Maryland
Department of the Environment

Air Quality 101
A Review of Air Quality Facts & Figures in the Baltimore Region

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Air Pollution

- Federal Clean Air Act requires the U.S. EPA to set National Ambient Air Quality Standards (NAAQS)
- Primary NAAQS are designed to protect health
  - Prevent effects such as respiratory and heart disease aggravation, respiratory symptoms, and even death
- Secondary NAAQS protect against welfare effects
  - Protect wildlife, vegetation, agriculture, buildings, and visibility

Air Quality Standards

- NAAQS are set for six common air pollutants ("criteria air pollutants")
  - Ozone (smog, O_3)
  - Fine particulate matter ($PM_{2.5}$)
  - Lead (Pb)
  - Nitrogen dioxide, (NO_2)
  - Sulfur dioxide (SO_2)
  - Carbon monoxide (CO)
- Sources include motor vehicles, electricity production, industries, & even some trees

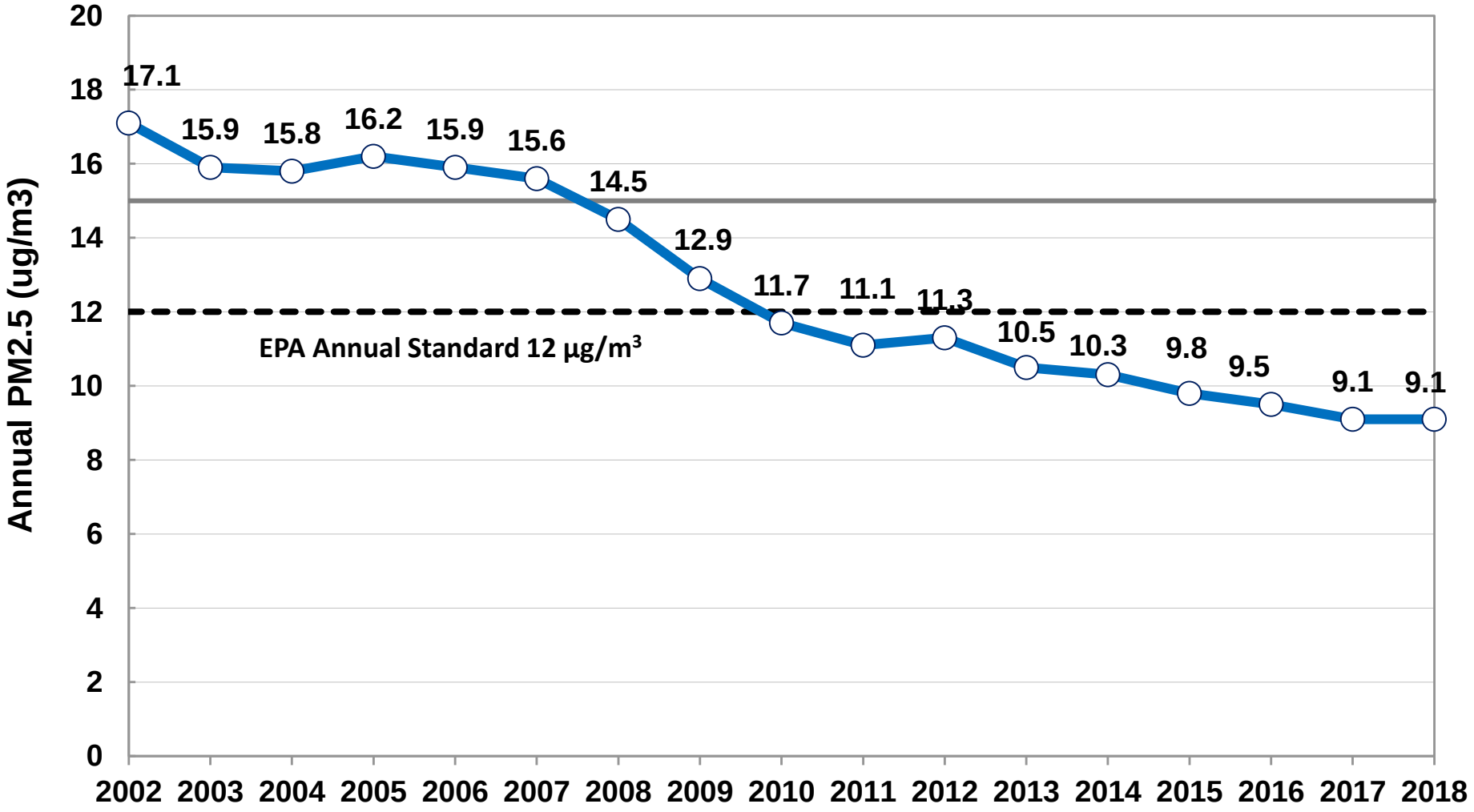
Pics: https://www.epa.gov/criteria-air-pollutants

Maryland is in attainment of most air quality standards

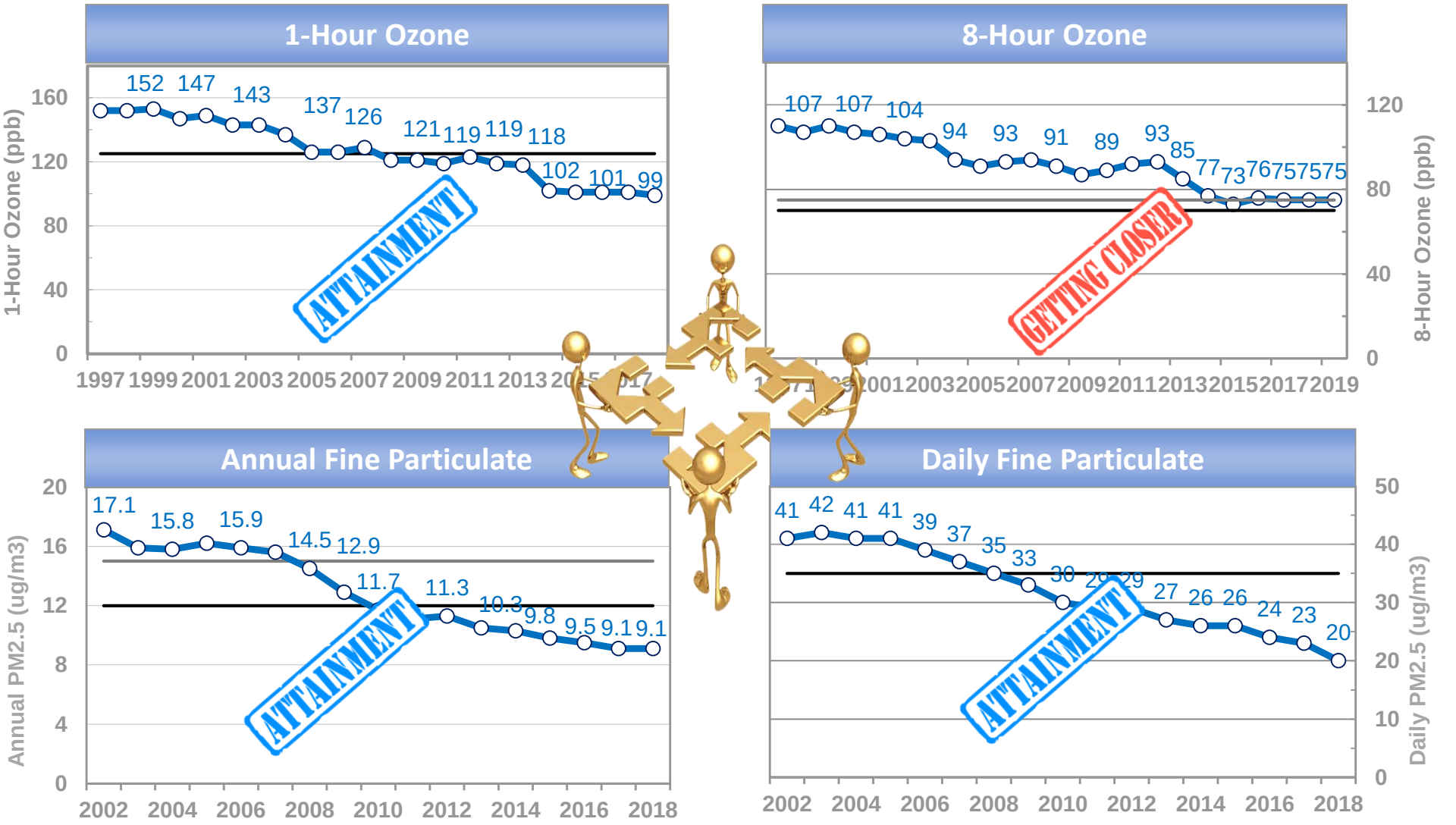
- Nitrogen dioxide – one of the highly reactive gases, nitrogen oxides (NOx)
  - Sources: Primarily from burning fuel in motor vehicles, power plants, & off-road equipment
- Particulate matter – fine particles ($PM_{2.5}$) and coarse particles (PM_{10})
  - Sources: motor vehicles, power plants, factories, wood burning, construction, forest fires, and more.
- Carbon monoxide – released from incomplete oxidation of carbon
  - Sources: particularly from the burning of fuel in motor vehicles
- Lead – released from industry & nature
  - Utilities, incinerators, & previously in gasoline

https://www.osha.gov/images/dsg-motor_vehicles.jpg

Fine Particle Air Pollution
Lower Levels Across the State



Progress in Cleaning Maryland's Air



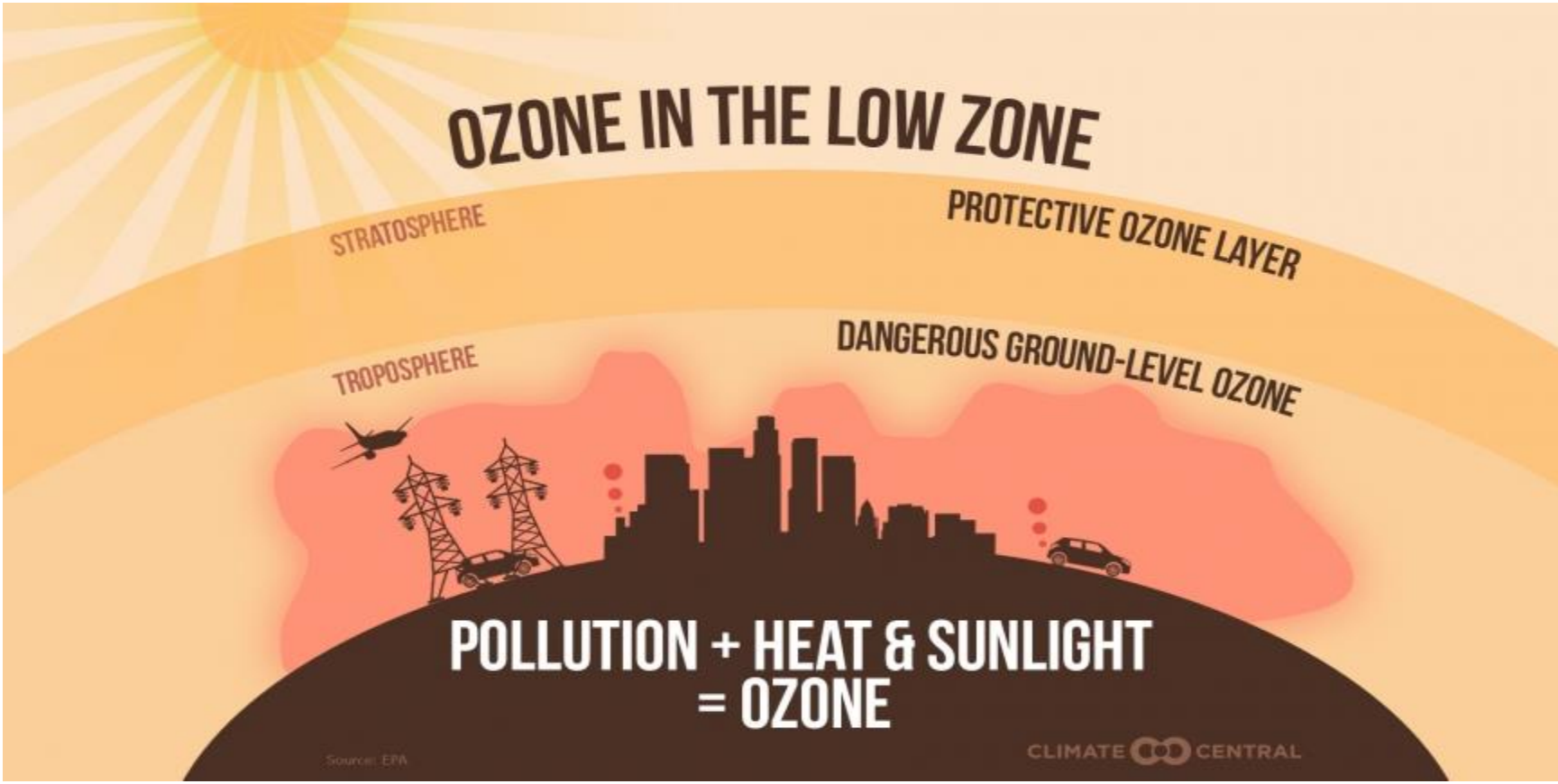
* 2019 data is preliminary
Though Aug 14th

Baltimore area is “nonattainment” but getting close to attainment for these:

- Ozone (smog) = nitrogen oxides (NOx) + volatile organic compounds (VOCs) + sunlight
  - Sources of NOx: burning fuel in motor vehicles, power plants/industries
  - Sources of VOCs: motor vehicles, recreational marine vehicles, consumer products
  - Sources of formed ozone: upwind states
- Sulfur dioxide
  - Sources: burning of fossil fuels, especially coal & diesel in power plants, paper & steel industries, ships

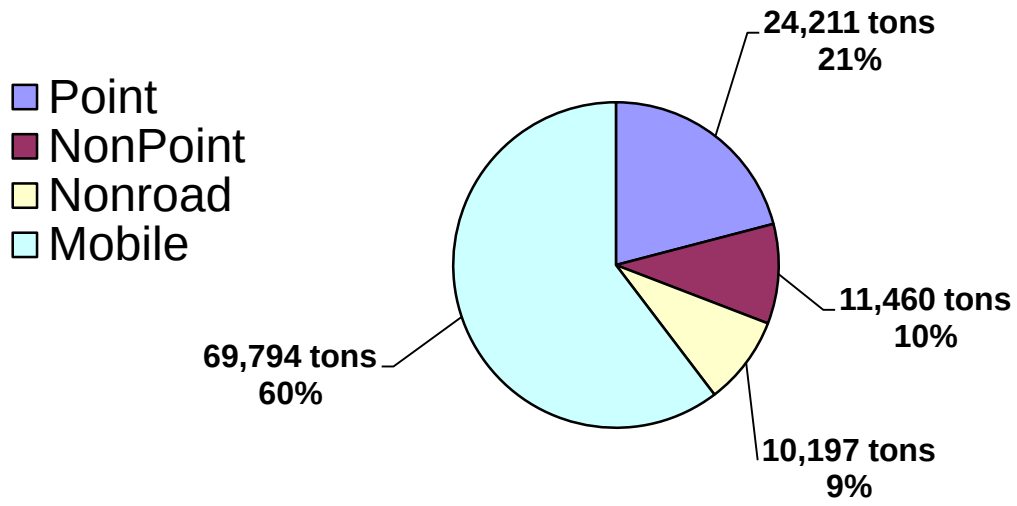
https://en.wikipedia.org/wiki/Sulphur_Emission_Control_Area

Ozone - Smog


OZONE IN THE LOW ZONE
STRATOSPHERE
PROTECTIVE OZONE LAYER
TROPOSPHERE
DANGEROUS GROUND-LEVEL OZONE
POLLUTION + HEAT & SUNLIGHT
= OZONE
Source: EPA
CLIMATE CENTRAL

NO_x Emissions 2014

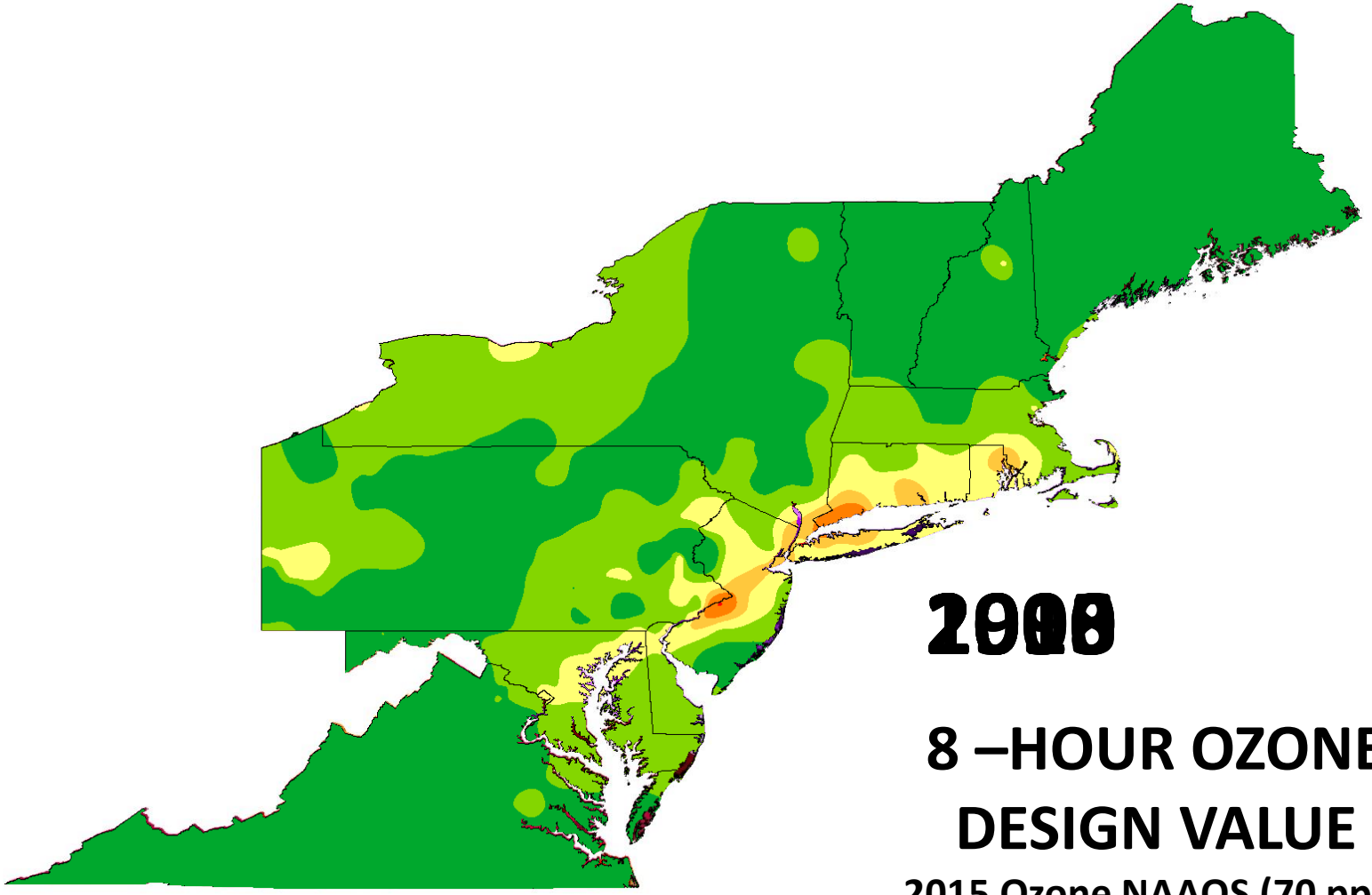
2014 Annual NO_x Emissions
115,700 tons per year
(NEI 2014 v1)



2014 TOP 12 VOC SOURCES

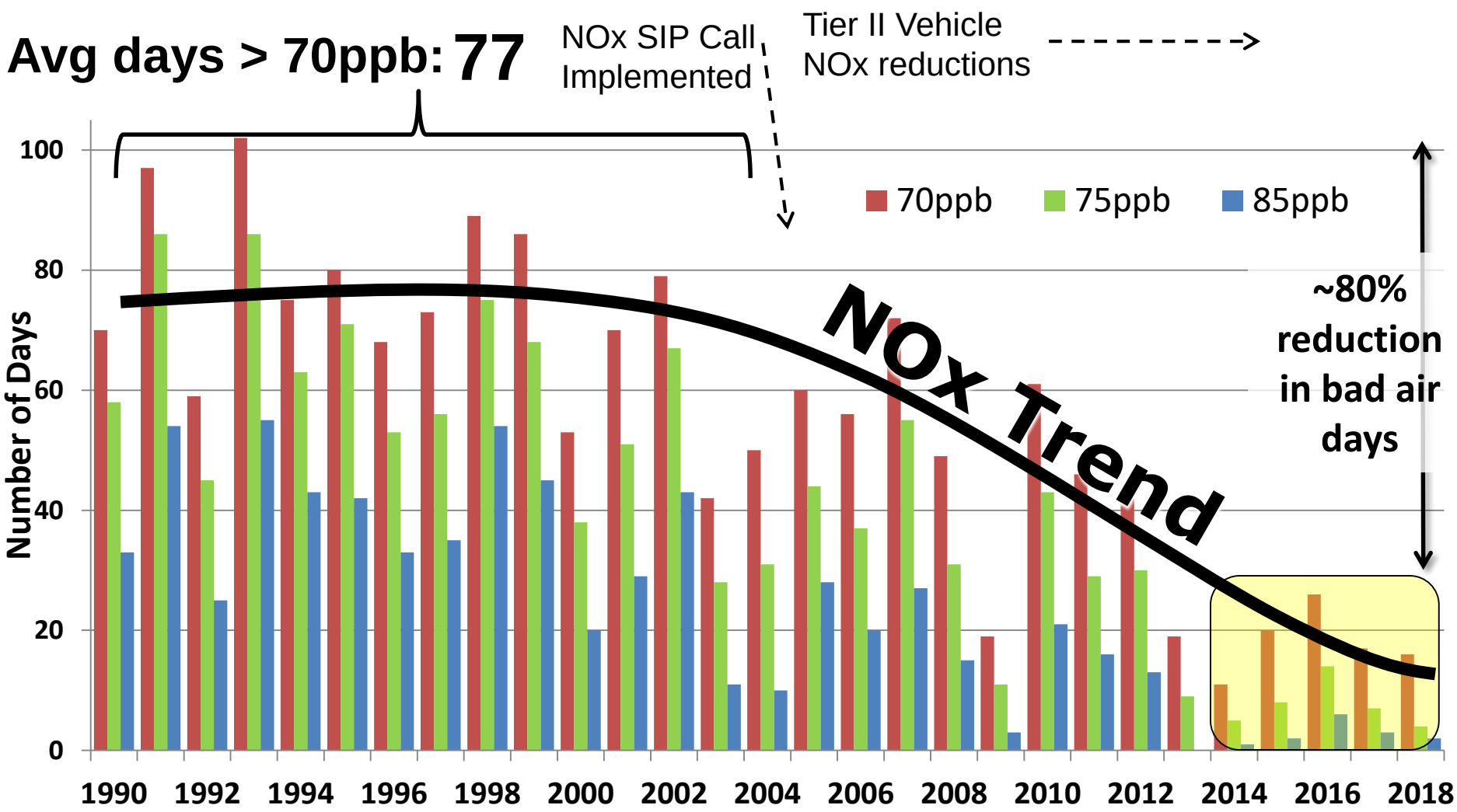
Source	Source Description	VOC tons per year
Mobile	Onroad	27,790
Nonpoint	Commercial & Consumer Products	16,007
Nonpoint	Industrial Surface Coatings	4,334
Nonpoint	Architectural Surface Coatings	4,236
Nonpoint	Prescribed Fires	3,983
Nonpoint	Residential Wood Combustion	2,894
Nonpoint	Portable Fuel Containers	2,782
Nonpoint	Cold Cleaning Degreasing	2,774
MAR	AIRCRAFT	2,756
Nonpoint	Forest Fires	2,035
Nonpoint	Graphic Arts	1,876
Nonpoint	Open Burning	1,765

Shrinking Ozone in the Ozone Transport Region



Maryland Exceedance Days are Decreasing

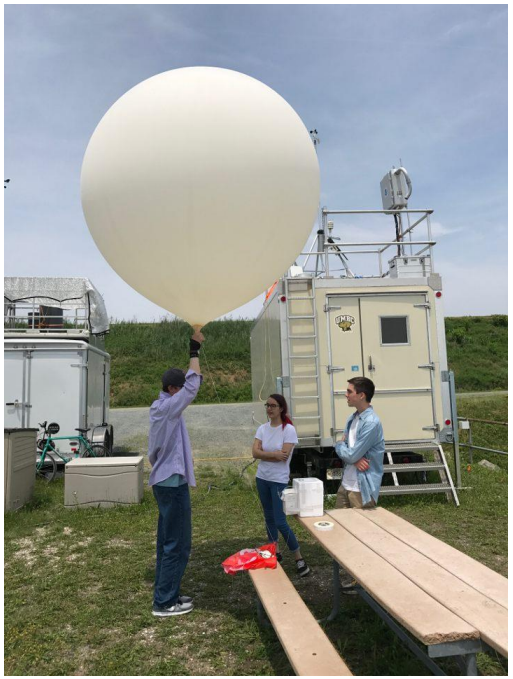
Number of days annually when any MD monitor exceeds NAAQS



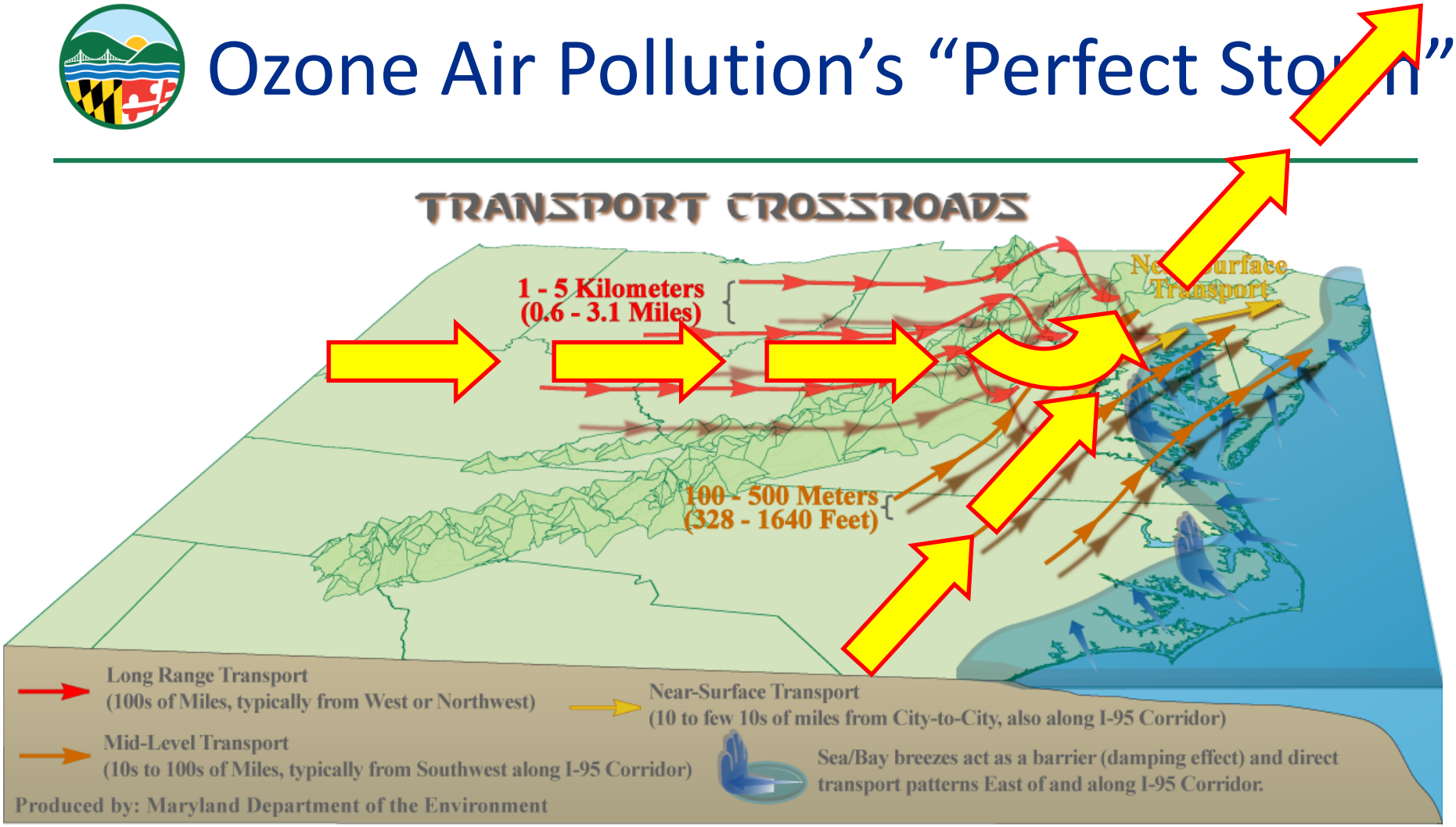
Understanding Ozone Transport

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 major contributor
  - **Night-time, Southerly Transport** – Vehicles, power plants, more
  - **“Local” or “City-to-City” Transport** – An urban soup … D.C. to Baltimore … Baltimore to Philly… NJ & NY to CT… etc.



Ozone Air Pollution's "Perfect Storm"

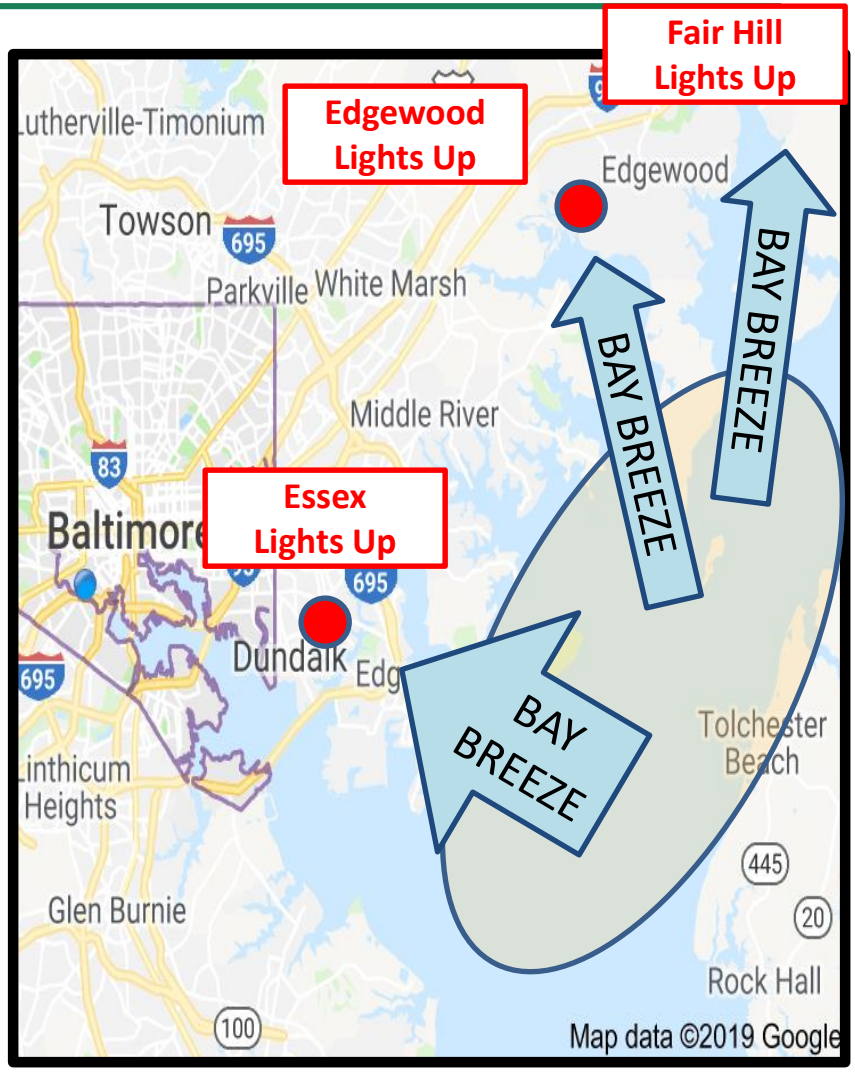


- Westerly, southerly and city-to-city transport converge on the Mid-Atlantic area.
- Sea and bay breezes & other interesting meteorology like the Appalachian "Lee Side Trough" act as a barrier or a "wall" and drives a hard left turn that funnels ozone and other air pollutants up the Northeast Corridor.

Our Theory for How High Ozone Days are often Created in MD

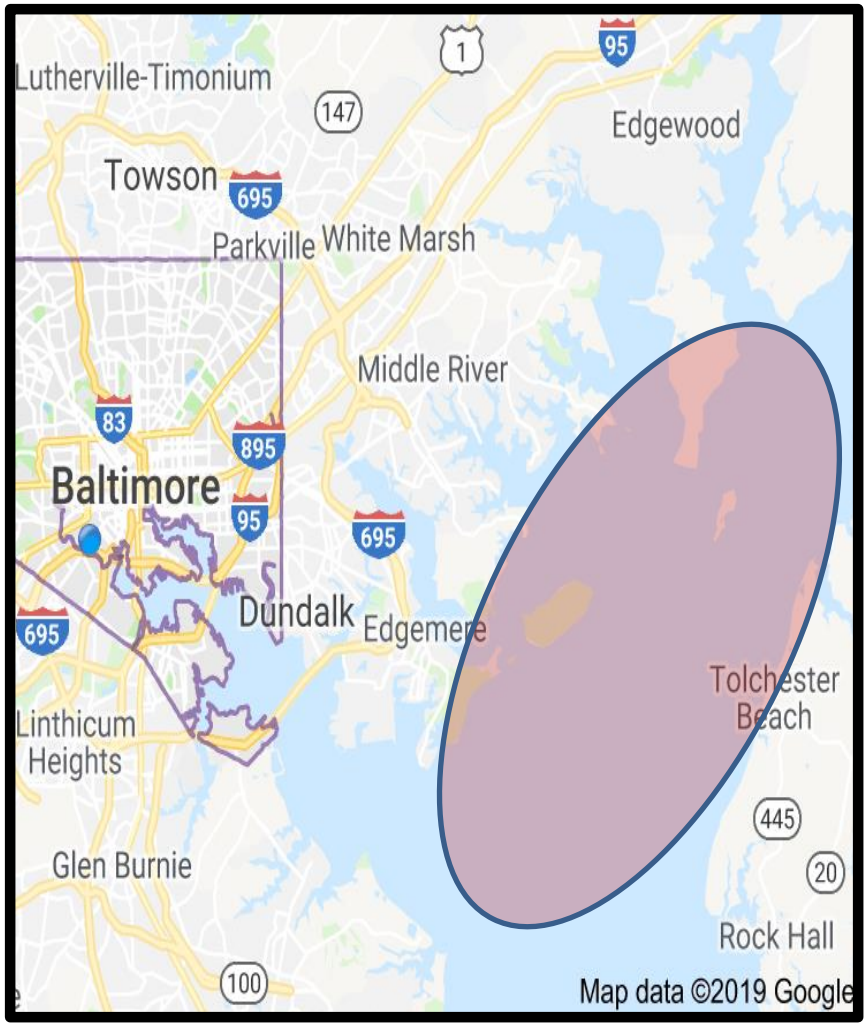
- Linked to our research on the "Land-Water Interface"
  - Why are highest levels of ozone often right near the Bay … close to water?

- The theory
  1. Ozone builds up over the Bay
     - Transport plays a role … mobile sources play a role … but
     - How significant are stationary sources that may emit at higher levels on real hot days
  2. In the afternoon, Bay breezes push pollution over the Bay to the west, north, northwest or southwest
  3. Monitors directly downwind of Bay breeze record highest daily ozone



So Where Does the High Ozone Over the Bay Come From?

- We believe there are four major contributing emission sectors to the high ozone we measure over the Bay
  - Some research … some expert judgment
- The four most likely largest contributors:
  - Longer distance transport
  - Cars and trucks - VA and MD - I-95 corridor
  - Big and small boats
  - Close-by High Electric Demand Day (HEDD) Units



So What is Maryland Doing About These Sectors?

- Cars and Trucks
  - Huge effort, partially driven by climate change - Clean Cars Programs, EVs, multiple legal challenges related to EPA backsliding on mobile source control programs
- Long Distance Transport
  - Huge effort - 126 Petitions, multiple legal challenges related to EPA actions on "good neighbor" State Implementation Plans - We are accepting public comments re: an initiative on PA power plants that run controls poorly on peak ozone days
- Close-by High Electricity Demand Day (HEDD) Sources
  - Several initiatives including – (1) daily optimization of controls on power plant units in Maryland and (2) efforts to reduce ozone via a voluntary program with industry - the Peak Day ozone reduction partnership
- Small and Large Boats
  - Not doing much - still a research issue and an area of major uncertainty

Closing Thoughts

- Mobile sources, including motor vehicles such as cars and light trucks are a significant source of:
  - NOx & VOCs, which form ozone (smog) in sunlight
  - Particulate matter, PM2.5, Baltimore area & MD are “attainment” for current standards
  - Greenhouse gases (GHGs)
- Bicycling and walking are effective at reducing motor vehicle air pollution, especially for displacing short trips by car
- Transit, carpooling, teleworking, and electric vehicles help reduce longer trip pollution