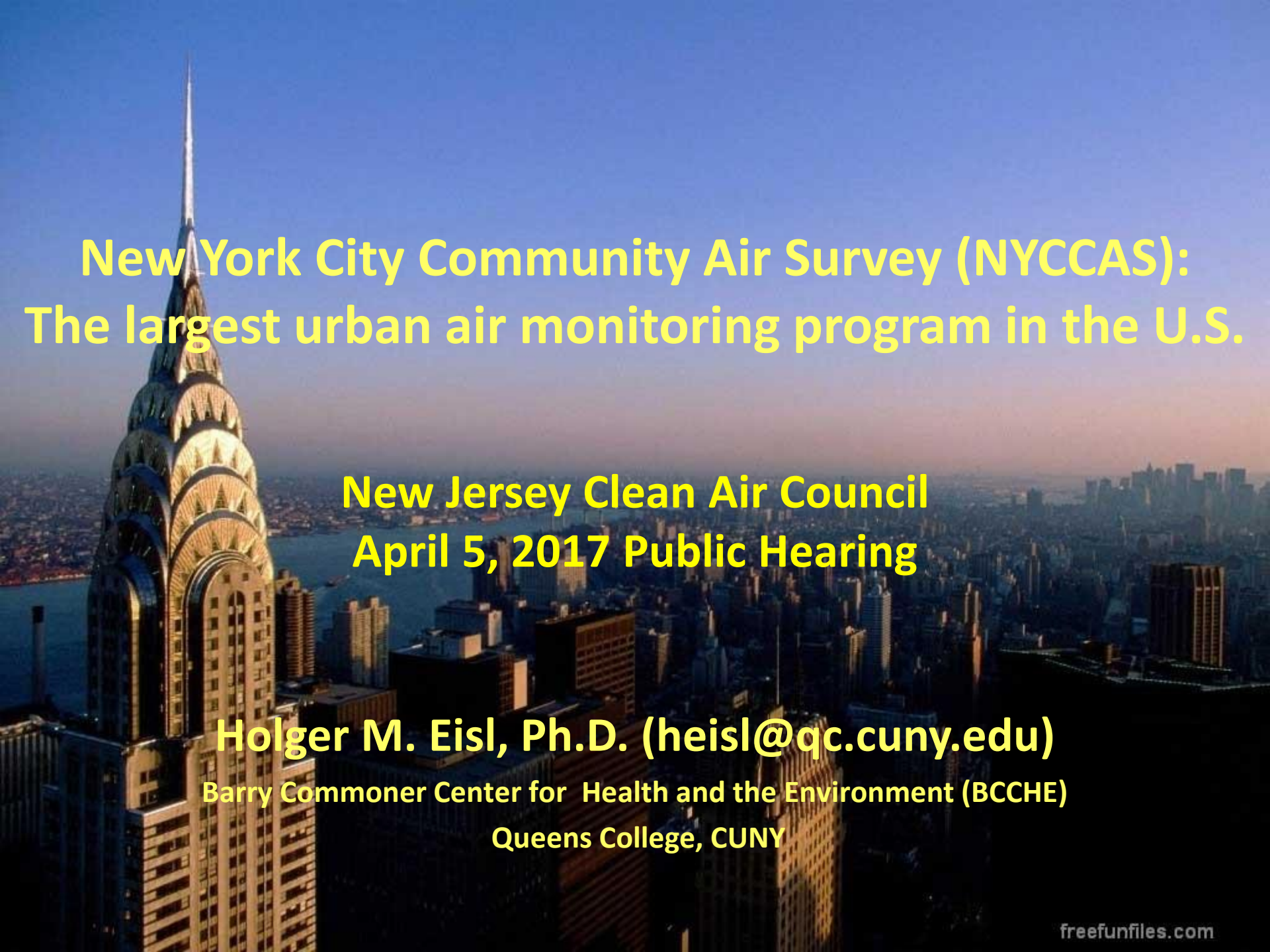
New York City Community Air Survey (NYCCAS):
The largest urban air monitoring program in the U.S.
New Jersey Clean Air Council
April 5, 2017 Public Hearing
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Holger M. Eisl – Background

Holger Eisl, Ph.D. is an environmental scientist with backgrounds in physics, engineering and urban planning. He received his graduate education at the Technical University of Berlin (Berlin, Germany) and the University of Pennsylvania (Philadelphia, PA, USA). Dr. Eisl's research interest centers on the analysis of environmental, energy and resource issues as well as providing concerned citizens and community organizations with technical and scientific advice.

Dr. Eisl is currently principal investigator of the New York City Community Air Survey (NYCCAS) in a joint project with the NYC Department of Health and Mental Hygiene. He oversees all activities related to the collection of ambient air monitoring data, lab analysis, and data validation procedures for the NYCCAS project. Under his direction, the Center works on new and innovative air monitoring instruments and performs field testing of environmental monitoring devices.

Overview

- **NYCCAS Air Surveillance Program**
- **NYCCAS Real-time $PM_{2.5}$ Monitoring Network**
- **Planned Queens College/DOHMH Citizen Science Project**

Health Effects of Urban Air Pollutants

- Fine particles ($PM_{2.5}$)
  - Penetrate deep into the lungs
  - Worsen lung and heart diseases, leading to shortened life expectancy
- Nitrogen oxides (NO_x-NO-NO_2), Sulfur dioxide (SO_2), Ozone (O_3)
  - Lung irritants linked to emergency department visits and hospital admissions for asthma and other respiratory conditions
  - Ozone exposures linked to reduced life expectancy
- Hazardous Air Pollutants (HAPs) / Air Toxics
  - Benzene and formaldehyde are known carcinogens
  - Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) compounds are associated with neurological effects

Note: Concentration-response relationships for these health effects are observed at levels below clean air standards.

Air Pollution: A Local and Global Health Risk

- WHO recently estimated that 7 million premature deaths occur each year around the world due to air pollution. About 3.7 million deaths are due to outdoor pollution (http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/)

- Ambient PM pollution is the 9th leading risk factor for all diseases in the world (Lim et al., The Lancet 2012, 380:2224–2260, December 15, 2012)

- **DOHMH estimated that approximately 2,000 premature deaths, more than 1,500 hospitalizations and 4,800 emergency department visits occur each year in NYC due to $PM_{2.5}$ exposure (NYC Health, 2013. NYC Trends in Air Pollution and its Health Consequences)**

- New York City's long-term sustainability plan
- Launched in 2007
- Includes strategies on water, solid waste, climate, air, etc.
- Overall air goal to reduce emissions from:
  - On-Road vehicles
  - Other transportation (e.g., ferries)
  - Buildings
- Understand the scope of the challenge
  - Queens College/DOHMH Collaborative local air quality study: New York City Community Air Survey (NYCCAS)

NYCCAS Goals

- Assess year-round variation in multiple air pollutants across NYC neighborhoods;
- Identify sources contributing to intra-urban pollution patterns;
- Inform the public and city officials on air pollutant levels and efforts to improve air quality;
- Provide high quality air pollution exposure estimates for health surveillance and research.

NYCCAS Program Development and Implementation

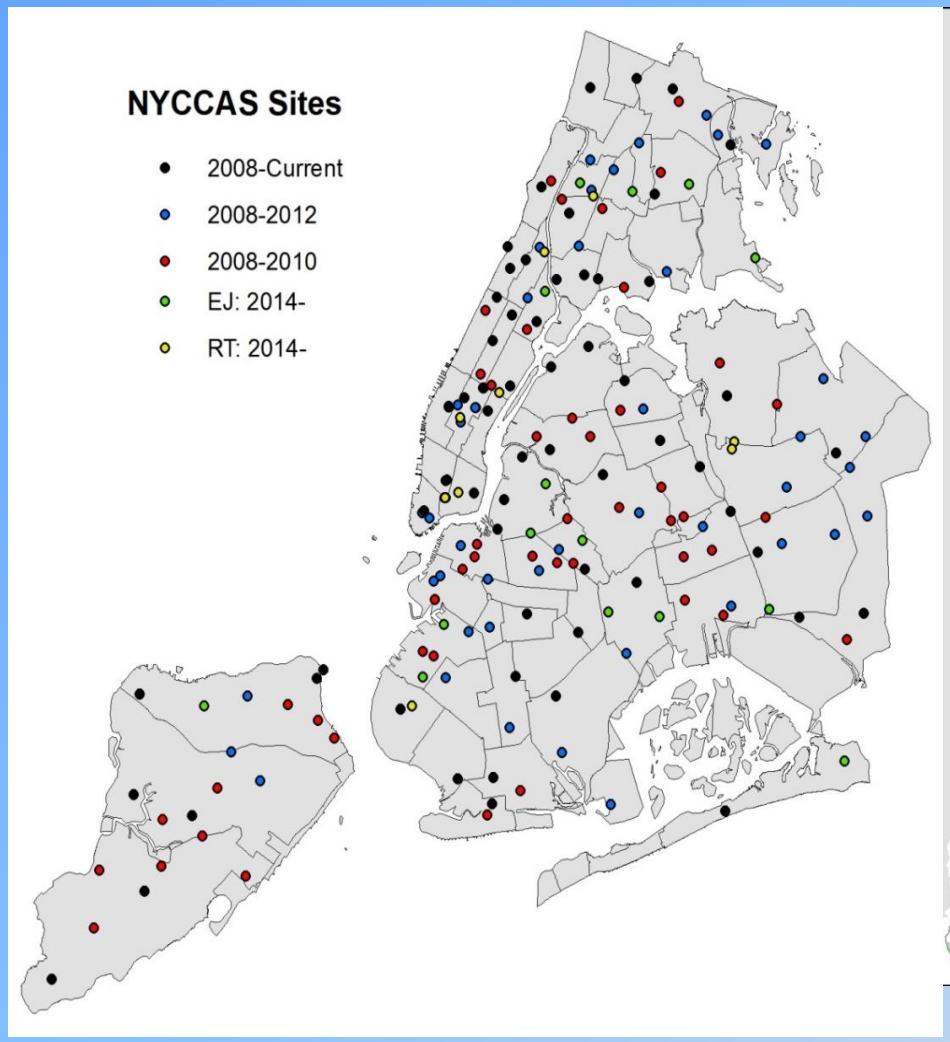
- Fall 2007 through Fall 2008: NYCCAS program design; instrument development, including lab and field testing
- Monitoring activities began in Winter 2008:

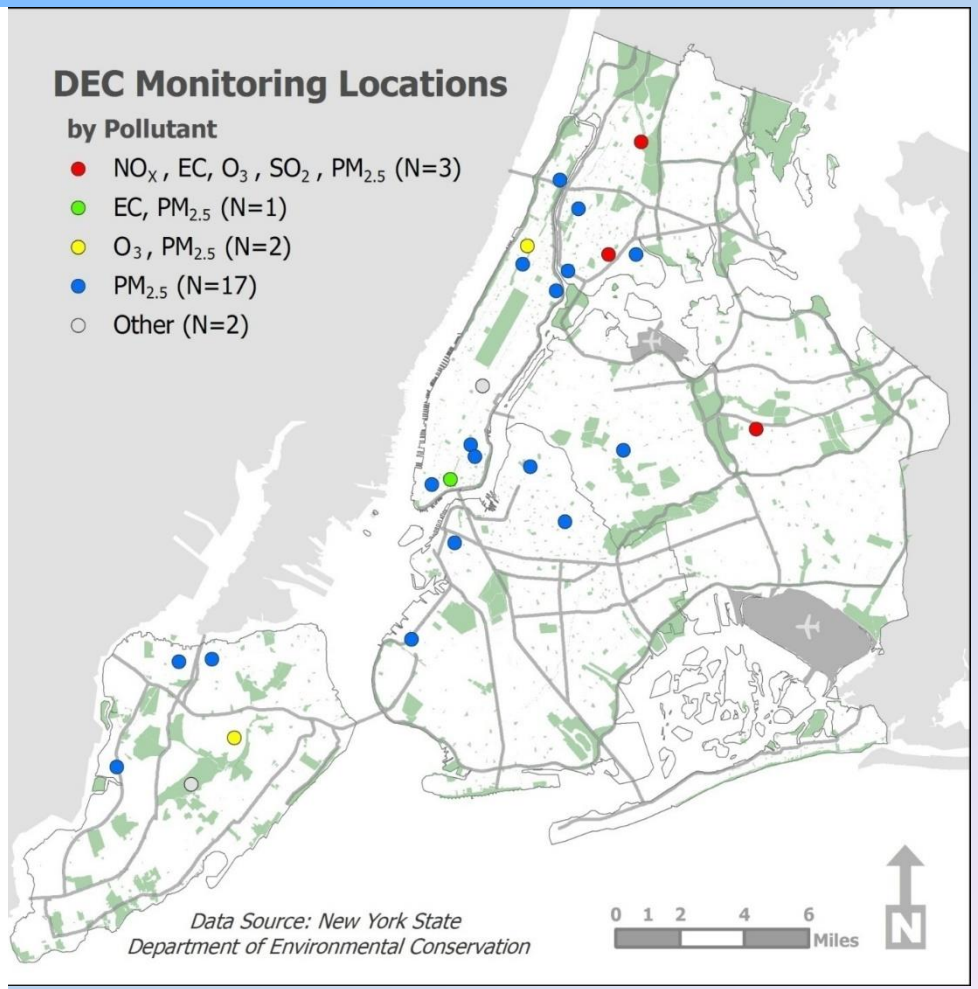
  Years 1+2: 150 Sites

  Years 3+4: 100 Sites

  Year 5-present: 75 sites (60 core sites plus 15 additional in low income neighborhoods 'EJ' sites)
- 2-Week, integrated samples taken once per site/season: $PM_{2.5}$, BC, NOx, O_3, SO_2, $PM_{2.5}$-metals constituents
- Filter-based monitoring data are integrated into a land use regression model (LUR) to predict ambient pollution concentrations at unmonitored locations

NYCCAS, the largest urban monitoring program in the U.S.





75-150 monitoring sites per year
$PM_{2.5}$, NO_2, SO_2, EC, O_3

17 $PM_{2.5}$ sites, 3 NO_2 Sites, 1 EC site, 2 O_3 sites and 3 multiple pollutant sites

Methods: Site Allocation

- Systematic allocation (120 sites):
  - Divided into 7,595 lattice cells in GIS (300m x 300m)
  - Over-sampled high traffic, high buildings cells
  - Sites are street-side or in parks
- Purposeful allocation (30 sites)
  - Fill spatial gaps
  - One per community district
  - Near sites of concern
- Reference sites (5 sites)

NYCCAS (PAAS-201) Filter-based Sampling Unit

Temperature/RH sensor data logger records temperature and relative humidity.

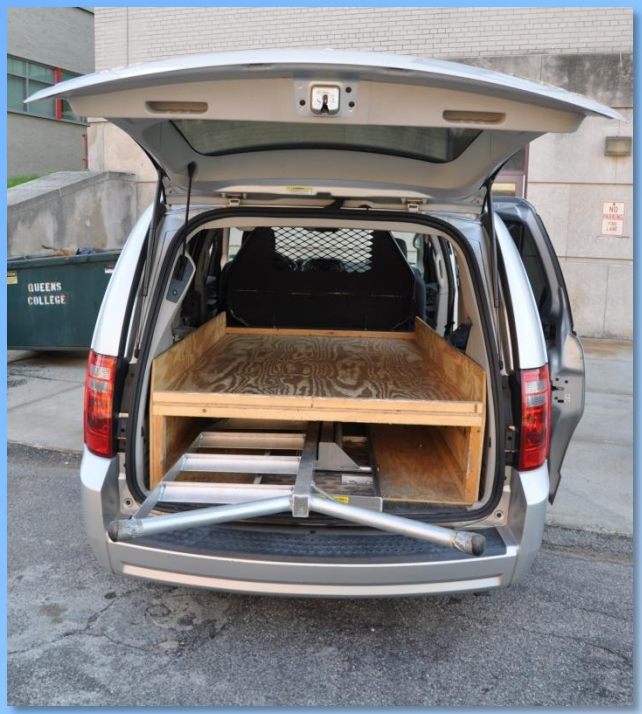
NO_x, NO_2, SO_2, and O_3 are collected with passive monitors in a protective housing

$PM_{2.5}$ samples are collected with a Harvard Impactor

NYCCAS Equipment Testing at NYS DEC Monitoring Sites

NYCCAS Lab at Queens College

NYCCAS Vehicle Fleet - Dodge Grande Caravans (interior modified)



Pre-installed mounting plate for rapid deployment and retrieval

Retrieval/deployment of sampling unit

NYCCAS sampling units deployed at street-level (10’ - 12’ above ground) in NYC neighborhoods

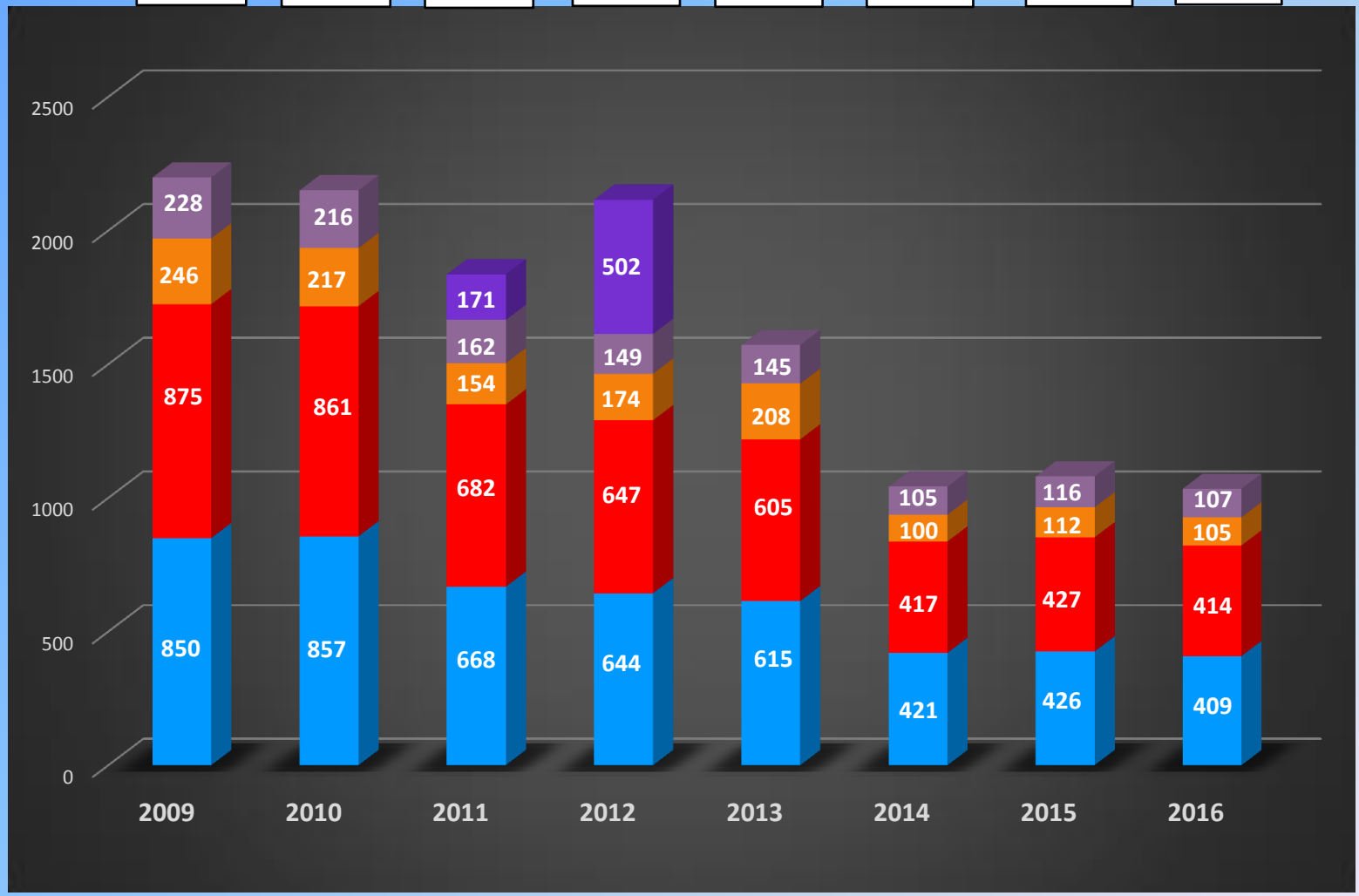
Laboratory Methods – Sample Analysis

- $PM_{2.5}$ or PM_{10} gravimetric analysis [Teflon]
- EC by reflectometry [Teflon]
- Thermal-Optical Analysis for Organic and Elemental Carbon (OC/EC) [Quartz]
- $PM_{2.5}$ analysis for polar organic compounds [Quartz]
- Metals constituents by X-Ray Fluorescence [Teflon]
- Metals constituents by inductively coupled plasma mass spectrometry (ICP-MS)
- NO_x and NO_2 by spectrophotometry
- O_3 and SO_2 by ion chromatography

NYCCAS Sampling Activities, 2009 through 2016

	2009	2010	2011	2012	2013	2014	2015	2016
Failed samples →	72 (3%)	42 (2%)	63 (3%)	47 (2%)	52 (3%)	70 (7%)	70 (6%)	54 (5%)
Total samples →	2199	2151	1837	2116	1573	1043	1081	1035

∑ 13,035



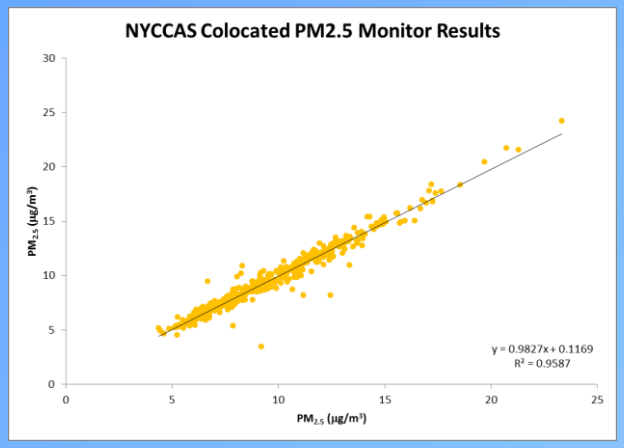
NYCCAS Program Year

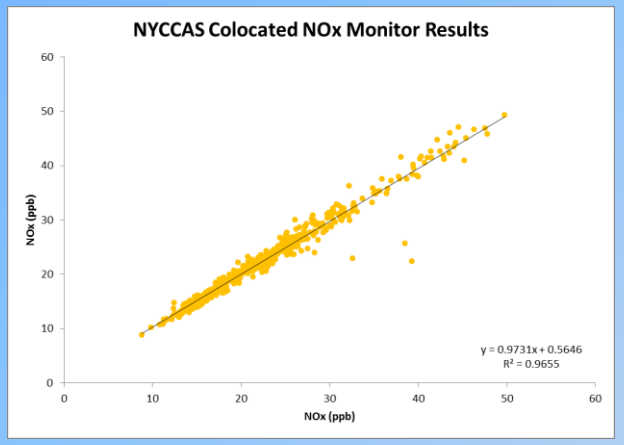
Data Precision/Comparability

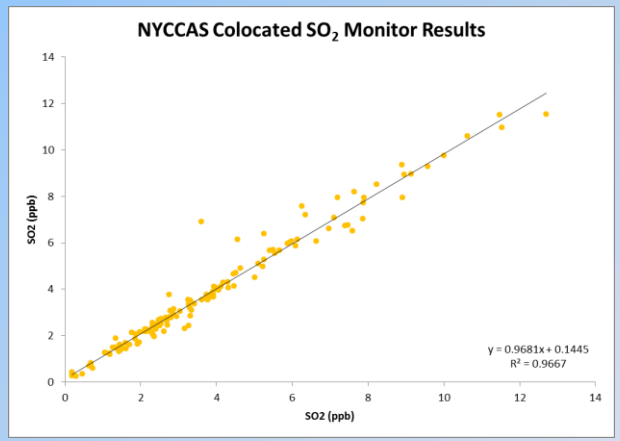
Comparability with Regulatory Monitors

NYCCAS Data Quality: Co-located Measurements

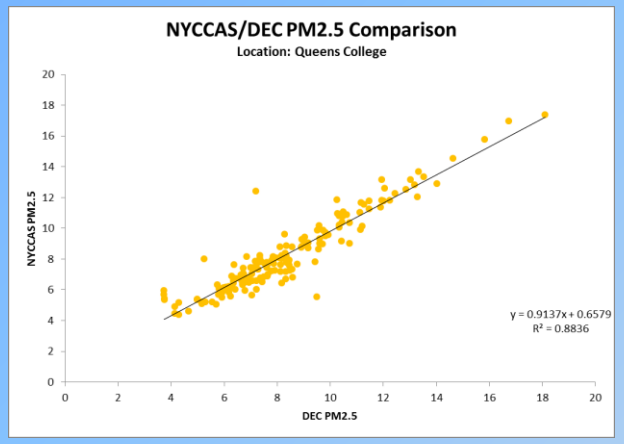
Co-located NYCCAS Measurements (Data precision)

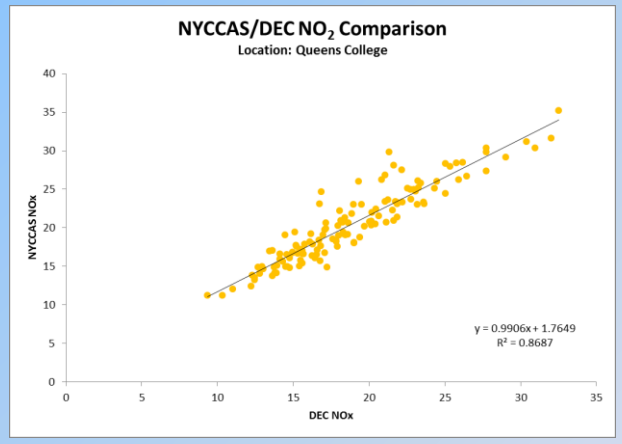


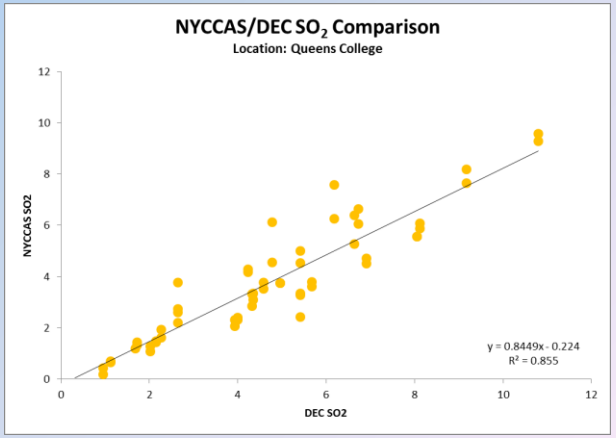


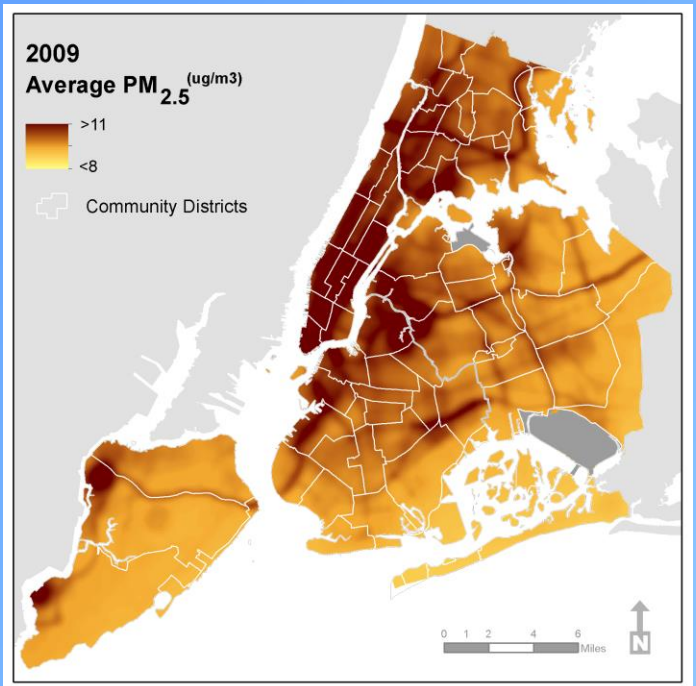


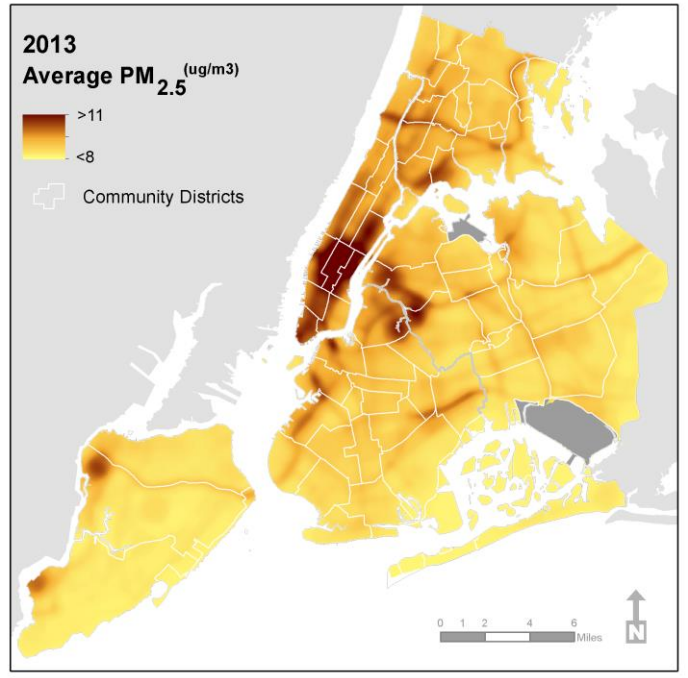
Co-located NYCCAS/DEC Measurements (Data comparability)







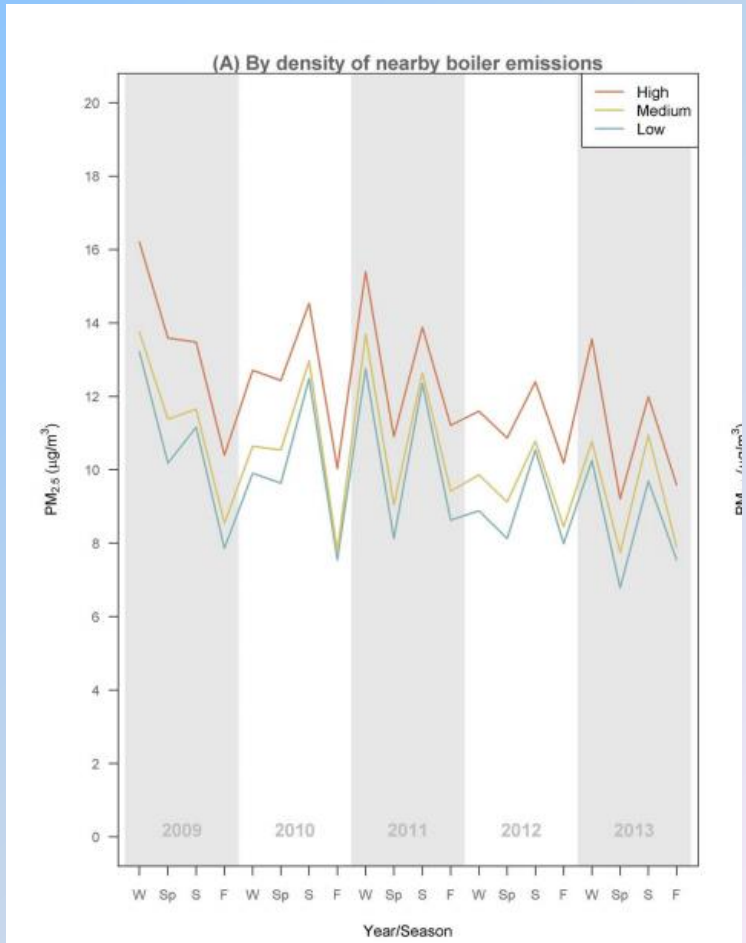


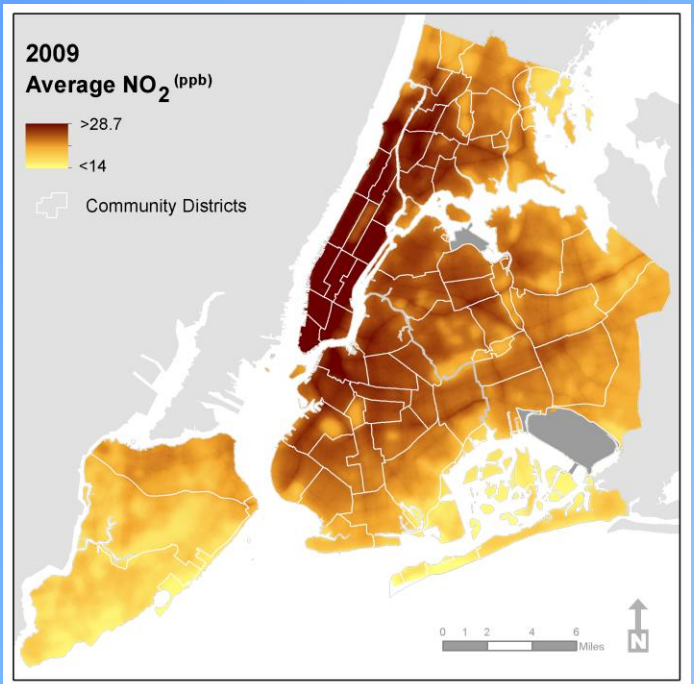


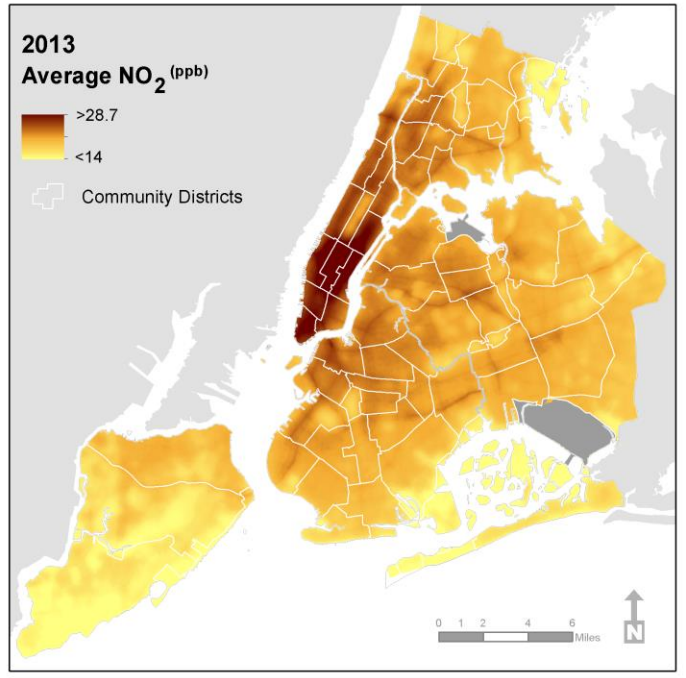
5-Year Results: $PM_{2.5}$

- **16% decline over 5 years**

Source indicators (buffer size):
- Emissions from building boilers (1km)
- Industrial land use area (1km)
- Traffic density, weighted by type (250m)





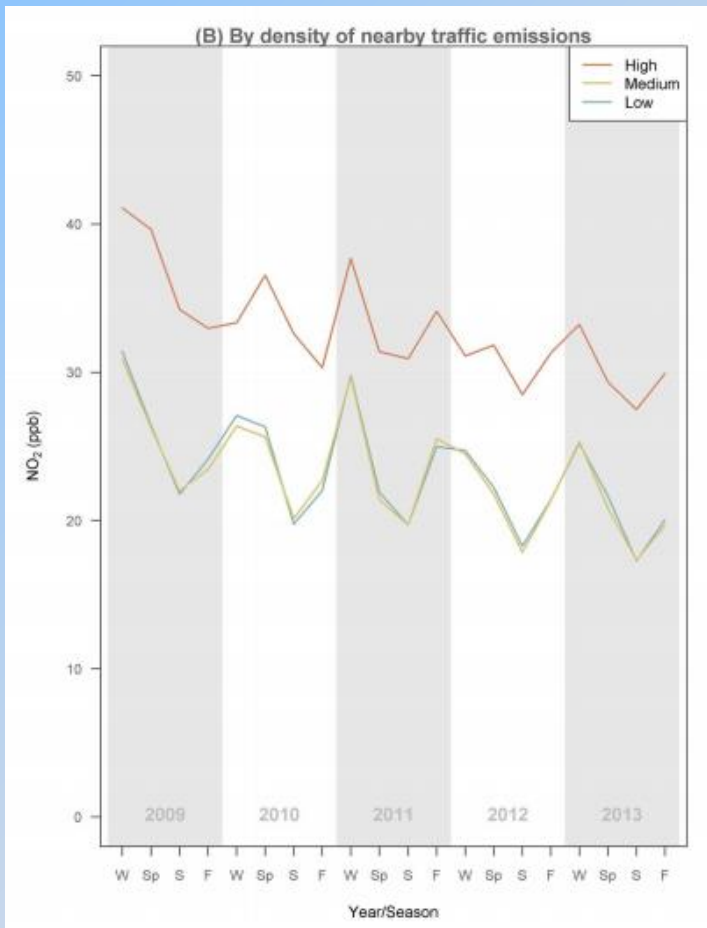


5-Year Results: NO_2

19% decline over 5 years

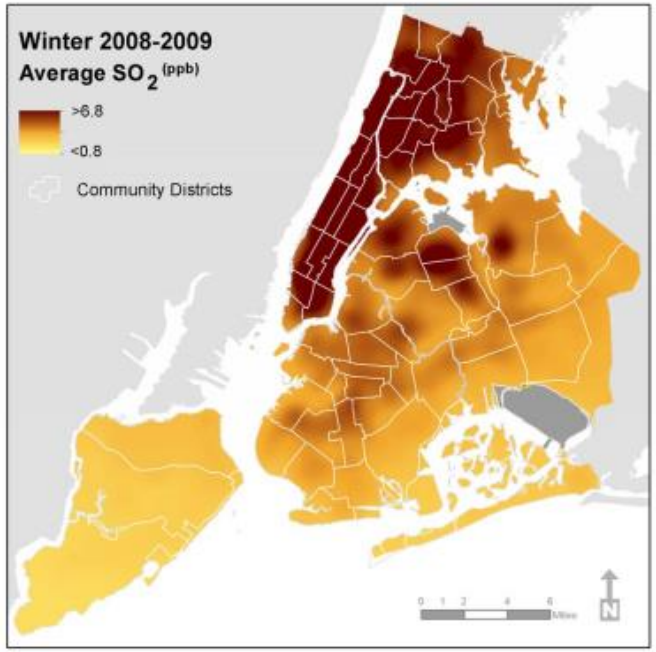
Source indicators (buffer size):

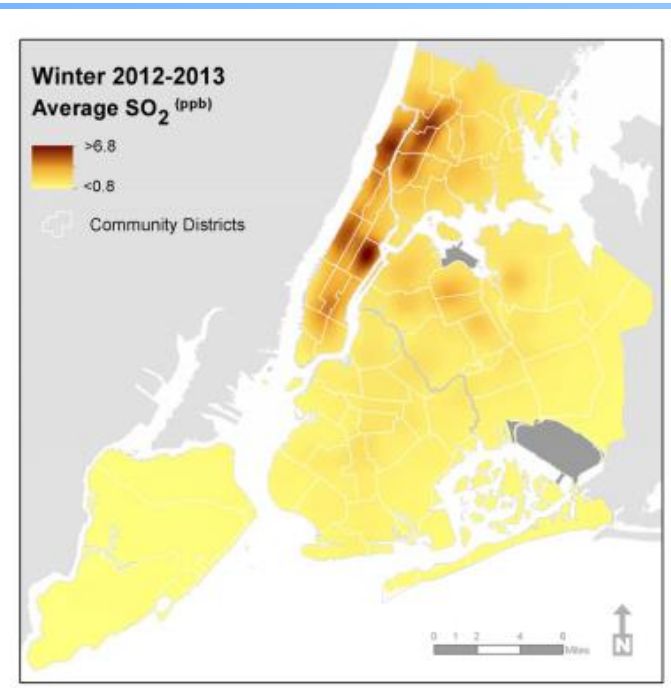
- Area of interior building space (1km)
- Traffic density (100m)
- Percent impervious surface (100m)



5-Year Results: SO_2

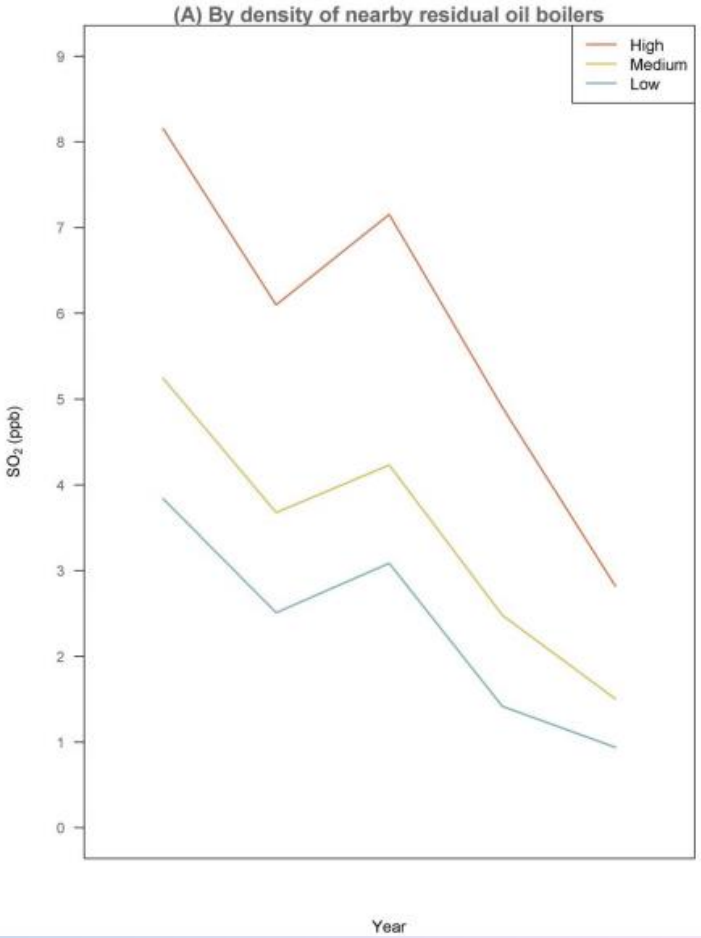
69% decline over 5 years





Source indicators (buffer size):

- Oil 4/6 boiler density (1km)
- Nighttime population (1km)



Recent NYC Government Actions as a Result of the Existence and Findings of the NYCCAS Program

- DEP Residual oil phase out: 4/25/2011
  - No new #4 or #6 boilers permitted, effective immediately
  - Phase out of #6 to new low sulfur #4 between 2013 and 2015
  - Mandatory switch to Low Sulfur #2 or Natural Gas by 2030 or boiler retirement
- Local Law 194-A, enacted by NY City Council 8/16/10
  - Requires by 10/1/2012 that the sulfur content of #4 heating oil be capped at 1500 ppm
  - Requires by 10/1/2011 that all heating oil sold in NYC contain at least 2% biodiesel
- Other NYC action
  - 35 schools are in the process of converting from #4/#6 to cleaner fuels within the next 10 years
  - All NYCHA housing is in the process of being converted to natural gas
- **The NYCCAS program was signed into law on November 4, 2015 by NYC Mayor Bill de Blasio and thus has become part of the New York City Charter.**

NYCCAS: Street-level, Real-time $PM_{2.5}$ Monitoring Network

5 units are currently deployed in NYC; a total of 12 unit will be deployed by August 2017

Planned Queens College/DOHMH Citizen Science Project

OneNYC 2015 (launched in 2014): **Air Initiative**

Identify targeted air quality improvements through community engagement

- Creating citizen science toolkits, working with partners to integrate community monitoring with existing networks (e.g. NYCCAS, DEC)

Tentative Work Plan

- Consultation with academic, government, industry and community groups on best practices and strategies for increased community engagement around air quality monitoring.

- Review of existing low cost air quality sensors for $PM_{2.5}$, NO_2, BC and total VOC (air toxics) for suitability in citizen operation and community/academia/government partnership research projects.

- Design and implementation of two pilot studies (e.g. high traffic zone, marine transfer station) to assess neighborhood air quality levels with a community partner (e.g. We ACT).

- Development of data portal for communities to view citizen science data (including database development, data analysis tools and data visualization).

- Development of outreach materials.

Thank you

NYCCAS Team

Queens College: Holger Eisl, John Gorczynski, Jung Kim, Christian Meyers, Paul McFarlane, Jonah Markowitz, Laura Ruiz-Olivo, Brett Siegel, Steven Markowitz

DOHMH: Iyad Kheirbek, Sarah Johnson, Kazuhiko Ito, Kazue Anan, Christopher Huskey

Zev Ross Spatial Analysis

For more information about NYCCAS, visit:
http://www1.nyc.gov/site/doh/data/data-publications/air-quality-nyc-community-air-survey.page

To download air quality and other environmental health data visit:
http://www1.nyc.gov/site/doh/data/health-tools/environmental-public-health-tracking-program.page