MDE

MARYLAND
DEPARTMENT OF THE ENVIRONMENT

Solving the Ozone Transport Problem

Some Thoughts from Your Neighbor to the South

Let me know what you think … are we a "Good" or "Bad" Neighbor

Tad Aburn, Air Director, MDE
New Jersey Clean Air Council Hearing - April 14, 2015

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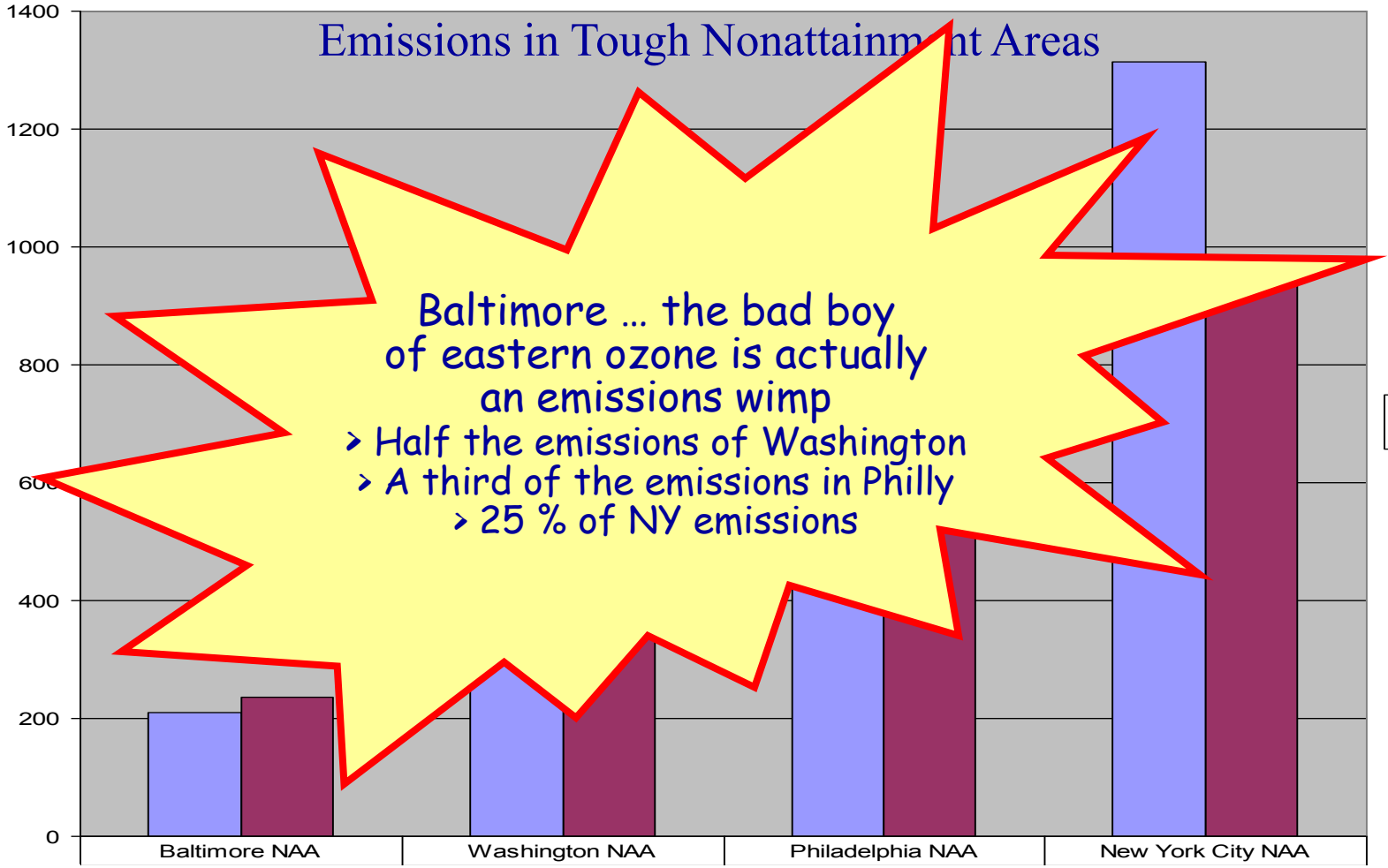
My Challenge

Just submit the SIP!! …

I don't care what you think - the law says you can clean the air by 2015

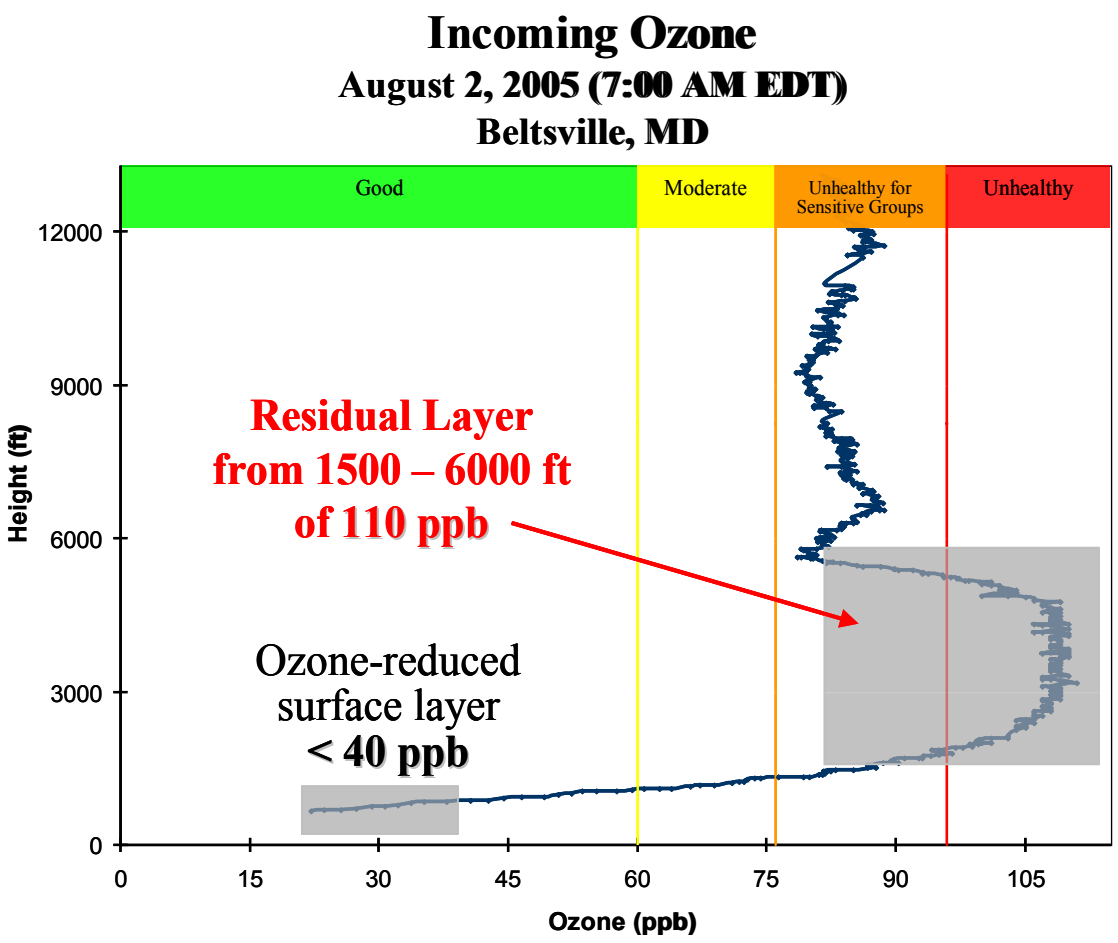
But that's scientifically impossible … man

Baltimore – Worst Ozone in the East?



So What the Heck is Going On?

Why does Baltimore measure the worst ozone in the East?



Source: Maryland Department of the Environment & Howard University

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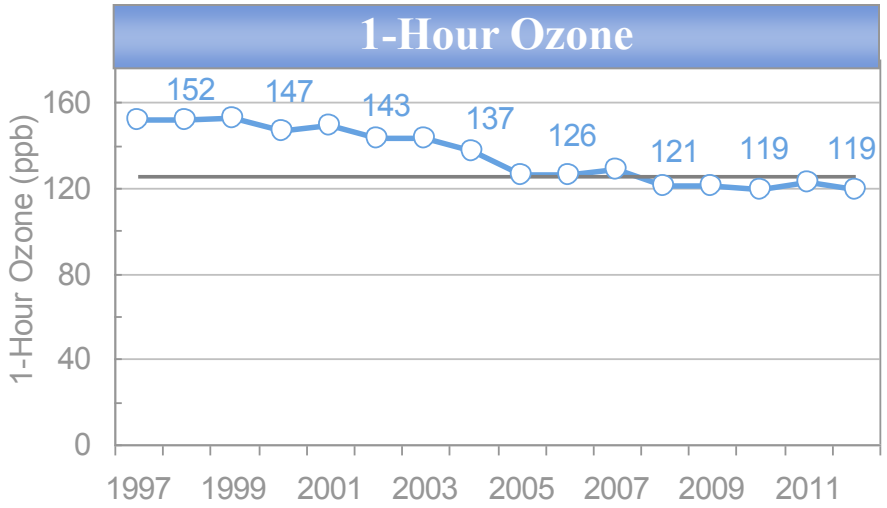
Topics

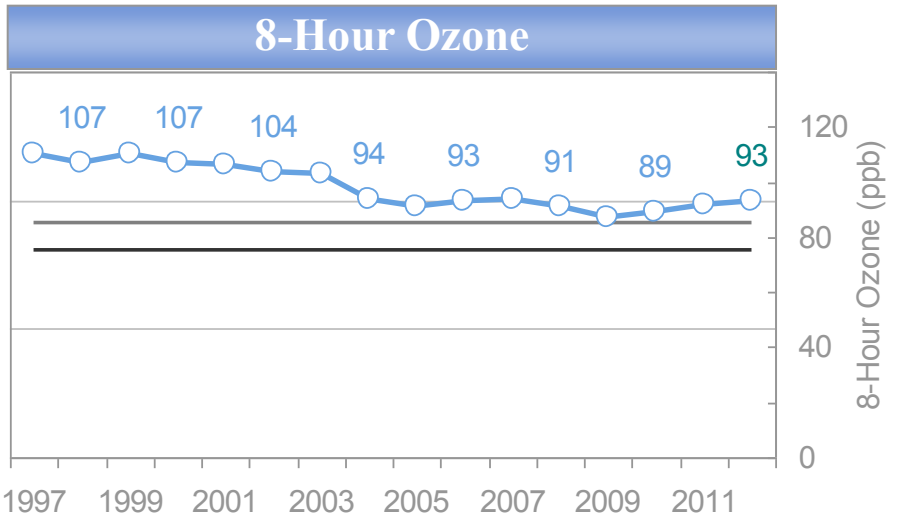
- What does the Maryland Ozone Research Program tell us about the significance of ozone transport?
- What does the Maryland modeling tell us about what NJ and MD need from others to meet standards and protect public health?
  - Power plants, vehicles, other …
    - … or all of the above
  - What MD needs to do to help NJ
  - What NJ needs to do to help MD and CT
- Some issues for the roundtable discussion

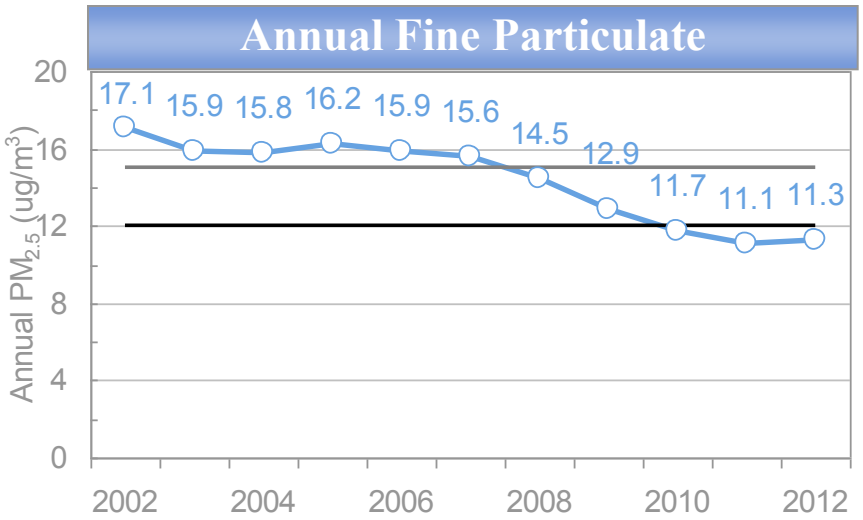
Background – Ozone Transport

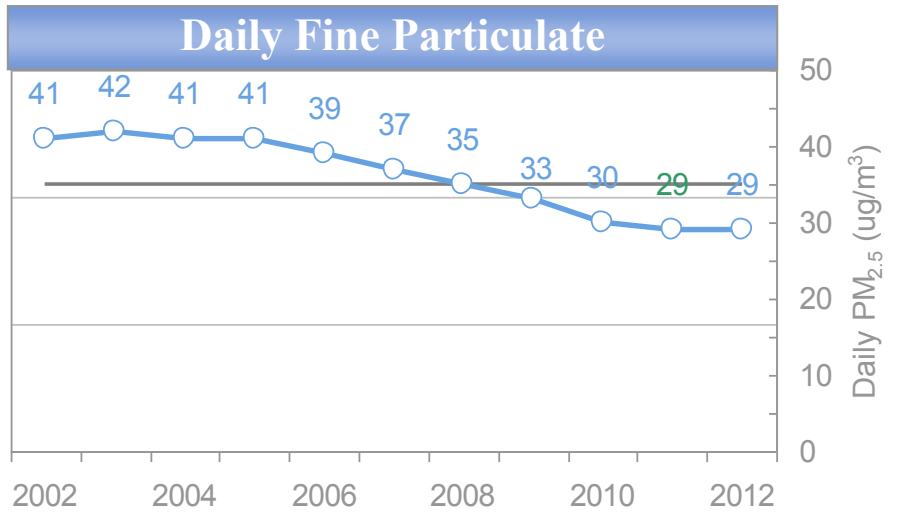
- Many, many balls in the air
  - Supreme Court has acted
    - Several times over the past two years
  - "Expand the Ozone Transport Commission (OTC)" Petition under Section 176A of the Clean Air Act (CAA)
  - Challenges to EPA over large nonattainment areas (CAA Section 107)
  - Challenges to EPA over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

Progress in Cleaning Maryland's Air



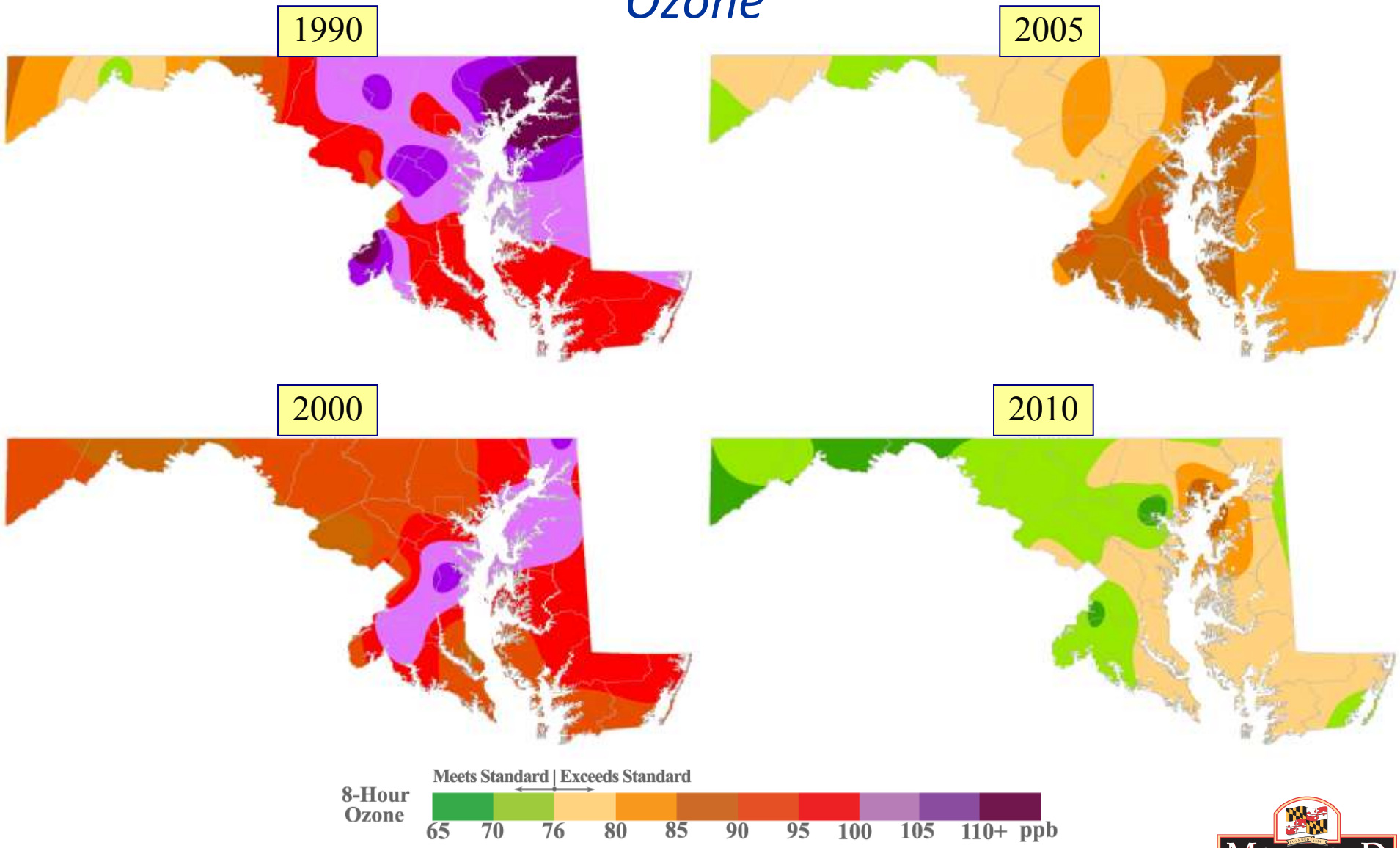




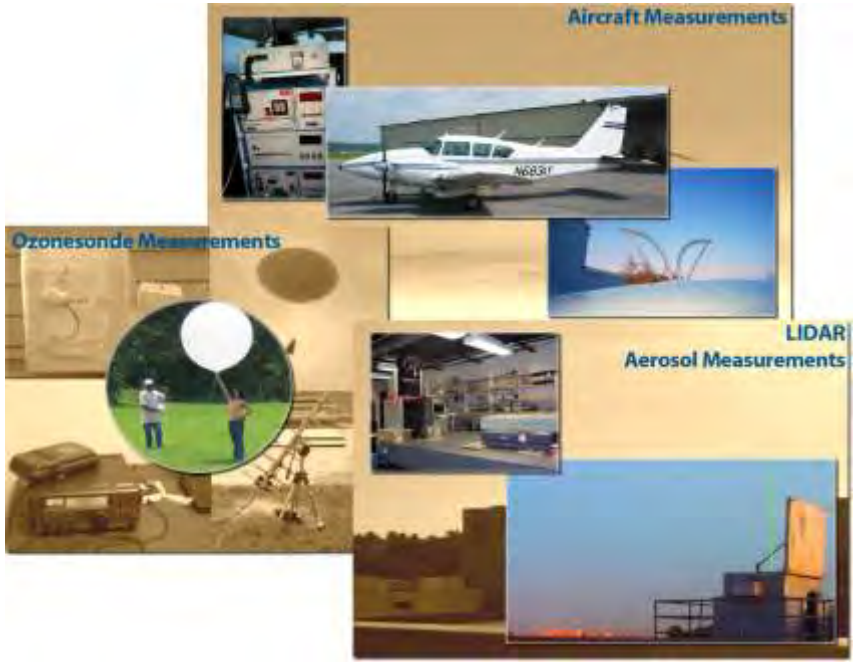


Lower Concentrations & Smaller Problem Areas

Ozone



Maryland's Ozone Research Effort



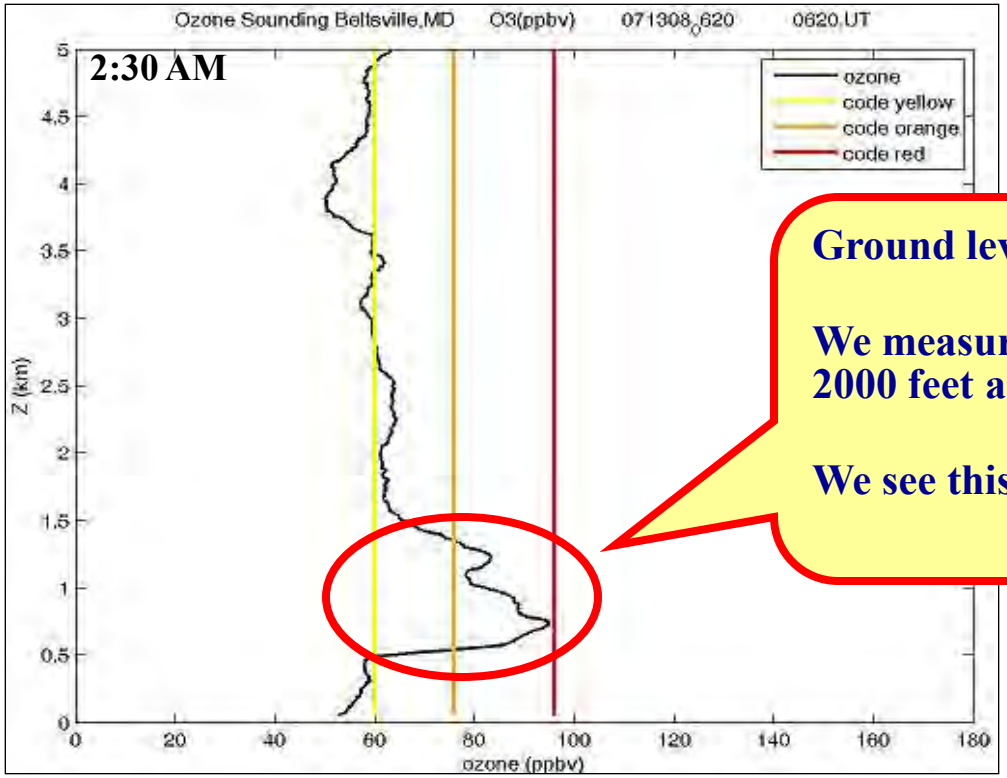
- MDE works in partnership with local universities (UMD at College Park, UMBC, Penn State and Howard University) to study Maryland's air pollution problems
  - Airplanes
  - Balloons
  - Lidar
  - Profilers
  - Satellites
  - Special monitors
  - Modeling
  - More

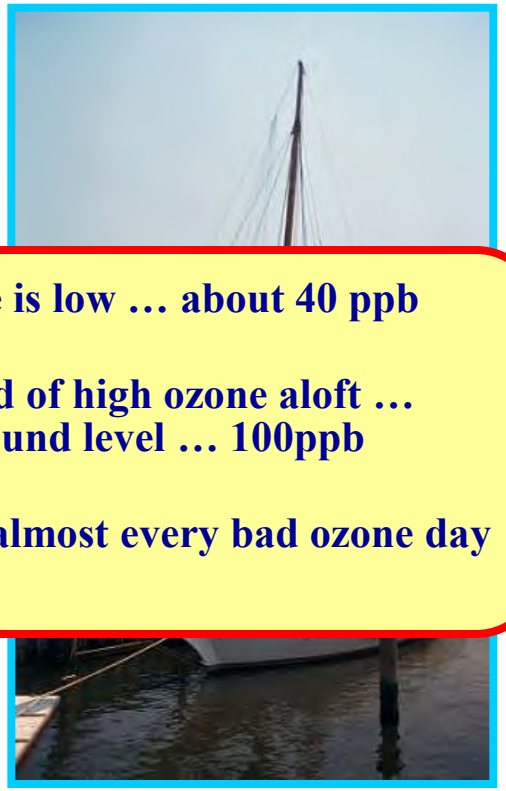
Understanding Ozone Transport

- 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





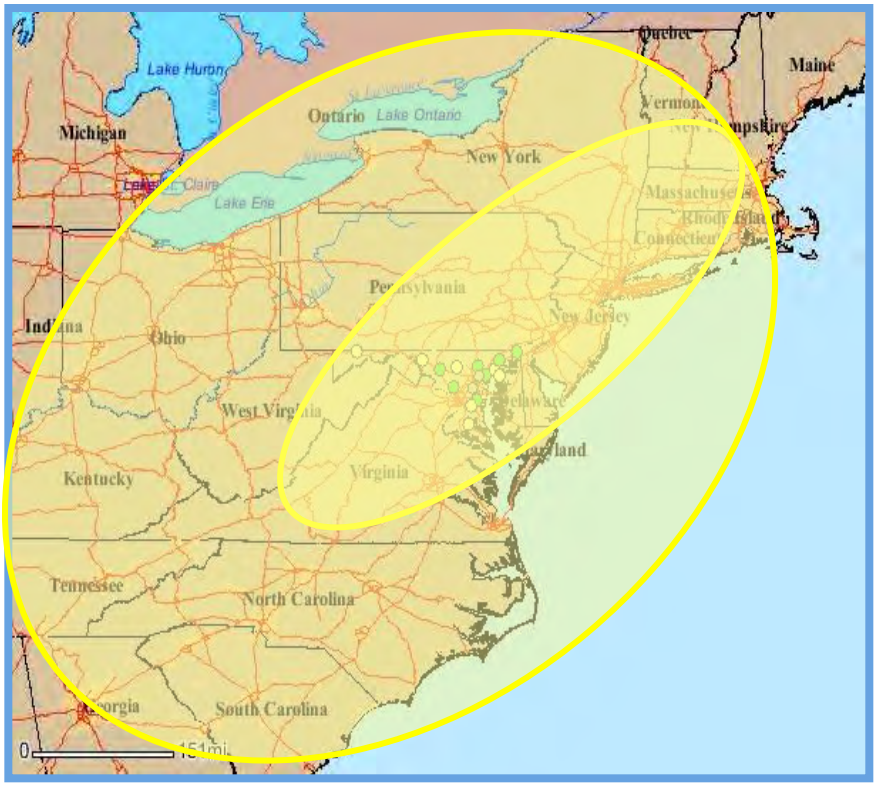
Ground level ozone is low … about 40 ppb

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

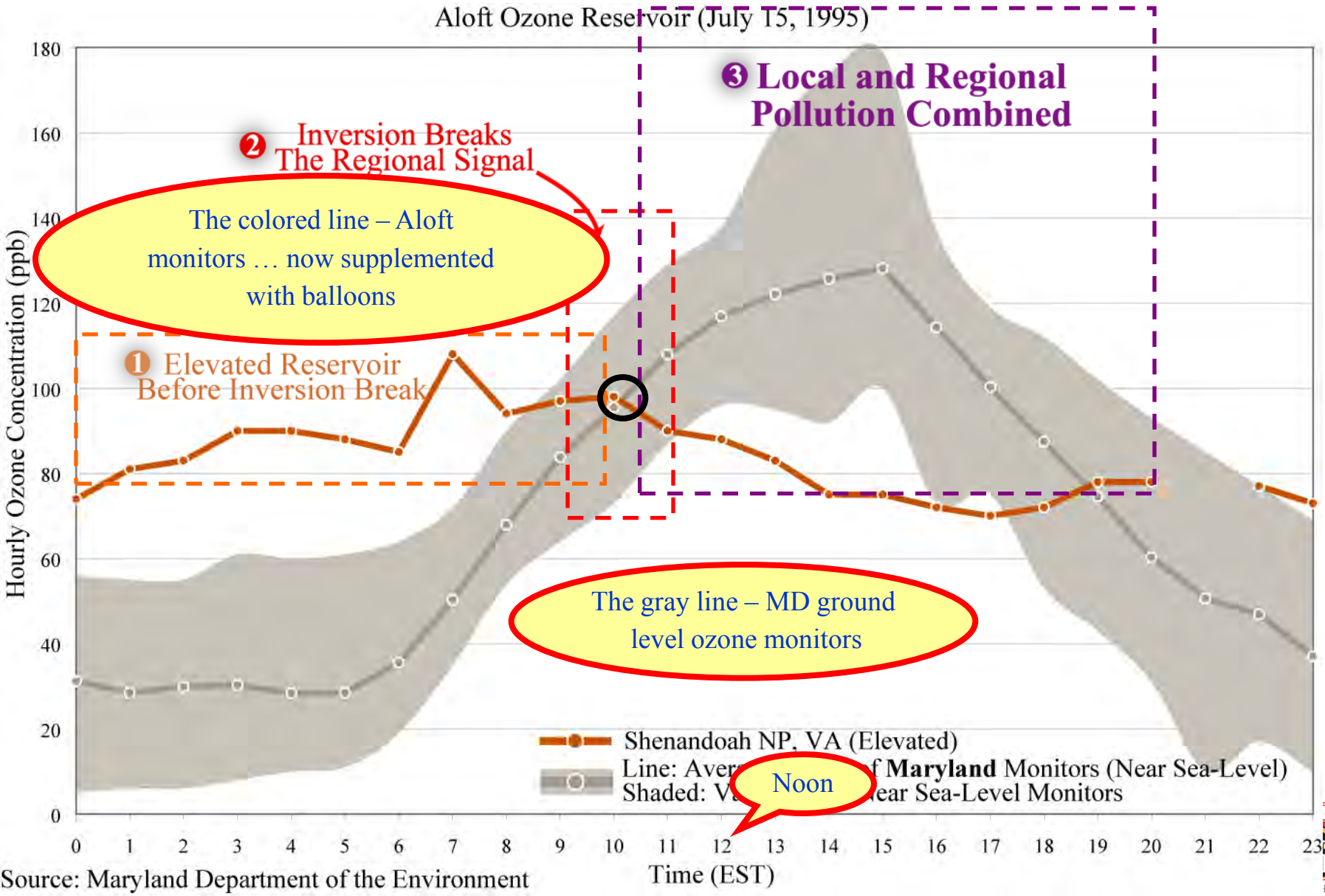
We see this before almost every bad ozone day

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

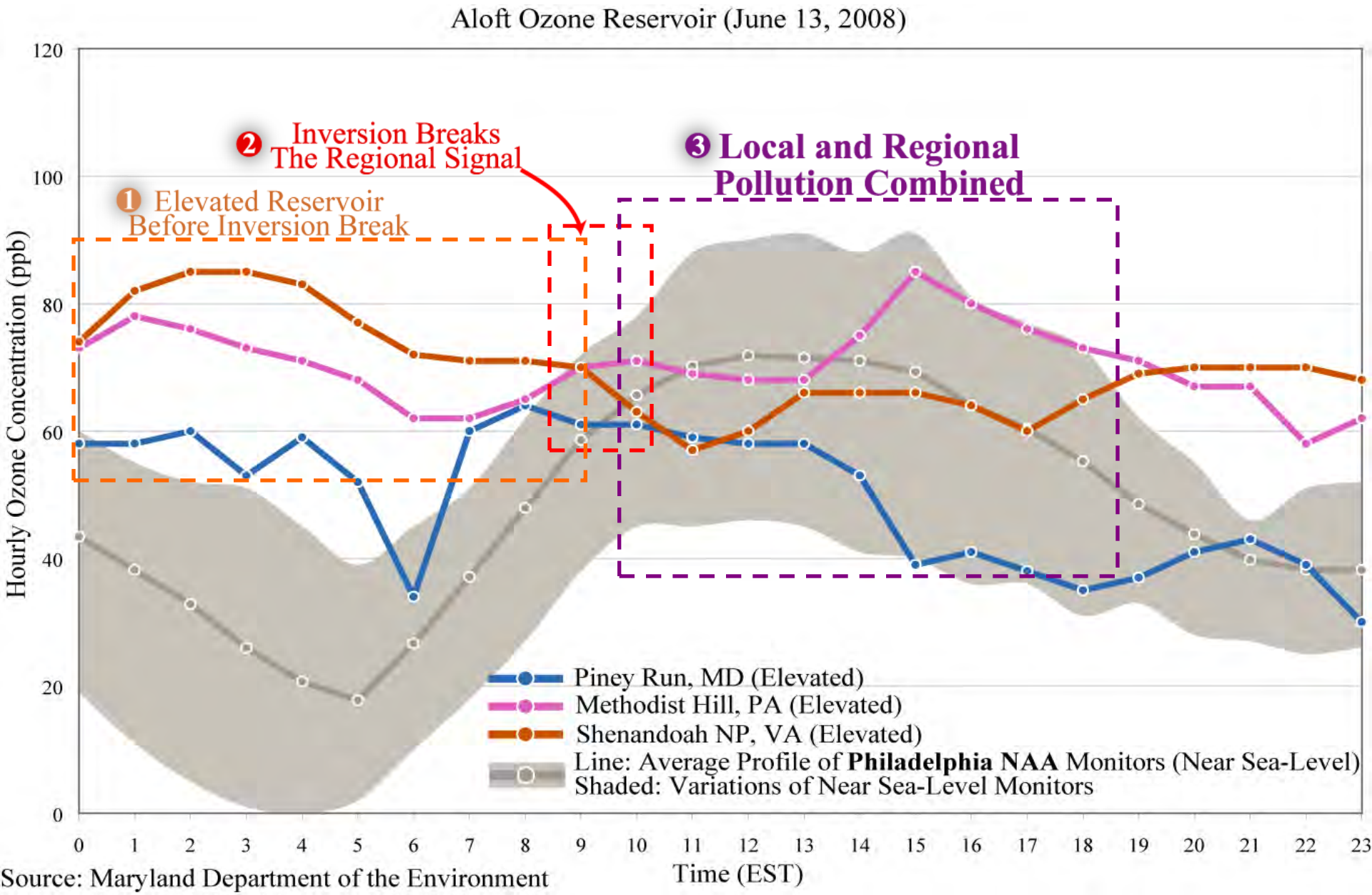


The Elevated Reservoir – The 90's

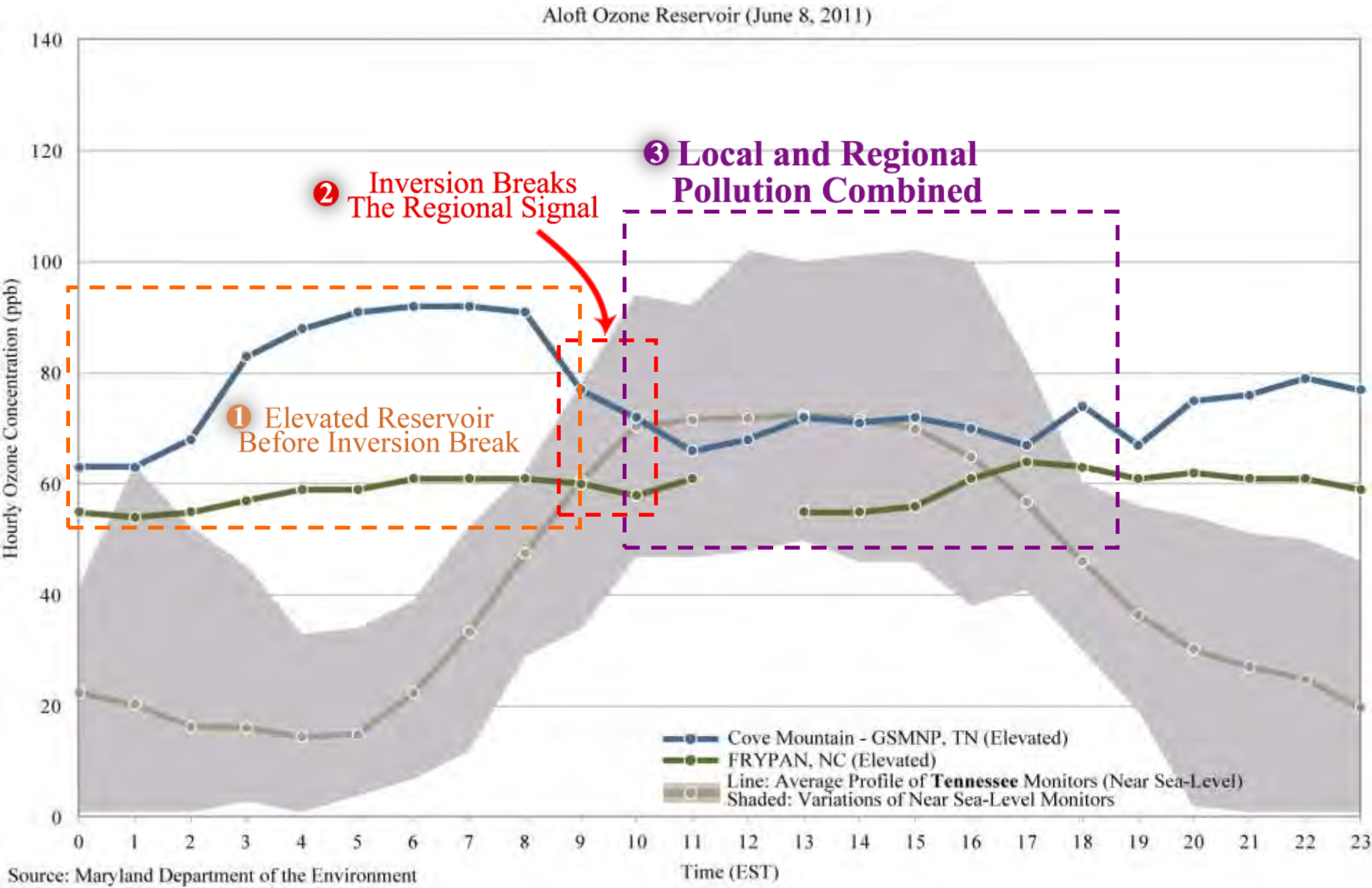


Source: Maryland Department of the Environment

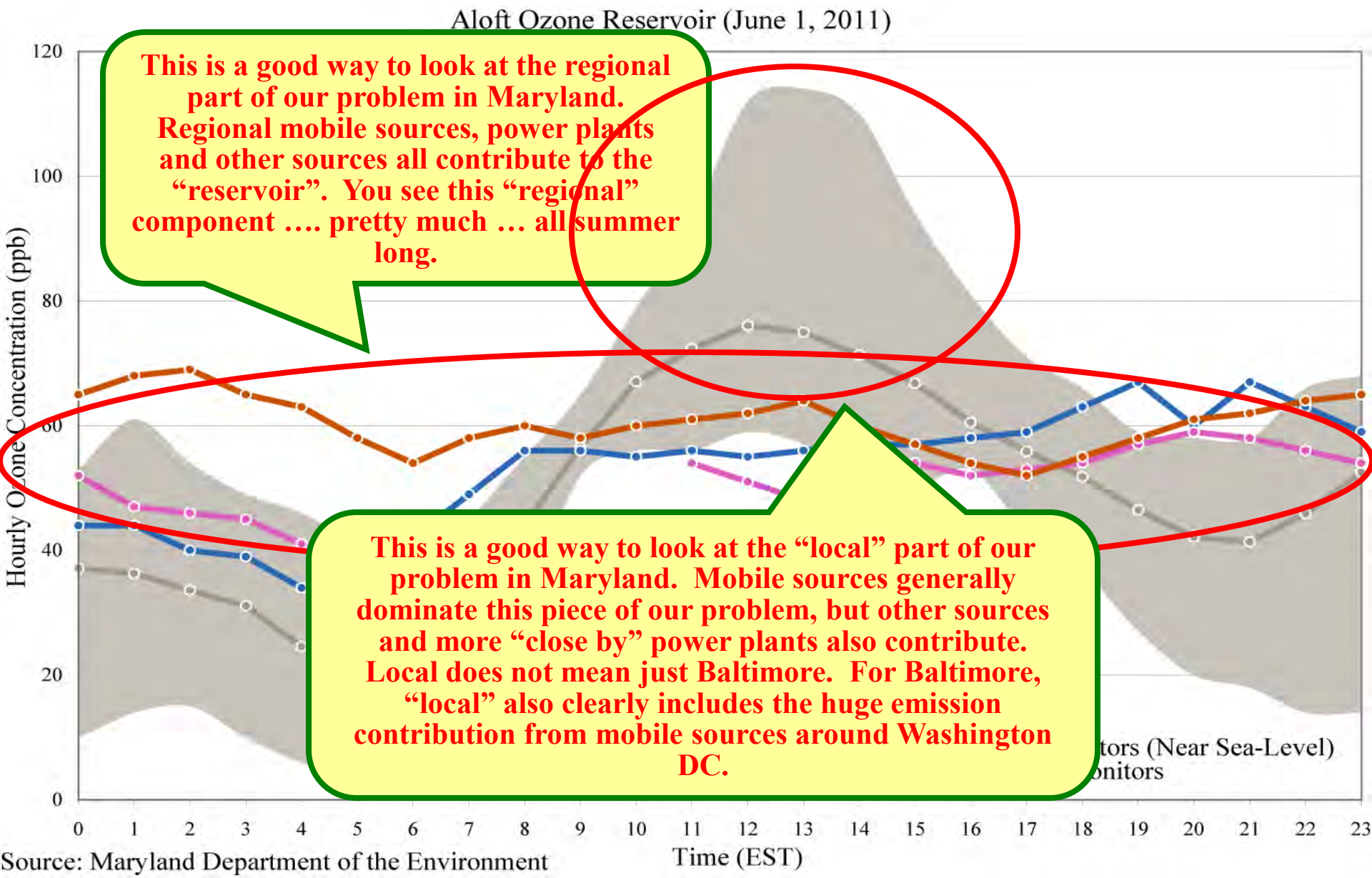
Same Signal – Philly/NJ 2008



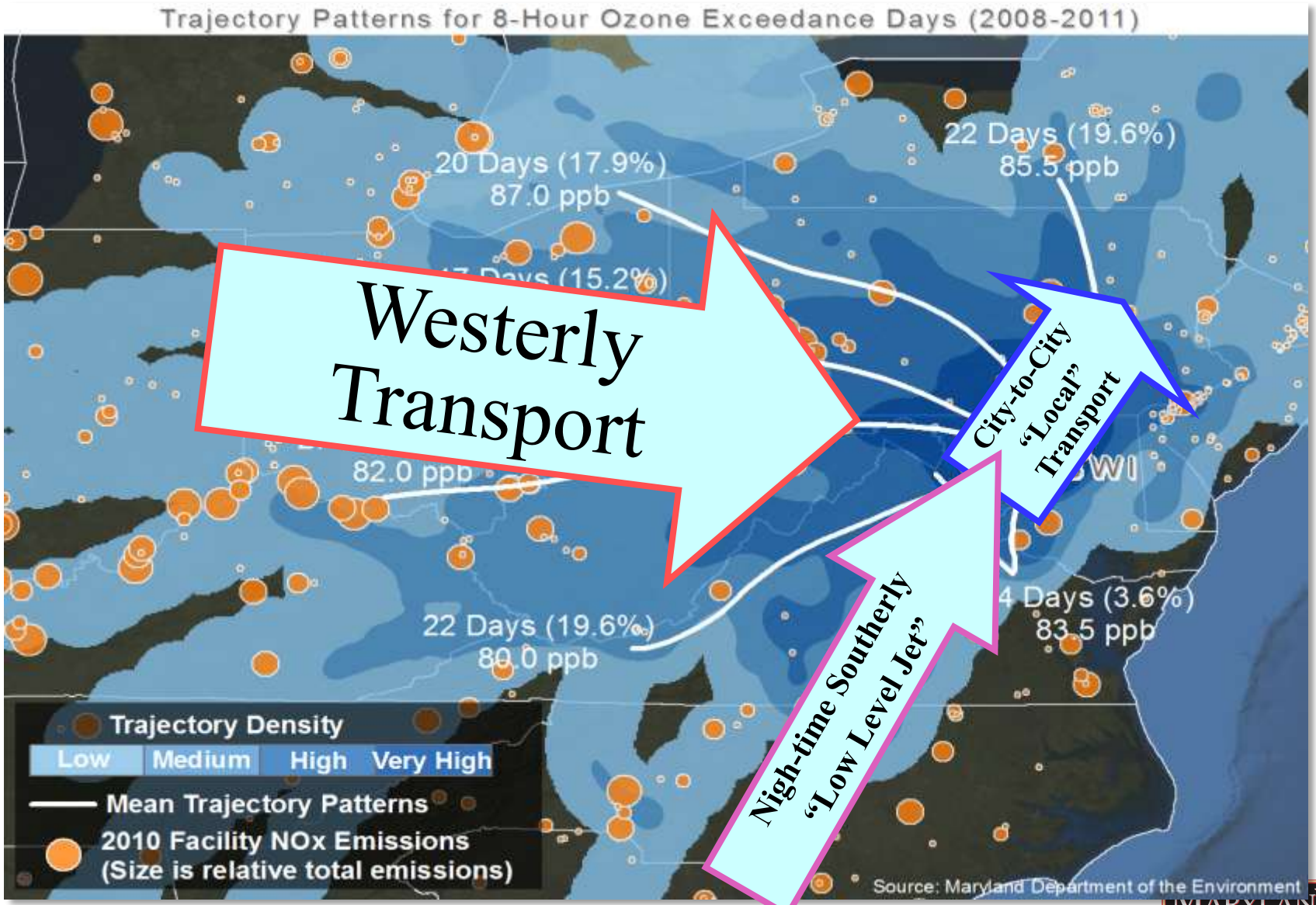
Same Signal – Tennessee 2011



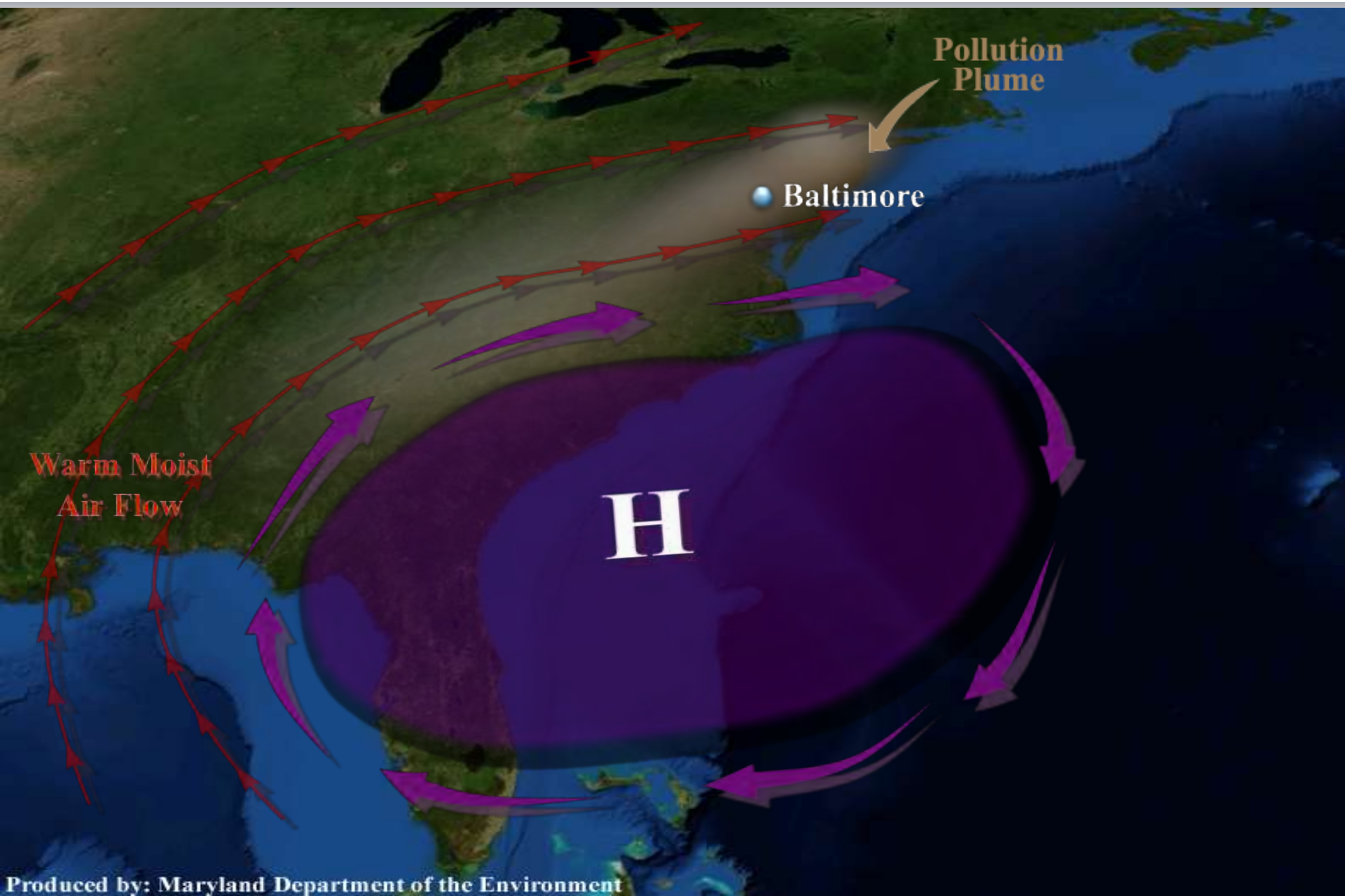
Same Signal – Maryland 2011



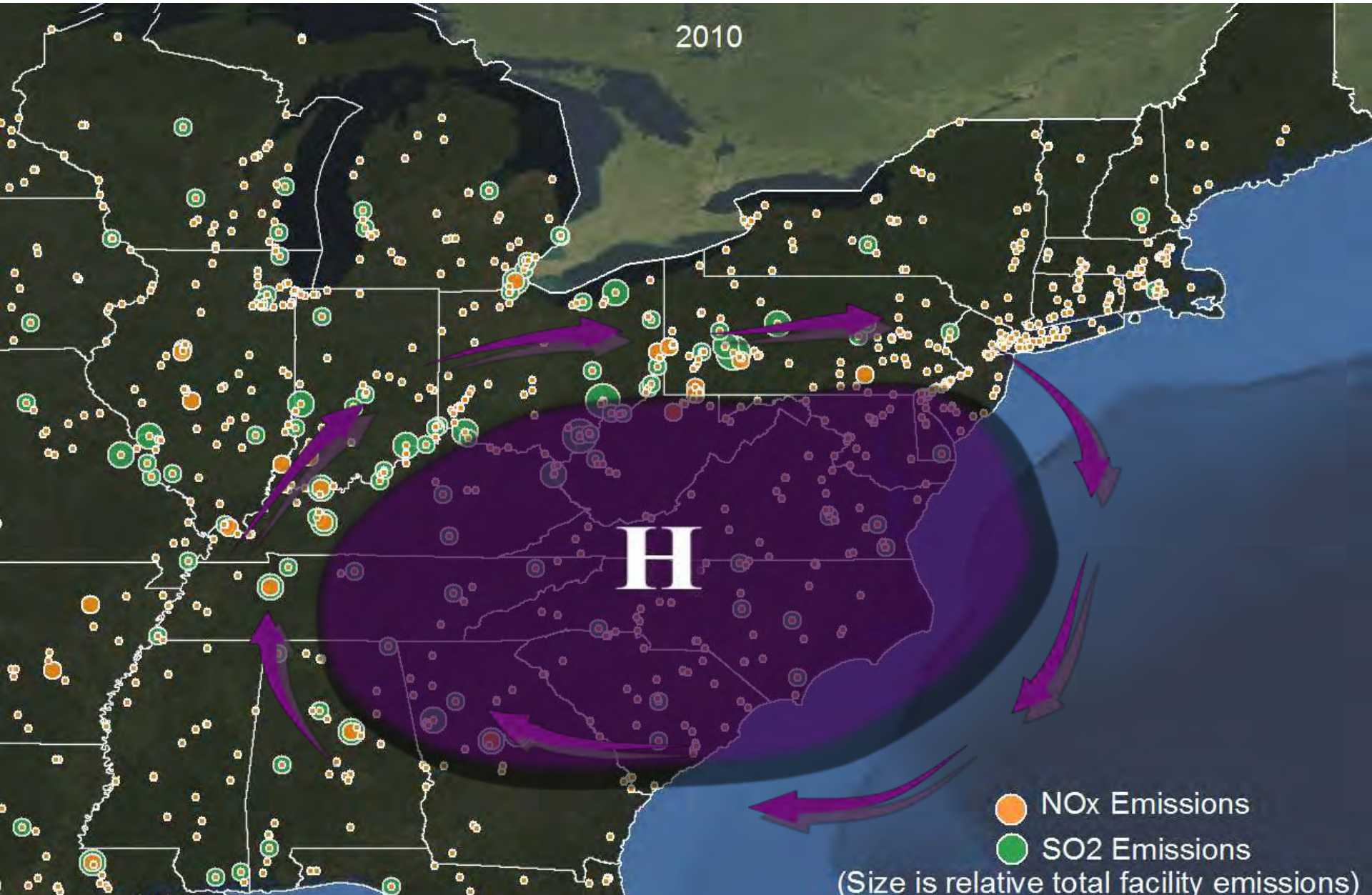
The Three Different Types of Transport



Classic Mid-Atlantic Ozone Weather

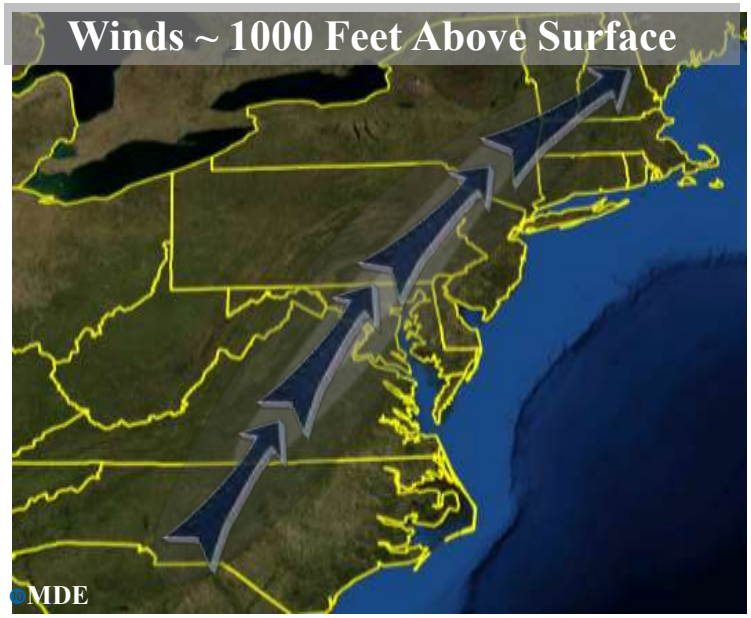


Westerly Transport



Southerly Transport at Night

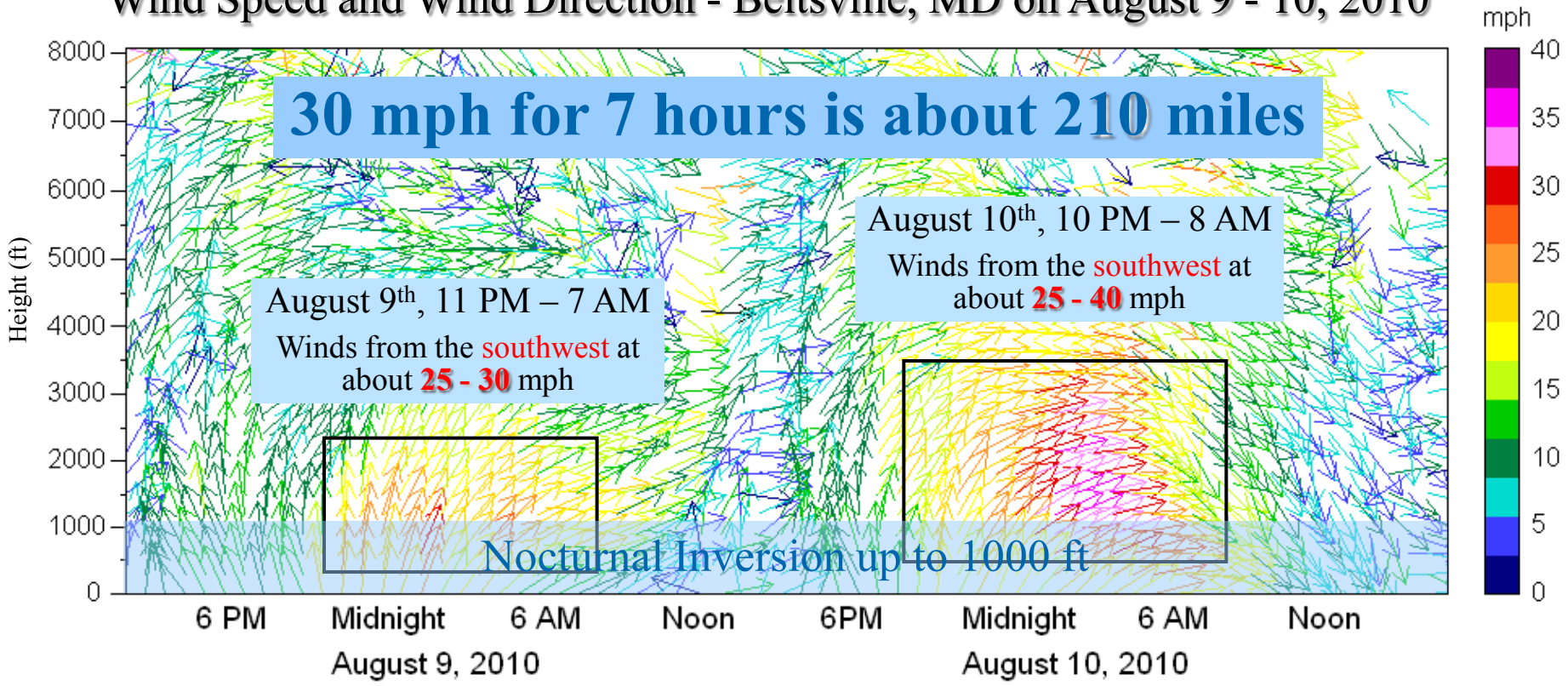
The Nocturnal Low Level Jet (NLLJ)



- 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

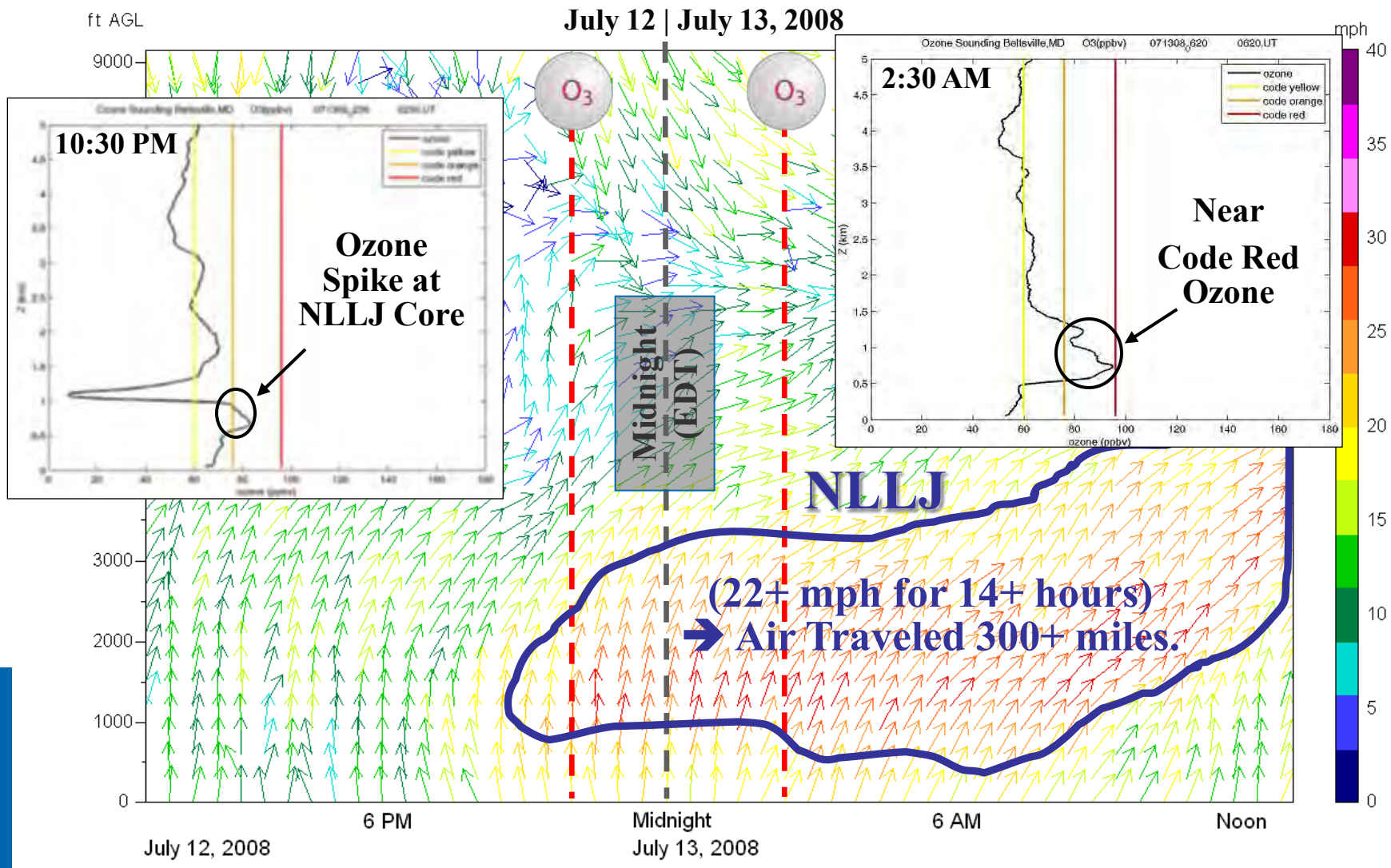
Wind Speed and Wind Direction - Beltsville, MD on August 9 - 10, 2010



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

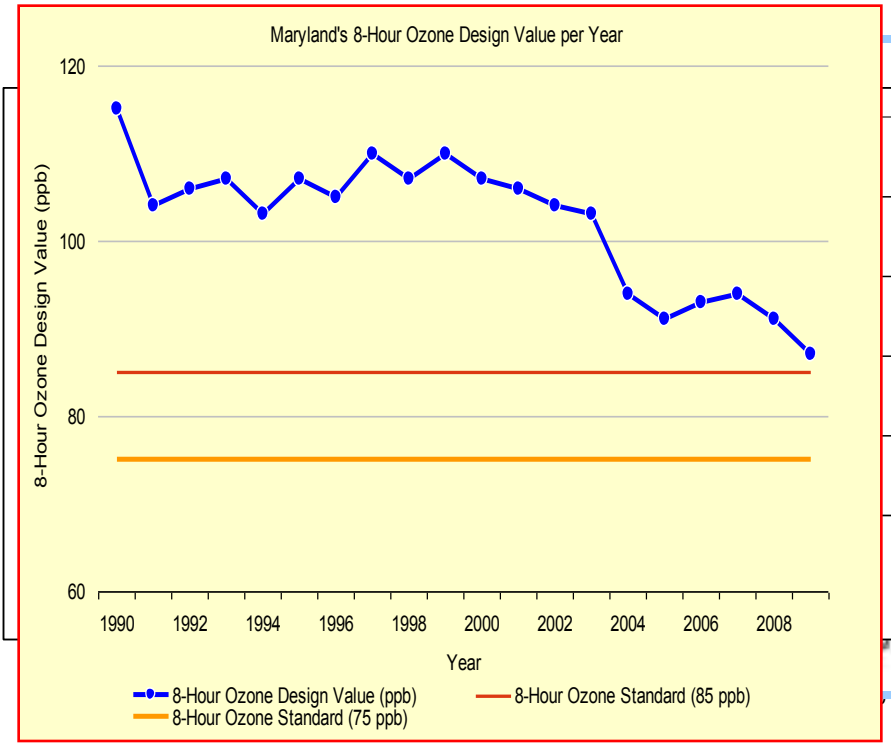
Measuring Ozone Transport in the NLLJ

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
- MD… and NJ … need a two-part strategy to continue making progress
  - Local controls are still critical
    - We need to be pushing the envelope on mobile sources
  - 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

What Does the MD Modeling Tell Us?

- Maryland has conducted a large amount of photochemical modeling – still preliminary but getting close to "SIP Quality"
  - Only state East of the Mississippi designated as a "Moderate" nonattainment area by EPA - Only area required to do modeling and a SIP by 2015
  - EPA modeling and other regional modeling efforts (LADCO and SESARM) are consistent with Maryland's work
- We believe we have enough modeling to begin to identify what states may need to do for Transport or "Good Neighbor" SIPs and what MD needs to do in it's "Attainment" SIP to meet the 75 ppb std.

EPA's Recent Transport Guidance

- On January 22, EPA issued a guidance memo to begin a process that will require states to submit Good Neighbor 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
- The Maryland modeling can begin to give us a glimpse of how the EPA process may play out and what states may owe in their Good Neighbor SIPs

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

Control Measures in the MD Modeling

- More detail provided later …
  - But the current modeling focuses on 3 basic packages of control measures
- Measures 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) reductions include:
  - All coal-fired units in selected eastern states (MD, PA, VA, NC, TN, KY, WV, OH, IN, IL, MI, CT, NJ, NY, WI, LA, MO) running controls in the summertime consistent with emission rates measured in earlier years
- New OTC and local Maryland measures include:
  - Nine new Ozone Transport Commission (OTC) model reduction programs for mobile sources and other sources implemented in just the OTC states … and
  - Additional EGU and mobile source reductions just in MD

Modeling Preliminary EPA Problem Areas

	County, State	AQS #	Design Value 2011	2018 Future Projections		
				Measures "on the way"	Add in Optimized EGUs	Add new OTC & local MD measures
	Attainment Problems - 2018					
→	Harford, MD	240251001	90	76.0	74.5	73.5
→	Fairfield, CT	090013007	84.3	73.0	72.5	71.5
→	Fairfield, CT	090019003	83.7	75.5	75.1	74.1
→	Suffolk, NY	361030002	83.3	78.2	77.7	76.7
	Maintenance Problems - 2018					
→	Fairfield, CT	090010017	80.3	76.4	75.9	74.9
→	New Haven, CT	090099002	85.7	74.1	73.8	72.8
	Jefferson, KY	211110067	82.0	70.6	69.0	69.0
	Allegan, MI	260050003	82.7	73.0	72.8	72.8
	Saint Charles, MO	291831002	82.3	71.3	69.6	71.1
→	Camden, NJ	340071001	82.7	70.7	69.6	68.6
→	Gloucester, NJ	340150002	84.3	72.3	70.9	69.9
→	Richmond, NY	360850067	81.3	74.7	74.0	73
→	Philadelphia, PA	421010024	83.3	72.8	71.4	70.4
	Sheboygan, WI	551170006	84.3	75.4	75.2	75.2

Other Difficult Monitors in the East

County, State	AQS #	Design Value 2011	2018 Measures "on the way"	2018 – Add in Optimized EGUs	2018 – Add new OTC and local MD measures
Prince Georges, MD	240338003	82.3	68.6	67.0	66.0
New Castle, DE	100031010	78.0	66.6	65.1	64.1
Bucks, PA	420170012	80.3	69.3	68.0	67
Fairfax, VA	510590030	82.3	69.4	68.1	67.1
Wayne, MI	261630019	78.7	72.9	72.8	72.8
Mecklenburg, NC	371191009	79.7	63.5	63.0	63.0
Fulton, GA	131210055	81.0	70.3	70.1	70.1
Knox, TN	470931020	71.7	61.7	61.2	61.2
Hamilton, OH	390610006	82.0	69.7	67.5	67.5
Franklin, OH	390490029	80.3	69.7	69.2	69.2

All values in parts per billion (ppb)

NY/NJ/CT Nonattainment Area

- There are very preliminary analyses started that begin to look at how a strategy that targets smaller combustion sources … with relatively large peak day NOx emissions … might help the NY/NJ/CT nonattainment area
- This sensitivity run was designed to get a very rough idea of how that kind of a strategy might work
  - Extra 10% NOx reduction in just NY, NJ, CT, PA and MD

County, State	AQS #	Design Value 2011	2018 Future Projections			
			Measures "on the way"	Add in Optimized EGUs	Add new OTC & local MD measures	Add in 10% Extra NOx Reduction in NY, NJ, CT, PA and MD
Fairfield, CT	090013007	84.3	73.0	72.5	71.5	71.0
Fairfield, CT	090019003	83.7	75.5	75.1	74.1	73.6
Suffolk, NY	361030002	83.3	78.2	77.7	76.7	75.7
Fairfield, CT	090010017	80.3	76.4	75.9	74.9	74.5
New Haven, CT	090099002	85.7	74.1	73.8	72.8	71.7

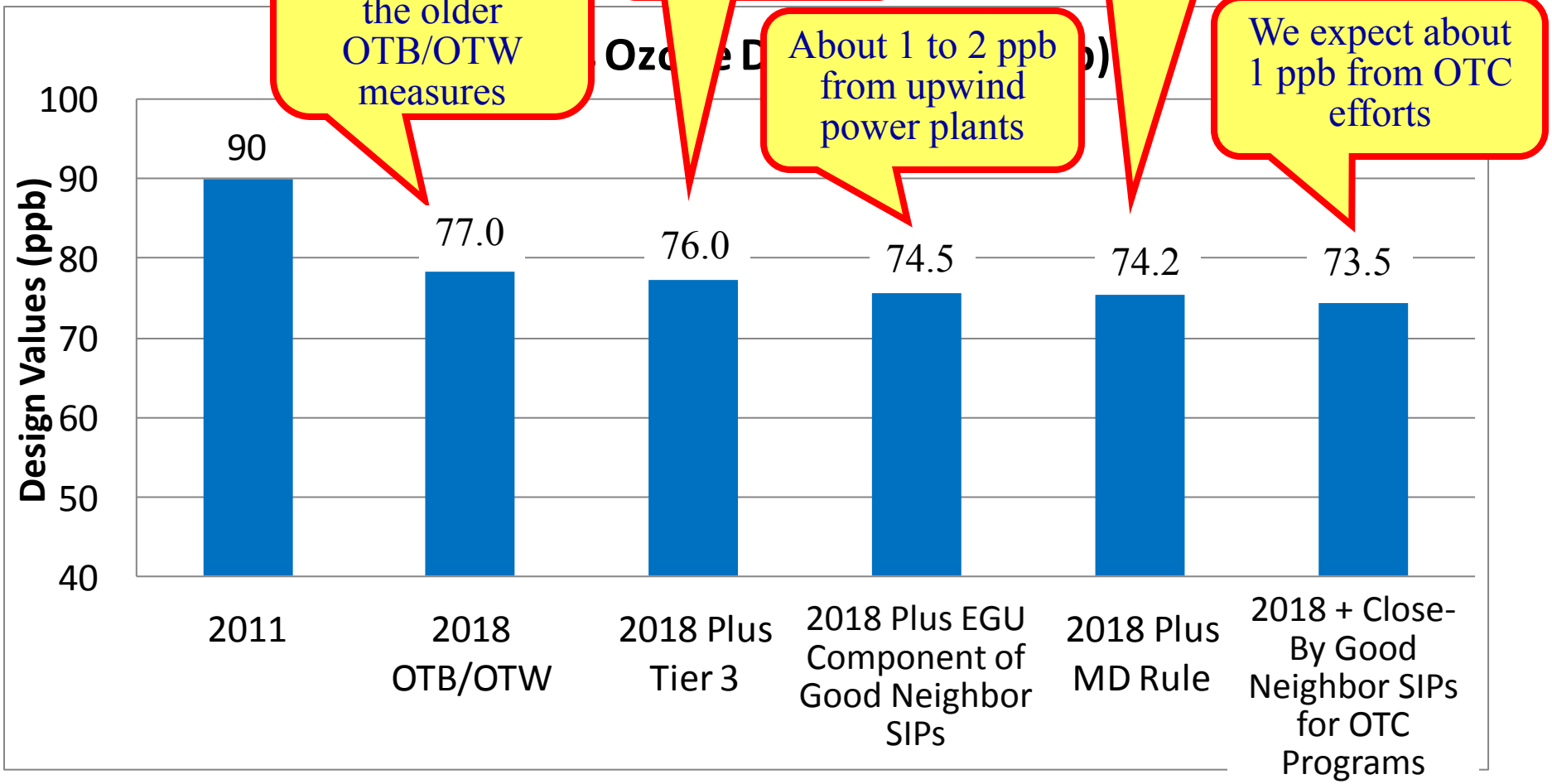
Good Neighbor SIPs …

… What does the MD modeling say about what control measures states may need to include in their Good Neighbor SIPs?

- Very preliminary – Based upon current modeling effort
- For all of the toughest areas: Harford County, MD - NJ/NY/CT nonattainment area – Sheboygan, WI … all of the other tough areas in the east … except Texas

Control Programs Needed	CT	DE	IL	IN	KY	MD	MI	MO	NJ	NY	OH	PA	TN	TX	VA	WV
Optimized EGU controls	x	x	x	x	x	+	x	x	x	x	x	x	x	x	x	x
Aftermarket Catalyst	x	x				x			x	x		x			x	
On- and off-road idling	x	x				x			x	x		x			x	
OTC VOC initiatives	x	x				x			x	x		x			x	
SmartWays	x	x				x			x	x		x			x	
Smaller Combustion	?					?			?	?		?			?	

Where Do Reductions Come From?



Where Do the OTB/OTW Reductions Come From?

- There are over 40 control programs in this piece of our modeling
  - Generally older control programs that continue to generate deeper reductions as they are phased in or as fleets turn over
- By far, the largest contributors to NOx reductions in the OTB/OTW category are mobile sources
  - Tier 2 Vehicle Standards
  - Federal fuel economy (CAFÉ) standards
  - Heavy Duty Diesel Standards
  - Marine Diesel Engine Standards
  - Emission Control Area (ECA) requirements
  - Many more …
- VOC reductions from the OTB/OTW category come from programs like
  - Federal consumer product and paint regulations
  - Tier 2 Vehicle Standards
  - VOC RACT … Many more …

What "Inside MD" Reductions are Included?

- New EGU regulation for NOx
  - Required for RACT and Attainment
- Maryland efforts on mobile sources
  - Electric vehicle initiatives
  - Zero Emission Vehicle or "ZEV" efforts
  - "Beyond Conformity" partnerships
- All of the new OTC measures

Reductions in Transport Included?

- Three new significant transport strategies are included
- The Federal Tier 3 Vehicle and Fuel Standards … maybe the most significant new transport strategy
- New OTC Regional Measures … just in OTC states
- "Good Neighbor Partnerships" that address coal-fired power plants in 10 states upwind of MD are also included in the modeling (PA, VA, NC, TN, KY, WV, OH, IN, IL, MI)*
  - Focuses primarily on the large potential reductions from insuring that currently installed technologies are run well
    - Also includes significant reductions from units scheduled for retirement (or other major changes) by 2018
  - Already a discussion item between states and EGU operators

* Recent sensitivity runs added in optimized EGUs in CT, NJ, NY, WI, LA and MO to look at other tough nonattainment issues in CT, NY and WI

What Inside the OTC Measures are Included?

- Mobile Source Initiatives
  - Aftermarket Catalyst effort
  - ZEV/CALEV state programs
  - Onroad and offroad idling
  - Heavy Duty I&M
  - Smartways
- NOx and VOC reductions
- New potential initiatives like Ports are not included

- Stationary and Area Source Efforts
  - Third Generation OTC/SAS Initiatives
    - Consumer products
    - Architectural and Industrial Maintenance (AIM) Coatings
    - Auto coatings
    - Ultra Low NOx burners
- NOx and VOC reductions

Reductions from OTC Measures

OTC Model Control Measures	Regional Reductions (tons per year)	Regional Reductions (tons per day)
Aftermarket Catalysts	14,983 (NOx) 3,390 (VOC)	
On-Road Idling	19,716 (NOx) 4,067 (VOC)	
Nonroad Idling	16,892 (NOx) 2,460 (VOC)	
Heavy Duty I & M	9,326 (NOx)	
Enhanced SMARTWAY	2.5%	
Ultra Low NOx Burners	3,669 (NOx)	10 (NOx)
Consumer Products	9,729 (VOC)	26 (VOC)
AIM	26,506 (VOC)	72 (VOC)
Auto Coatings	7,711 (VOC)	21 (VOC)

… About a 150 ton per day total NOx Emission Reduction in the 13 OTC states

- Just in the OTC states – for now
- Reductions developed as part of OTC Committee work
- Thanks to Roger Thunell. Emily Bull, Marcia Ways, Joseph Jakuta and Julie McDill
- These emission reduction estimates are being updated as we speak

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

Dickers & 3 - 2012

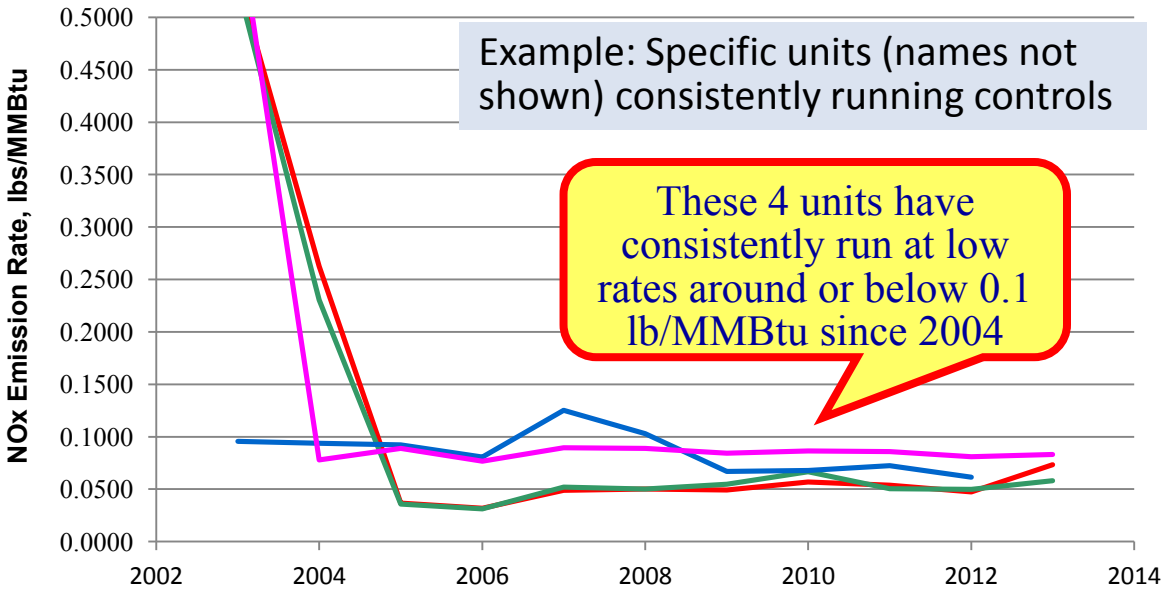
We began looking at Maryland sources in 2011 and 2012. This issue of "Optimized Controls" is one of the two major issues addressed by our current proposed regulation.

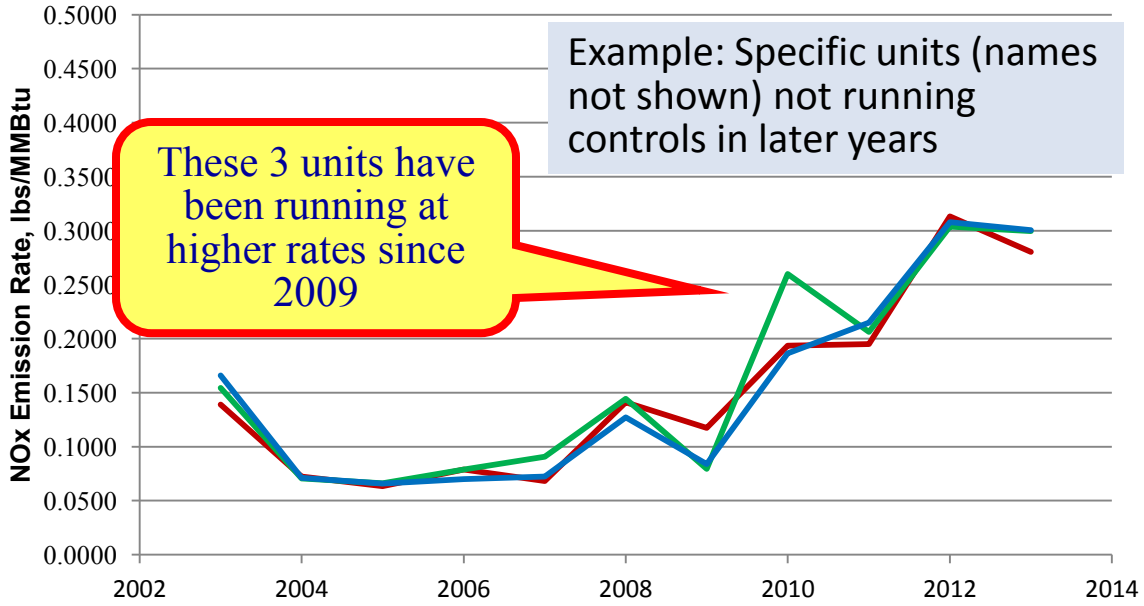
Running EGU Controls Well?

Average Ozone Season Emission Rates at Specific Units by Year

Many Sources Run Controls Well →

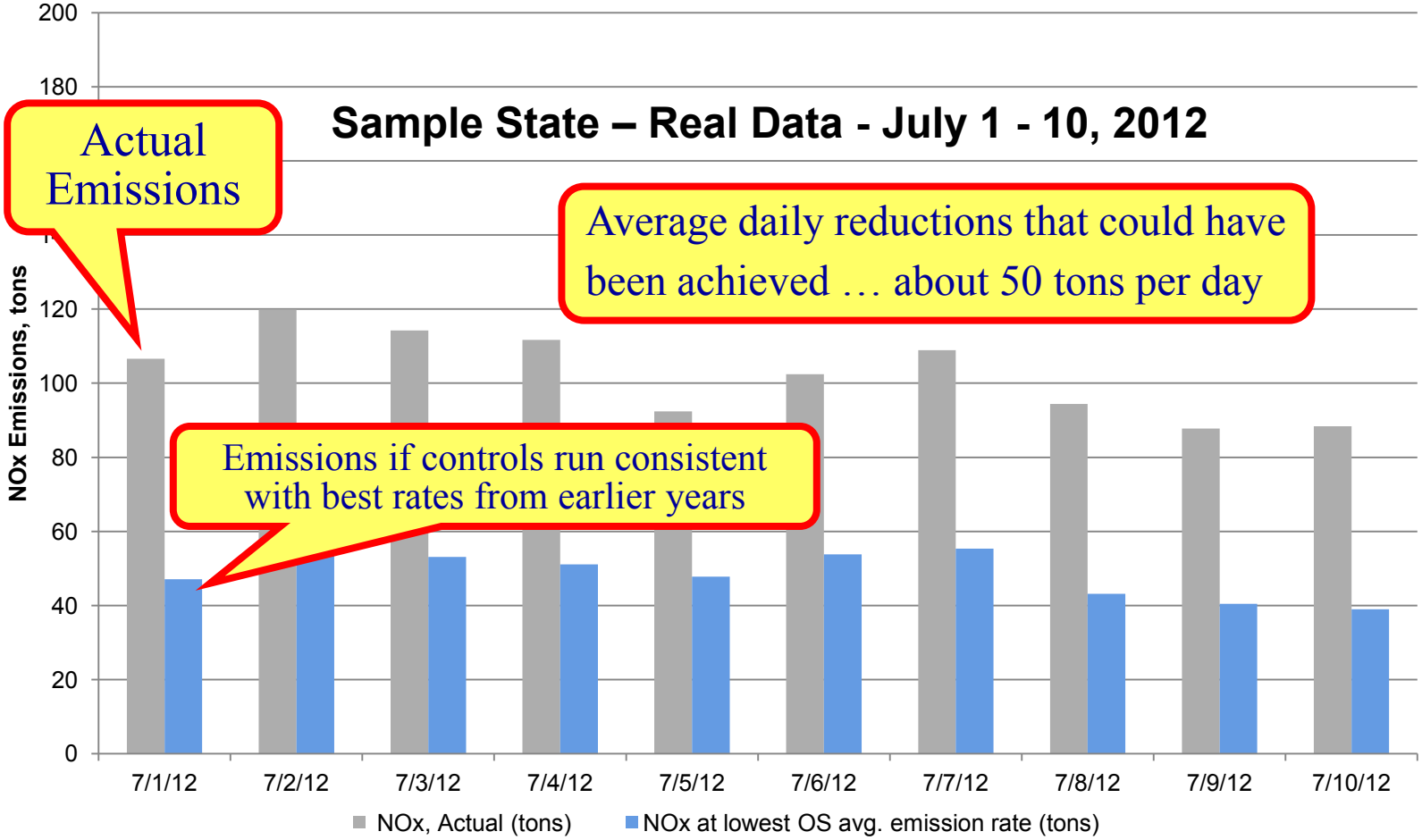
Some Units Are Not Running Controls as Well →



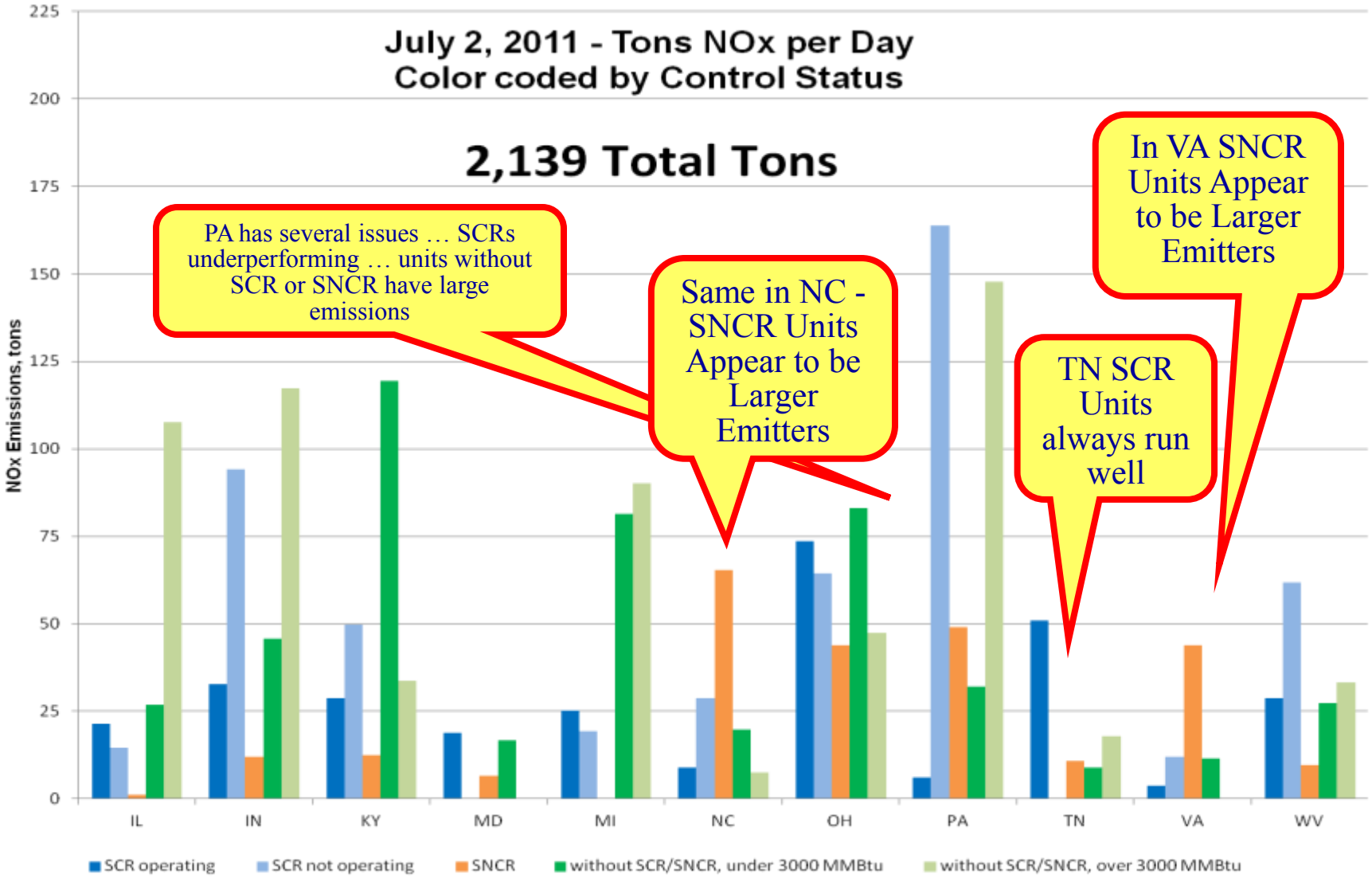


Emission Increases Can be Significant

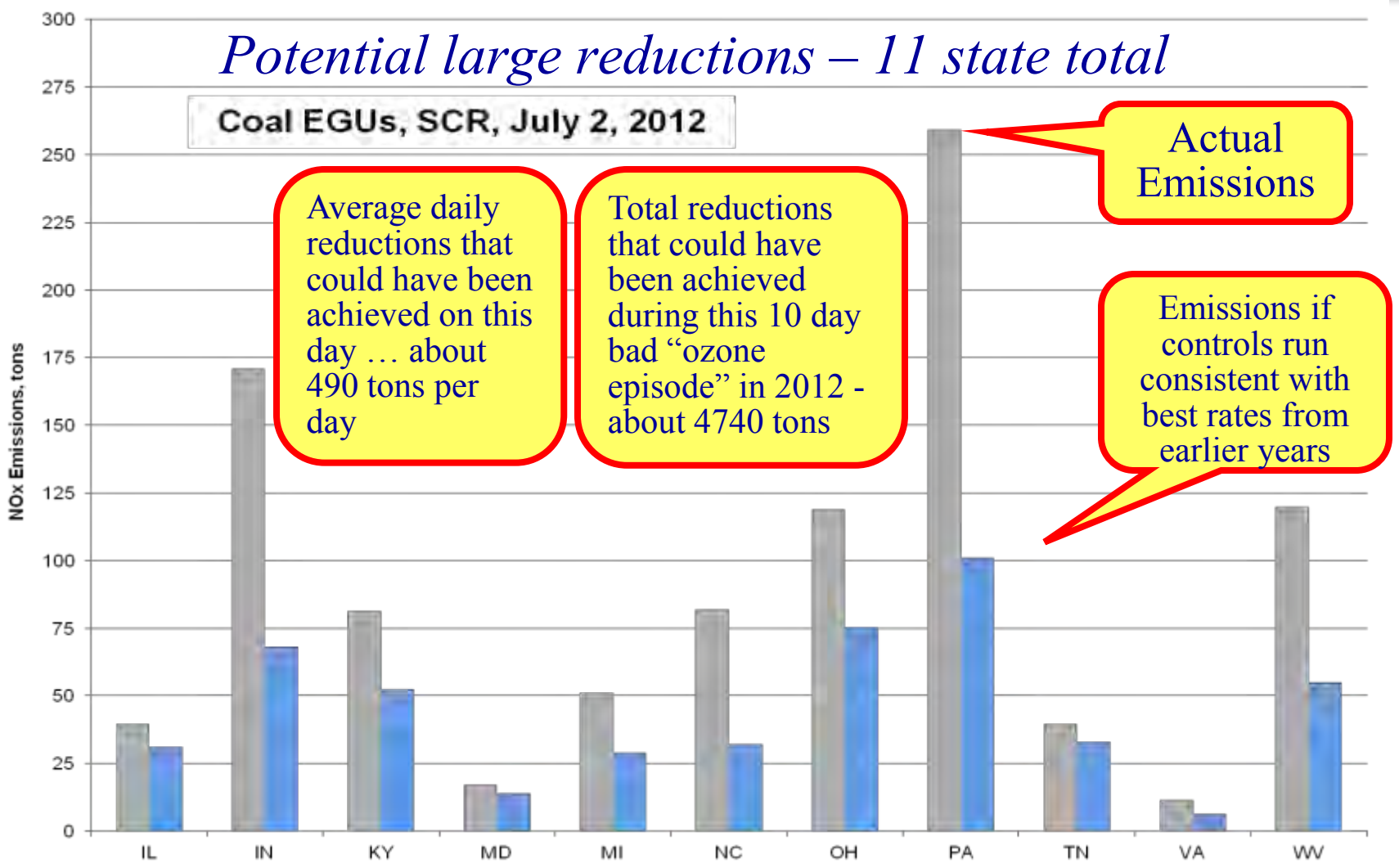
MDE conducted detailed analyses of the July 1 to 10 ozone episode in 2012 – Every coal unit in 11 states



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

Other Changes Are On the Way

Summary of Generation in WV - 2012

- Total number of units = 60
- Total heat input capacity = 173,267MMBTU/hr = 17,586 MW
- Total State MW Capacity in %
  - Total number of Coal units = 35 = 88%
  - Total number of NG units = 20 = 9%
  - Total number of other (oil, etc.) units = 5 = 3%
  - Total number of Nuclear units = 0 = 0%
- Total Capacity Coal = 15,489 MW
  - 15 units with SCR = 11,755 MW = 76%
  - 4 units with SNCR = 496 MW = 3%
  - 16 units without SCR/SNCR = 3,237 MW = 21%

Summary of Generation in WV - 2018

- Total number of units = 39
- Total heat input capacity = 143,851 MMBTU/hr = 14,493 MW
- Total State MW Capacity in %
  - Total number of Coal units = 19 = 90%
  - Total number of NG units = 20 = 10%
  - Total number of other (oil, etc.) units = = 0%
  - Total number of Nuclear units = 0 = 0%
- Total Capacity Coal = 12,946 MW
  - 15 units with SCR = 11,648 MW = 90%
  - 2 units with SNCR = 191 MW = 1.5%
  - 2 units without SCR/SNCR = 1,107 MW = 8.5%

Mid-Atlantic Neighbors

- How are close-by states doing with adopting new measures to reduce ozone transport?

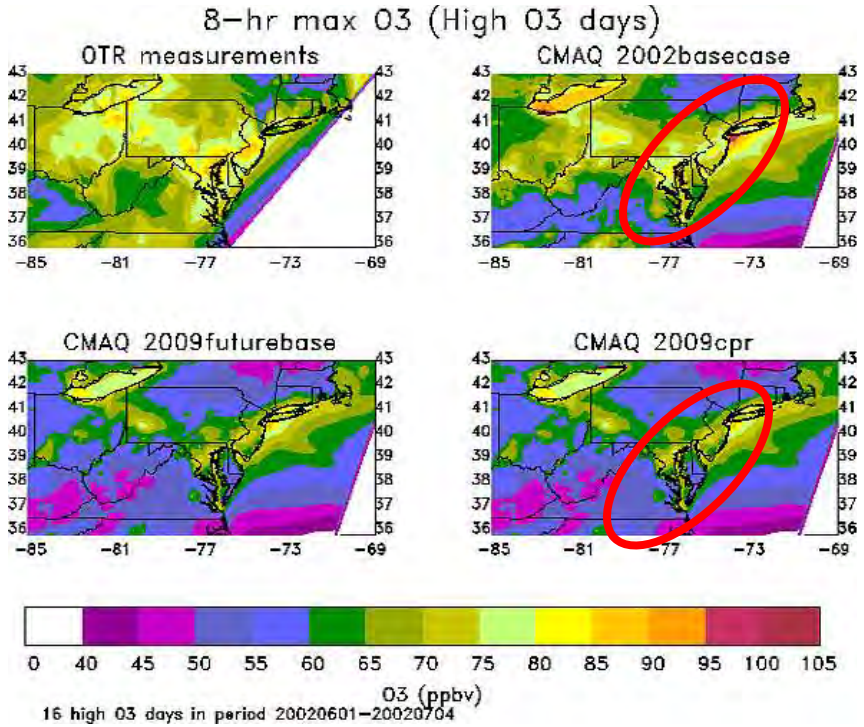
Potential Good Neighbor Actions	NJ	MD	PA	DE
Optimized EGU Controls	A+	A-	?	A+
Aftermarket Catalysts	?	B	?	?
On-Road Idling	B	B-	B	B
Nonroad Idling	B	B-	?	?
Heavy Duty I & M	A+	B	?	B
Enhanced SMARTWAY	?	B	?	?
Ultra Low NOx Burners	A	B	?	A
Consumer Products	?	B	?	B
AIM	?	B	?	B
Auto Coatings	?	B	?	B
Small Combustion/Peak Day	B*	C+	?	B

* The NY/NJ/CT nonattainment area will need help from NY on this one

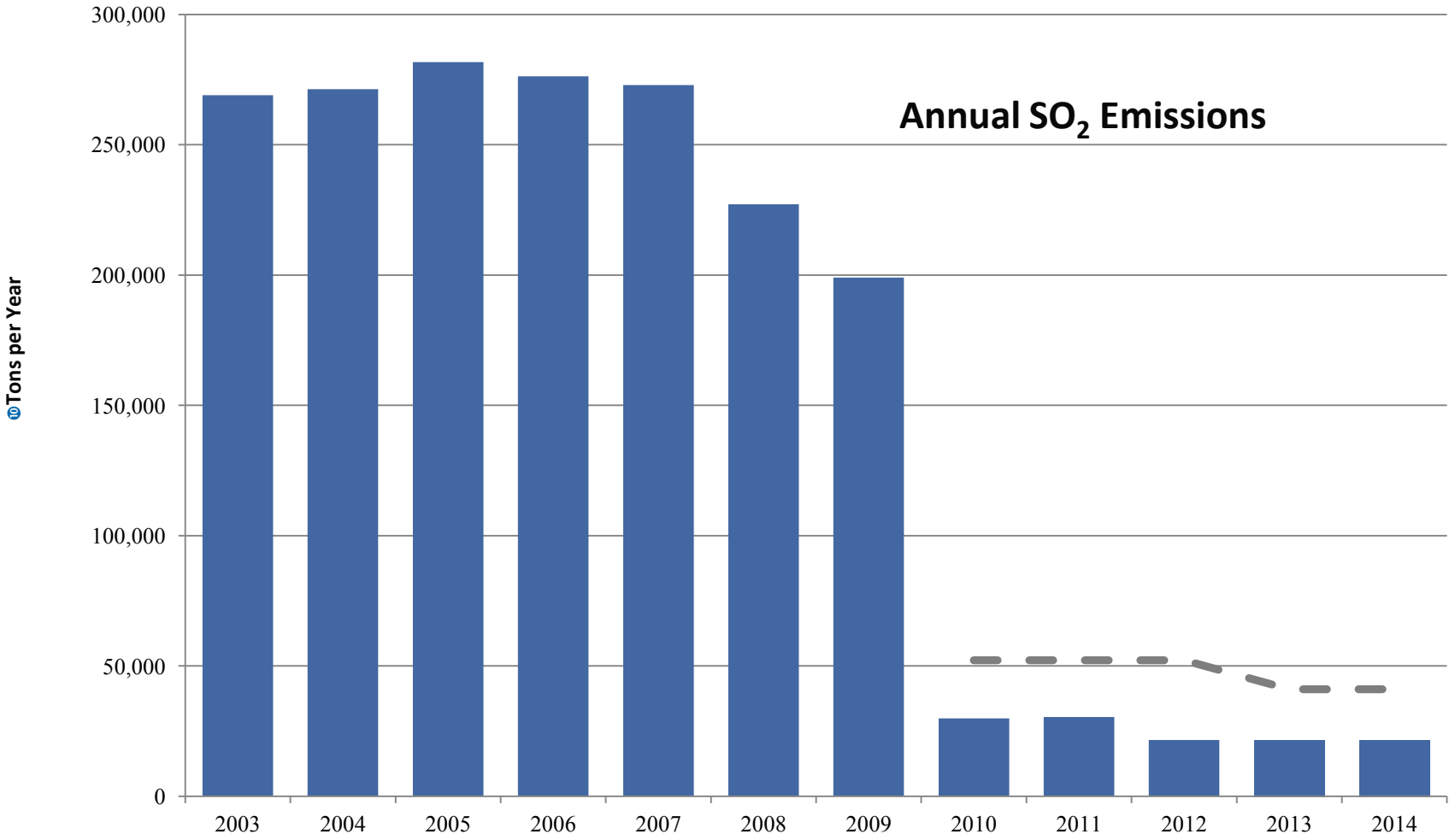
Maryland's Healthy Air Act

Good News For New Jersey

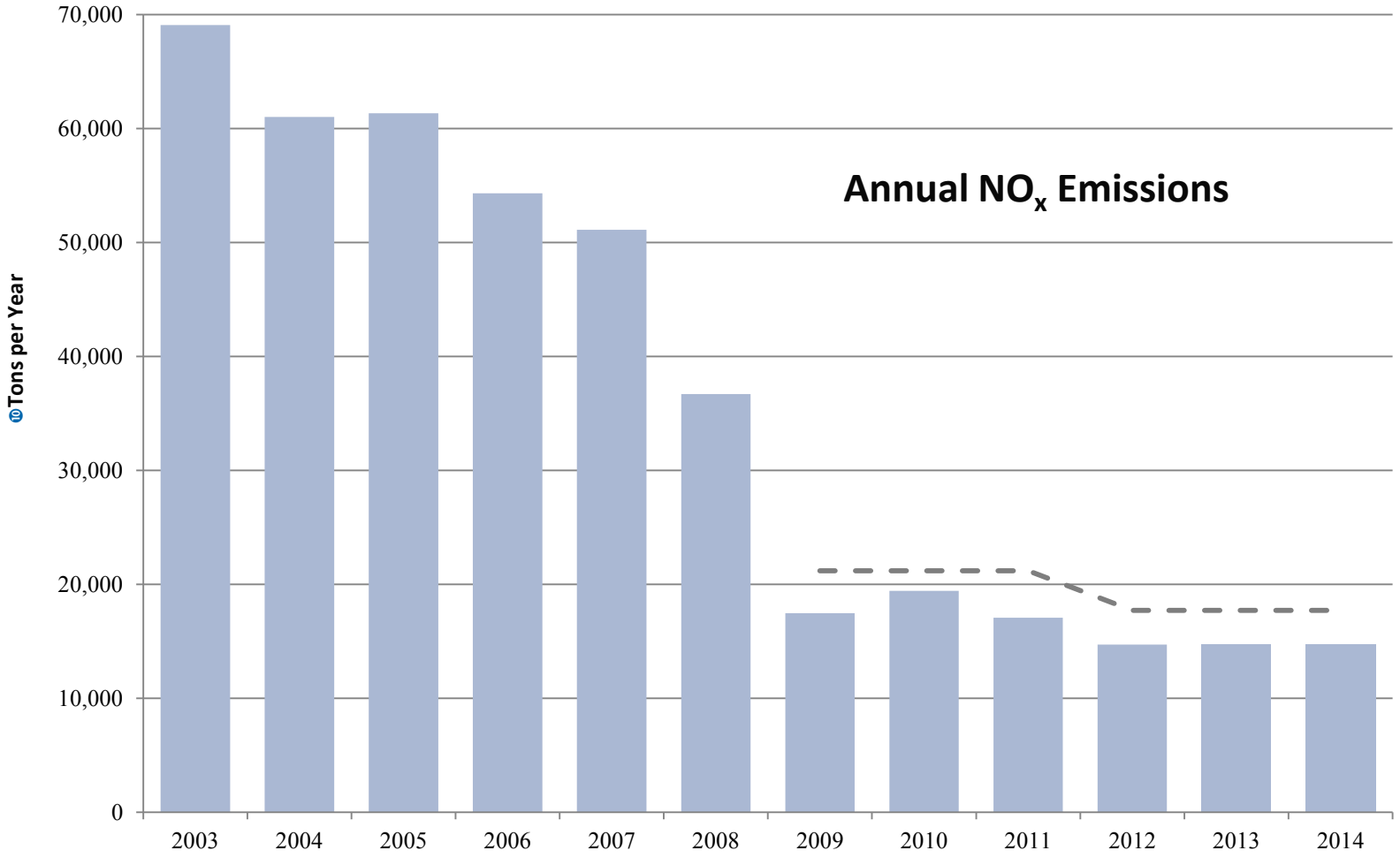
- Maryland's Healthy Air Act (HAA) now fully implemented
  - May 2009 and 2012 deadlines for NOx controls
  - January 2010 and 2013 deadlines for SO2 and Hg controls
  - All controls installed on time
  - 6 plants – 9 units
- Major investment in Scrubbers, SCRs, ACI, baghouses and other controls
  - $2.6 Billion investment into state-of-the-art pollution control equipment
- Yes … Maryland is pretty much directly upwind of NJ



HAA Results – SO2

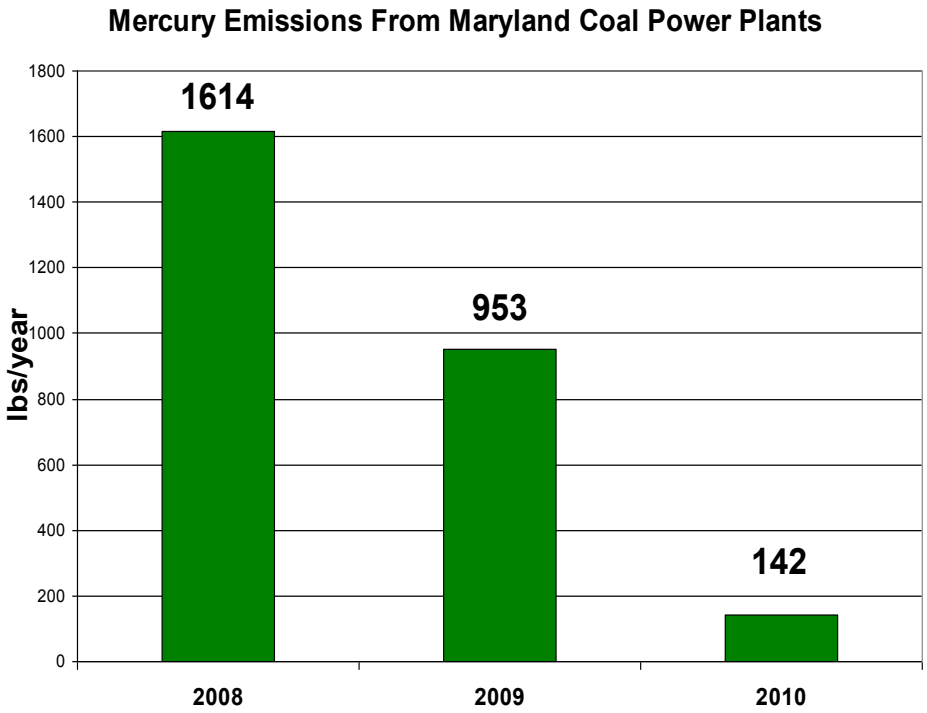


HAA Results – NOx



HAA Results – Mercury & Other Air Toxics

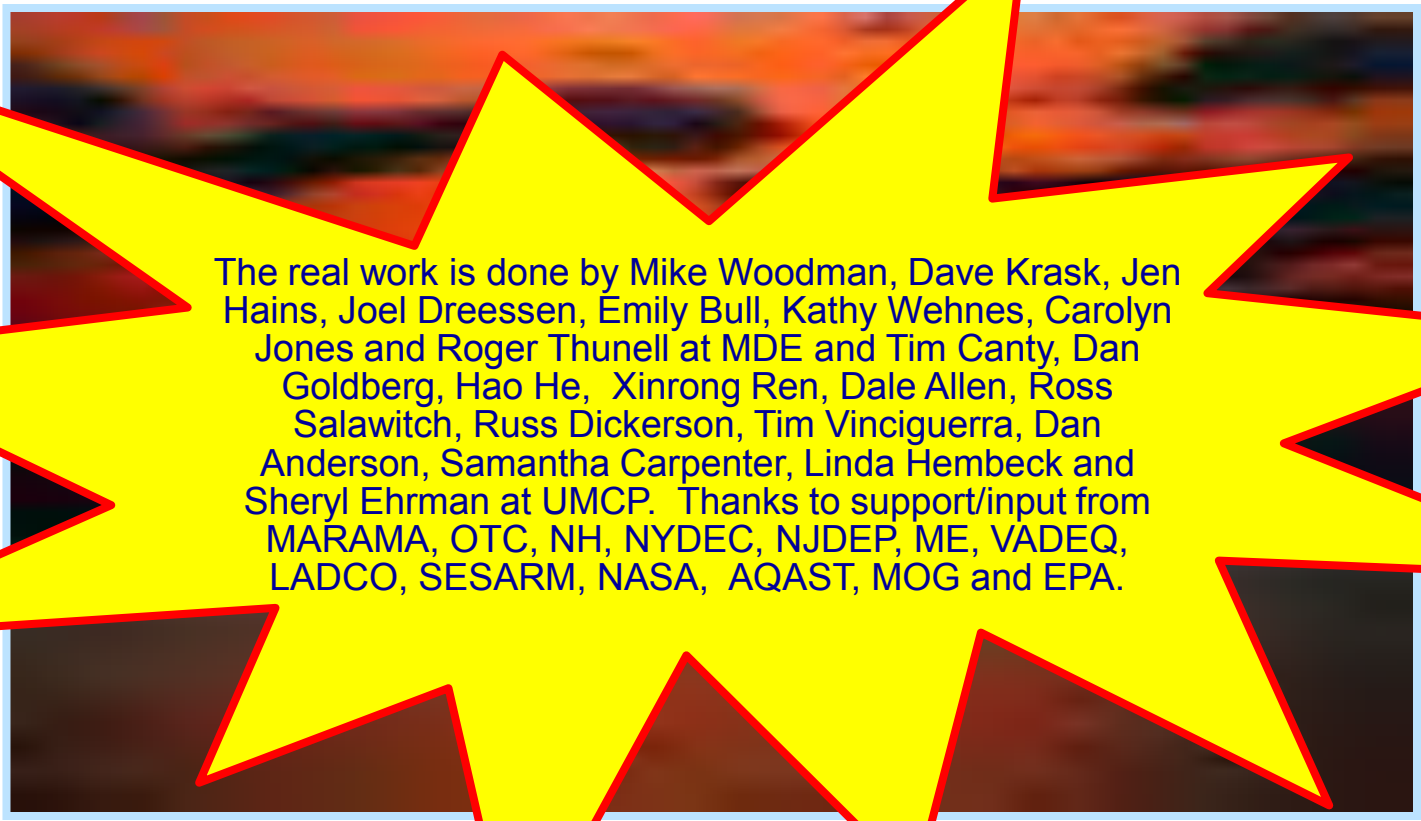
- Mercury
  - Exceeded 2012 90% reduction requirement in 2010
- Hydrogen Chloride reduced 83%
- Direct particulate matter reduced 60%



Roundtable Discussion Ideas

- How to move forward with the OTC Measures?
  - In MD … in NJ … in other states
- Three of the OTC measures (Aftermarket Catalysts, Consumer Products and AIM) are supported by the private sector … except … "better if implemented through a Federal Rule"
  - What about Federal rules from EPA?
- Making sure power plant controls are actually run … and run well
  - NJ is done … give Bill and Chris a gold star
  - Maryland has rule in last stages of adoption
  - Can EPA help with PA – RACT can not possibly mean just buying the controls … it must also mean running the controls?
- Future Ozone Standards
  - Mobile sources will dominate future ozone problems.
  - How can we get these controls started now as the timing of reductions from mobile source control programs involves fleet turnover and is therefore … very slow

Thanks



The real work is done by Mike Woodman, Dave Krask, Jen Hains, Joel Dreessen, Emily Bull, 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.