



# What Else is in the Air? Breathing for Two:

## The Near- and Far-Reaching Health Impacts of Tiny Air Pollution Particles

Robert Laumbach MD, MPH, CIH, DABT

Associate Professor

Environmental and Occupational Health and Justice

Rutgers School of Public Health

Environmental and Occupational Health Sciences Institute

# Overview of health effects of air pollution

## **Respiratory disease mortality**

## **Respiratory disease morbidity**

## **Lung cancer**

## **Pneumonia**

Upper and lower respiratory symptoms

Airway inflammation

Decreased lung function

Decreased lung growth

Insulin resistance

## **Type 2 diabetes**

## **Type 1 diabetes**

Bone metabolism

## **High blood pressure**

Endothelial dysfunction

Increased blood coagulation

Systemic inflammation

## **Deep venous thrombosis**

## **Stroke**

Neurological development

Mental health

## **Neurodegenerative diseases**

## **Cardiovascular disease mortality**

## **Cardiovascular disease morbidity**

## **Myocardial infarction**

## **Arrhythmia**

## **Congestive heart failure**

Changes in heart rate variability

ST-segment depression

Skin ageing

## **Premature birth**

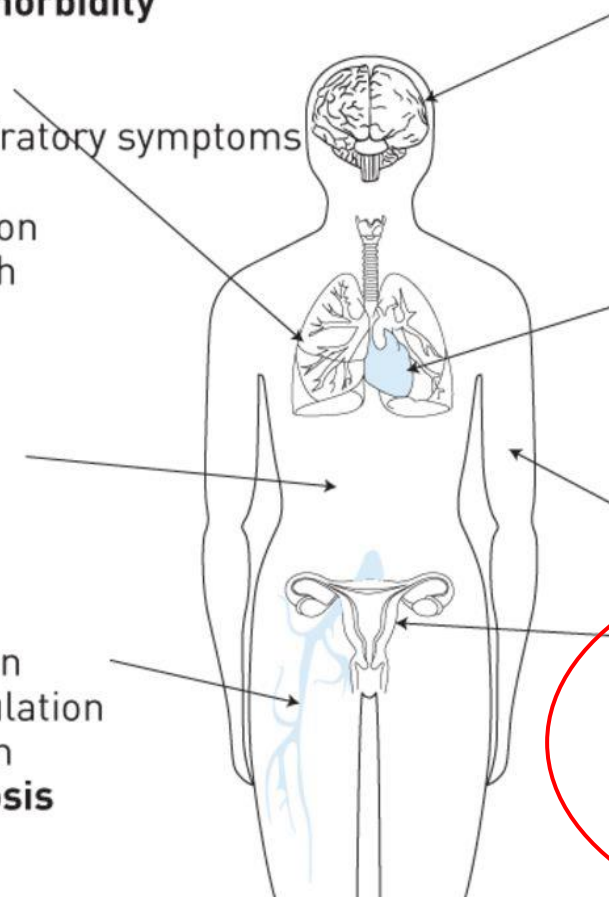
## **Decreased birthweight**

Decreased fetal growth

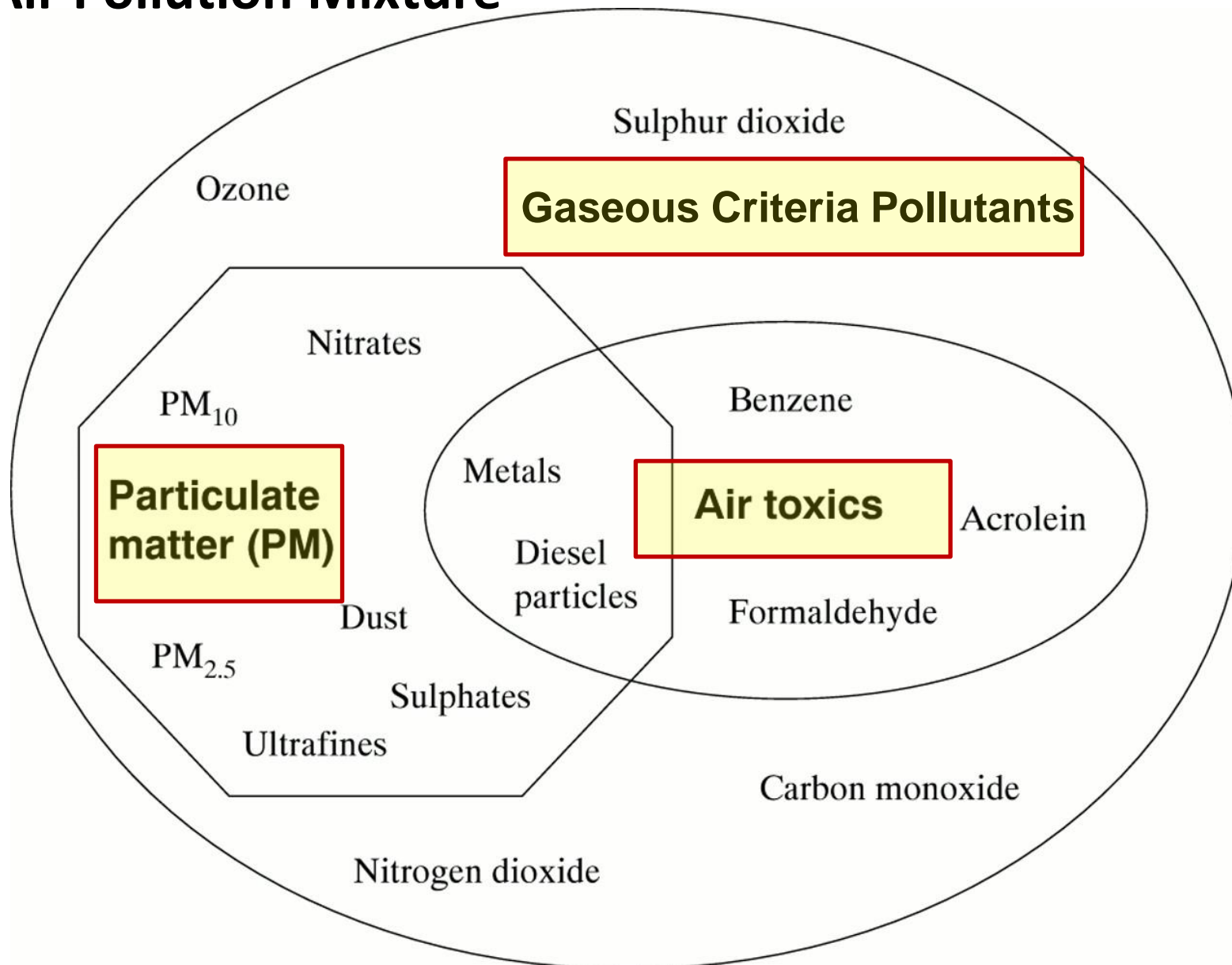
Intrauterine growth retardation

Decreased sperm quality

Pre-eclampsia

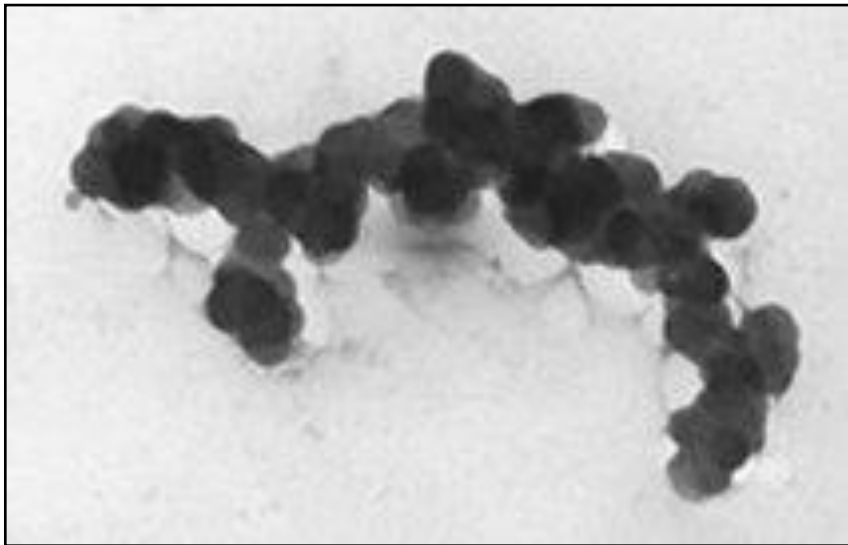


# The Air Pollution Mixture

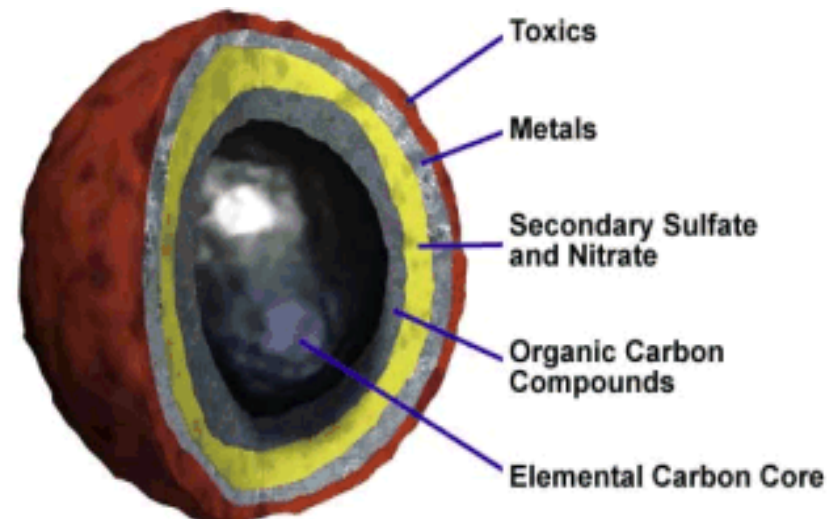


# Focus on Diesel Exhaust: a major source of air pollution in New Jersey

- A complex mixture of gases and particles
- Particles less than 2.5 microns in diameter (PM2.5)
- Mostly less than 0.1 micron (ultrafine PM)
- More than 40 known toxic chemicals
- It's an established cause of lung cancer, asthma exacerbation, and linked all of the health effects of PM2.5

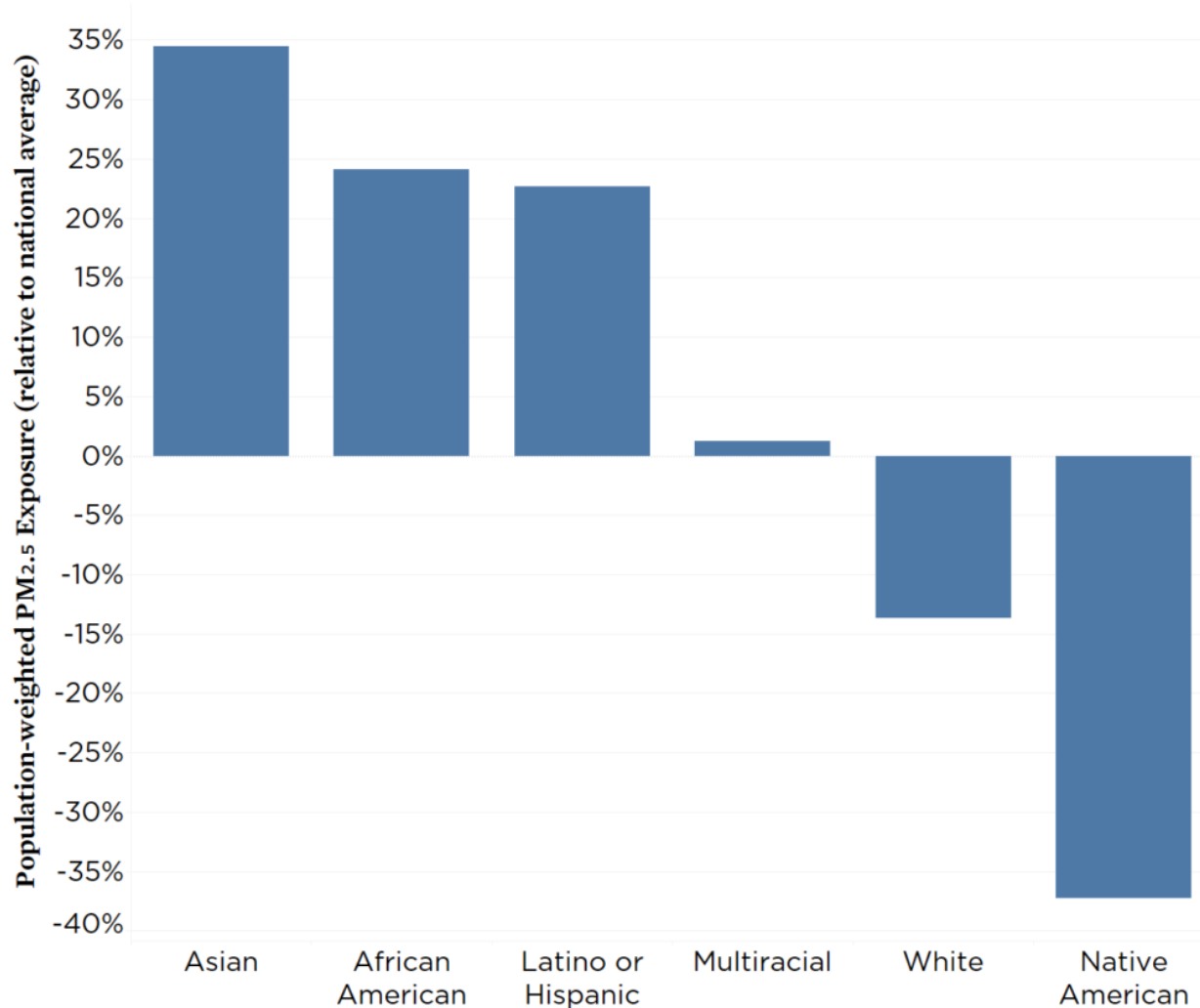


0.1 micron



# Diesel PM exposure disparities with race and income in US

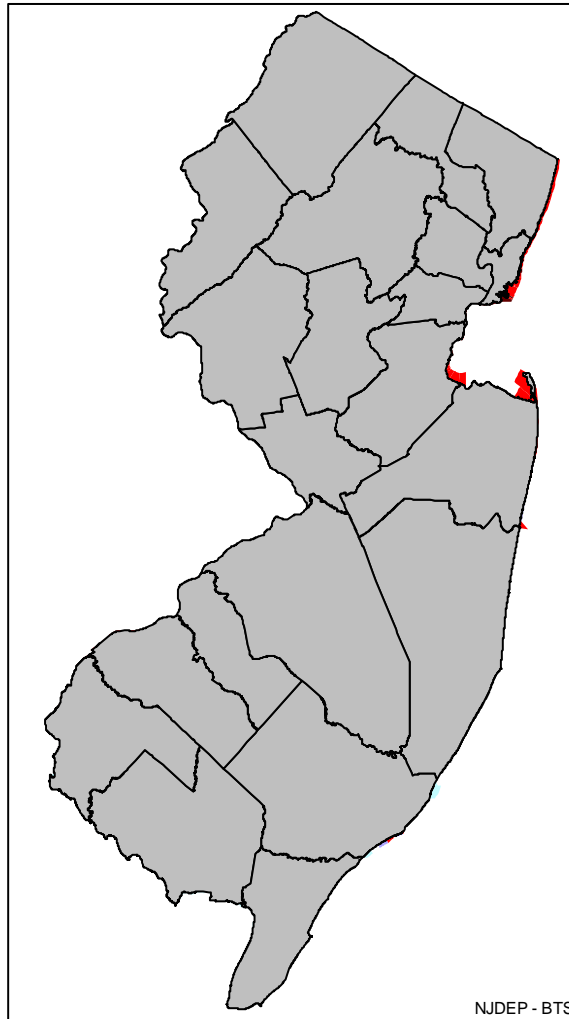
Union of Concerned Scientists, 2021



## Estimated Diesel Particulate Risk in New Jersey from Mobile Sources

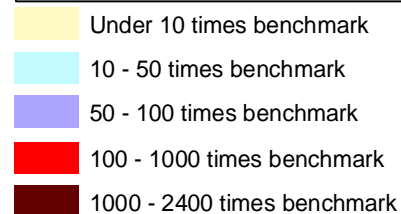
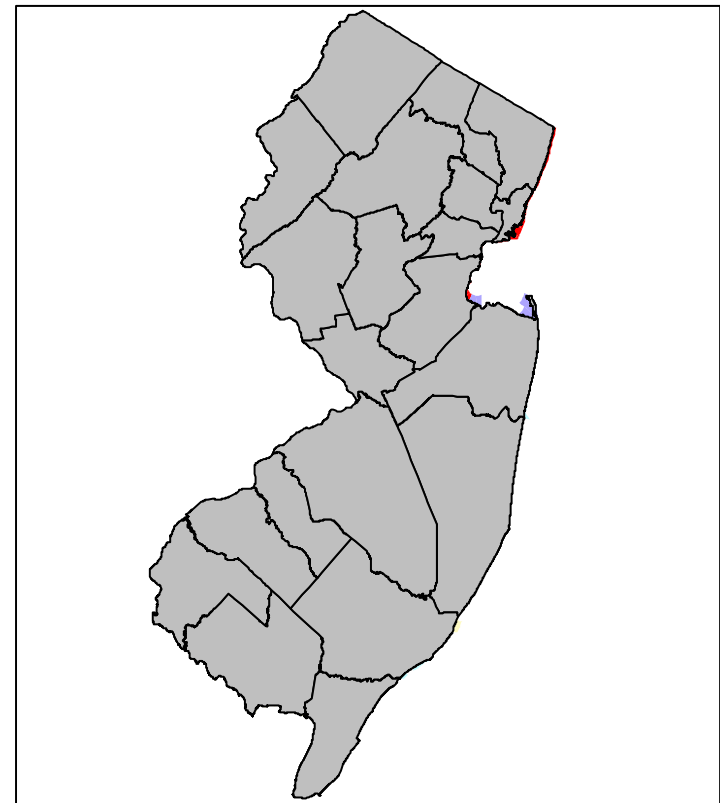
Estimated  
Cancer Risk  
from Diesel  
Exhaust in NJ

Estimated Risk in 2005



NJDEP - BTS

Estimated Risk in 2020



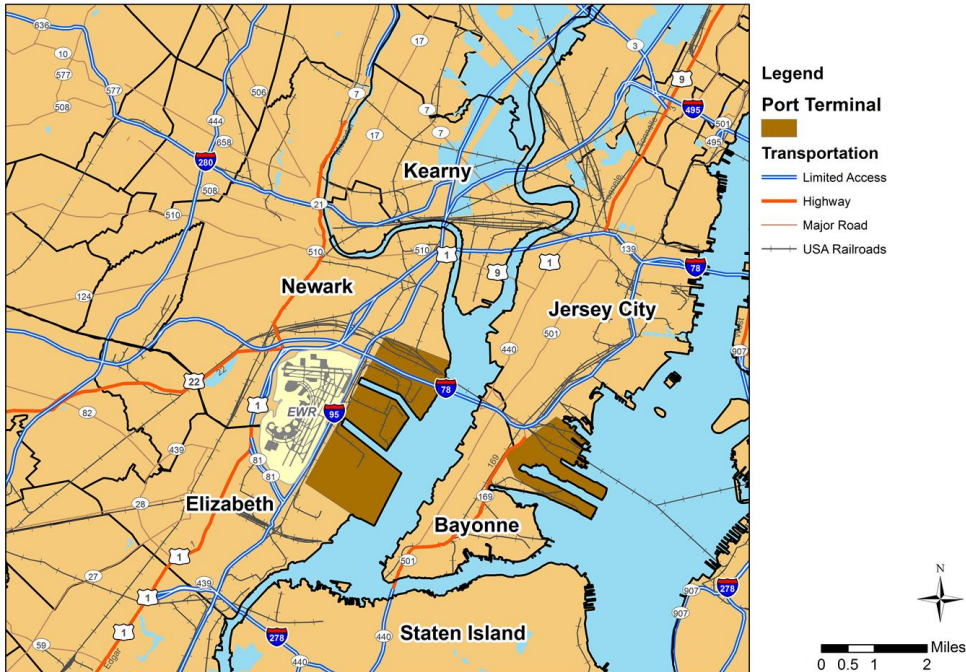
Maps are based on 2005 NATA concentrations and California risk factor. The 2020 estimates were developed by scaling the 2005 concentrations using state-level emission changes between 2005 and 2020.



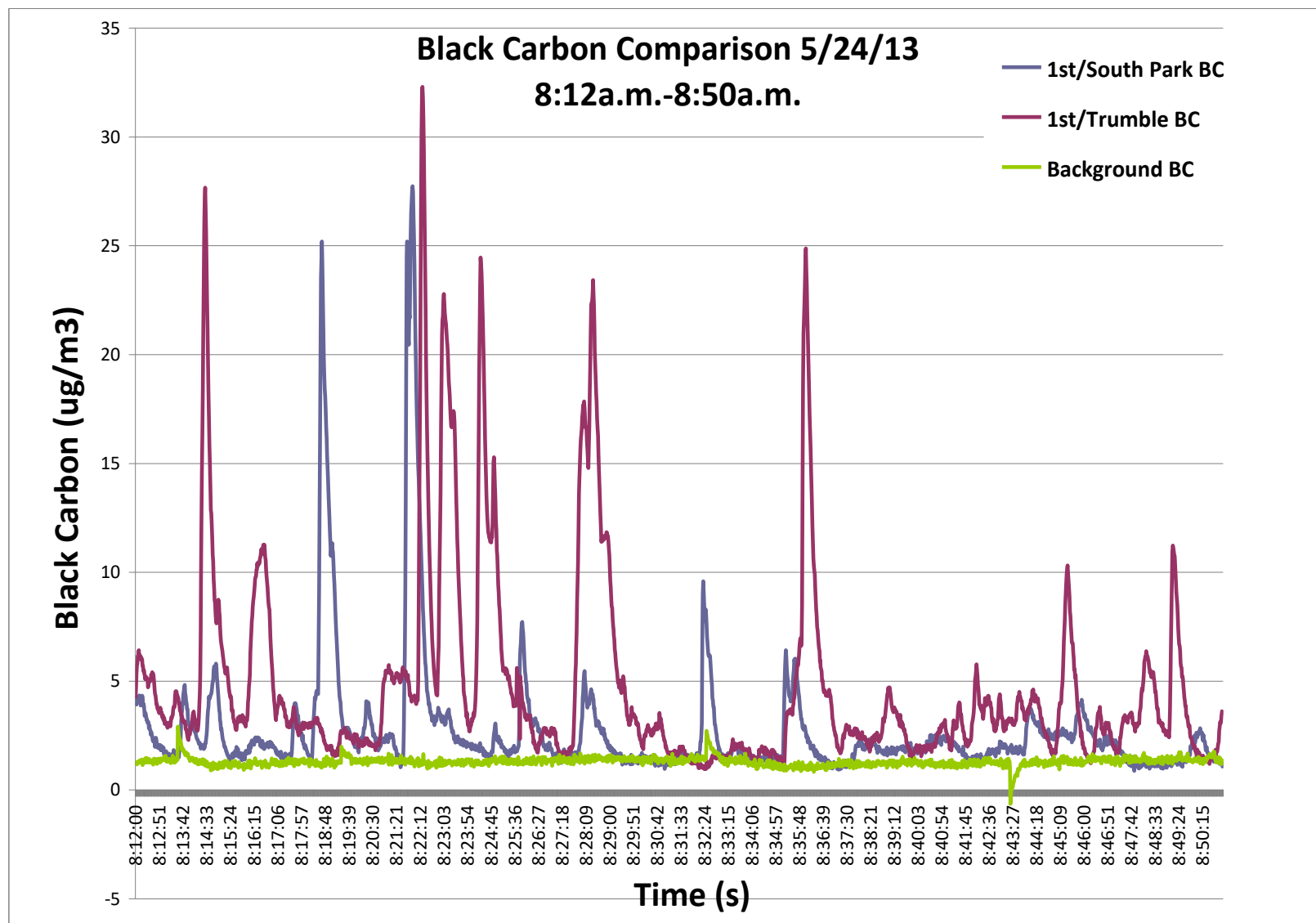
# Local sources of Diesel Air Pollution

- Port of Newark and Elizabeth
  - Ocean-going vessels and harbor craft, port equipment, rail, drayage trucks
- Transportation nexus: NJ TpK, Route 1&9, 278, 280, GSP
- Liberty Airport, Warehouses

Newark / Elizabeth port and surrounding areas



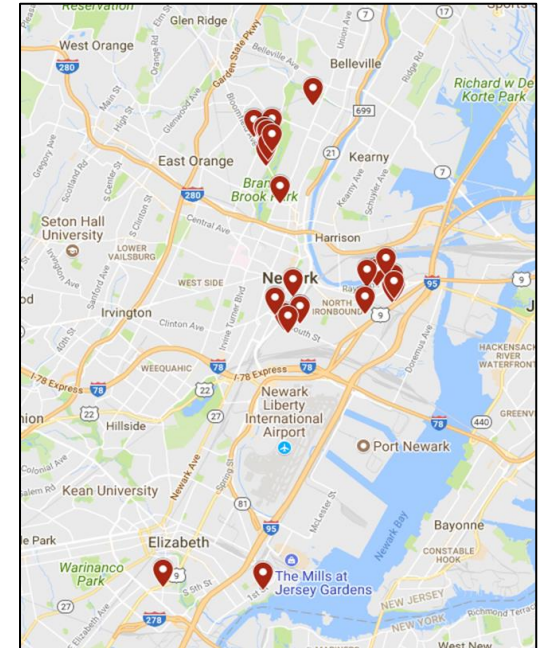
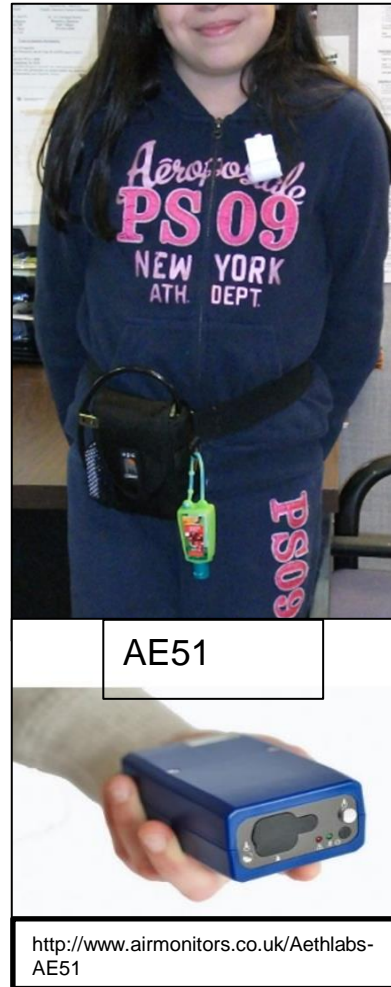
# Diesel particles on First Street, Elizabeth, in 2013





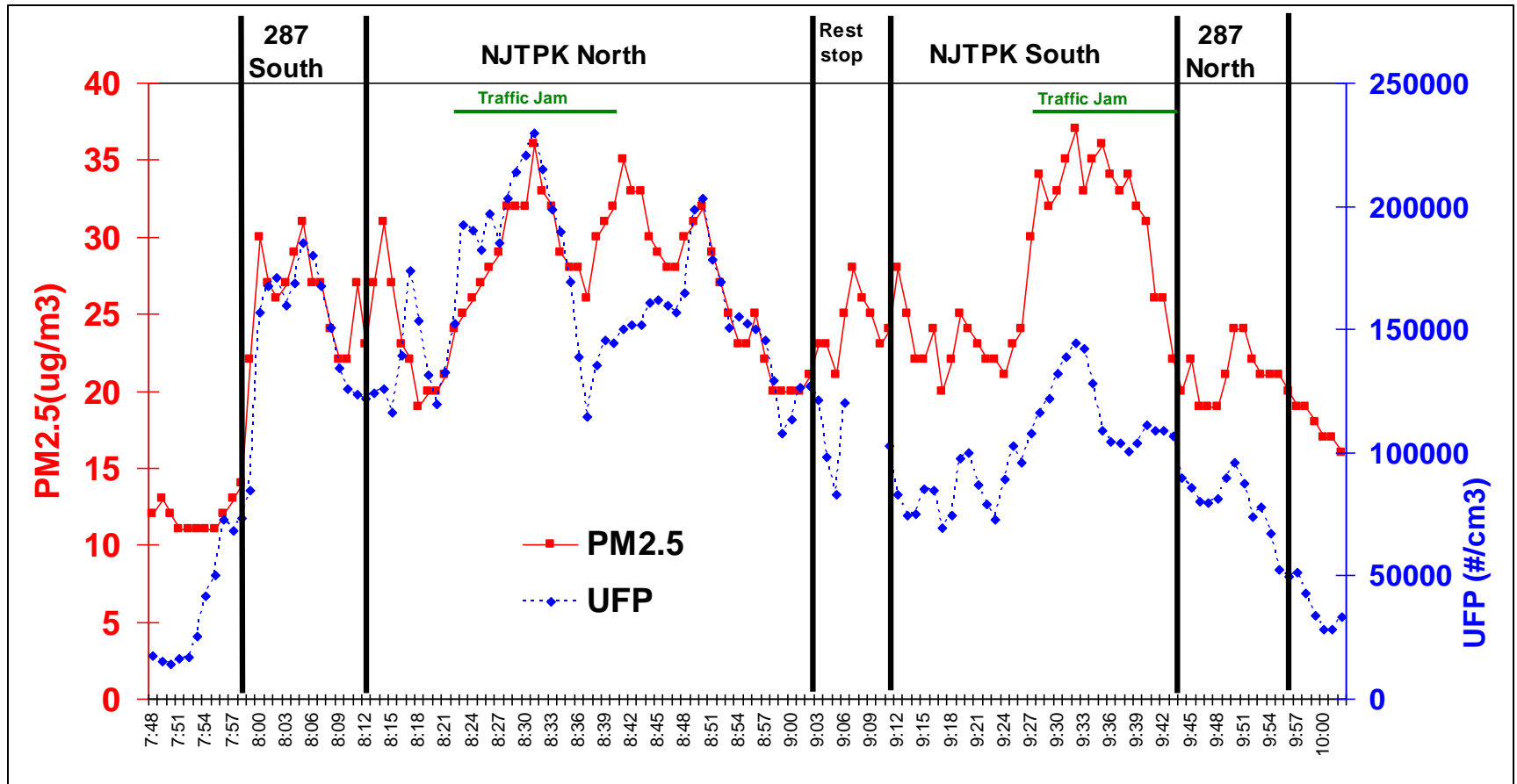
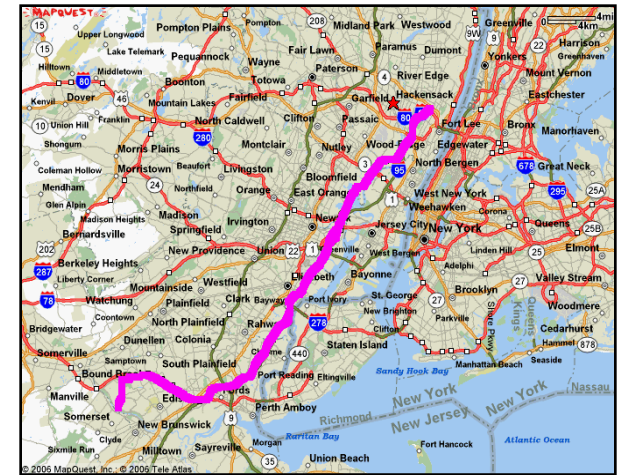
# Rutgers study of impacts of diesel emissions on kids with asthma in port-adjacent communities

- 34 children with asthma aged 9-14 wore personal monitors for black carbon (diesel exhaust particles) for up to 30 days
- Measured nitric oxide, an indicator of worse asthma, in exhaled breath every weekday.
- RESULTS: With increased exposure to black carbon in the previous 24 hours, exhaled nitric oxide increased.



... and, we are all exposed.

Rutgers study of commuter exposure to PM in the truck lanes of the NJ TPK during morning rush hour:



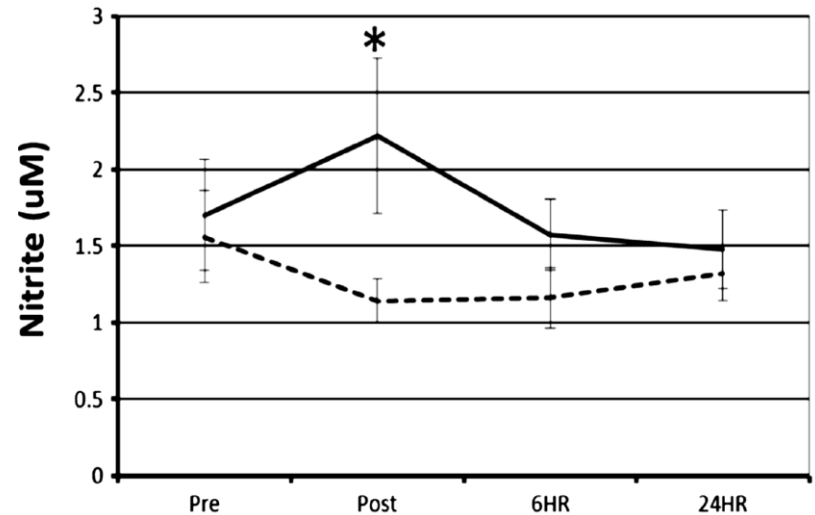
# Respiratory health effects of single rides on the NJ Turnpike during morning rush hour

- 20 healthy young adults, two 1.5-hour rides
- With and without HEPA filtration



Study technician demonstrating participation

## Nitrite levels in exhaled breath condensate before and after diesel vs. cleaned air exposure



Solid line: no filtration

Dashed line: with filtration



# Elizabeth Low-Cost Monitor Project



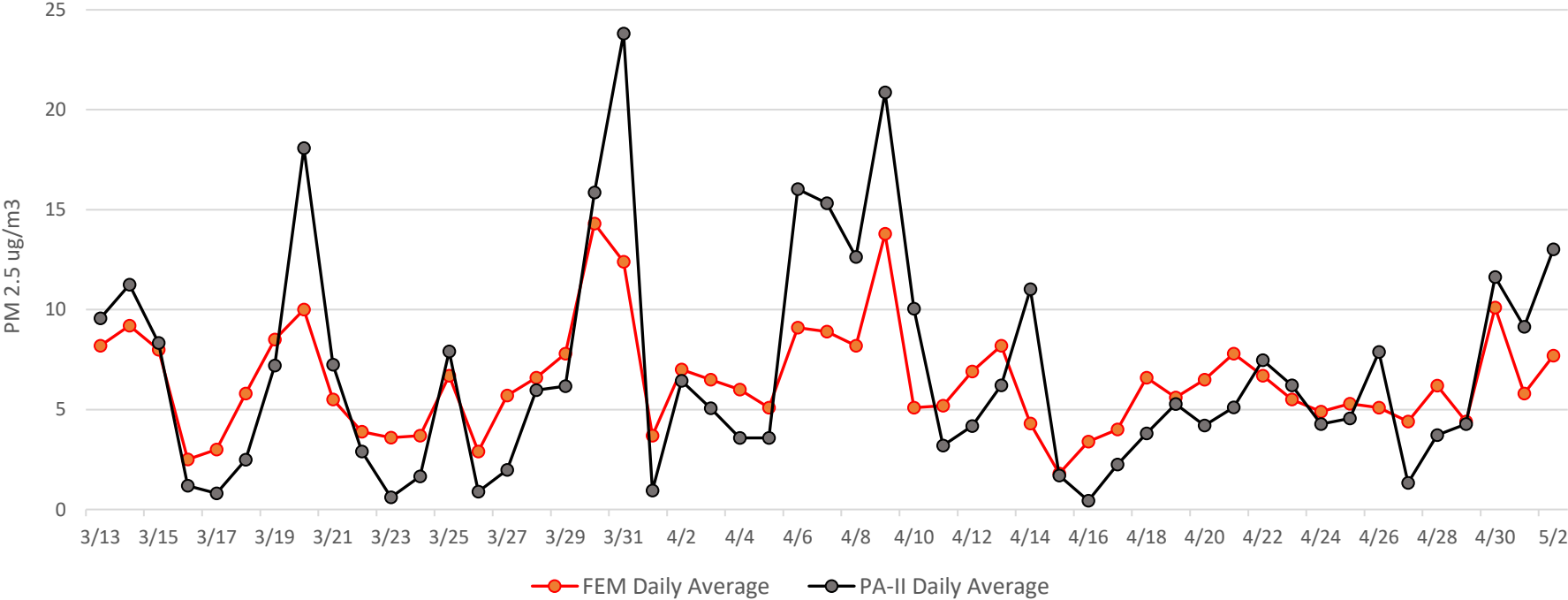
**GROUNDWORK**  
Elizabeth



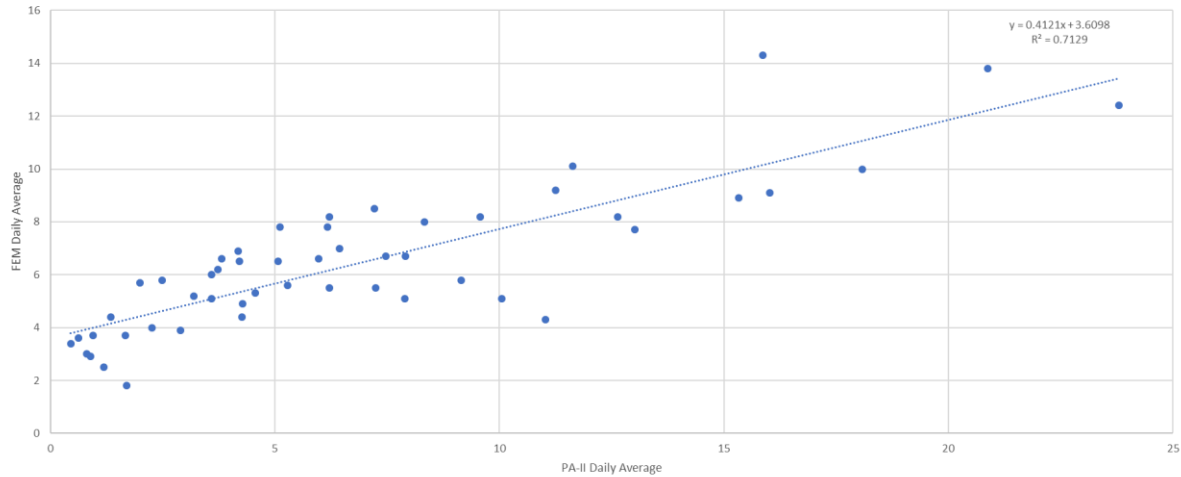
**RUTGERS**  
THE STATE UNIVERSITY  
OF NEW JERSEY



# Co-Location of low-cost PM2.5 Monitor (Black) with NJDEP monitor (Red) over 50 days



EOHSI (Rutgers) PA-II vs FEM 24hr Average Correlation



## Time line of partnerships between Elizabeth and CEED/EOHSI on local air quality





# Some Solutions

- More rail: fewer trucks
- Re-Routing: fewer trucks in neighborhoods
- Clean, zero-emission trucks and equipment
  - Advanced Clean Truck Program
  - Port pilot programs – 10 new electric trucks at Red Hook
  - Still a large proportion of pre-2008 diesel engines on the road
- Biodiesel and Renewable Diesel?
  - ~50% reduction in diesel particulate matter
  - Lower net lifecycle greenhouse gas emissions
  - A “drop-in” fuel that can be used in most current vehicles