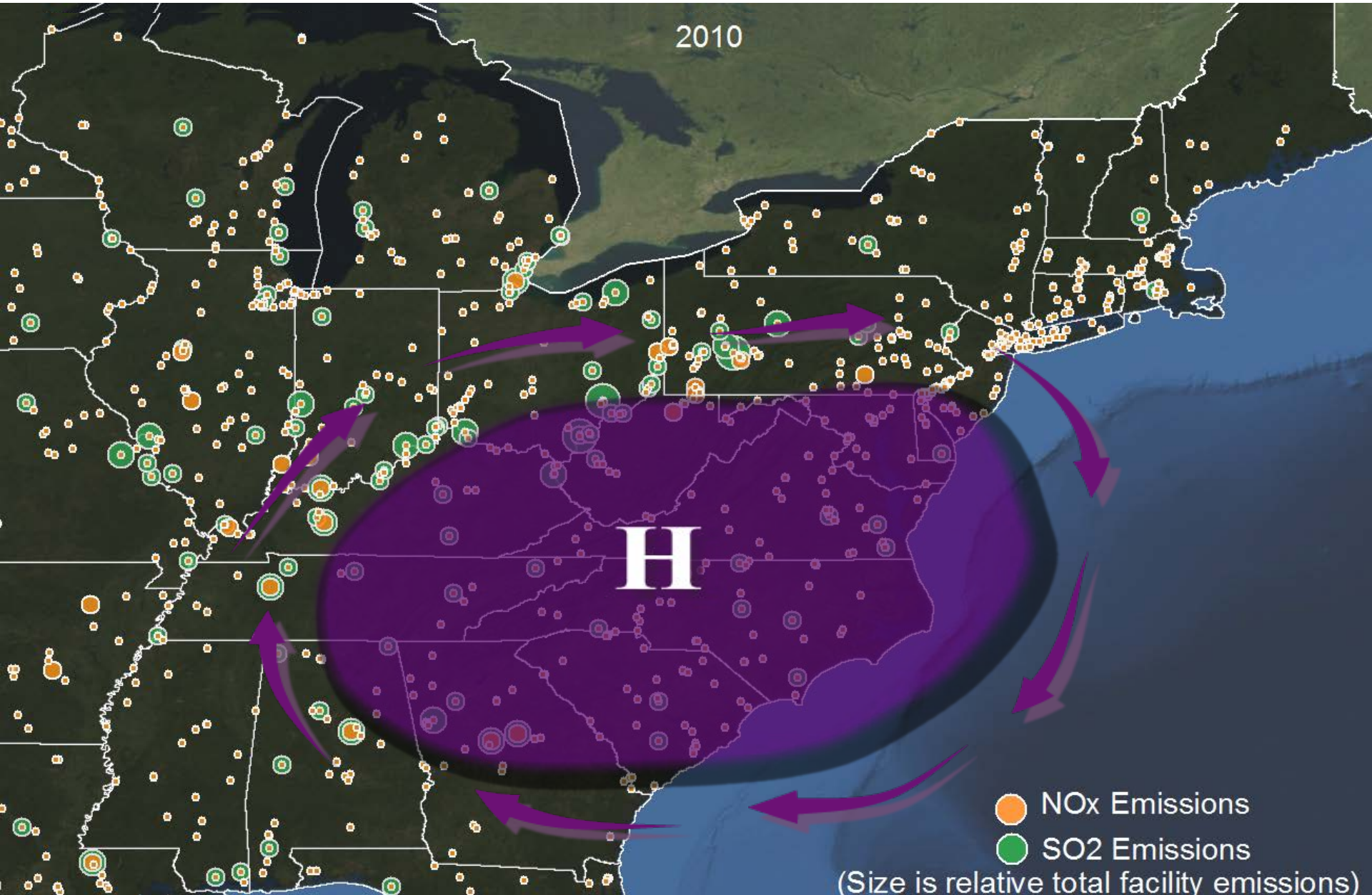
The Three Different Types of Transport



Classic Mid-Atlantic Ozone Weather

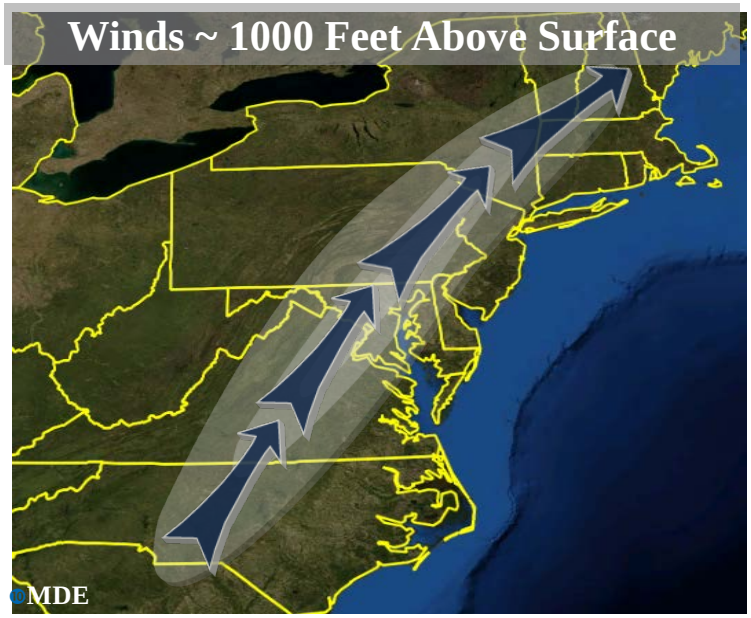


Westerly Transport



Southerly Transport at Night

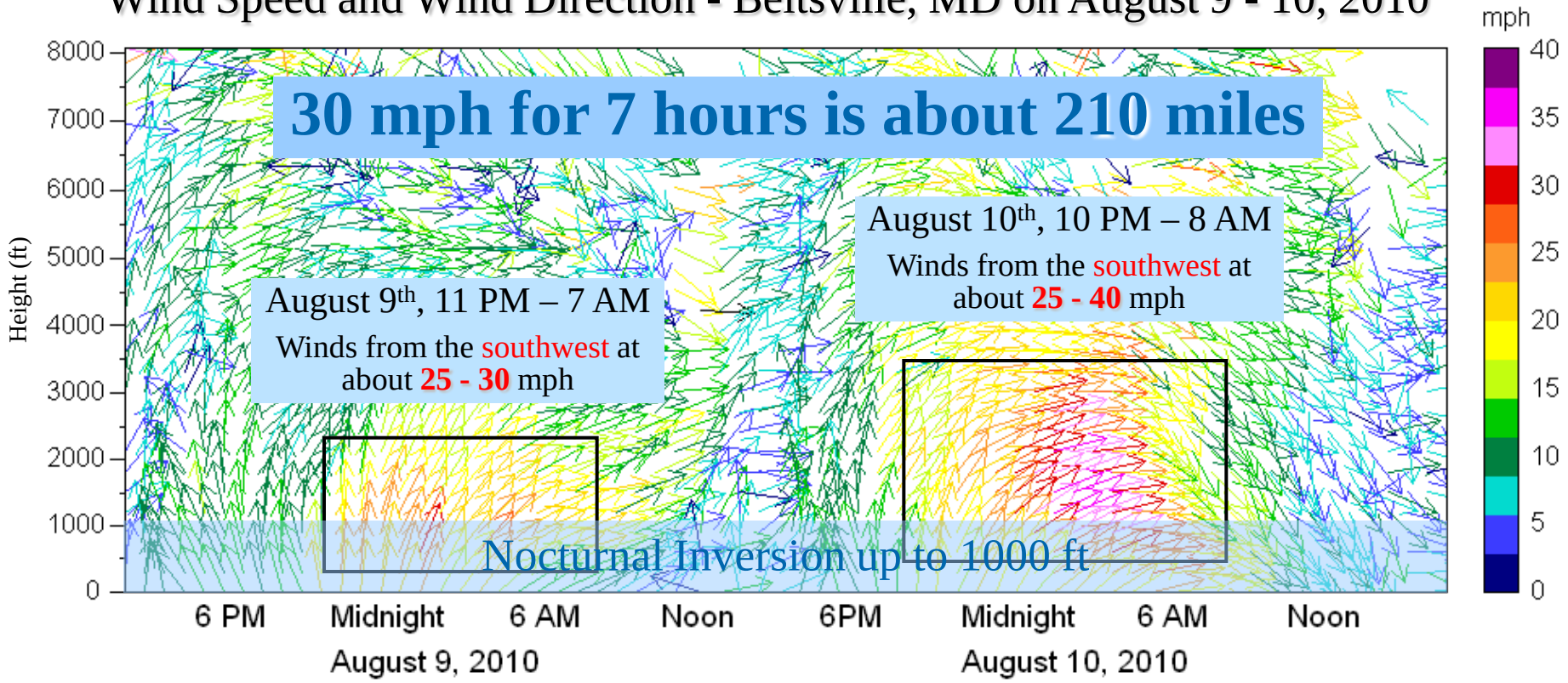
The Nocturnal Low Level Jet (NLLJ)



- Fast-moving, narrow "river" of air typically around 1000 feet above the surface
- In the Mid-Atlantic, typically observed during the night between Appalachians and the Atlantic Ocean.
  - Wind speeds can reach 40 mph or more.
  - Stretches from NC to MD to NJ and further up the east coast.
- Seen during most, Mid-Atlantic summer-time air pollution events.
  - Some form of NLLJ on virtually all code orange or red days
- Recent findings indicate:
  - Presence of a NLLJ increased Baltimore maximum ozone by 7 ppb.
  - Ozone concentrations of 90 – 100 ppb have been measured in the NLLJ.

Measuring the Nocturnal Low Level Jet

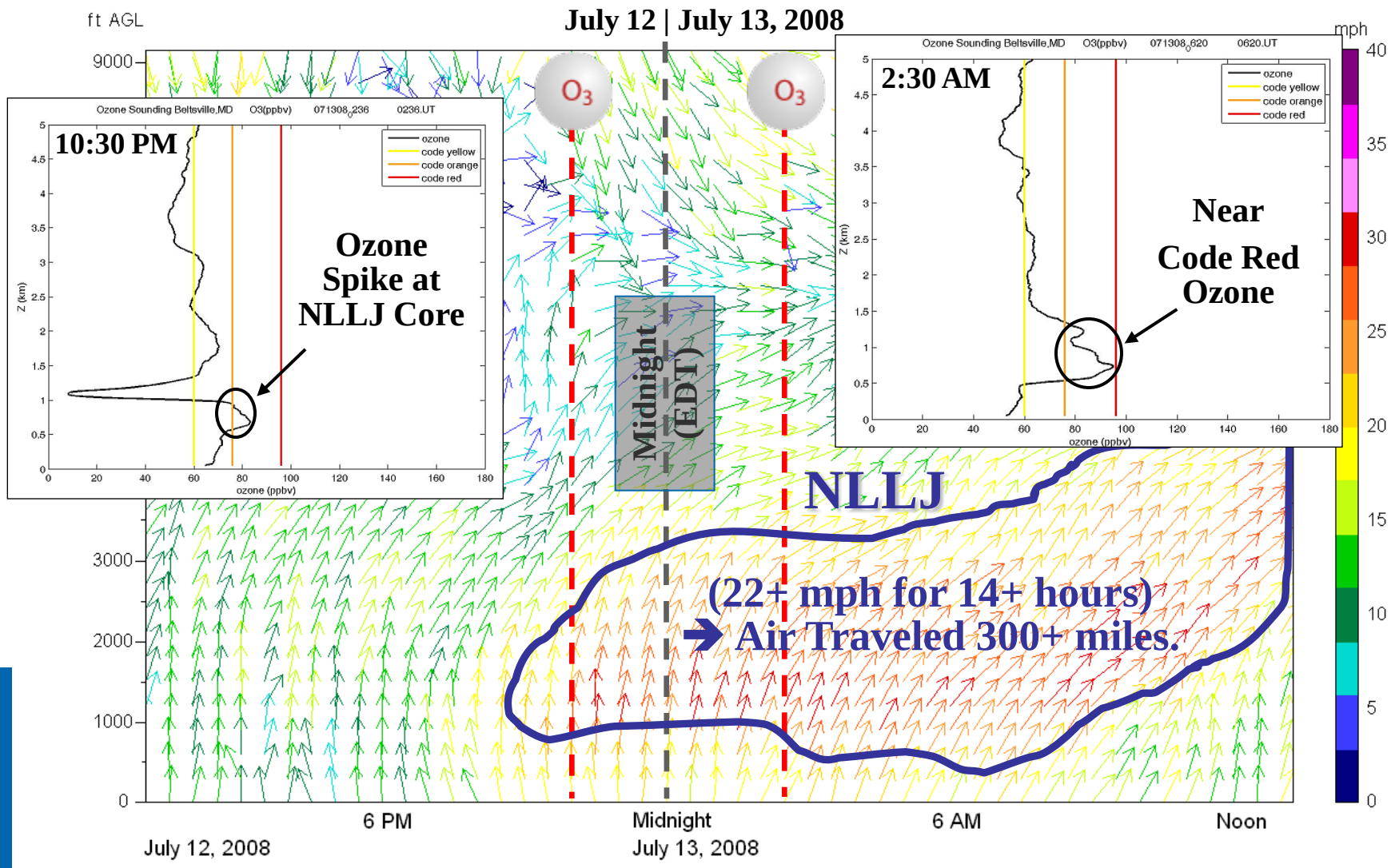
Wind Speed and Wind Direction - Beltsville, MD on August 9 - 10, 2010



What does this graph tell us?
- Wind direction
- Wind speed
- From the ground up

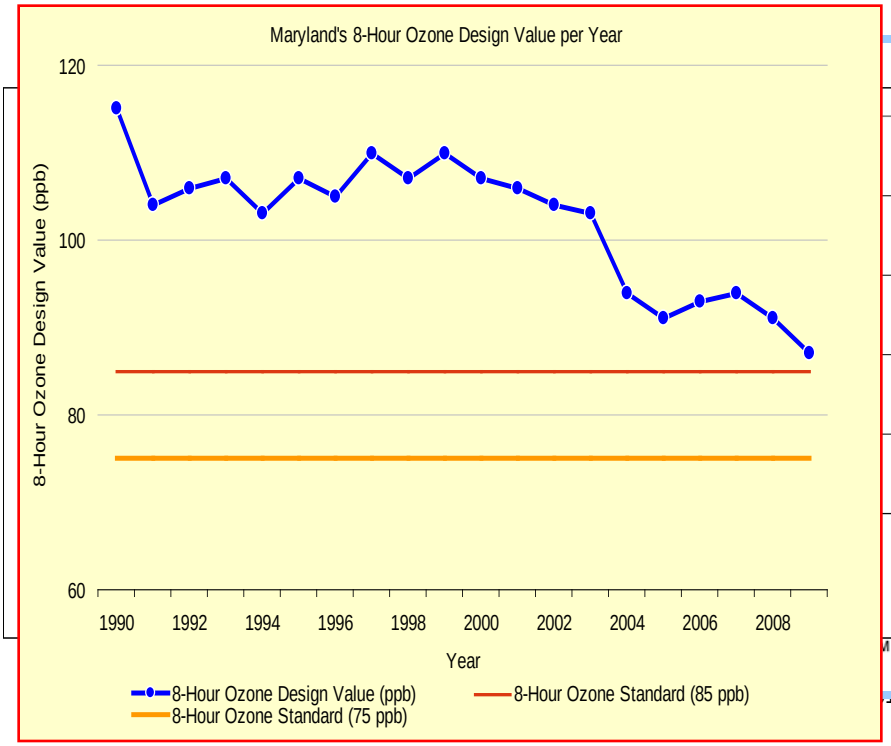
Measuring Ozone Transport in the NLLJ

Howard University launched 4 ozonesondes on July 12-13, 2008. The 10:30 PM (Saturday, July 12th) and 2:30 AM (Sunday, July 13th) occurred during a NLLJ event, as captured by MDE's Wind Profiler.



Reducing Regional Ozone – A Case Study

Ground Level Ozone Drops Dramatically in the Same Time Frame



- The 2003/2004 "NOx SIP Call" as a case study. Significant nitrogen oxide (NOx) reductions from Federal Tier 2 Vehicle Standards occurring in the same time frame
  - A classic ozone transport success story
  - Incoming ozone levels collect in an elevated reservoir over night
  - Real world programs like the NOx SIP Call (power plants) and the Tier 2 Vehicle Standards show that:
    - Adding regional controls …
    - Results in regional NOx emission reductions …
    - Which leads to reduced ozone in the elevated reservoir …
    - Which lead to lower ozone at ground level and public health protection!

So … Where Does This Take Us?

- We understand the science of ozone better than ever
- We've implemented programs that have worked in the real world
- Maryland needs a two-part strategy to continue making progress
  - Local controls are still critical
    - AQCAC has seen many of these over the past year
  - National/super-regional controls are also essential
    - EPA's Tier 3 Vehicle and Fuels Standard is the most important new measure needed by Maryland – but more is needed
    - There has been significant progress in reducing NOx from regional power plants
      - But there are a few significant issues that need to be resolved

EPA's Recent Transport Actions

- On January 22, EPA issued a guidance memo to begin a process that will require states to submit Good Neighbor SIPs (GN SIPs) to address ozone transport in the East
  - A 2011 requirement that's a little late
  - The guidance builds from Supreme Court decisions … and provides preliminary analyses to identify which states are contributing significantly to downwind problem areas
- On June 30, 2015 EPA made a "Finding of Failure to Submit" for GN SIPs in 24 States
  - Maryland not included - Submitted GN SIP in 2011
  - These states are now required to submit GN SIPs in a timeframe that allows EPA to approve those SIPs or implement a FIP (Federal Implementation Plan) in two years - All driven by a consent agreement
- Additional federal rules and guidance and a "federal backstop" rule are expected in about a month

Preliminary EPA Contribution Work

- EPA has performed preliminary modeling to identify which states may owe Good Neighbor SIPs for selected downwind problem areas … Future problems for **nonattainment** and **maintenance** both identified. Texas problem areas not included.

	Contributing States from Preliminary EPA Analyses																				
Problem Monitors	**AL**	**AR**	**DE**	**IA**	**IL**	**IN**	**KS**	**KY**	**LA**	**MD**	**MI**	**MO**	**NJ**	**NY**	**OH**	**OK**	**PA**	**TN**	**TX**	**VA**	**WI**	**WV**
Harford, MD						x		x			x				x		x		x	x		x
Fairfield, CT ★										x	x		x	x	x		x			x		x
Fairfield, CT ★										x			x	x	x		x			x		x
Suffolk, NY ★					x	x				x	x		x		x		x		x	x		x
Fairfield, CT ★					x	x				x			x	x	x		x			x		x
New Haven, CT ★						x				x			x	x	x		x			x		x
Jefferson, KY					x	x					x				x							
Allegan, MI		x		x	x	x	x					x				x			x		x	
St. Charles, MO	x	x			x				x							x		x	x			
Camden, NJ ★			x		x	x		x		x	x			x	x		x		x			x
Gloucester, NJ ★			x		x	x		x		x	x			x	x		x		x	x		x
Richmond, NY ★			x			x		x		x			x		x		x			x		x
Philadelphia, PA ★			x		x	x		x		x			x		x			x	x	x		x
Sheboygan, WI					x	x	x		x		x	x				x			x			

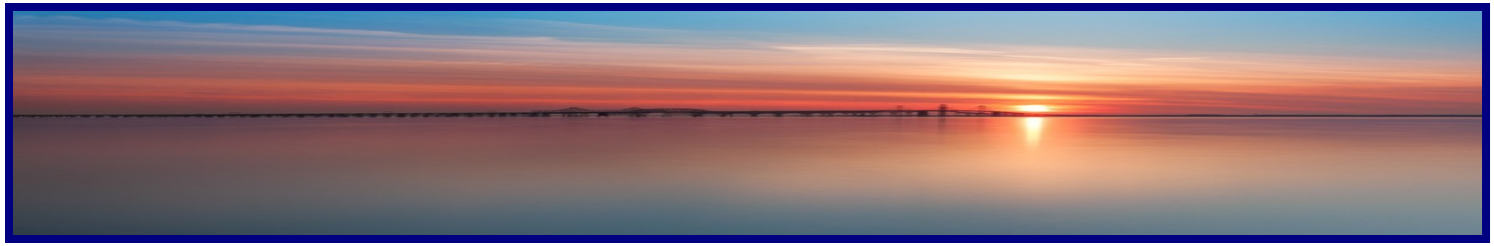
In the same nonattainment area … ★ = NY/NJ/CT ★ = Philadelphia

Transport Control Measures on the Way

- Federal measures that will reduce transport that are “on the way” include:
  - Over 40 control programs: generally older federal programs that continue to generate deeper reductions as they phase in or as fleets turn over
- “Optimized” Electric Generating Unit (EGU) controls across the East:
  - Coal-fired units in eastern states simply running controls in the summertime consistent with best emission rates measured in earlier years
- New OTC Regional Control Measures:
  - Nine new Ozone Transport Commission (OTC) model reduction programs for mobile sources and other sources implemented in just the 11 OTC states
- The rest of this presentation will focus on the effort to insure that EGU controls across the East are being run in a manner to minimize NOx emissions

What is "SCOOT"

- A collaborative partnership between about 25 Eastern states
  - "State Collaborative on Ozone Transport"
  - Commissioner level policy discussions
  - Air Director technical discussions
- Looking at a host of issues, but highest priority is focused on insuring that EGUs are optimizing the use of existing control technologies - some progress but still a ways to go
  - Most states in the East now have 80% to 90% of coal-fired generation controlled with SCR or SNCR control technology



Optimized EGU Controls

or … running power plant controls more effectively

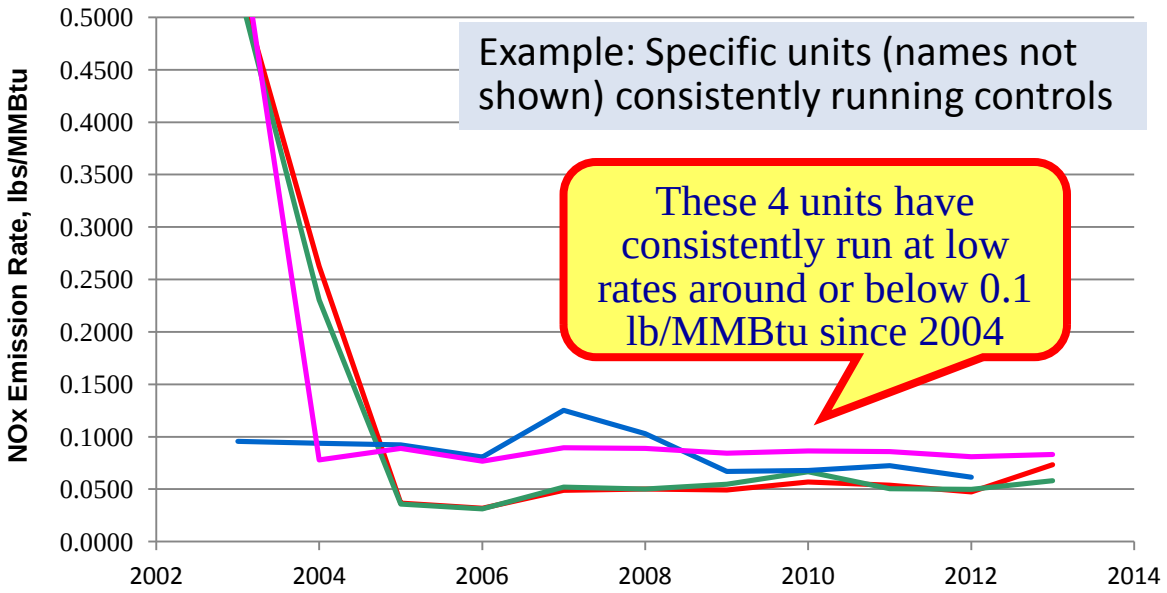
- Maryland and other states have analyzed EGU emissions data to see how well existing pollution controls are being run
- Changes in the energy market, a regulatory system that is driven by ozone season tonnage caps and inexpensive NOx allowances have created an unexpected situation
  - EGU operators can meet ozone season tonnage caps without operating their control technologies efficiently on bad ozone days
  - Sometimes not running them at all

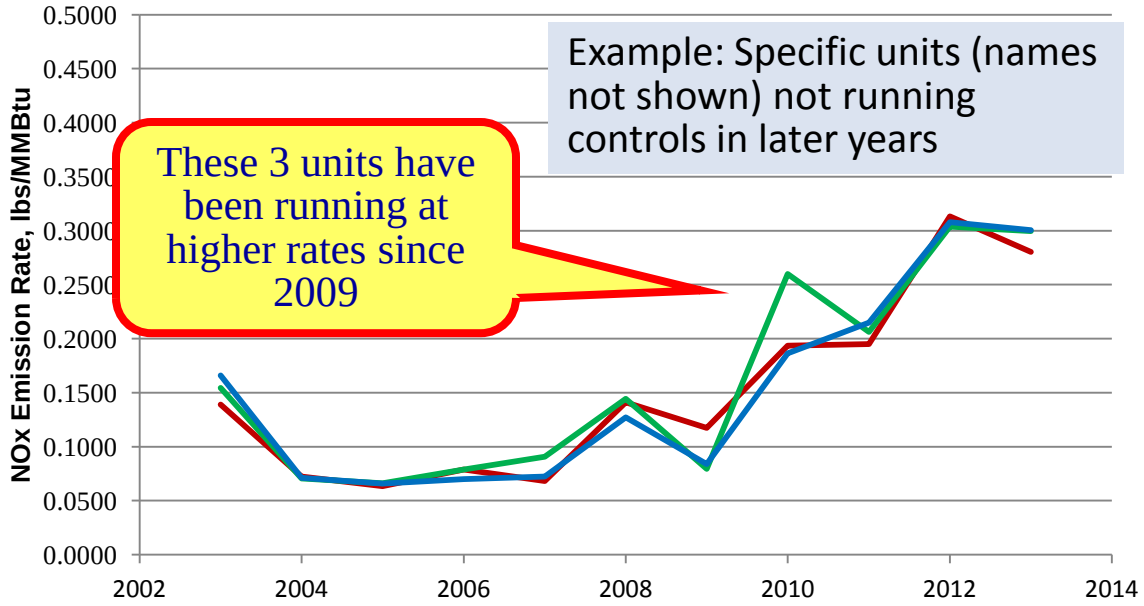
Running EGU Controls Well?

Average Ozone Season Emission Rates at Specific Units by Year

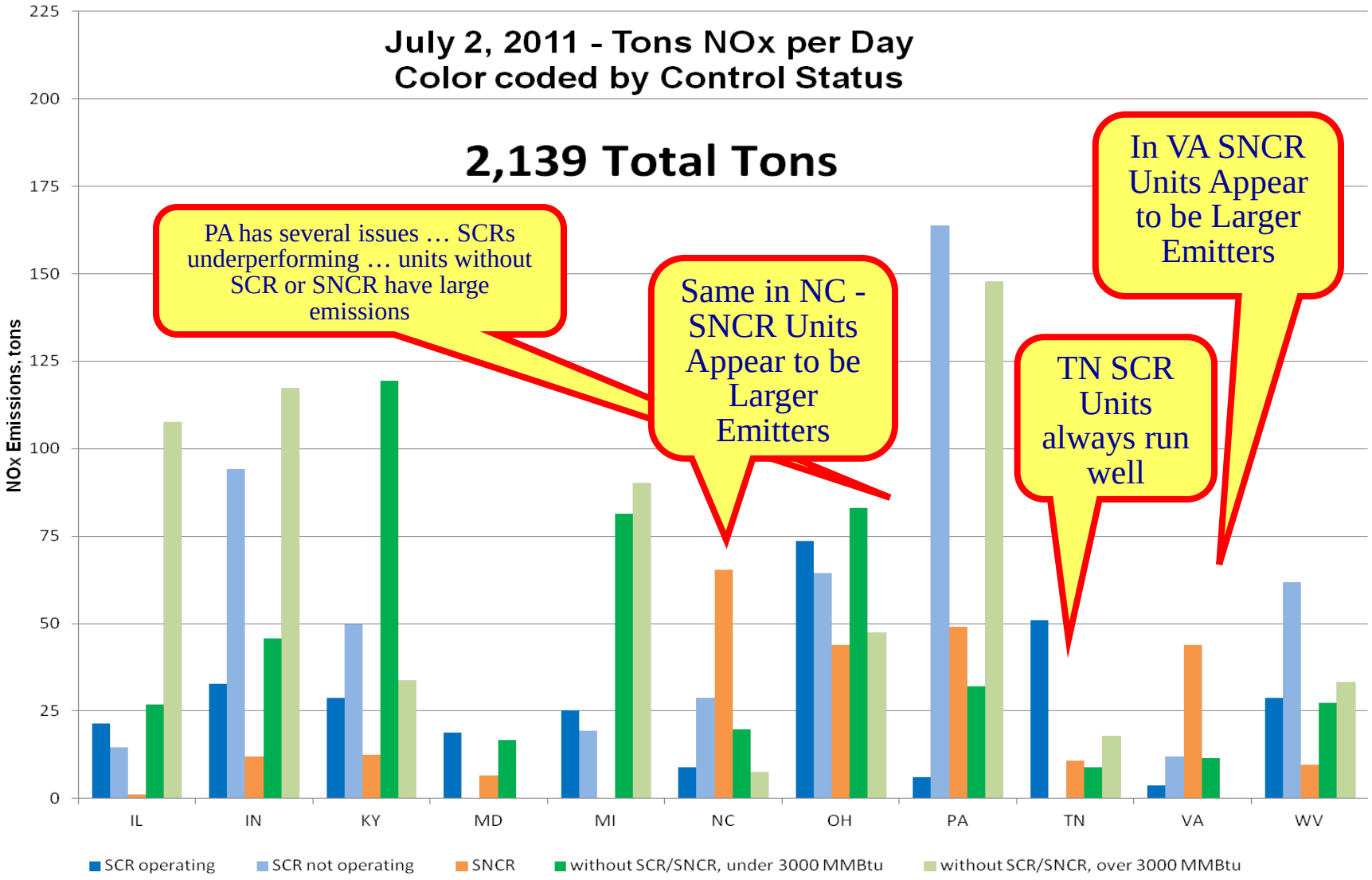
Many Sources Run Controls Well →

Some Units Are Not Running Controls as Well →

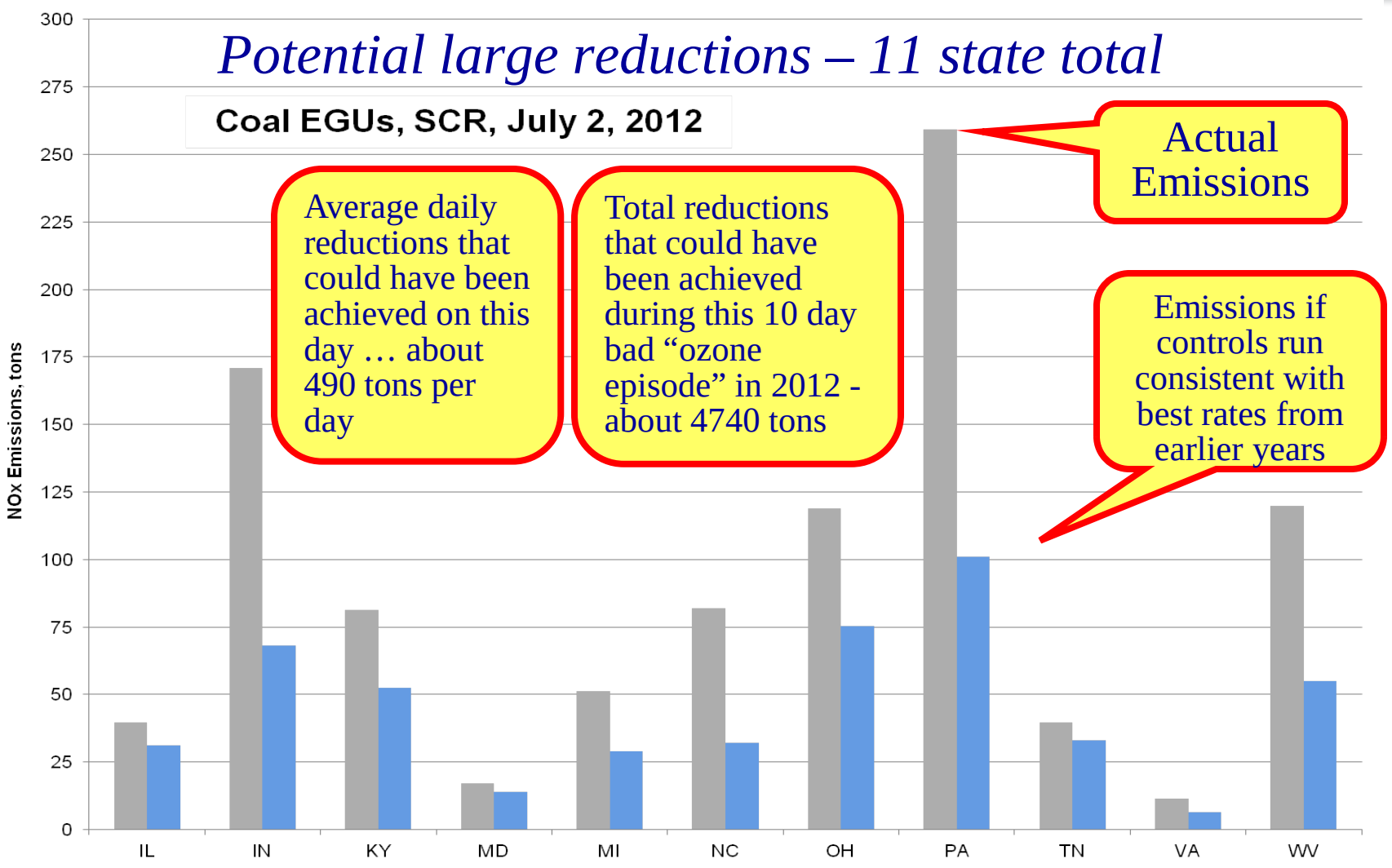




This is Happening in Many States



Reductions Could be Very Large



To put 490 tons per day in context, the expected reductions from the Tier 3 Vehicle and Fuel Standards in 2018 is projected to be 324 tpd (in OTC and 176A states) and 486 tpd for all states in SE and MW and OTC

Some Progress in 2015

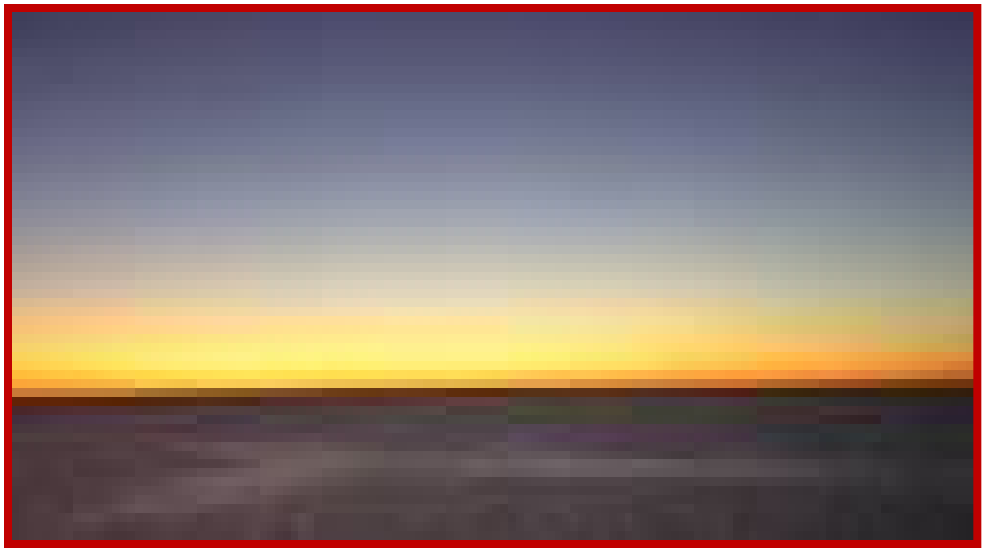
- The states participating in SCOOT have been working to optimize EGU controls
- Some progress in the summer of 2015, but still a long way to go
- Pushing to have states include optimized controls in Good Neighbor SIPs
- More success by the summer of 2016?

Analysis of 2015 Optimization

- Maryland analyzed the emissions data submitted by sources for May and June of 2015
  - MD, PA, VA, NC, TN, KY, WV, OH, IN, IL, MI
- Looked at 2015 May through June average emission rates at 233 individual units
- Compared those rates to the lowest demonstrated ozone season average emission rate from the past
- Identified which units are and are not optimizing controls
- Identified which states are doing better than others
- Mixed results
  - Clearly some real efforts being made to optimize controls
  - Clearly some lack of effort as well

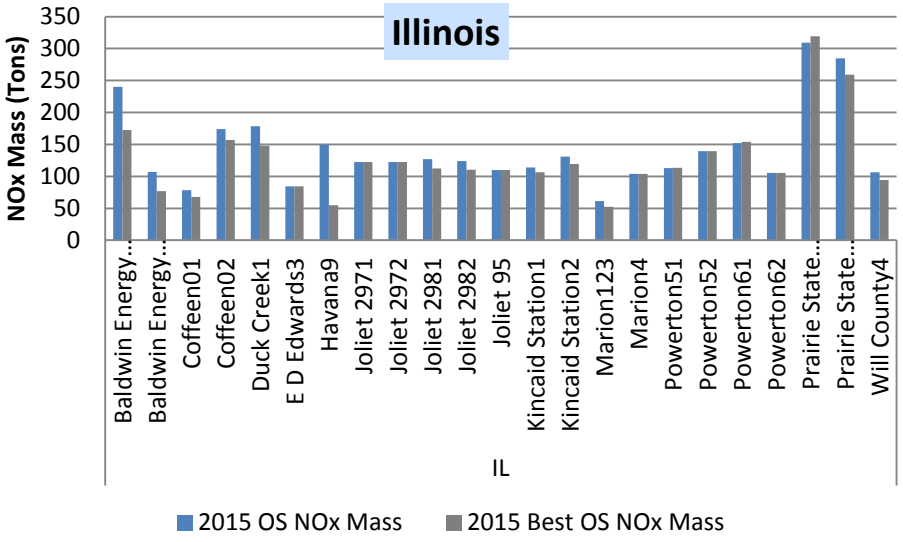
Optimization Appears to be Underway

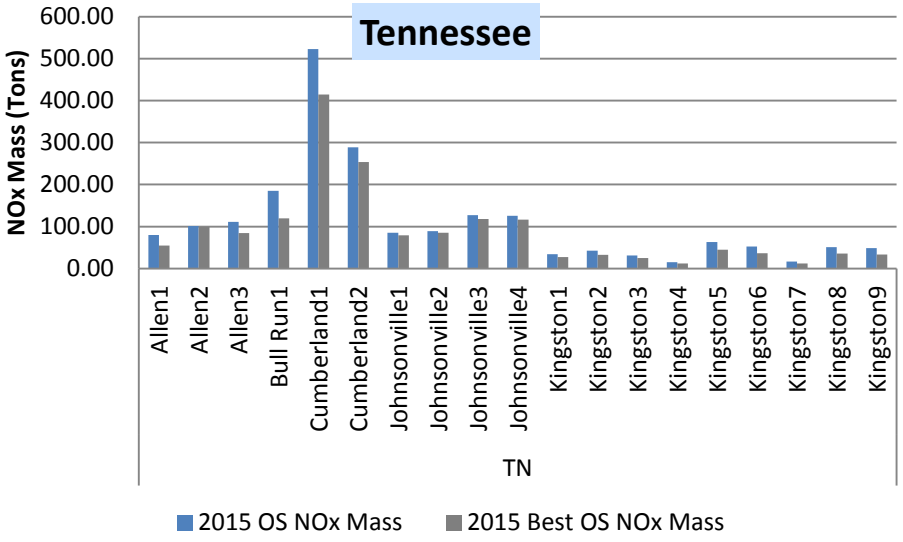
- States with the majority of their units meeting or out-performing best historical rates
  - Illinois
  - Michigan
  - Tennessee
  - Virginia
  - Maryland

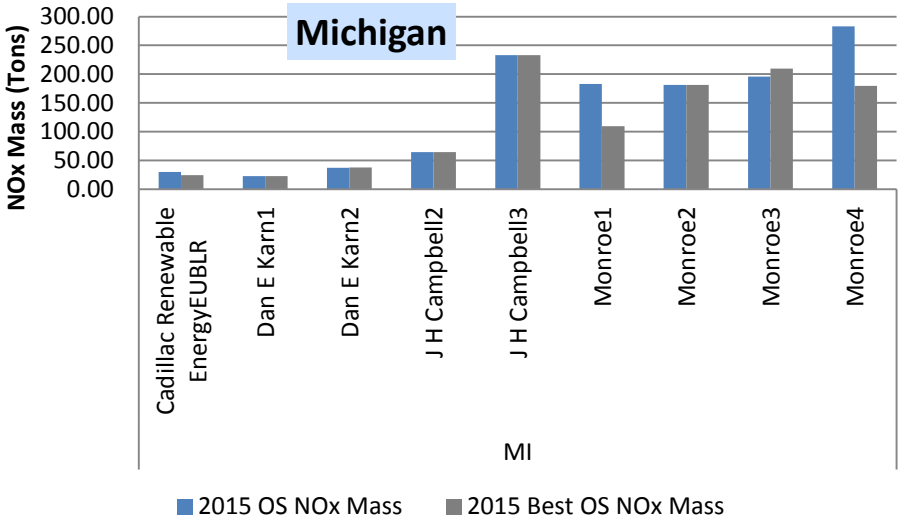


Optimization Appears to be Underway

May and June 2015 Total NOx Emissions – Actual and Best Rates from Past



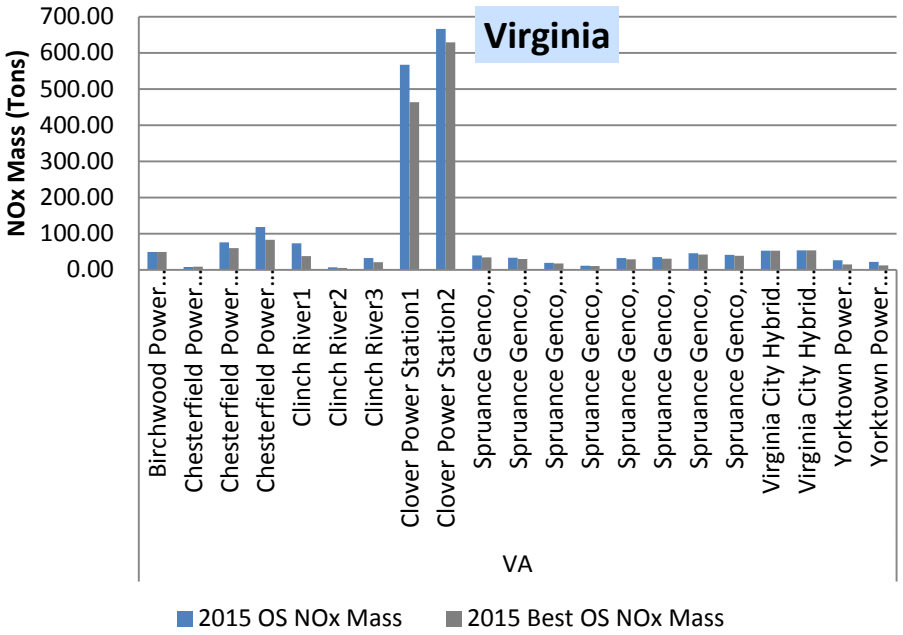


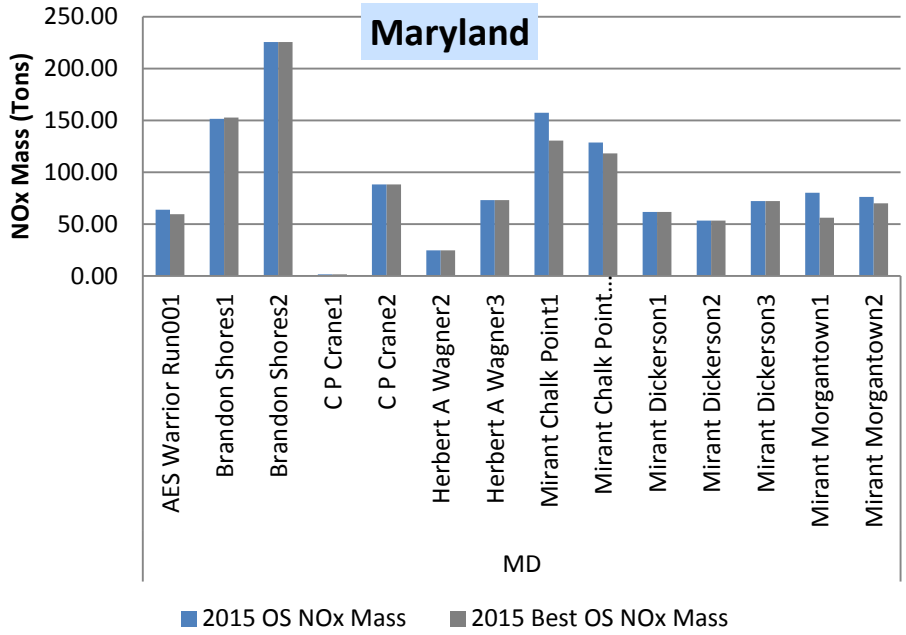


	2015 Actual OS NOx Mass (Tons)	2015 @ Best Rates OS NOx Mass (Tons)	Lost Savings (Tons)	% of Total Loss
Illinois	3,236	2,905	332	1.26%
Michigan	1,231	1,064	167	0.64%
Tennessee	2,070	1,684	386	1.47%

Optimization Appears to be Underway

May and June 2015 Total NOx Emissions – Actual and Best Rates from Past





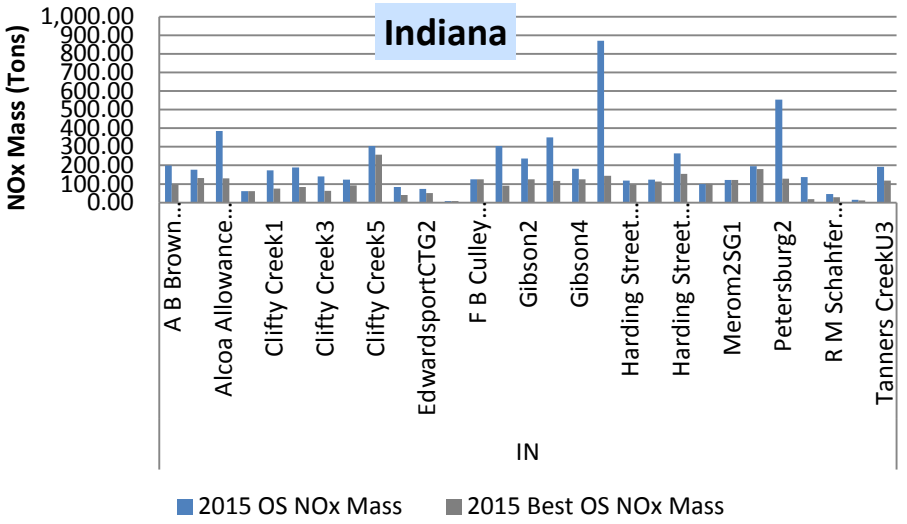
	2015 Actual OS NOx Mass (Tons)	2015 @ Best Rates OS NOx Mass (Tons)	Lost Savings (Tons)	% of Total Loss
Virginia	2,018	1,728	290	1.10%
Maryland	1,258	1,187	71	0.27%

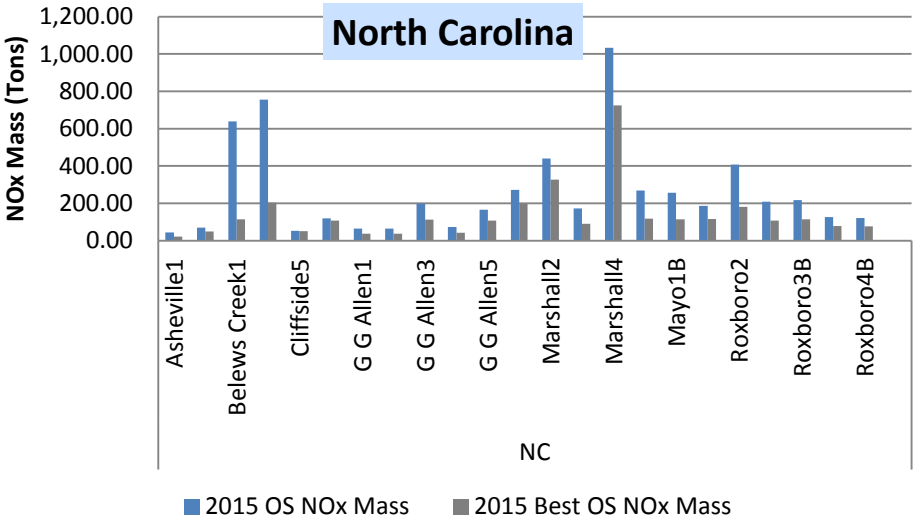
Review of Optimization Needed

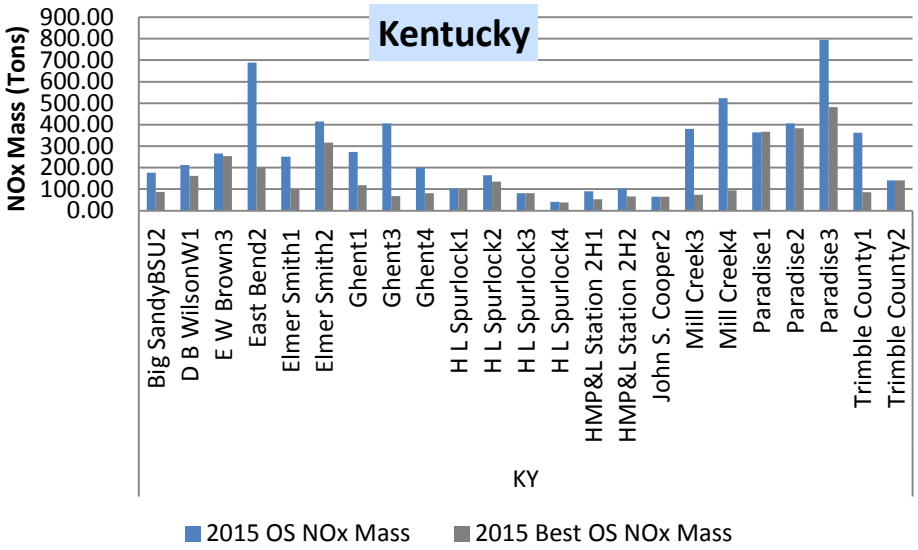
- States with a meaningful portion of their units with rates exceeding best historical rates and higher than expected 2015 rates
  - Indiana
  - Kentucky
  - North Carolina
  - Ohio
  - Pennsylvania
  - West Virginia

Review of Optimization Needed

May and June 2015 Total NOx Emissions – Actual and Best Rates from Past



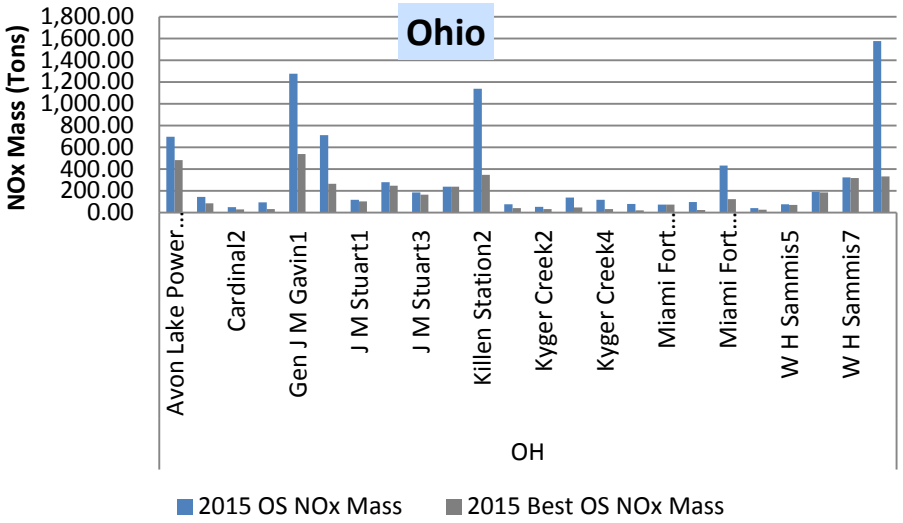


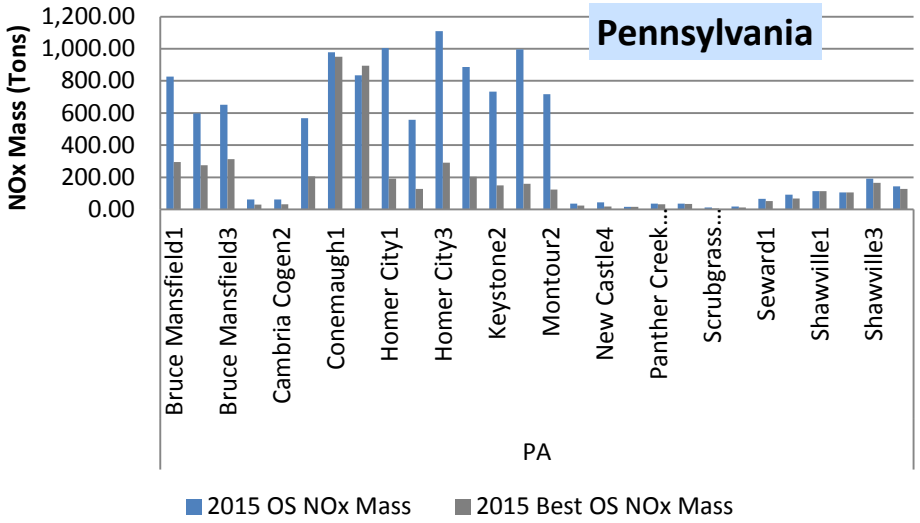


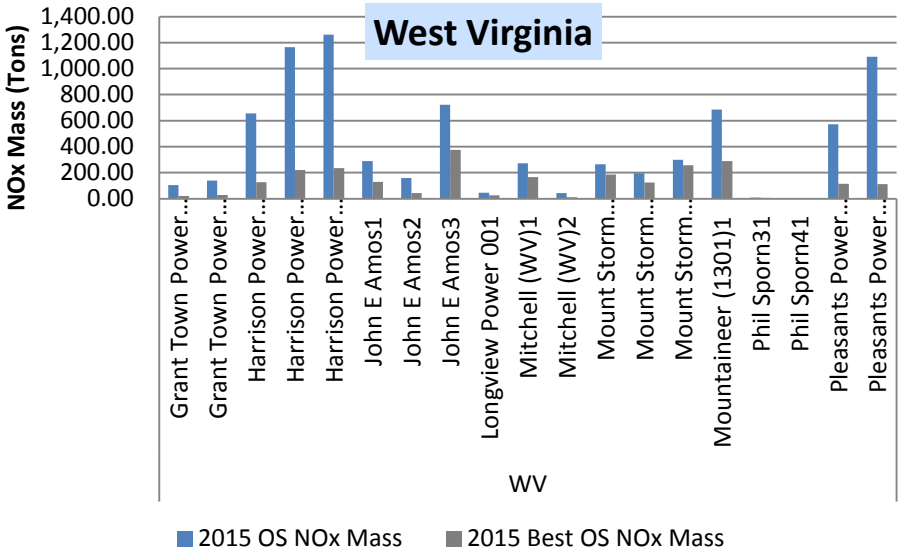
	2015 Actual OS NOx Mass (Tons)	2015 @ Best Rates OS NOx Mass (Tons)	Lost Savings (Tons)	% of Total Loss
Indiana	5,852	2,890	2,962	11.25%
North Carolina	5,956	3,135	2,822	10.72%
Kentucky	6,503	3,546	2,957	11.23%

Review of Optimization Needed

May and June 2015 Total NOx Emissions – Actual and Best Rates from Past

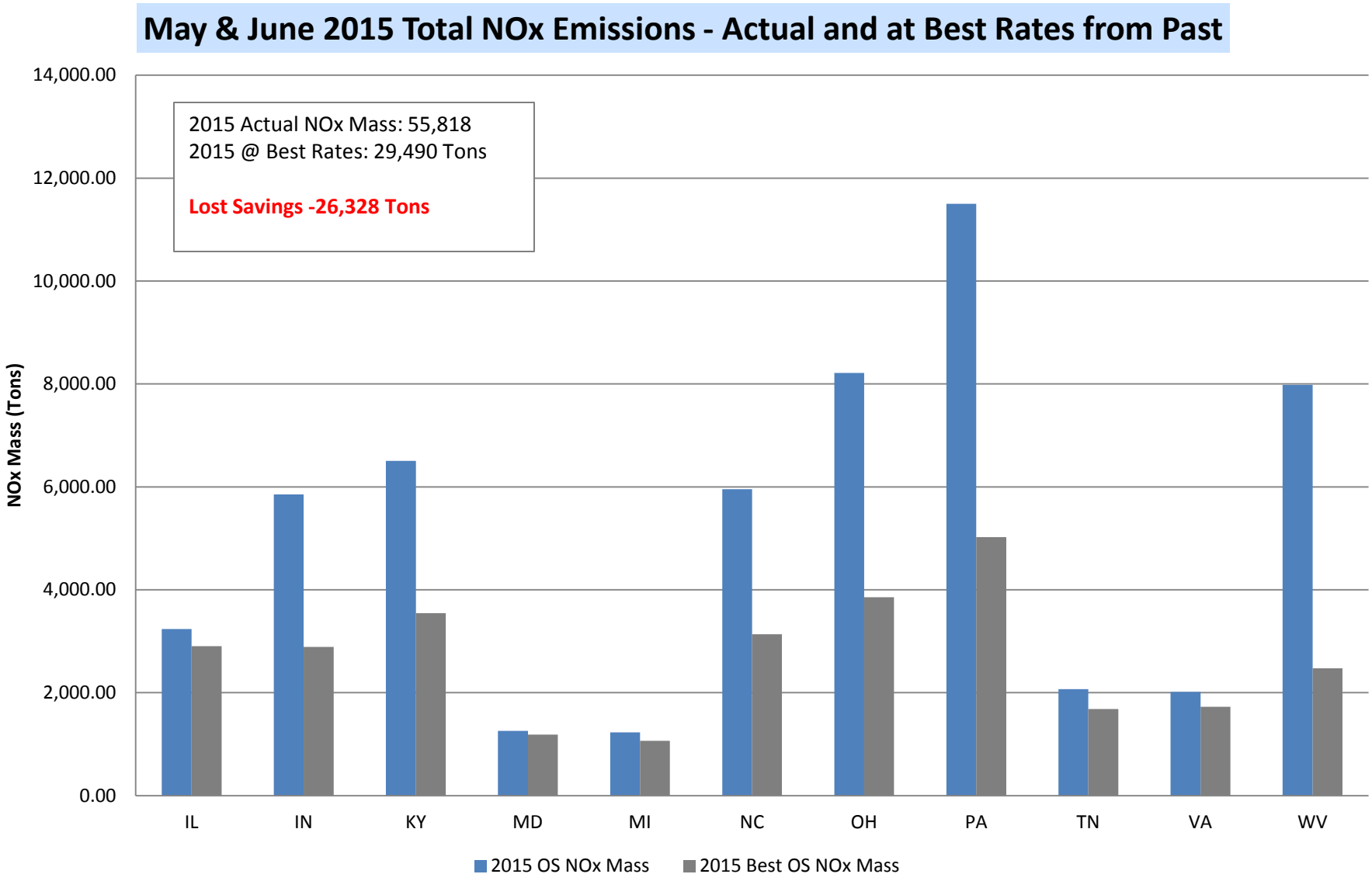






	2015 Actual OS NOx Mass (Tons)	2015 @ Best Rates OS NOx Mass (Tons)	Lost Savings (Tons)	% of Total Loss
Ohio	8,212	3,855	4,356	16.55%
Pennsylvania	11,499	5,023	6,476	24.60%
West Virginia	7,982	2,474	5,508	20.92%

Lost NOx Reductions - By State

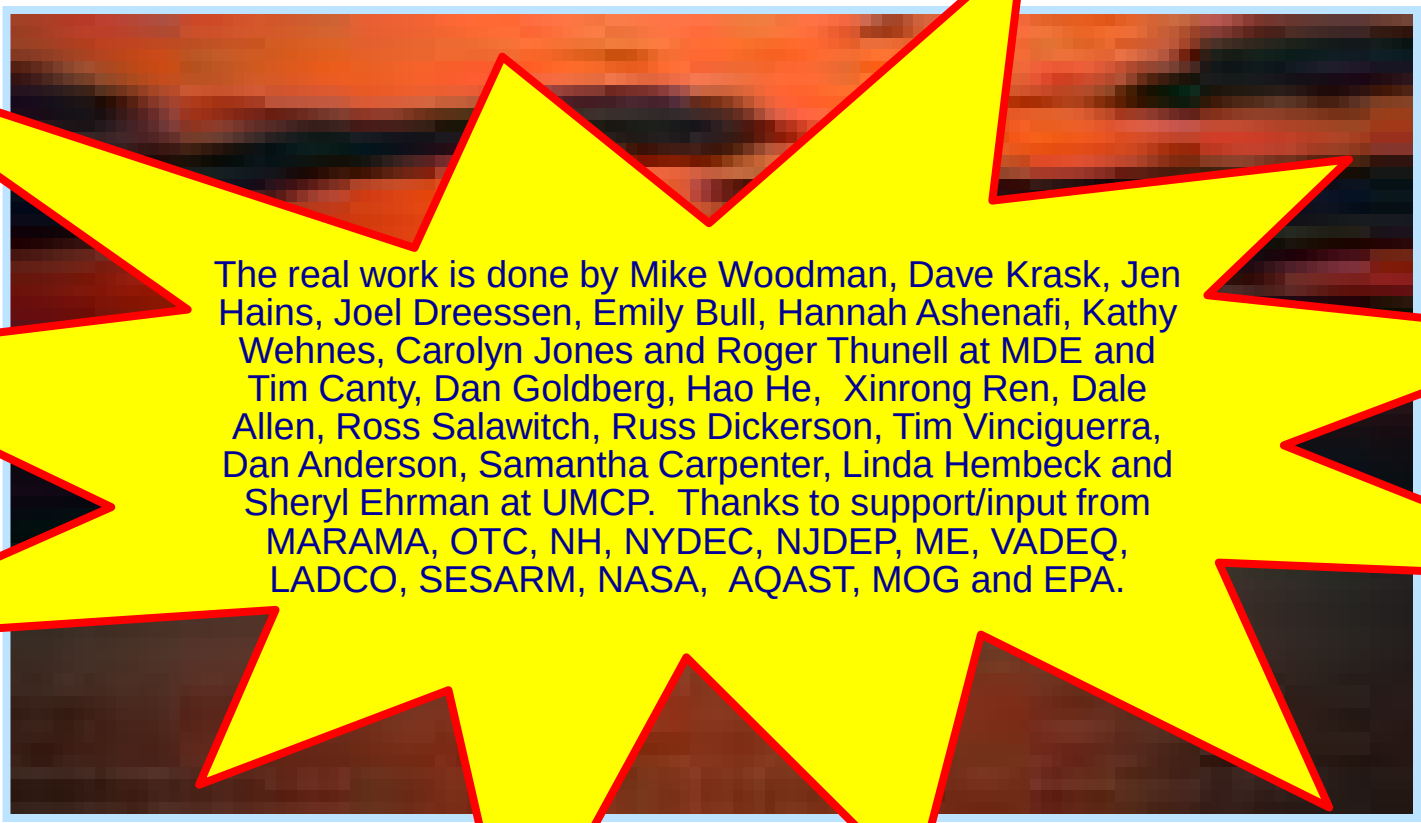


What Happens Next?

- SCOOT Effort will continue - Additional push for 2015 optimization
- EPA transport rule and federal backstop expected by late 2015
- Downwind states pushing for more reductions from optimized EGUs by 2016
- The Good Neighbor SIP clock is ticking
- Maryland pushing for other states to adopt the "optimized EGU" control requirement from our Phase 1 NOx regulation approved by AQCAC and now being implemented
  - Could drive up to a 400 to 500 ton per day NOx reduction - A huge reduction

… for each day during the ozone season, the owner or operator of an affected EGU shall minimize NOx emissions by operating and optimizing the use of all installed pollution control technology and combustion controls consistent with the technological limitations, manufacturers specifications, good engineering practices and good air pollution control practices for minimizing emissions (as defined in 40 CFR Section 60.11(d)) …

Questions?



The real work is done by Mike Woodman, Dave Krask, Jen Hains, Joel Dreessen, Emily Bull, Hannah Ashenafi, Kathy Wehnes, Carolyn Jones and Roger Thunell at MDE and Tim Canty, Dan Goldberg, Hao He, Xinrong Ren, Dale Allen, Ross Salawitch, Russ Dickerson, Tim Vinciguerra, Dan Anderson, Samantha Carpenter, Linda Hembeck and Sheryl Ehrman at UMCP. Thanks to support/input from MARAMA, OTC, NH, NYDEC, NJDEP, ME, VADEQ, LADCO, SESARM, NASA, AQAST, MOG and EPA.