Florida Department of Environmental Protection

Office of Communications

Why and How We Monitor
Hands-On Training
Tampa, Florida

April 14, 2015





Overview

- The regulations
- The human impact
- Monitoring in the past, present and future

History of Asthma in Air Regulation

1904

National Association for the Study and Prevention of Tuberculosis, the first nationwide, voluntary health organization aimed at conquering a specific disease, was founded.

1956

The National Association, finding it increasingly difficult to concentrate on the eradication of tuberculosis without paying attention to such related illnesses as asthma, chronic bronchitis, emphysema and many other respiratory diseases, expanded its education and program goals to include all lung disease and the elimination of the causes of these diseases.

1973

The National Tuberculosis and Respiratory Disease Association changed its name to the American Lung Association (ALA).

Building Support

- In 1969 at a UNESCO Conference in San Francisco, peace activist John McConnell proposed a day to honor the Earth and the concept of peace, to first be celebrated on March 21, 1970, the first day of spring in the northern hemisphere. This day of nature's equipoise was later sanctioned in a Proclamation written by McConnell and signed by Secretary General U Thant at the United Nations. A month later a separate Earth Day was founded by United States Senator Gaylord Nelson as an environmental teach-in first held on April 22, 1970.

Clean Air Act

- The 1955 Air Pollution Control Act was the first U.S federal legislation that pertained to air pollution;
- The first federal legislation to actually pertain to "*controlling*" air pollution was the Clean Air Act of 1963.
- In 1967, the Air Quality Act enabled the federal government to increase its activities to investigate enforcing interstate air pollution transport, and, for the first time, to perform far-reaching ambient monitoring studies and stationary source inspections.
- The 1970 amendments expanded the federal mandate, requiring comprehensive (permitting, compliance and monitoring) federal and state regulations for both stationary (industrial) pollution sources and mobile sources.
- Also, the Environmental Protection Agency was established on December 2, 1970 for the purpose of consolidating pertinent federal research, monitoring, standard-setting and enforcement activities into one agency that ensures environmental protection. expanded federal enforcement.

The Ways of the Act

- NAAQS are set,
- Designations made,
- SIPs written to attain the NAAQS describing control measures,
- Facilities are permitted,
- Monitoring (ambient and CEMs) is performed,
- Cycle begins again as the NAAQS are required to be reviewed every 5 years.

The Drivers

- What drove people to support organizations like those that became the American Lung Association?
- And to want to celebrate an Earth Day to draw attention to our environment?
- And to have congress write laws like the Clean Air Act?

Air Pollution Disasters

1930 Meuse River Valley, Belgium

A three-day episode of severe air pollution makes 6,000 ill and kills 63.

1948 Denora, PA

Oct. 26 to 31: air pollution episode leaves 20 dead out of 14,000 persons.

Donora, PA at noon on Oct. 29, 1948

1952 London, England

Dec. 4 to 9: “Killer Fog” leaves three to four thousand people dead.

London buses are escorted by lantern at 10:30 in the morning.

Current Air Pollution Disasters

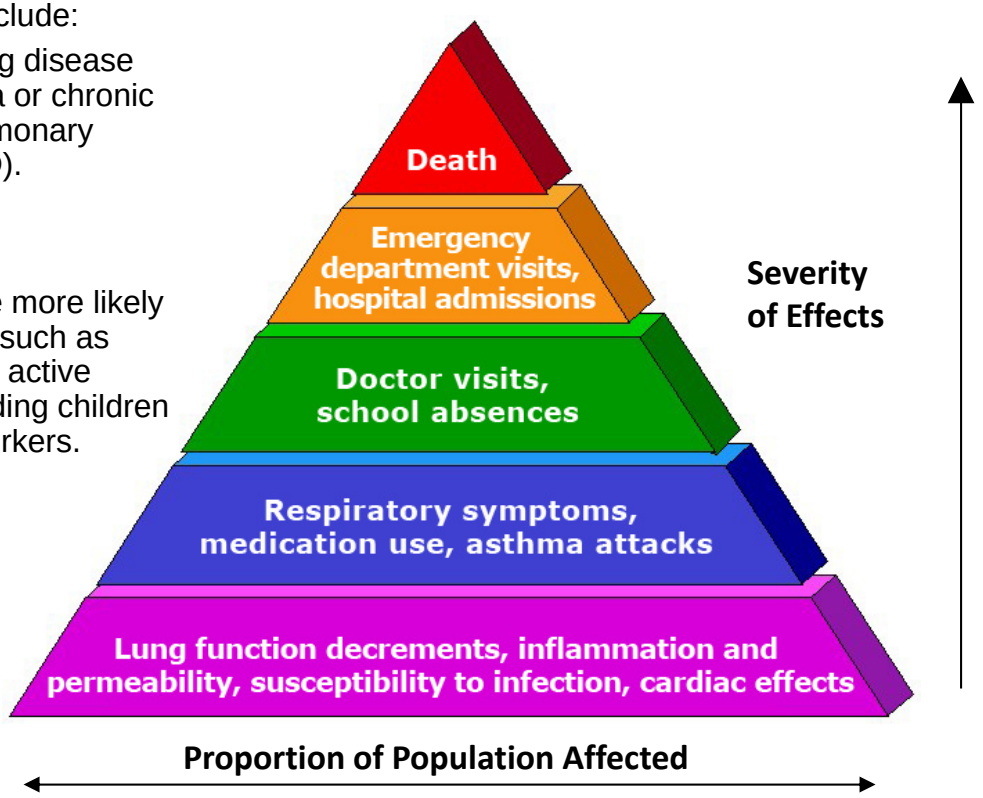
Eerie Smog Descends On Northern China

Imaginechina / AP

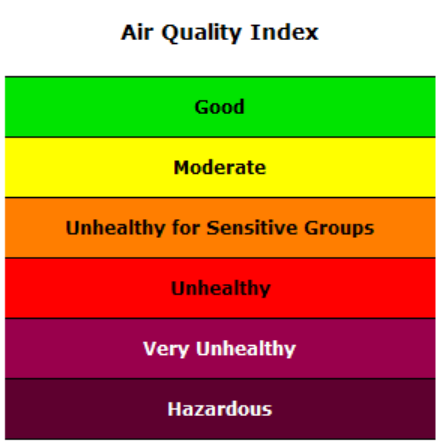
A cyclist wearing a face mask rides on a road in heavy smog in Harbin, northeast China's Heilongjiang province, October 21, 2013.

Ozone Health Impacts: “ Pyramid of Effects”

- At-risk groups include:
  - People with lung disease such as asthma or chronic obstructive pulmonary disease (COPD).
  - Children.
  - Older adults.
  - People who are more likely to be exposed, such as people who are active outdoors, including children and outdoor workers.

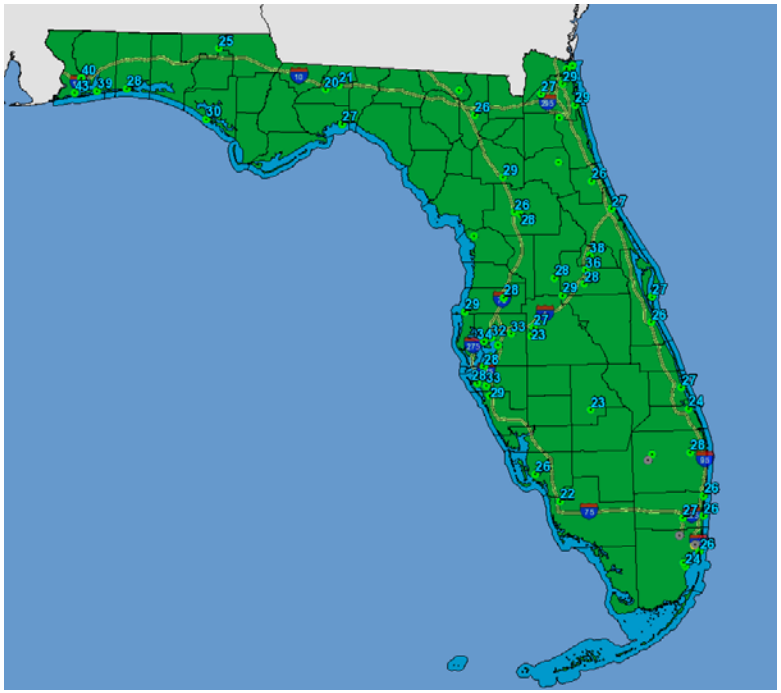


AQI



- AQI is common communication device
- All criteria pollutants, (except lead) are on the same scale
- An index value of zero means no pollution and the level of 101, Unhealthy for Sensitive Groups, is where the concentration passes the level of the NAAQS

Data outgoing from FAMAS: SAQS and FLAQS



Air Quality Monitoring
Daily Readings for September 7, 2014

Air Resource Management

Data on this page are updated hourly from 7:20 AM until 11:20 PM (Eastern time)

It is important to note that the ozone monitoring data less than three months old viewed on this website have generally not been verified and checked for quality assurance in accordance with federal requirements.

More Details about: Tallahassee Community College
Ad Hoc Reporting

AQS # 0073-0012
Tallahassee Community College
Leon County
Tallahassee, FL 32304
Began Monitoring PM 2.5: 07/14/2003
PM 2.5 Data For Sunday, September 07, 2014

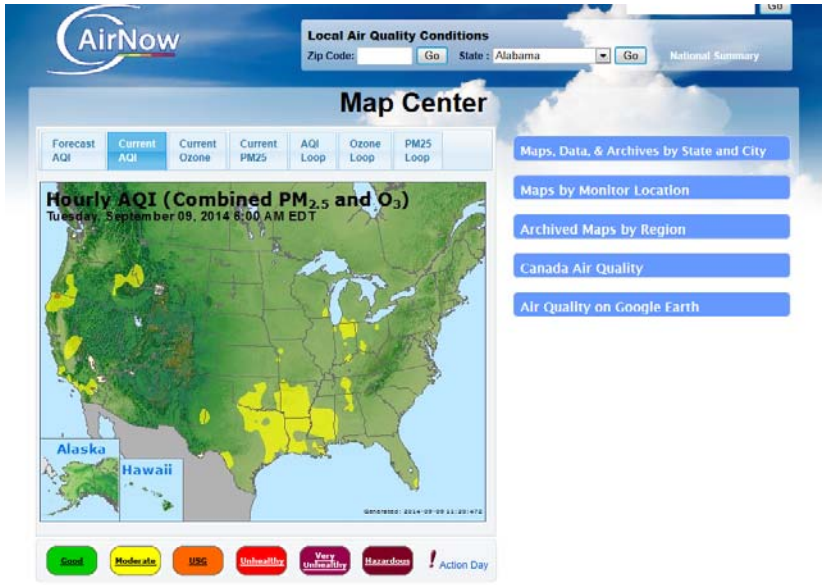
PM 2.5 data below are shown in Micrograms Per Cubic Meter ($\mu g/m^3$)

Hour LST	Reading	Hour LST	Reading
1:00 AM	7.7	1:00 PM	15.6
2:00 AM	6.3	2:00 PM	7.9
3:00 AM	5.8	3:00 PM	5.2
4:00 AM	6	4:00 PM	5.7
5:00 AM	6.8	5:00 PM	2.9
6:00 AM	6.3	6:00 PM	8.7
7:00 AM	7.7	7:00 PM	7.1
8:00 AM	11.7	8:00 PM	5.2
9:00 AM	2.3	9:00 PM	10.1
10:00 AM	11.5	10:00 PM	8.4
11:00 AM	13.8	11:00 PM	10.2
12:00 PM	9.7	12:00 AM	5.4

* = Hourly Value Not Available
M = Missing Hourly Value
B = Bad Hourly Value
Last Updated: Eastern

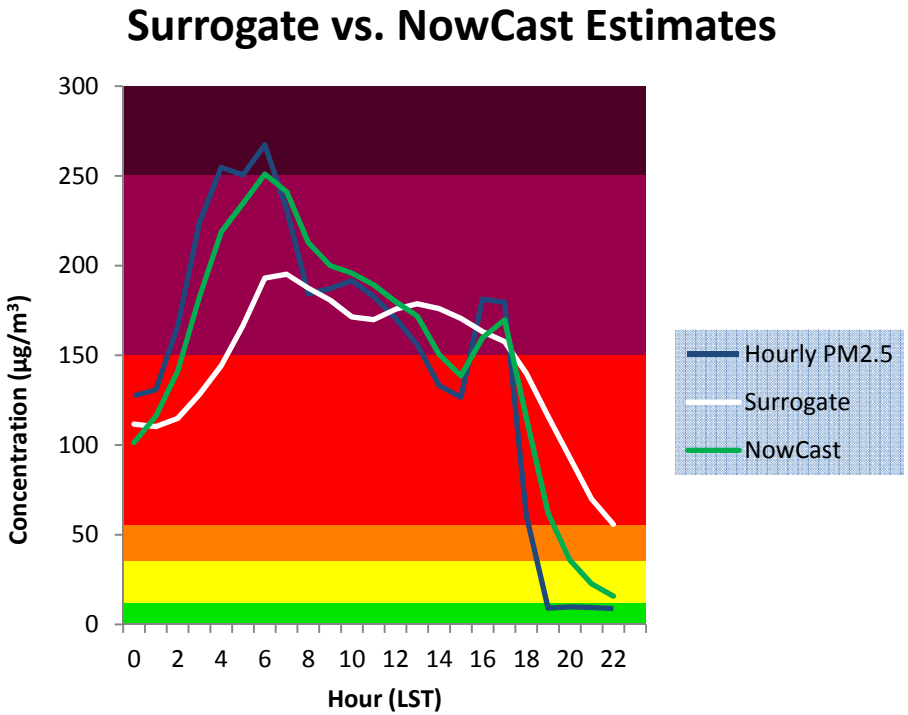
Federal Air Quality Standard
Go To Top

AirNow



- Data are transferred to AirNow hourly
- The same data are posted to FLAQS and SAQS
- Only continuous PM2.5 and ozone are mapped on AirNow

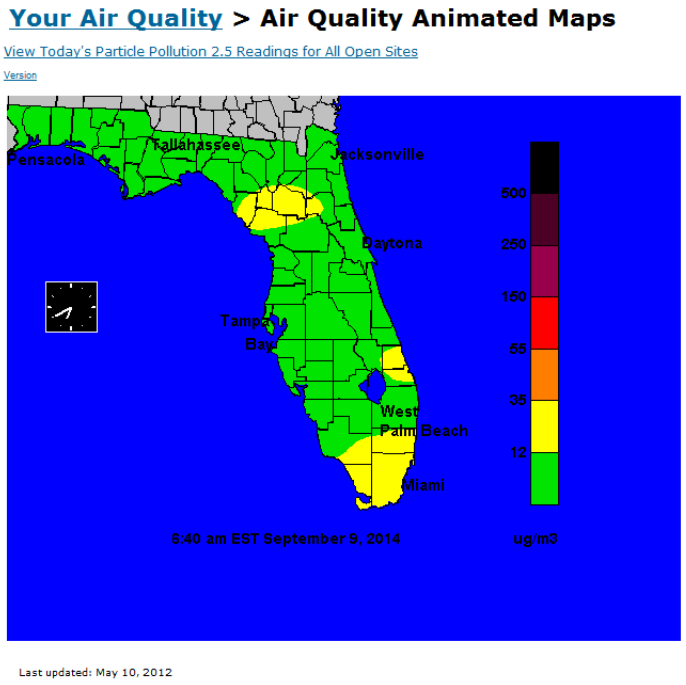
New NowCast is performing well in AirNow



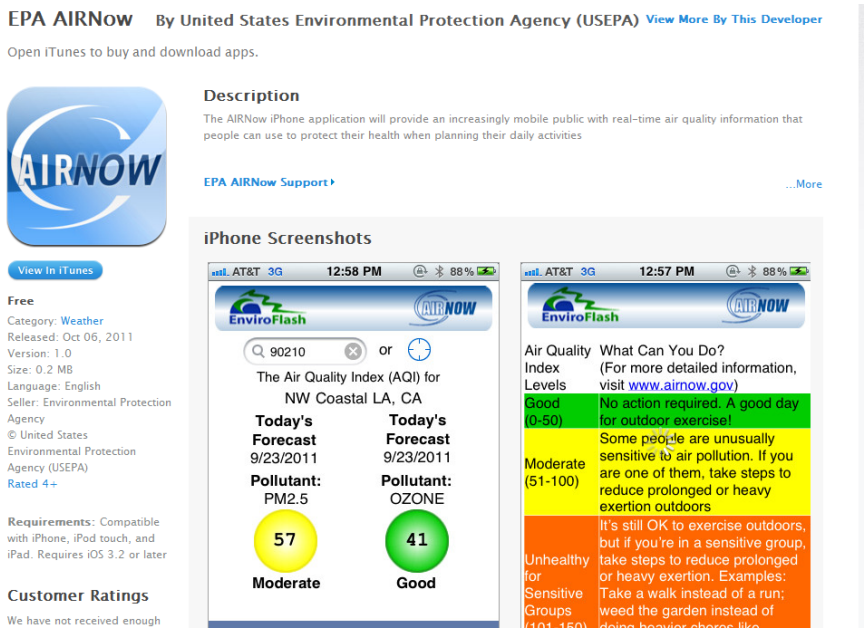
$PM_{2.5}$ Hourly values, Surrogate, and NowCast (µg/m^3) for Medford, Oregon on August 1, 2013. Background shading represents Air Quality Index (AQI) categories.

Animated Maps

- Part of FLAQS
- Display the data for yesterday and today
- While popular, these maps will be unavailable soon as they are not compatible with the new server hardware



There's an Ap for that



- EPA AIRNow offers an iPhone free downloadable app
- It provides real-time air quality information.

Pollutants

- There are six criteria
- National Ambient Air Quality Standards for these six pollutants are set for these pollutants
- There are many non-criteria pollutants
- The most harmful ones are referred to as toxics or hazardous air pollutants, called (HAPs)

Lead

Lead Sampler

Lead NAAQS Changes

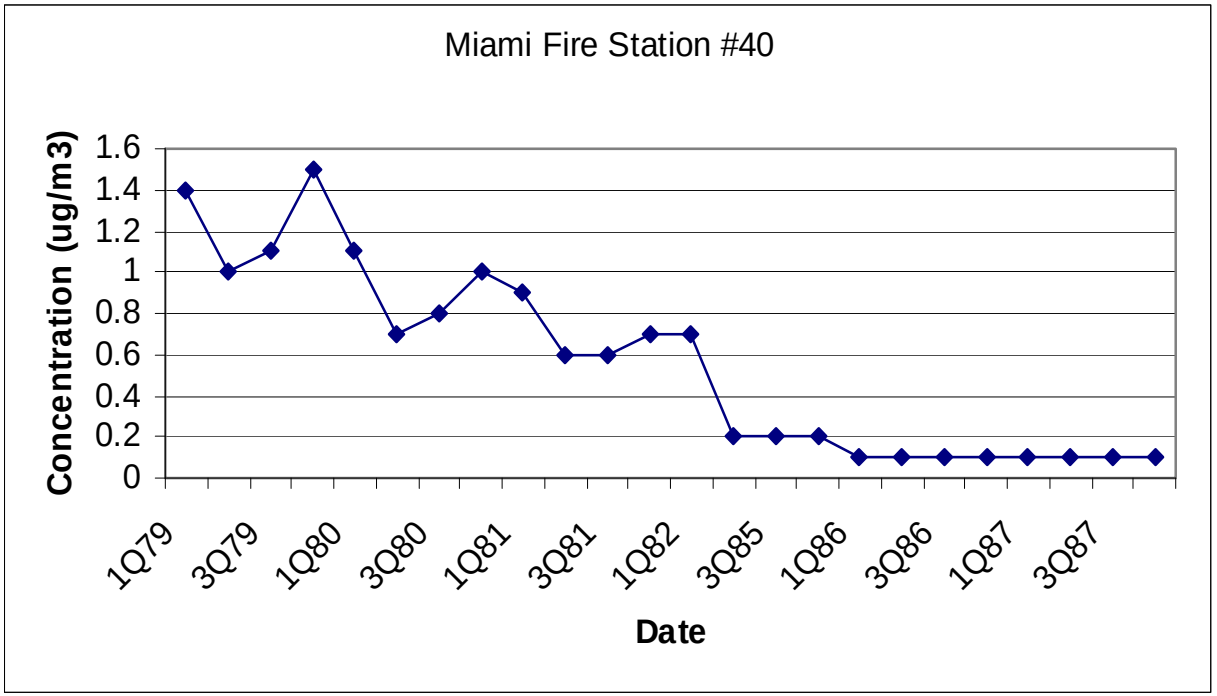
Date	Change
January 12, 2009	NAAQS changed to rolling 3 month average of 0.15 from quarterly average 1.5 ug/m3

Designated area	Designation for the 2008 NAAQS [a]	
	Date [1]	Type
Tampa, FL:		
Hillsborough County (part)	12/31/10	Nonattainment.
Area is located within a 1.5 km radius centered at UTM coordinates 364104 meters E, 3093830 meters N, Zone 17, which surrounds the EnviroFocus Technologies facility.		
Rest of State		Unclassifiable/Attainment.

Lead

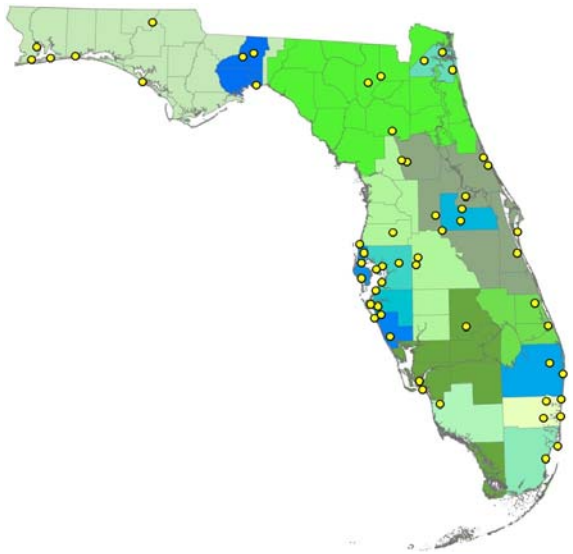
- Mid 70's, lead was removed from gasoline
- Quickly disappeared from ambient air
- Now, only found near sources
- The new standard included a requirement to monitor near some airports

Dropping Lead Levels



Ozone (O_3)

Ozone



- Ozone, a part of smog is not directly emitted but created in the atmosphere by chemical reactions
- It harms things susceptible to oxidation
- Respiratory injury risk is increased

Ozone Instruments

- The analyzer uses UV photometry to calculate the concentration of ozone in the air
- Each night, calibrators in our PQAO challenge the analyzer to verify that the concentrations reported are correct
- New proposed federal reference method (FRM) Nitric Oxide (NO)-Chemiluminescence Method to add to (Ethylene-Chemiluminescence method)

AGC of America the Association of General Contractors of America

- Most expect the agency to tighten the standard to between 60 and 70 ppb. Former EPA Administrator Lisa Jackson and her assistant administrator for air, now Administrator Gina McCarthy, had already proposed to strengthen the ozone health standards to between 60 and 70 back in January 2010 – at an EPA-estimated cost of $90 billion annually. But 18 months later President Obama intervened in the process, and **the proposal was put on hold** due to economic concerns and efforts to reduce regulatory burdens and uncertainty at that time.
- A strengthened ozone standard will lead to new requirements for emissions controls on sources that emit nitrogen oxides and volatile organic compounds, which contribute to ozone formation, including vehicles and equipment, industrial facilities and power plants. In addition, industries in nonattainment areas will face additional regulatory hurdles when they try to expand or build new facilities. This also poses a risk to highway funding if transportation planning does not meet the test of "conforming" to air quality planning documents. For more information on how tighter NAAQS and resultant nonattainment designations impact the business of construction.
- Leading experts predict that setting the 8-hour ozone average lower than the present 75 ppb would throw an estimated 96 percent of U.S. cities into nonattainment and potentially lead to a $1 trillion hit to the economy. Under present standards, urban areas have seen substantial reductions in ozone levels over the last few decades and many have reported that a tighter standard would have minimal effect on actual ozone levels, especially if they come from background conditions that cannot be controlled. While cities and regions across the country can lower their anthropogenic NOx and VOC emissions, which are precursors for ozone, the amount of sunlight and weather-related factors that can cause ground-level ozone are beyond their control. Cities located in southern latitudes are more likely to have high ozone events due to longer summer seasons.
- At a recent hearing of the House Science Subcommittee on Environment, witnesses testified that an ozone standard of 60 and 70 ppb would be unattainable in the intermountain West where background ozone levels are at or above 70 ppb on a regular basis despite small populations and scant local industry. Failure to acknowledge these uncontrollable concentrations could result in EPA setting a new ozone standard next year that is at or near background levels, with catastrophic economic impacts for large swaths of the country.
- AGC Environmental Forum Steering Committee member Dean Word III, Dean Word Company Ltd., located in New Braunfels, Texas, recently spoke before the U.S. Small Business Administration (SBA) Roundtable on the potential impacts of a tighter ozone standard on small-business construction companies. According to an SBA 2012 study, small businesses pay 36 percent more in compliance costs per employee. That study also shows that environmental regulations cost small businesses 364 percent more than larger companies.
- **EPA Releases 'Secret Data' Underlying Costly Air Regulations**
- This week, EPA delivered on request from Senate Environment and Public Works Committee ranking member David Vitter (R-La.) some of the scientific information behind several Clean Air Act rules that had been previously withheld from the public. The release comes amid greater congressional pressure on EPA to release several air pollution studies that reportedly contain the data underlying virtually all of the agency's claimed benefits from recent NAAQS rules on ozone and fine particulate matter. The House Science, Space and Technology Committee Chairman Lamar Smith (R-Texas) has subpoenaed the data from EPA to allow the public to "determine whether the EPA is basing its regulations on sound science"
- The agency had said that the data in the studies belongs to researchers outside the federal government and that it would be difficult to release the data without also breaching individuals' private health records. But prompted by Vitter and other congressional Republicans, EPA is now saying that it is working on ways to release the information while addressing privacy concerns.
- The EPA's recent Clean Air Act regulations, including the upcoming ozone standard, are expected to be some of the most costly that the federal government has ever issued. According to EPA, the agency is working with its independent scientific advisers to determine whether a revision of the ozone standard is appropriate, based on the latest research. The agency said it will follow its normal open and transparent review process, which allows for extensive public comment on key documents – including drafts of the risk and exposure assessments and policy assessments.

Why, How We Monitor Everyday Matters

TABLE 1

TABLE 1		
Area class	Design value*	Primary standard attainment date**
Marginal	0.121 up to 0.138	3 years after November 15, 1990
Moderate	0.138 up to 0.160	6 years after November 15, 1990
Serious	0.160 up to 0.180	9 years after November 15, 1990
Severe	0.180 up to 0.280	15 years after November 15, 1990
Extreme	0.280 and above	20 years after November 15, 1990

Estimated Number of Adverse Health Effects Avoided under Alternate Standard Levels in 2020*

	0.070 parts per million	0.060 parts per million
Chronic bronchitis	880	2,200
Nonfatal heart attacks	2,200	5,300
Hospital and emergency room visits	6,700	21,000
Acute bronchitis	2,100	5,300
Upper and lower respiratory symptoms	44,000	111,000
Aggravated asthma	23,000	58,000
Days when people miss work or school	770,000	2.5 million
Days when people must restrict their activities	2.6 million	8.1 million
Avoided premature mortality	1,500 to 4,300	4,000 to 12,000

*Includes benefits of reduced fine particle concentrations associated with illustrative ozone controls applied to meet a primary ozone standard in the proposed range

Ozone and the Environment

- Ground-level ozone is absorbed by the leaves of plants, where it can:
  - Interfere with the ability of sensitive plants to produce and store food.
    - This can lead to reduced growth, biomass production and yields.
  - Make sensitive plants more susceptible to certain diseases, insects, harsh weather, other pollutants, and competition.
  - Reduce or change plant species diversity in associated ecosystems.
    - This can lead to damage to ecosystems dependent on those species.
  - Visibly injure the leaves of plants, affecting the appearance of vegetation in national parks, recreation areas and cities.

New Ozone NAAQS

Step 1 - Compute the **Daily Index** value (D.I.)

- Preparation: Get a good scientific calculator. There is one online at http://web2.0calc.com/. For a given monitor, obtain the 12 hourly concentrations from 8am to 8pm. Apply the following steps to each hourly concentration, one at a time. Be sure to retain all decimal places in each step.

1. Multiply the hourly concentration by -126.
2. Compute e raised to the power of the result from step 1 by pressing the EXP button.
3. Multiply the result from step 2 by 4403.
4. Add 1 to the result from step 3.
5. Compute the inverse of the result from step 4 by pressing the 1/x button. (If your calculator doesn't have this button, divide 1 by the result from step 4.)
6. Multiply the result from step 5 by the original hourly concentration.
7. Repeat steps 1-6 for each of the 12 hourly concentrations
8. Sum the 12 values. Congratulations – you've just computed the Daily Index value (D.I.) below:

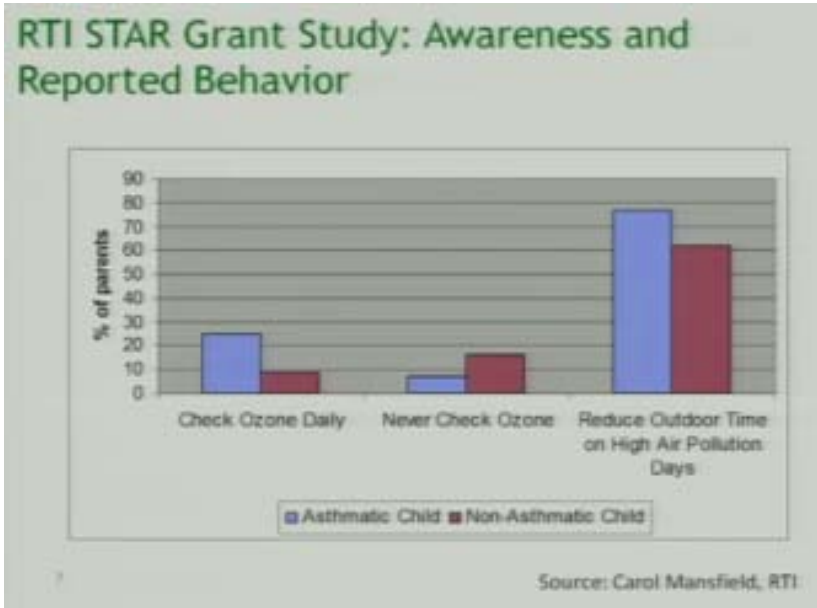
$$D.I. = \sum_{i=8am}^{7pm} O_{3i} * \left(\frac{1}{1 + (4403 * e^{-126 * O_{3i}})}\right)$$

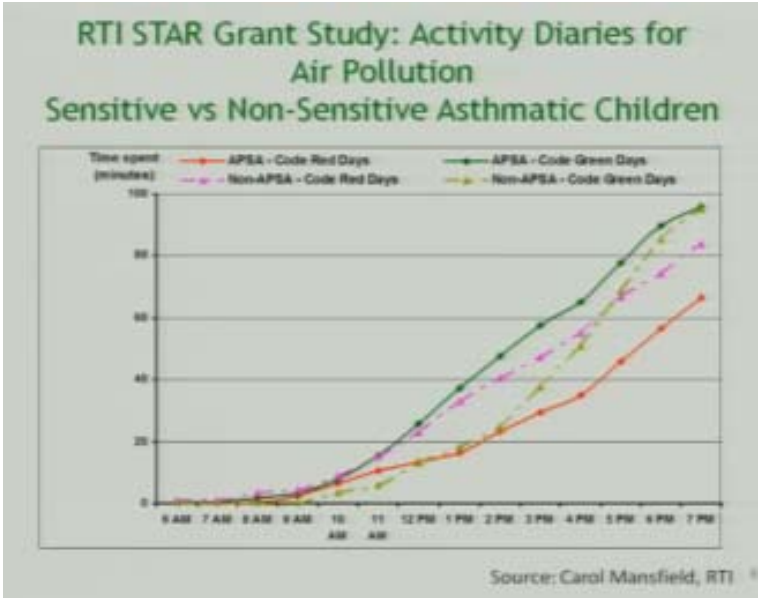
Start hour (local standard time)	Concentration (ppm)	Weighted Concentration (ppm)
8:00 AM	0.045	0.002781
9:00 AM	0.060	0.018218
10:00 AM	0.075	0.055701
11:00 AM	0.080	0.067537
12:00 PM	0.079	0.065327
1:00 PM	0.082	0.071715
2:00 PM	0.085	0.077394
3:00 PM	0.088	0.082448
4:00 PM	0.083	0.073683
5:00 PM	0.081	0.069667
6:00 PM	0.065	0.029260
7:00 PM	0.056	0.011676

→ 0.625406 ppm-hours

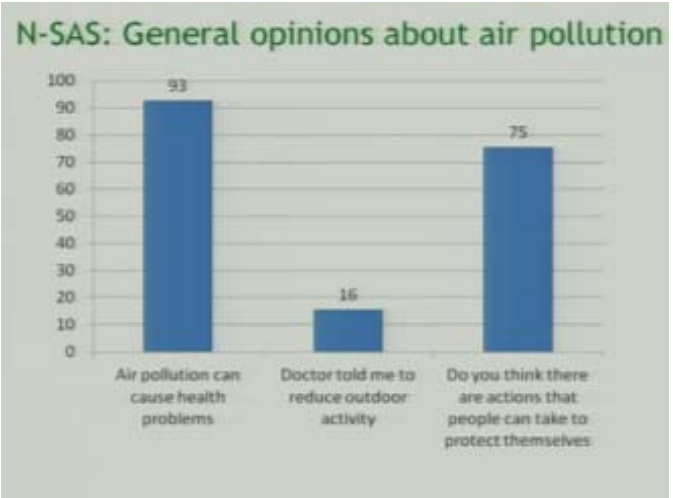
TIP: You can use the following formula in Excel or SAS to compute the weighted concentrations resulting from steps 1 to 6: OZ*(1/(1+4403*EXP((OZ*(-126))))), where OZ is the hourly ozone concentration in ppm.

Why we monitor…





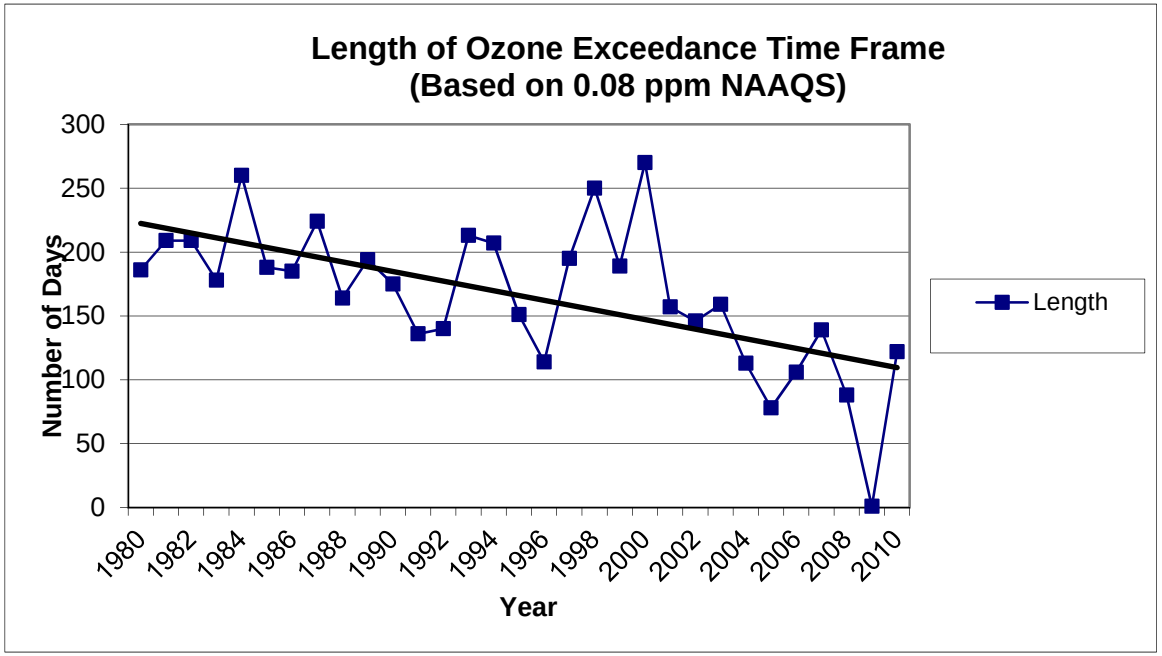
Why we monitor…



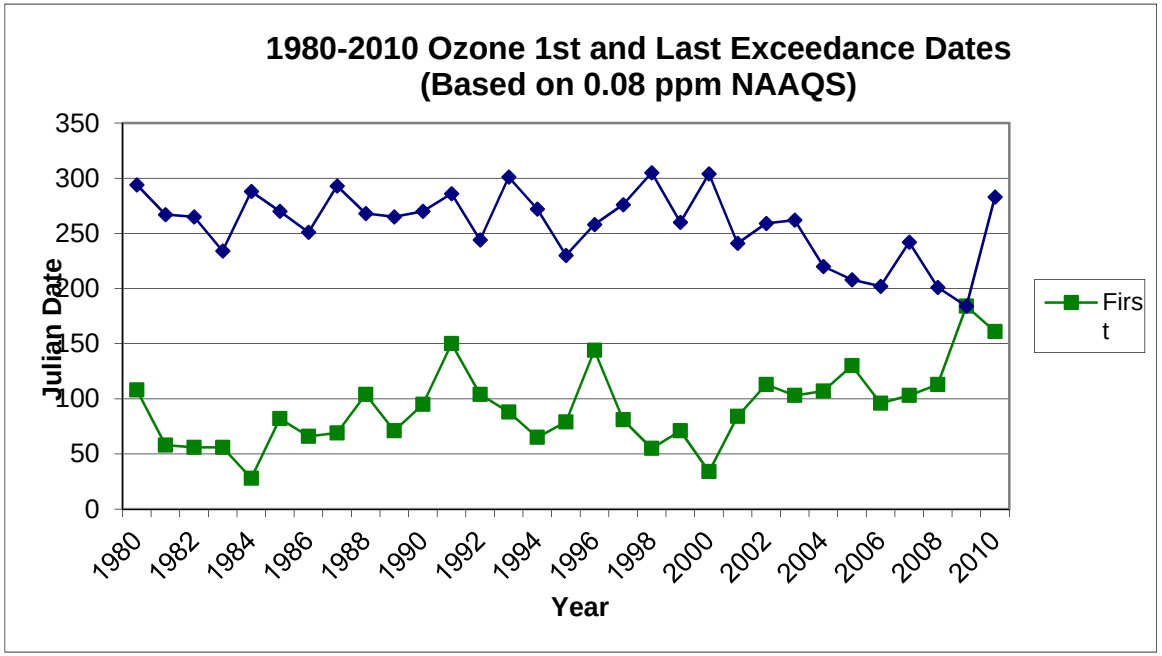
Why we monitor…

- Surveys show that large proportion of respondents are aware of the AQI
- Proportion has been increasing from 50% in 2003 to 75-80% more recently
- Of those who were aware, about 50% report taking action

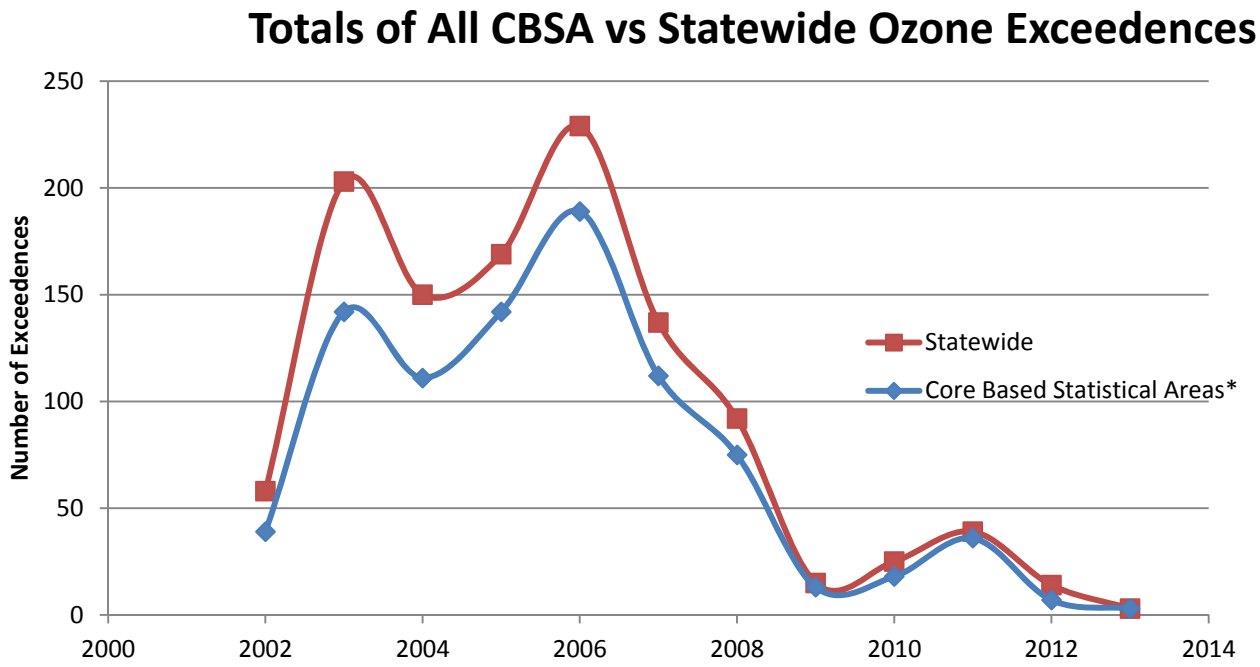
1st to Last Exceedance



First and Last Exceedance

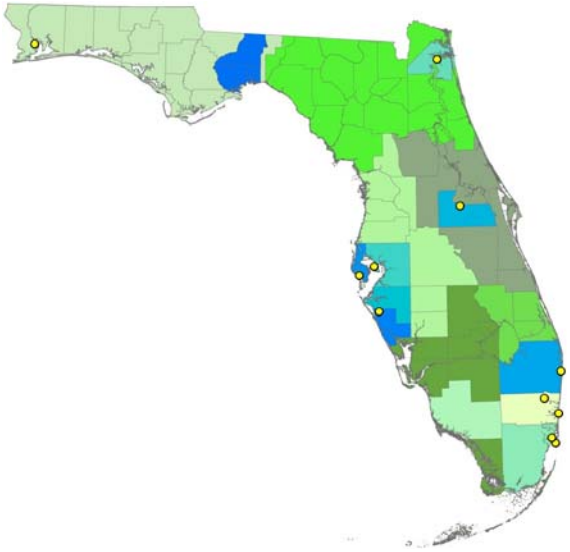


Number of Ozone Exceedances of the 8-hr 75 ppb standard



Nitrogen Dioxide (NO_2)

Nitrogen Dioxide



- NO2
- Results from burning
- Found in car exhaust
- Found in plumes from power plants and industrial boilers
- Found naturally
- Not a health threat as a primary pollutant
- New standard requires near road monitoring

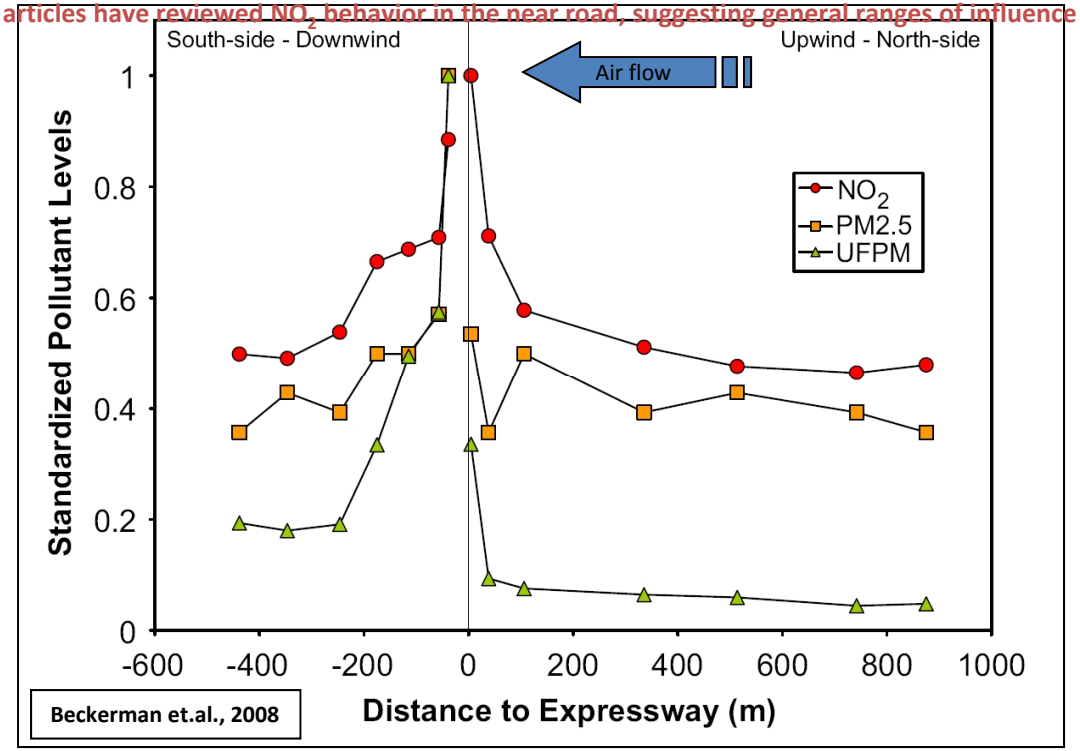
New NO_2 Standard

- EPA recently adopted a lower standard for NO_2
- Each such change presents an opportunity for better science and technology to be introduced

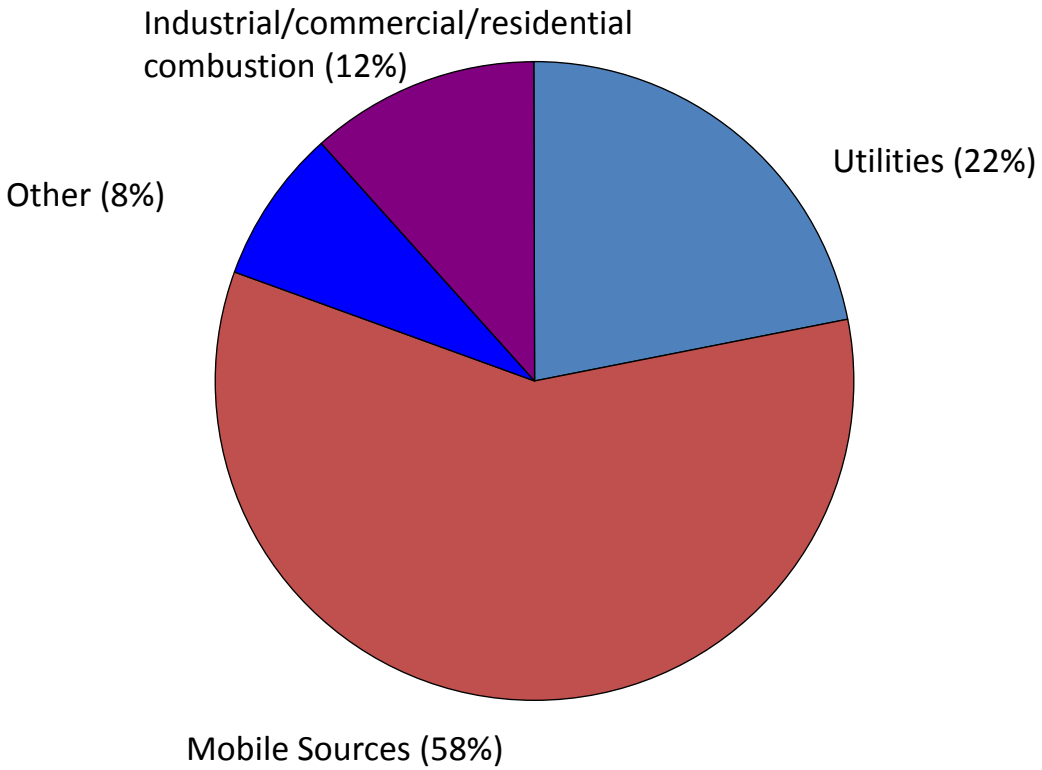
Why worry about near-road exposure?

Tens of millions of people live near major roads – their exposure is higher than areas away from roads

Multiple articles have reviewed NO_2 behavior in the near road, suggesting general ranges of influence

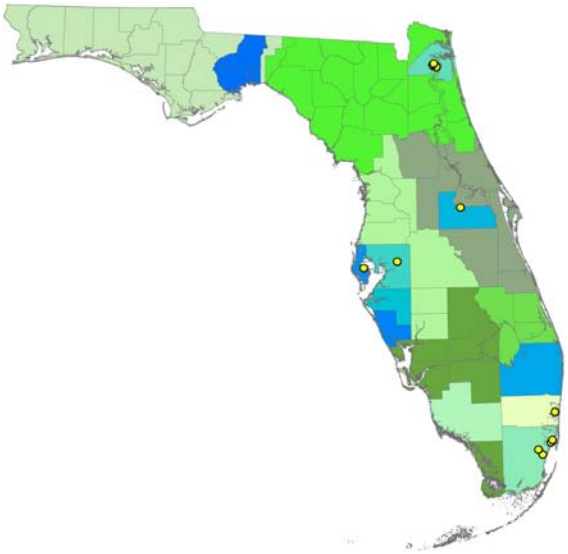


Sources of NO_x Pollution



Based on 2002 National Emissions Inventory data

Carbon Monoxide

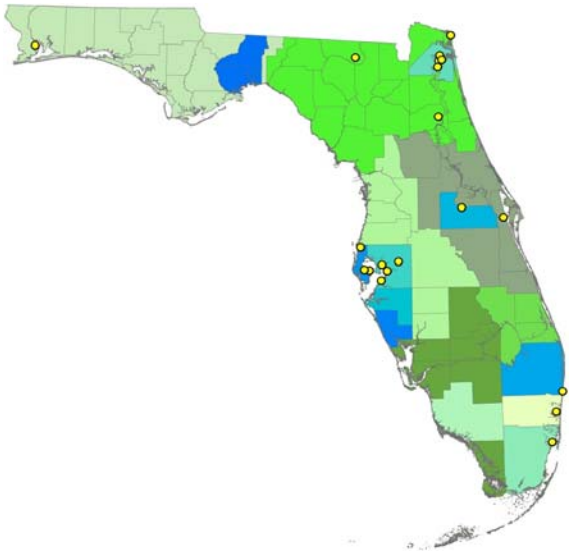


- CO
- Inefficient engines
- Idle
- Cold Weather
- Stagnation
- Will be part of near road monitoring in the largest MSAs

Sulfur Dioxide (SO_2)

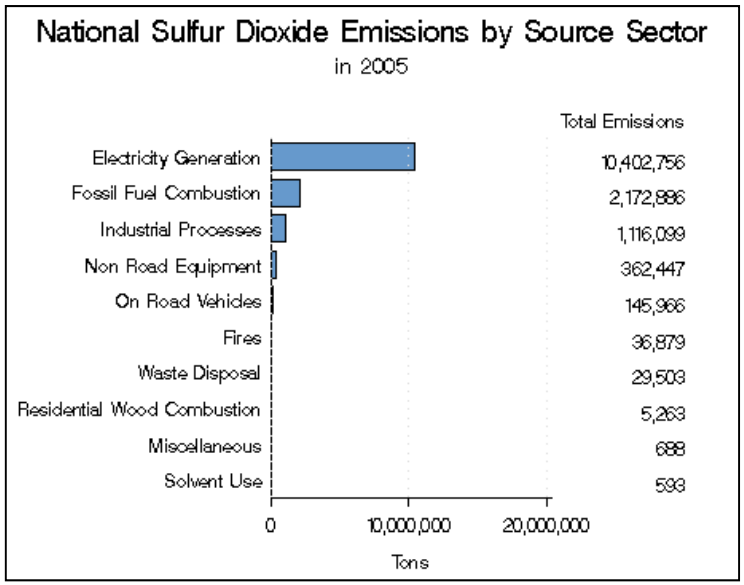
Sulfur Dioxide

- SO_2
- Found naturally from unusual events, e.g. volcano
- Sources include fuels with sulfur, phosphate, fertilizer plants, acid Diammonium phosphate (DAP) plants and paper mills



Sources of SO_2 Pollution

- Fossil fuel combustion at power plants (66%) and other industrial facilities (29%) are the main sources of SO_2 emissions
- Other sources include industrial processes such as extracting metal from ore, and the burning of high sulfur fuels by locomotives, large ships, and non-road equipment



SO2 NAAQS Changes

Date	Change
2012	NAAQS changed to 1-hour 75, kept 3 hour secondary at 0.5 ppm

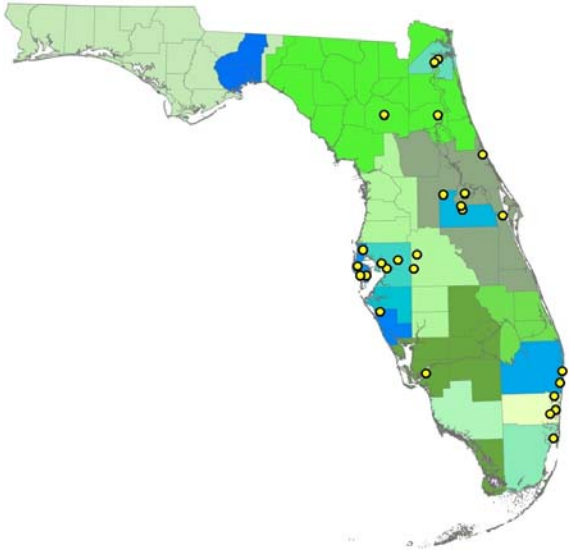
SO2 Nonattainment Areas

Designated area	Designation for the 2010 SO2 NAAQS [a]	
	Date	Type
Tampa, FL:		
Hillsborough County (part)	10/4/2013	Nonattainment.
That portion of Hillsborough County encompassed by the polygon with the vertices using Universal Traverse Mercator (UTM) coordinates in UTM zone 17 with datum NAD83 as follows: (1) vertices--UTM Easting (m) 35881, UTM Northing 3076066; (2) vertices--UTM Easting (m) 355673, UTM Northing 3079275; (3) UTM Easting (m) 360300, UTM Northing 3086380; (4) vertices-- UTM Easting (m) 366850, UTM Northing 3086692; (5) vertices--UTM Easting (m) 368364, UTM Northing 3083760; and (6) vertices--UTM Easting (m) 365708, UTM Northing 3079121		
Nassau County (part)		
That portion of Nassau County encompassing the circular boundary with the center being UTM Easting 455530 meters, UTM Northing 3391737 meters, UTM zone 17, using the NAD83 datum (the location of the violating ambient monitor) and the radius being 2.4 kilometers		
Rest of State		Unclassifiable/Attainment.

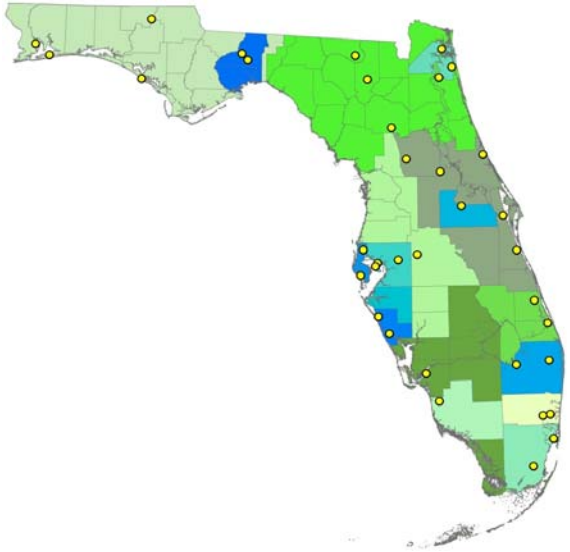
PM NAAQS

PM_{10}

- Particulate Matter 10 microns or less
- Associated with combustion, agriculture, air borne dust
- Transports long distances if lifted



$PM_{2.5}$



- Particulate Matter 2.5 microns and smaller
- Made of primary and secondary particles
- Primary sources include fires, dust and sea salt
- Secondary sources for nitrates and sulfates

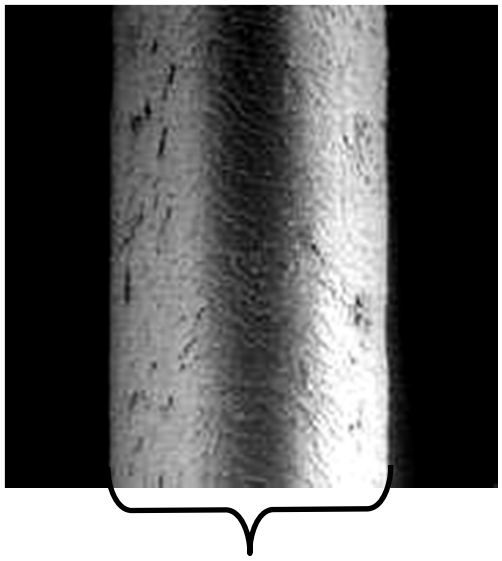
PM NAAQS Changes

Date	Change
March 18, 2013	PM2.5 annual changed to 12.0
Dec 18, 2006	PM2.5 24 hour change from 65 to 35 PM10 annual dropped
	AQI changed to 40 for USG
1997	PM2.5 introduced 65/15.0
1987	PM10 introduced 150/50

PM2.5 Sampler

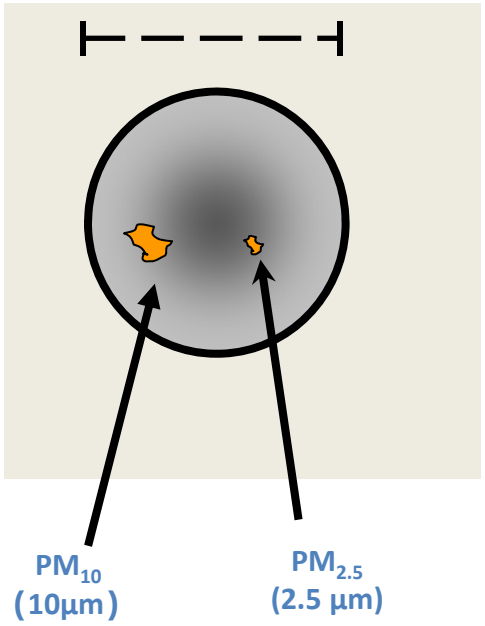
Particulate Matter: What is It?

A complex mixture of extremely small particles and liquid droplets



Human Hair (70 µm diameter)

Hair cross section (70 µm)



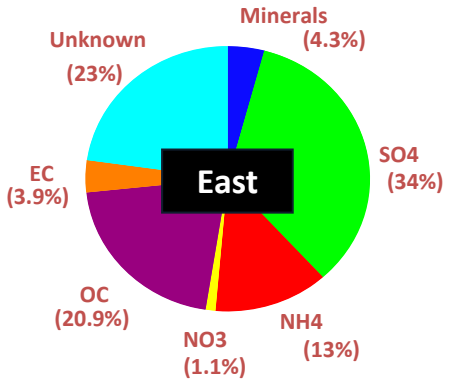
M. Lipsett, California Office of Environmental Health Hazard Assessment


Wood-Burning Stoves
Forest Fires
Heavy Duty Diesel Engines
Natural Sources
PM is derived from
many different sources
Cars andTrucks
Non-Road Vehicles
Leaf Burning
Industrial Sources

PM: A Complex Pollutant

PM-Associated Attributes

- Size
- Surface Area
- Acids
- Metals
- Organics
- Peroxides
- Bioaerosols



Can Trigger Myocardial Infarction

772 MI patients who survived 24 hours and completed interview

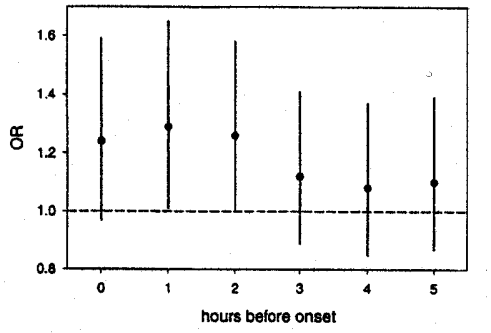
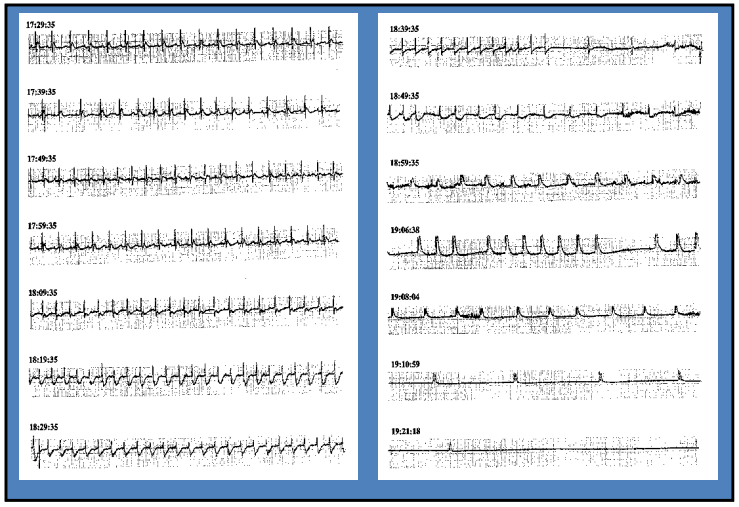


Figure 1. Univariate analyses for association between onset of MI and hourly concentrations of $PM_{2.5}$. Odds ratios and 95% CIs for an increase of 25 $\mu g/m^3$ $PM_{2.5}$.

Peters et al, 2001

ECG Abnormalities and death rats exposed to PM

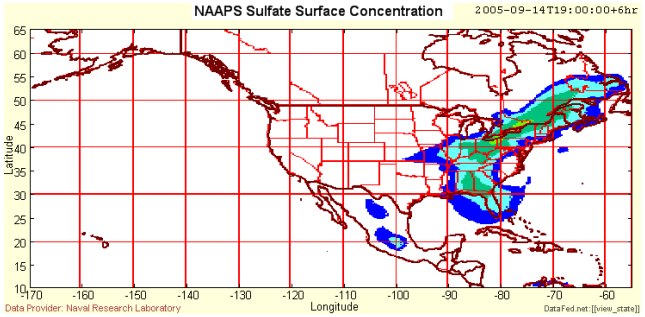


Watkinson et al., 1998

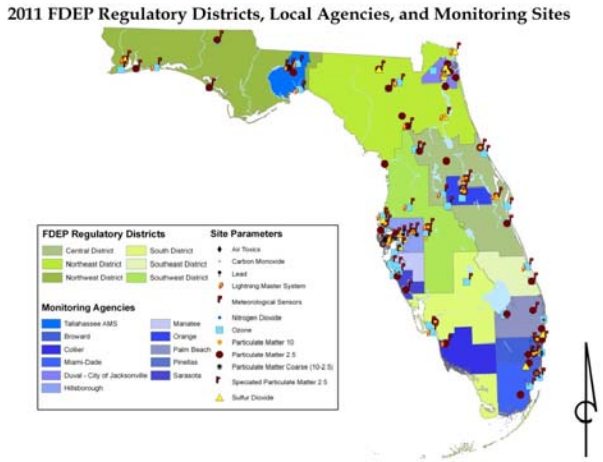
Payne's Prairie: Jan. 27, 2013

PM2.5 Exceedances

- On average, in Florida, there are:
  - 21 $PM_{2.5}$ Exceedances each year
  - On 8 days
  - At 12 sites
  - Event driven multiple exceedances



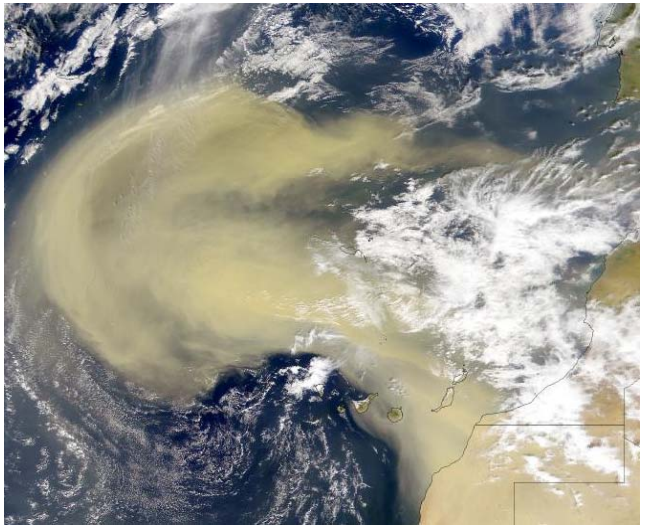
Transport



- Many areas have air quality influenced by their neighbors
- Florida is not often influenced by close neighbors because it is a peninsula

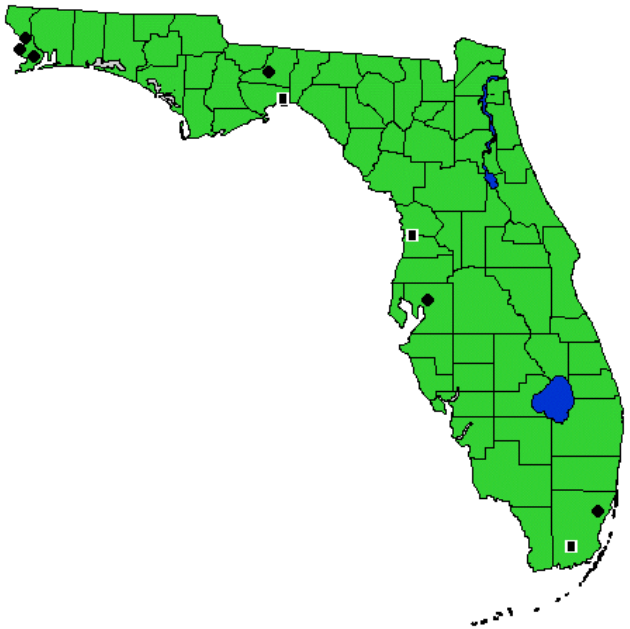
Transport

- There are times when the influence is from very far away
- Each summer the Caribbean and Florida are sprinkled with dust from the African deserts, the Saharan tends to influence Florida



Colors of Nature

Speciated $PM_{2.5}$



Visibility

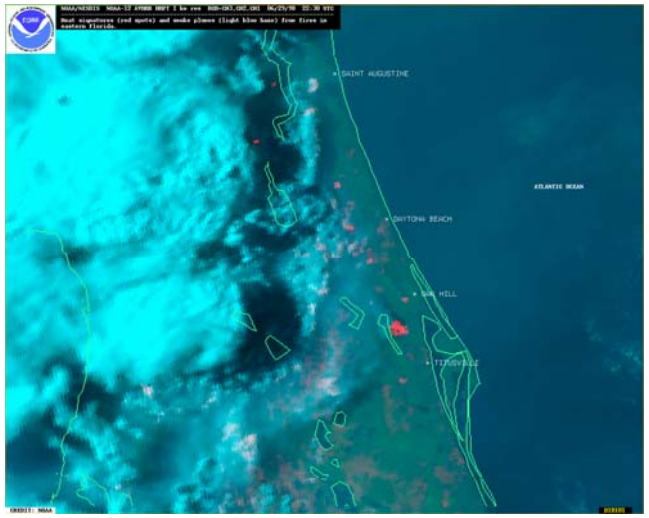
- Region haze
- Visibility will be dealt with over the 60 years following the enactment of the Regional Haze Rule, which was July 1999

Regional Haze Goals Great Smokies

DV: 3, 12, 23, 34

Exceptional Events Rule

- Large natural events, such as fire, (which is most common for Florida), impact air quality
- EPA and DEP are charged with controlling man-made pollution

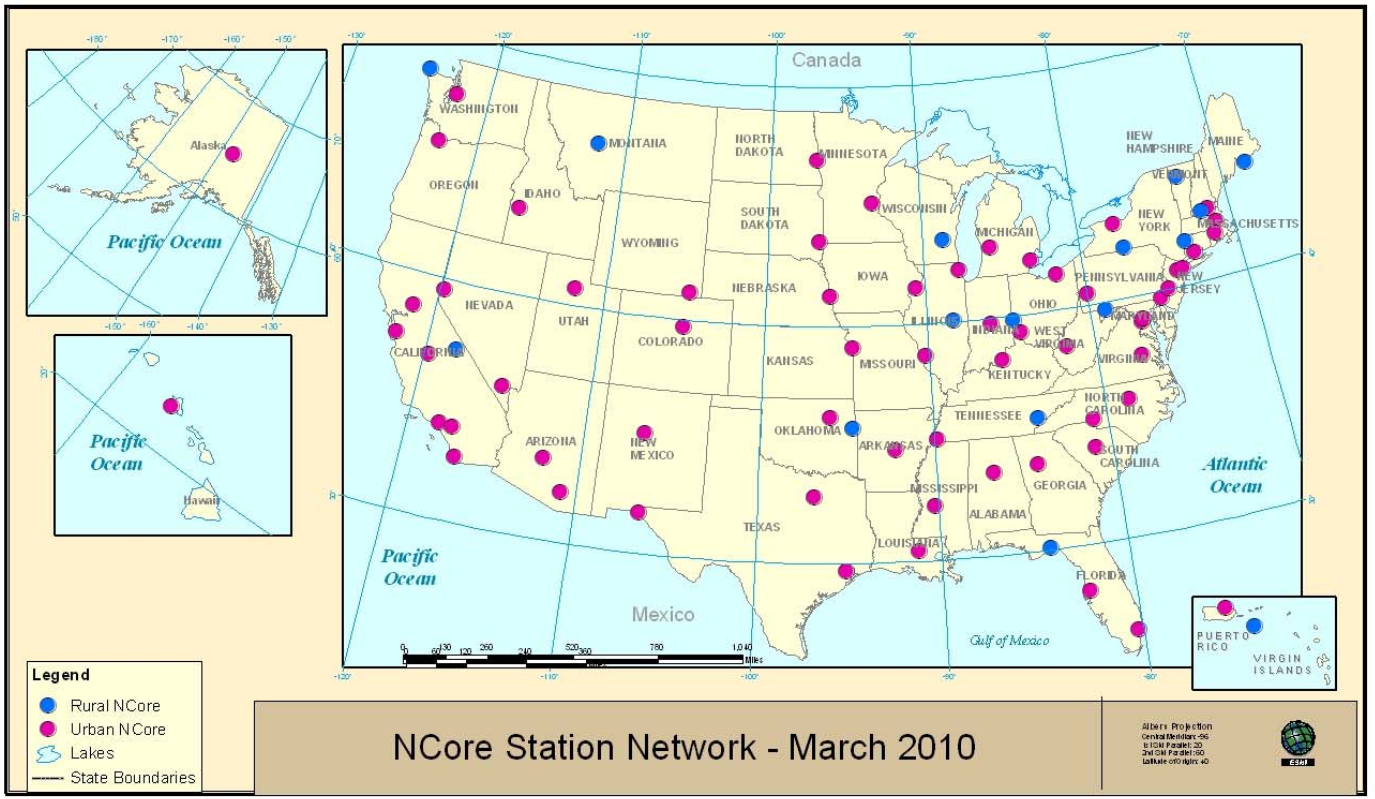


Monitoring: N-Core Multi-pollutant Sites

- EPA has changed the ambient monitoring requirements
- No longer will monitoring be centered around the maximum concentration site, (except O_3)
- Population exposure sites with multiple pollutants are emphasized
- The hope was to free resources for efforts like toxics monitoring
- N-Core sites may be location of Photochemical Assessment Monitoring Stations (PAMS) as part of enhanced ozone monitoring in nonattainment areas

N-Core

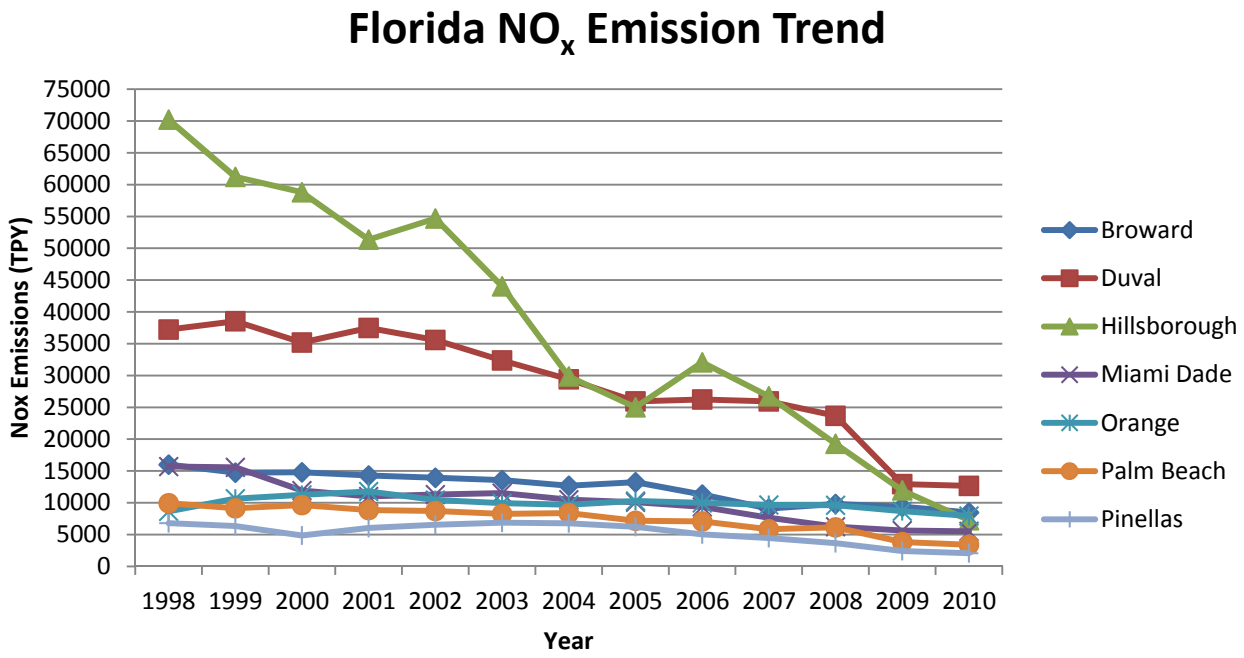
http://www.epa.gov/ttn/amtic/files/ambient/2009conference/Hanley.pdf



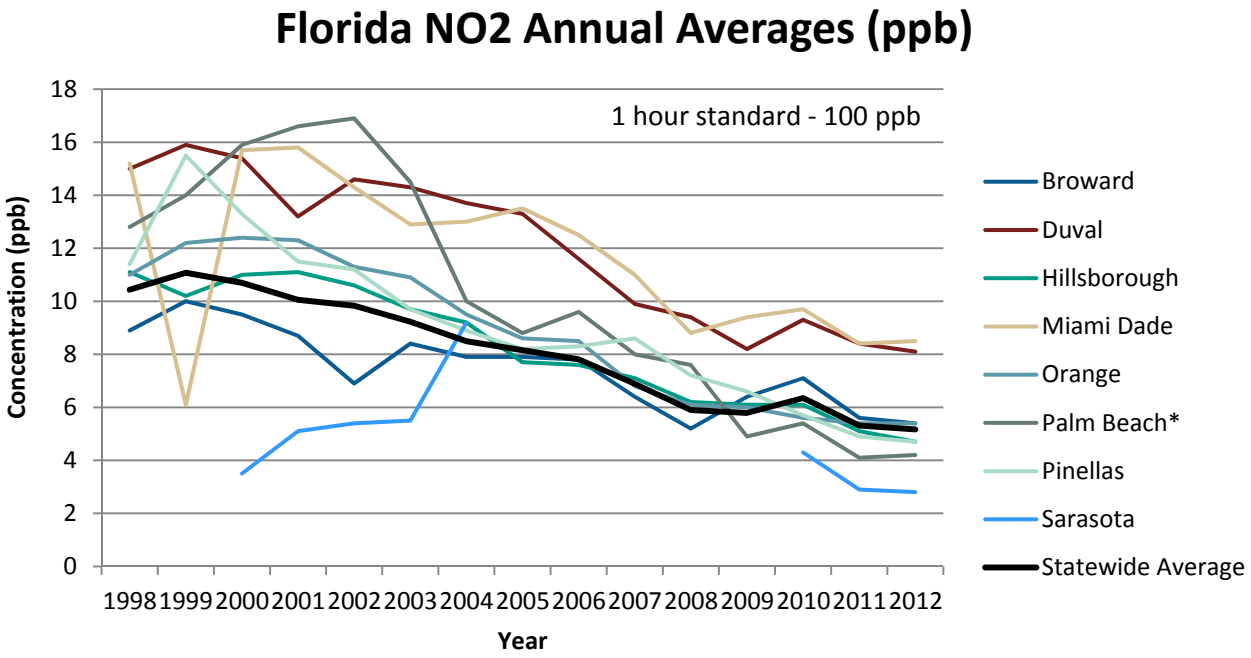
Florida's Air Quality

- Florida is the 3rd most populous state, behind California and Texas
- It is followed by New York, Illinois, Pennsylvania and Ohio
- Generally, where there are more people, there is more pollution
- Despite this generalization, Florida is attainment for most of the criteria pollutants

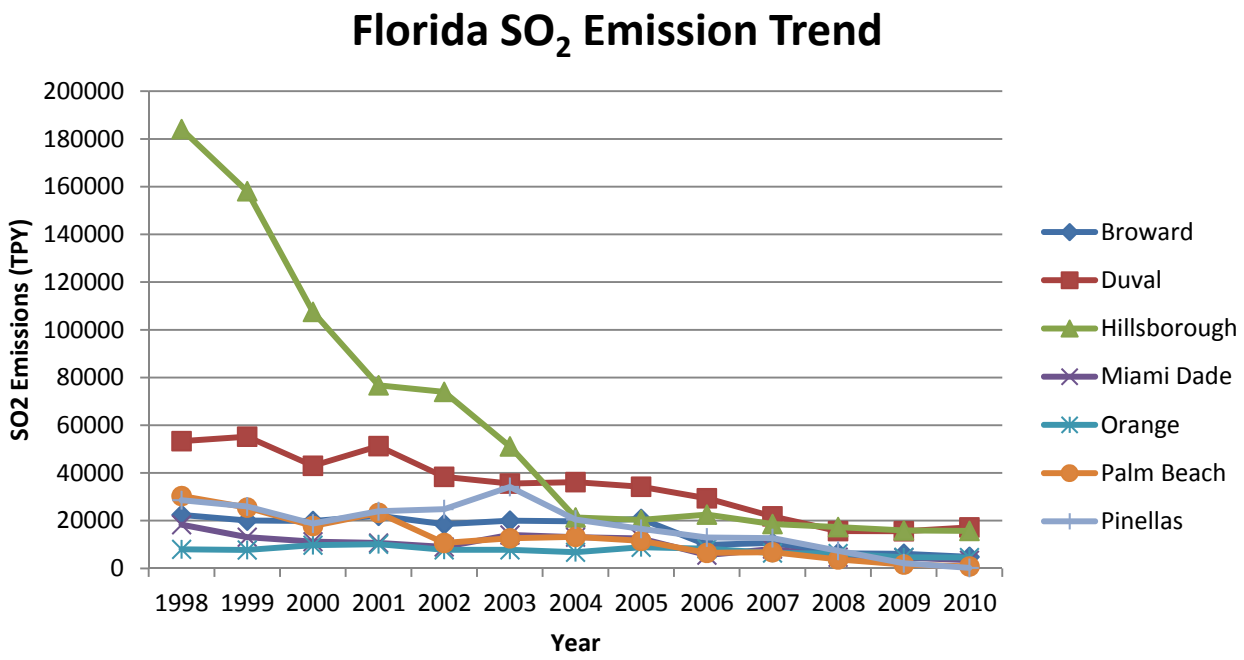
No_x Emissions



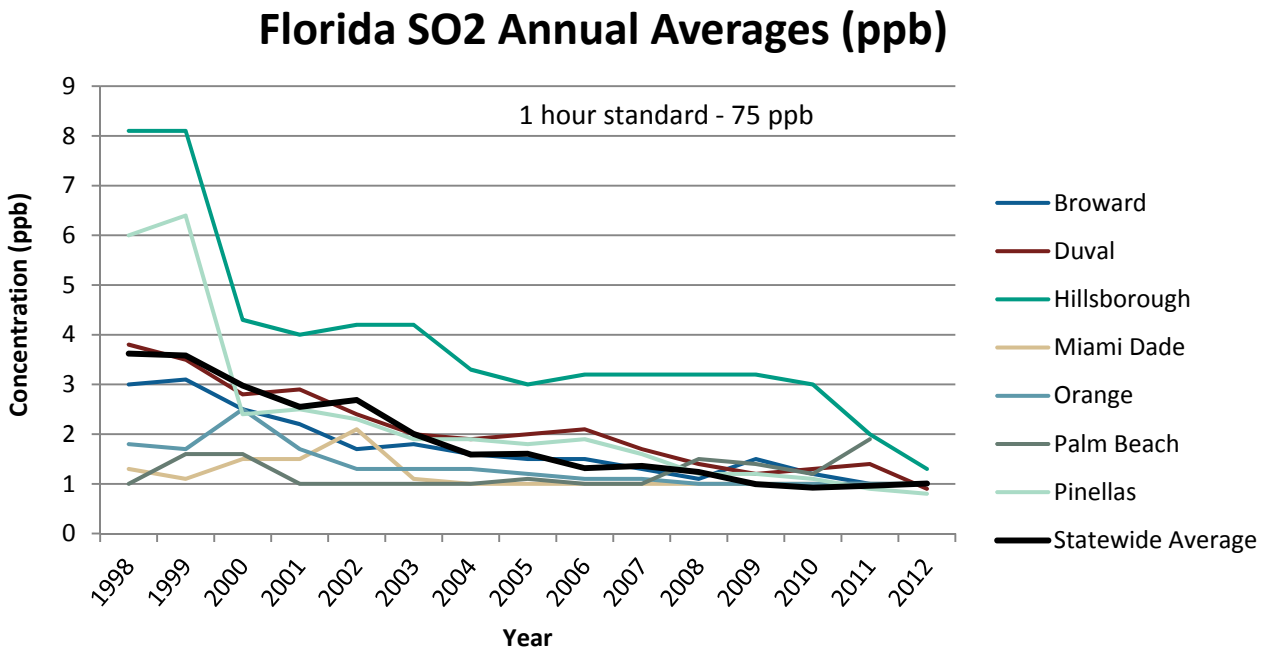
NO_2 Ambient Concentrations



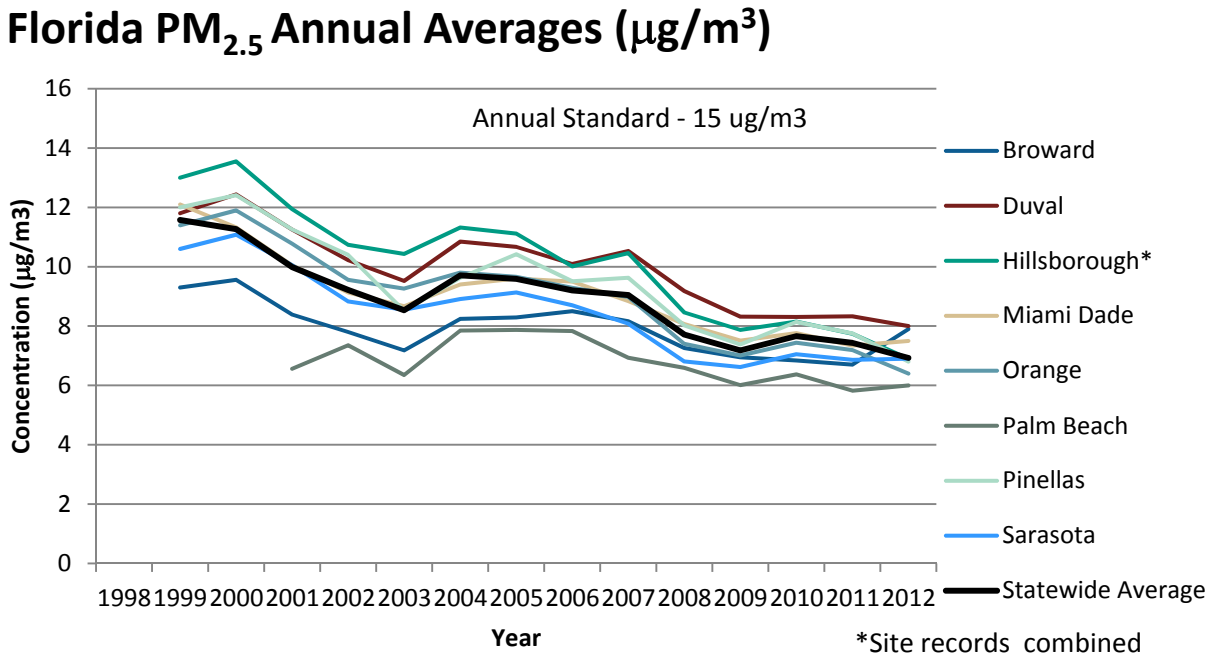
SO_2 Emissions



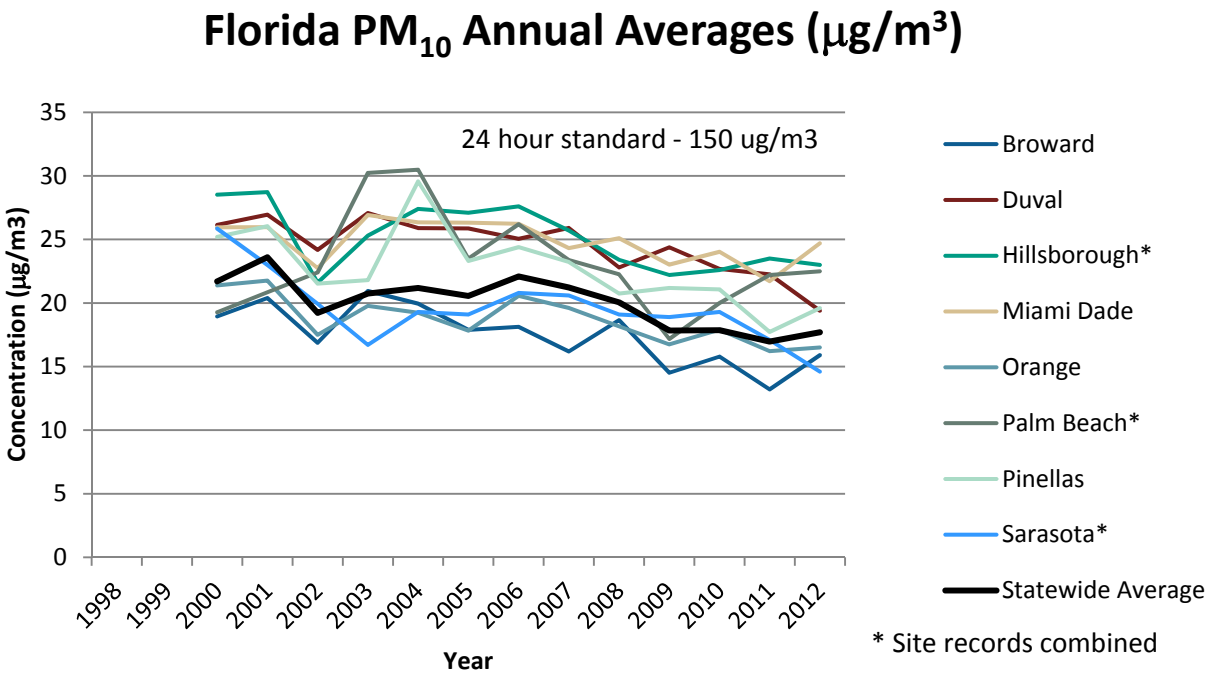
SO_2 Ambient Concentrations



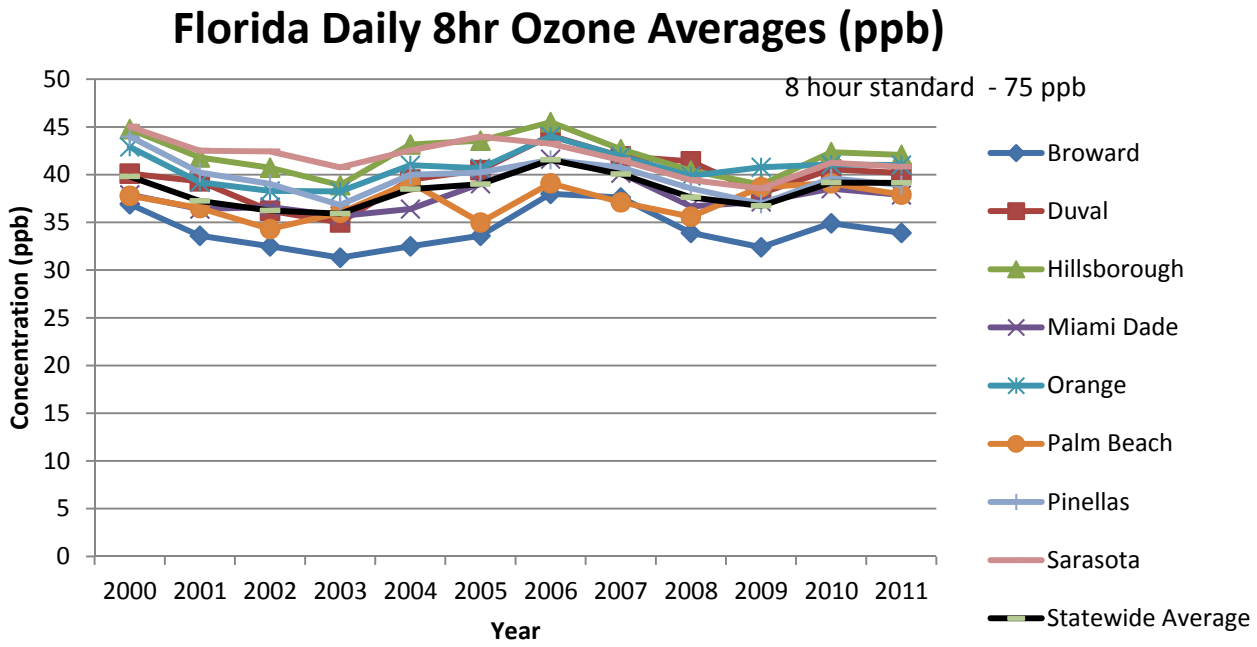
$PM_{2.5}$ Ambient Concentrations



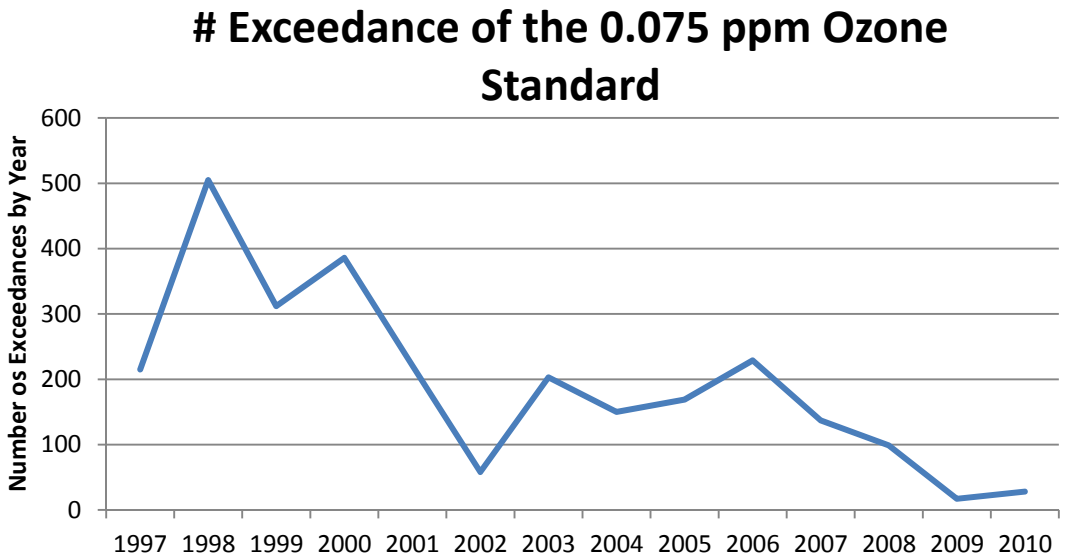
PM_{10} Ambient Concentrations



8 Hour Ozone Ambient Concentrations



Number of Ozone Exceedances by Year



Toxics

- There are no National Ambient Air Quality Standards for toxics
- Several areas of the state are participating in toxics monitoring
- NATTS in Pinellas and Hillsborough
- Broward, City of Jacksonville and Orange
- Most of the toxics found are associated with vehicle activities

Hurricanes

- A recent discovery is that Saharan dust and the dry layer in which it travels can adversely impact the growth of young storms over the Atlantic

Dennis 2005

Hurricanes

- Another discovery concerning hurricanes is that the thickness of the stratospheric ozone layer in the area of the hurricane helps determine its strength

Looking Ahead

How We Monitor… A One PQAO

- Particularly as the EPA has been changing the standards more frequently, and ambient data are being used more frequently for attainment determinations, we are working to meet the goal of legally defendable data

Questions?