Model-Based Assessment of the Air Quality and Public Health Benefits of New York City's 80 X 50 Plan

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Sponsored by the New York State Energy Research and Development Authority (NYSERDA)

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  - Sharon Douglas, ICF
  - Iyad Kheirbek, New York City DOHMH
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Air Quality and Health Effects Modeling: Project Overview

Project Goal: To inform NYC's air quality management strategies using state-of-the-science modeling tools and local emissions data for five policy, technology, or market scenarios relevant to NYC's air quality and climate goals

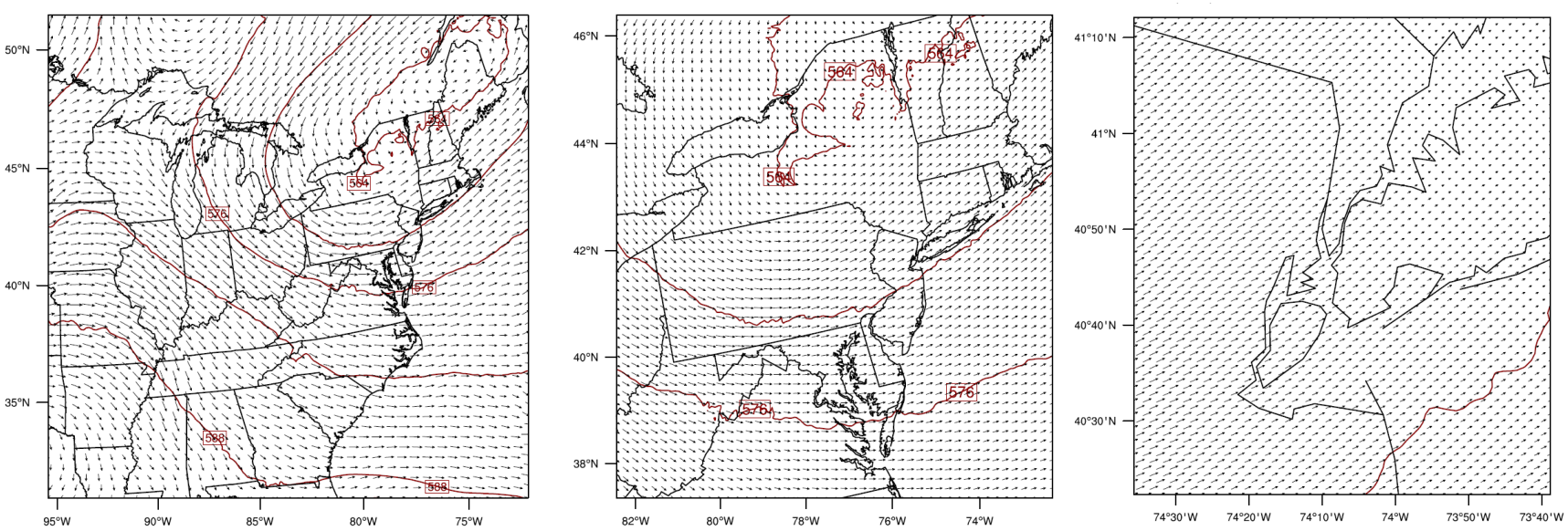
Air Quality and Health Effects Modeling: Tasks

- Task 1: Management
- Task 2: Meteorological Modeling
- Task 3: Emission Inventory Improvement
- Task 4: Emission Scenarios
- Task 5: Air Quality Modeling
- Task 6: Health Effects Assessment
- Task 7: Development of a Screening Tool

Task 2: Meteorological Modeling

- Prepare meteorological inputs for 2011 using the Weather Research and Forecasting (WRF) model (Version 3.8)

- Multiple nested grids with highest resolution over NYC



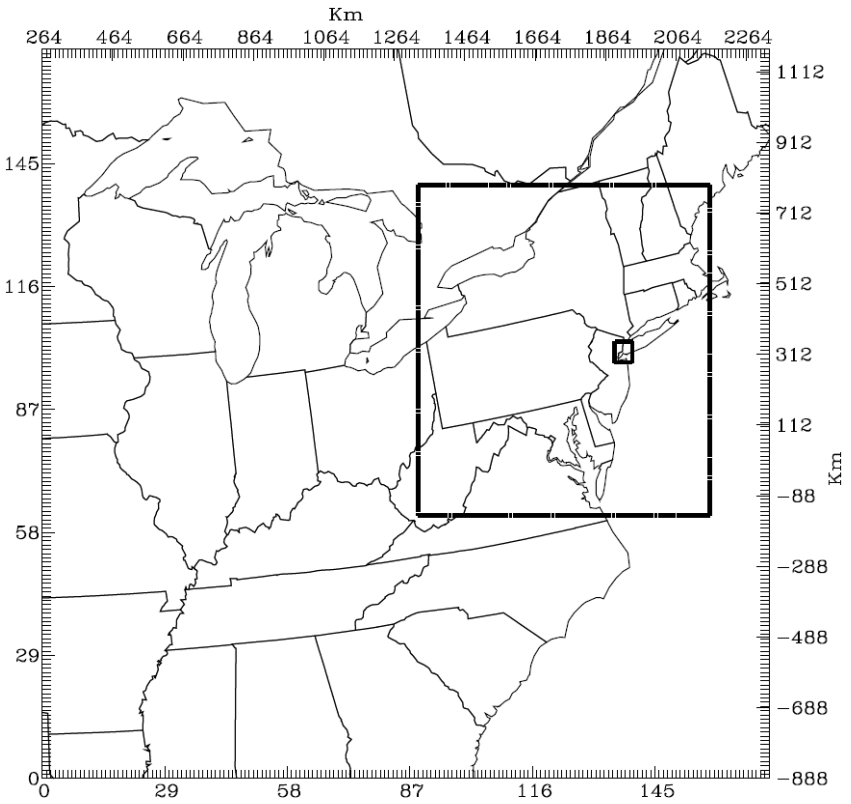
500 mb
14 June 2011

- Use output as input to the air quality model

Task 3: Emission Inventory Improvement

- Prepare updated regional-scale emission inventory based on 2011 National Emission Inventory (NEI)
- Update with NYS and NYC specific data to reflect changes in fuels, source types or operations
- Process using EPA's SMOKE emissions processing tool

Nested-Grid Modeling Domain



12-, 4- and 1.33-km Grids

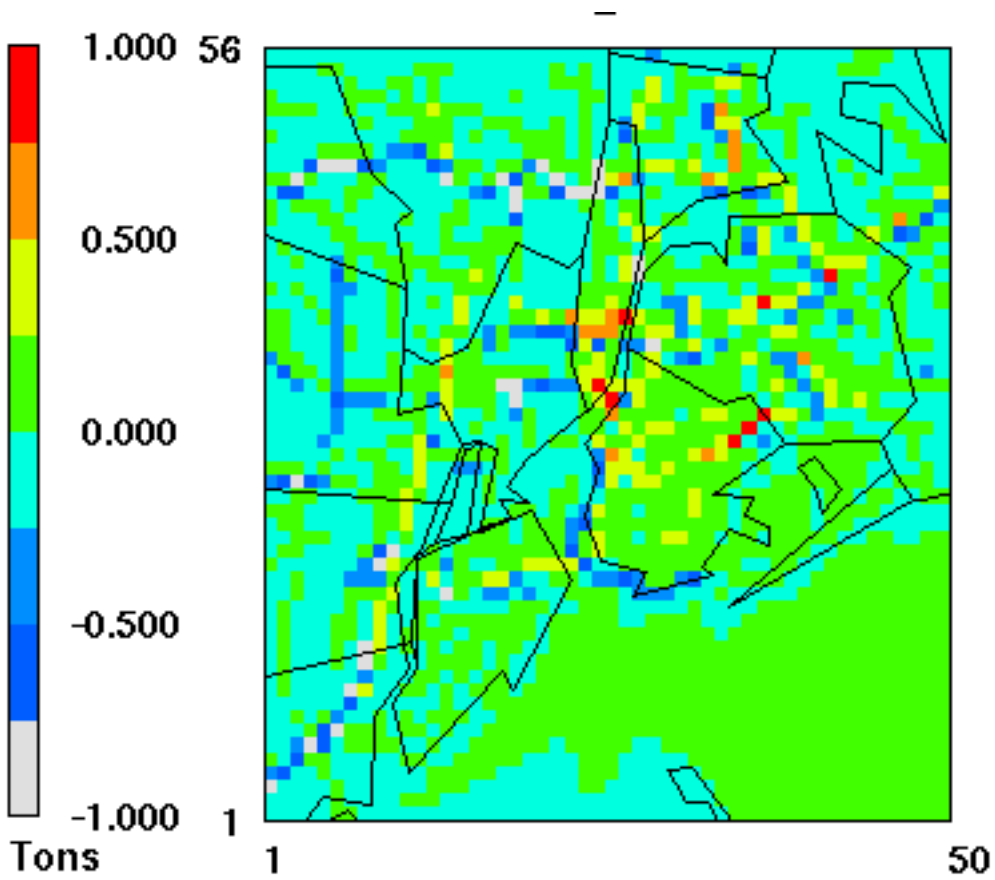
Task 3: Emission Inventory Improvement

- Specific NYC area emission updates include:
  - Use New York Metropolitan Transportation Council (NYMTC) data as a spatial surrogates
  - Building-level emissions are being quantified using
    - Permits from DEP
    - Reported fossil fuel use data from buildings over 50,000 ft^2 (as required by local law 84)
    - Heat and hot water fossil fuel emissions estimates based on building area, typology, and energy use intensity estimates
  - Commercial cooking spatial surrogate data generated from NYC DOH restaurant inspectors

Task 4: Emission Scenarios

- Five scenarios reflecting strategies for the 80 X 50 plan:
  - Deep energy retrofits in buildings (efficiency)
  - Traffic plan
    - Federal/state fuel economy programs
    - Increased ZEV/NZEV vehicles for fleets
    - Increased sustainable mode share
  - Changes in state energy policy
    - Low carbon intensity future grid
    - Increased community-scale distributed renewable energy

Task 4: Emission Scenarios (Example)



◄ Difference in daily NO_x emissions resulting from the use of link-based VMT data for the 1-km grid

Air Quality Modeling Objectives:

1) To examine the potential air quality impacts of changes in emissions related to different policy scenarios included in the 80 X 50 plan

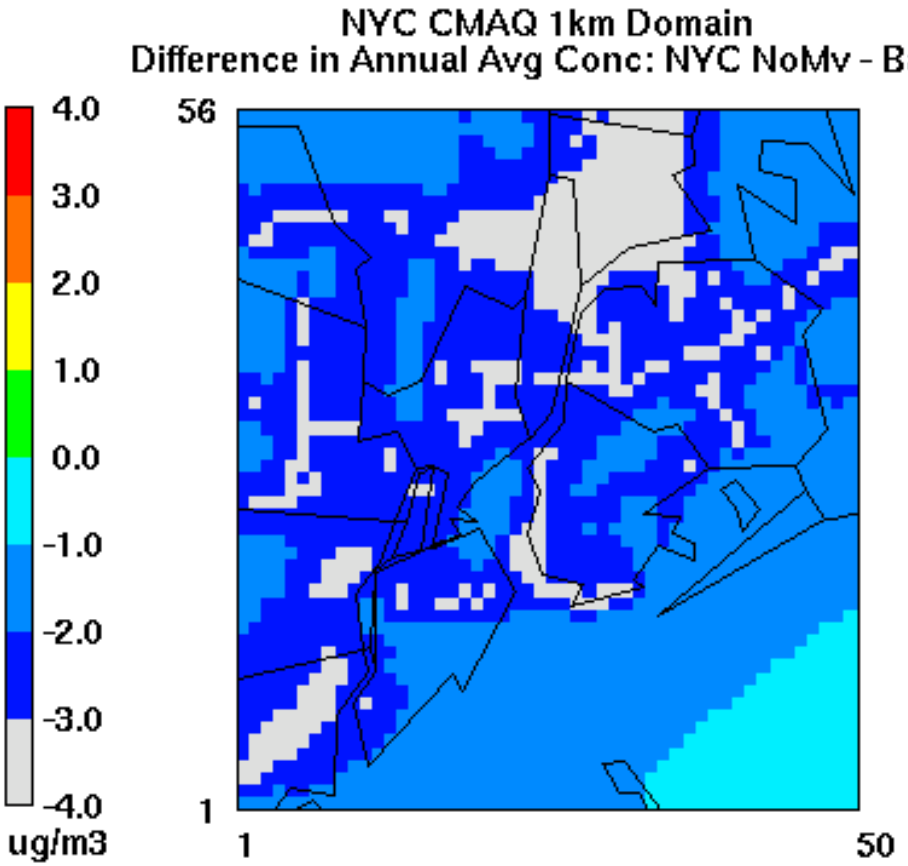
2) To provide a basis for a neighborhood-scale assessment of health effects

Task 5: Air Quality Modeling

- Apply EPA's Community Multiscale Air Quality (CMAQ) model for the baseline and each alternative emission scenario for an annual modeling period
  - Inputs include:
    - 2011 high-resolution meteorological inputs developed with the WRF prognostic meteorological model
    - Updated emissions for both baseline and alternative scenarios
  - Key metrics related to National Ambient Air Quality Standards (NAAQS) for ozone, $PM_{2.5}$ and NO_2 will be examined
- Compare results for each alternative scenario with the results for the baseline scenario

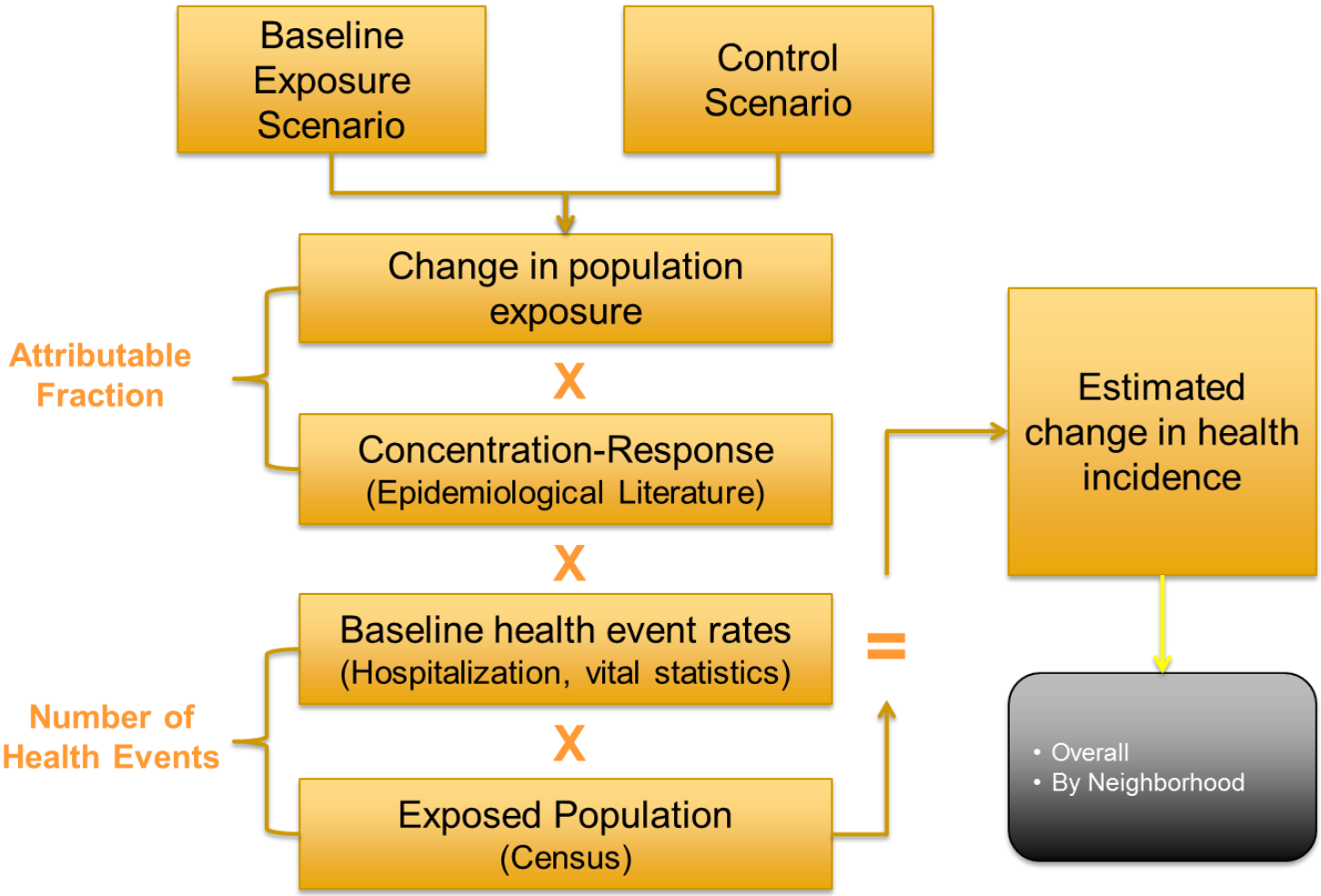
Task 5: Air Quality Modeling (Example)

NOMV – BASE PM2.5 DIFFERENCES (Micro-g/m^3)



◄ Difference in simulated annual average $PM_{2.5}$ concentration: no-motor-vehicle (NoMV) scenario minus base

Air Quality and Health Effects Modeling Methodology



Task 6: Health Effects Modeling

- Conduct a local-scale health impact analysis using EPA's MATS and BenMAP tools

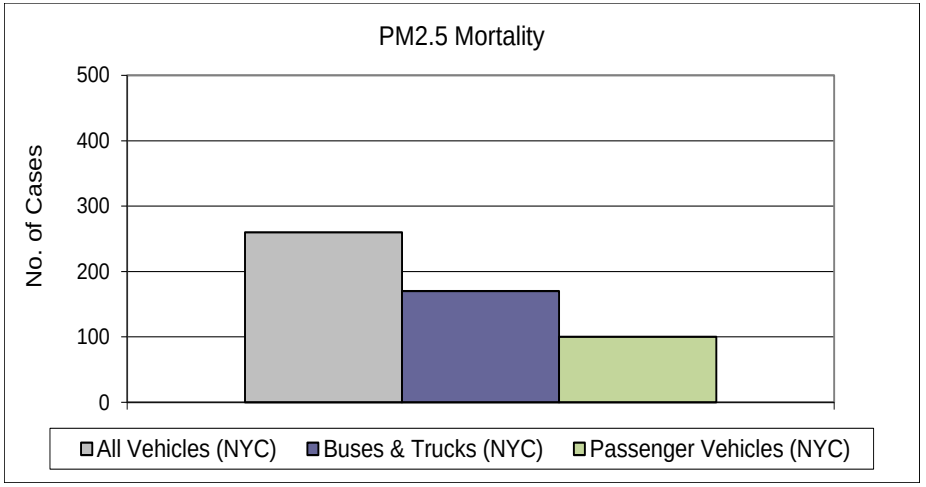
- Estimate reduction in mortality and morbidity due to changes in pollutant concentration levels relative to the baseline scenario

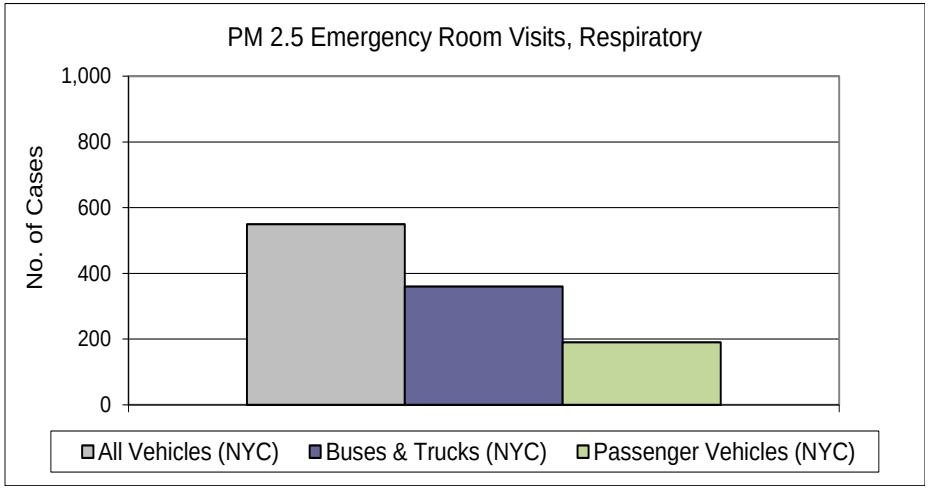
- Use health impact functions from epidemiological literature (including studies conducted in NYC) to quantify changes in
  - Premature mortality
  - Emergency department visits for asthma
  - Hospital admissions
  - Other endpoints

Task 6: Health Impacts Assessment (Example)

- Health impacts calculated for 42 NYC neighborhoods then summed to estimate the city-wide benefit of each scenario
- Health impacts compared across neighborhoods to evaluate impacts across differing socioeconomic status

City-wide $PM_{2.5}$-attributable health burdens of mobile source emissions ►

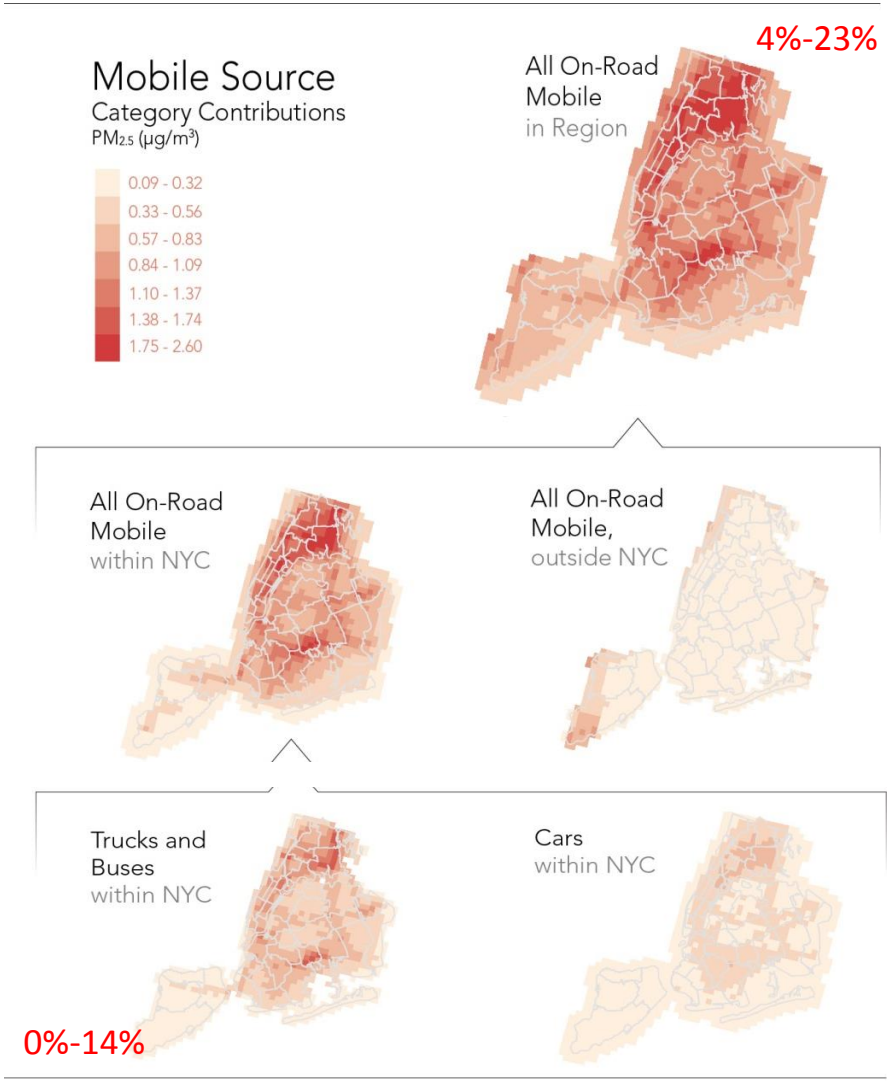




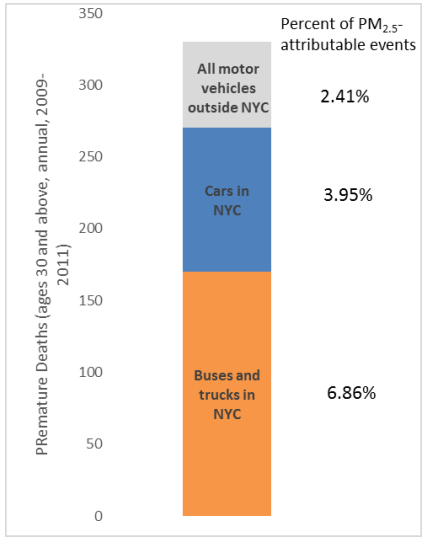
Contributions of Simulated PM2.5 Levels from MV Emissions in NYC

Baseline $PM_{2.5}$
($\mu g/m^3$)

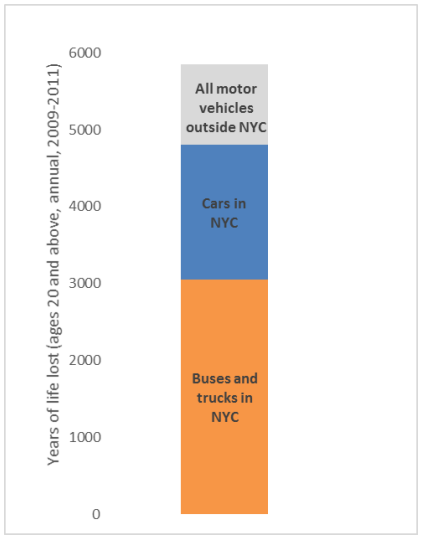
7.17 - 8.09
8.10 - 8.67
8.68 - 9.33
9.34 - 10.11
10.12 - 11.26
11.27 - 12.98
12.99 - 19.41



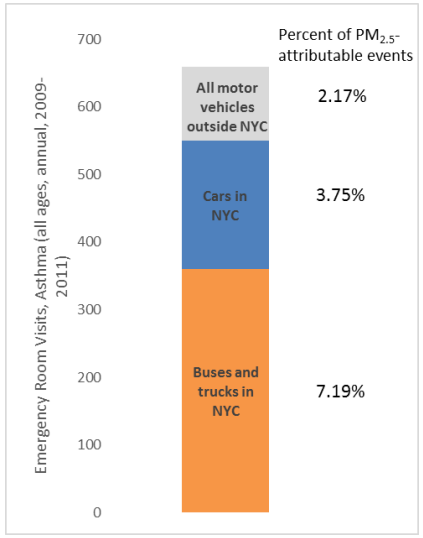
Effects of MV PM2.5 Levels on Public Health



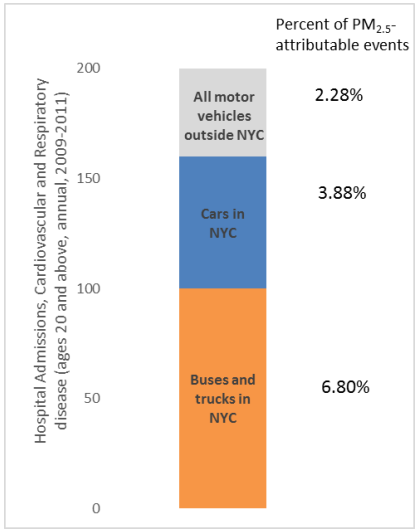
330 premature deaths



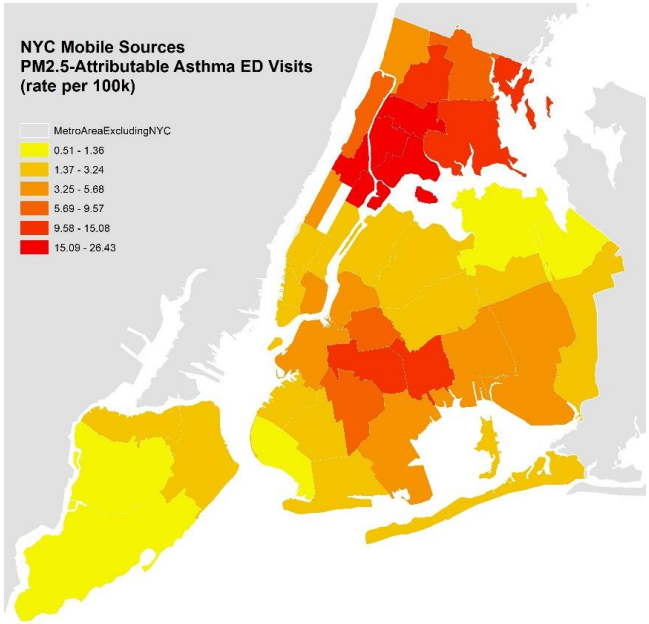
5850 years of life lost



660 ED asthma visits



200 Hospitalizations for cardiovascular and respiratory disease



All Mobile Sources: 50x variation in $PM_{2.5}$-Attributable ED Asthma Visits (rate) across neighborhoods

Task 7: Development of a Screening Tool

- Develop a screening tool for evaluation of other potential strategies and programs designed to reduce emissions
  - Simple Excel-based tool that requires input data on emissions (or differences in emissions relative to one of the modeled scenarios)
  - Limited to examining different levels of emission reductions for the sources modeled, within the range of scenarios modeled
  - Will provide estimates of specific air quality and health effects metrics, including maximum and average concentrations, NAAQS-relevant concentrations, exposure, and health endpoint incidences

Questions?