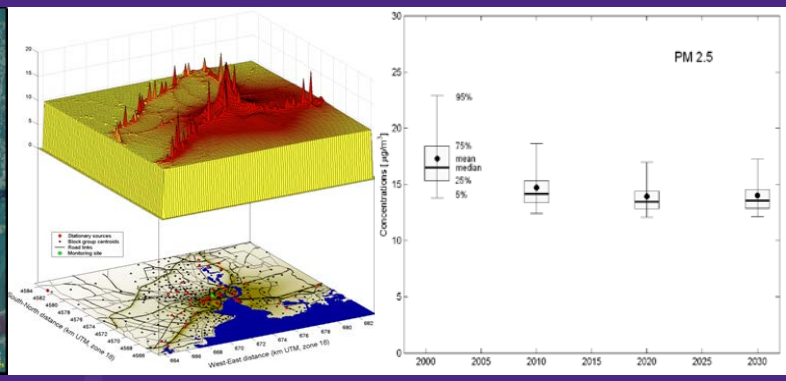
United States Environmental Protection Agency

Feasibility of assessing public health impacts of air pollution reduction programs on a local scale: New Haven accountability case study

Danelle Lobdell, Vlad Isakov*, Lisa Baxter*, Jawad Touma*, Marybeth Smuts and Halûk Özkaynak***

U.S. Environmental Protection Agency
Office of Research and Development
National Health and Environmental Effects Research Laboratory
***National Exposure Research Laboratory**
****Region 1**



Promoting Healthy Communities

September 27, 2011

Background

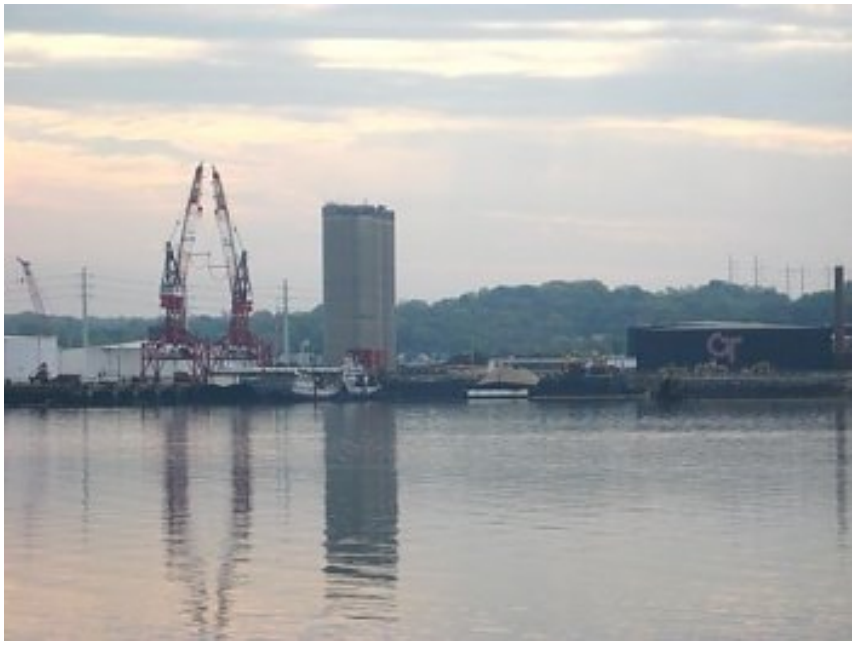
- New Haven, CT – Funded for EPA Community Air Toxics Project
  - Implemented a comprehensive Clean Air Initiative
  - Includes a number of voluntary and regulatory air pollution programs
- Development and validation of EPHIs are needed
- Existing health and environmental data are available across the United States
  - However, knowledge of these existing data may not be known
  - May have access limitations
  - Health and environmental data may not be compatible to link

Study Aims

- Identify existing human health, ambient air quality and human exposure-related data in New Haven, CT
  - Assess the availability and accessibility
- Determine the air pollution reduction activities and associated changes in emissions for multiple pollutants
- Refine, apply, and evaluate air quality and human exposure models that can be used with local health data
- Assess the feasibility of using this existing information to conduct an air accountability study
- Develop collaborations and partnerships with state and local agencies including government, academia, and the New Haven community
- Provide the methodologies developed under this project to future projects in other areas in the United States

Why New Haven?

- Identified as a concern from EPA Region 1
- Highest children asthma emergency room visits in CT
- New England County with 2nd highest NATA risks
- PM and Ozone noncompliance
- City, state & community partnerships and actions



New Haven, CT
Where highways, power plants and an industrial port converge

Assessing Feasibility

Step 1 – Identify health end-points and pollutants of interest specific to New Haven

Step 2 – Ascertain relevance, completeness, and availability of identified health databases, emissions, environmental and exposure databases

Step 3 – Develop emission estimates representative of impacts of local sources and projected impacts of federal, state, and local regulatory reduction activities

Step 4 – Predict pollutant-specific air pollution concentrations and population exposures using coupled models for key pollutants for base year 2001 and projected years 2010, 2020, 2030

Step 5 – For each morbidity and mortality health-endpoint, determine minimum statistically detectable amount of reduction that can be expected for New Haven study area (population ~370,000)

Step 6 – Estimate for each health outcome, the portion that may be attributed to effects due to air pollution

Step 7 – Estimate the size of air pollution reduction that would be necessary for New Haven in order to test likely impacts of pollution reductions on determined health indicators

Step 8– Determine feasibility (not feasible, potentially feasible, likely feasible) considering alternative study designs

Existing Data

Ambient Air Quality Data

- 6 ambient air monitors in City of New Haven operated by Connecticut Department of Environmental Protection
  - Currently only 4 are active

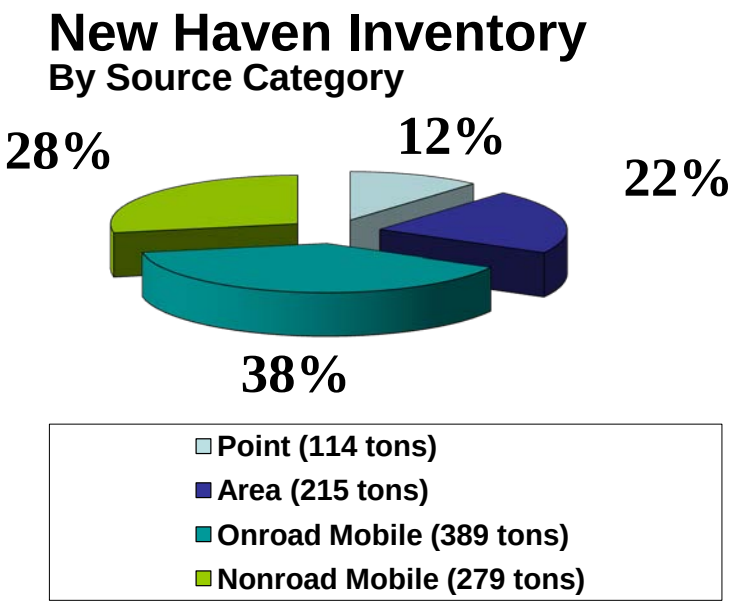
Existing Human Health Data

- Hospital discharge data (CHIME)
- Vital records
- Birth defects registry

Existing Human Health Data (continue)

- Connecticut Department of Public Health's Asthma program
  - Asthma surveillance
  - School based asthma surveillance
- Medicaid data – HUSKY
- School absenteeism
- CT Tumor Registry
- Emergency services data
- Hill Health Community Health Center Data
- New Haven Health Project

Emission Estimates Representative of Local Sources



Total HAPS = 997 tons

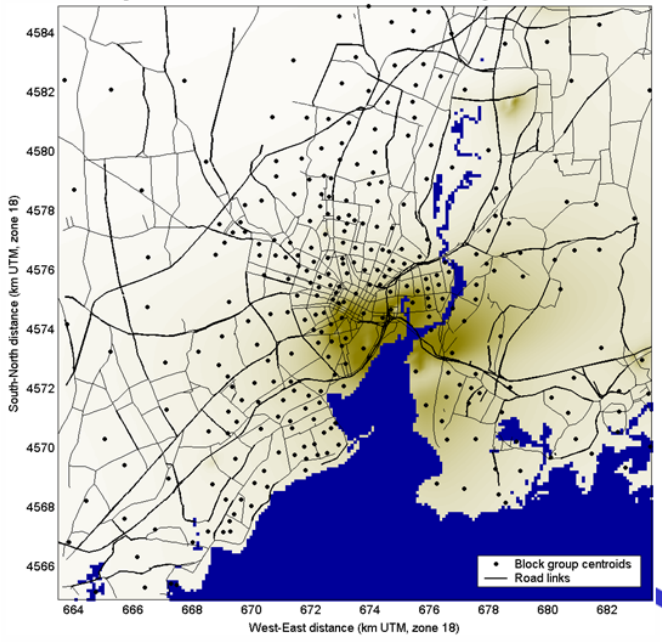
(116 HAPs categories)

Weil M. (2004) New Haven Air Toxics Inventory and Risk Reduction Strategy. http://www.cityofnewhaven.com/CityPlan/pdfs/EnvironmentalInitiatives/AirToxicsProject/InventoryReport .pdf

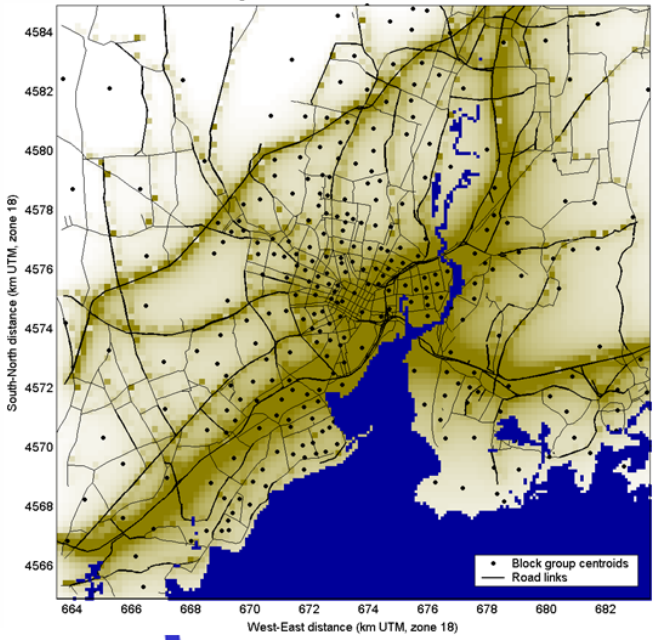
- Local inventory available for 2001
- Assessed location of local sources and updated the 2001 emissions inventory
- Regulatory and Voluntary Actions to Consider
  - National regulations for mobile sources
    - Road
    - Non-road
  - Voluntary actions for mobile sources
    - Road
    - Non-road
  - National regulations for stationary sources
  - Voluntary actions for stationary sources
  - Indoor air reduction activities

Hybrid Modeling Approach for Resolving Local Scale Impacts

Local impact from stationary sources



Near-road impact from mobile sources



Regional background from CMAQ

Combined model results for multiple pollutants for each of the **318** census block group centroids in New Haven area

Note: annual average benzene concentrations are shown

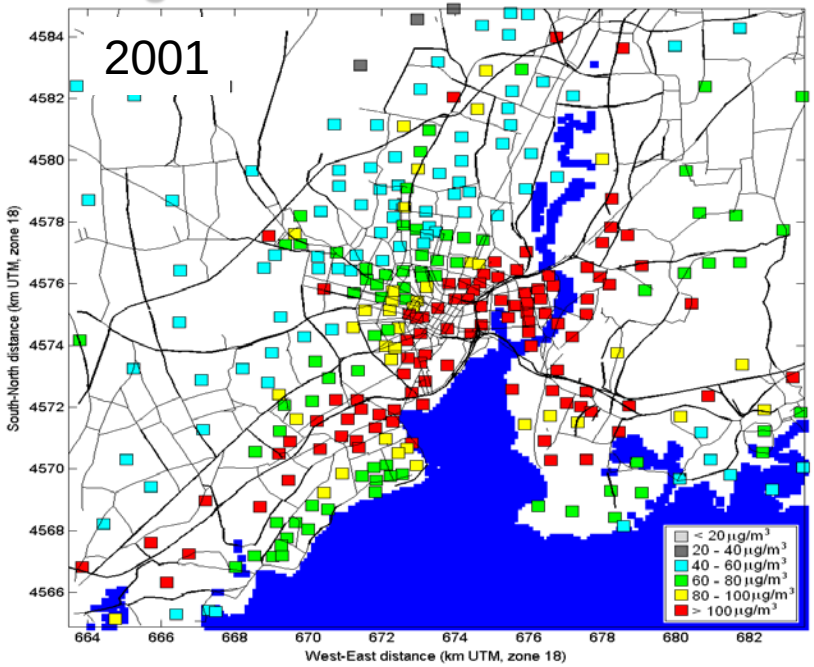
CMAQ – Community Multiscale Air Quality Model

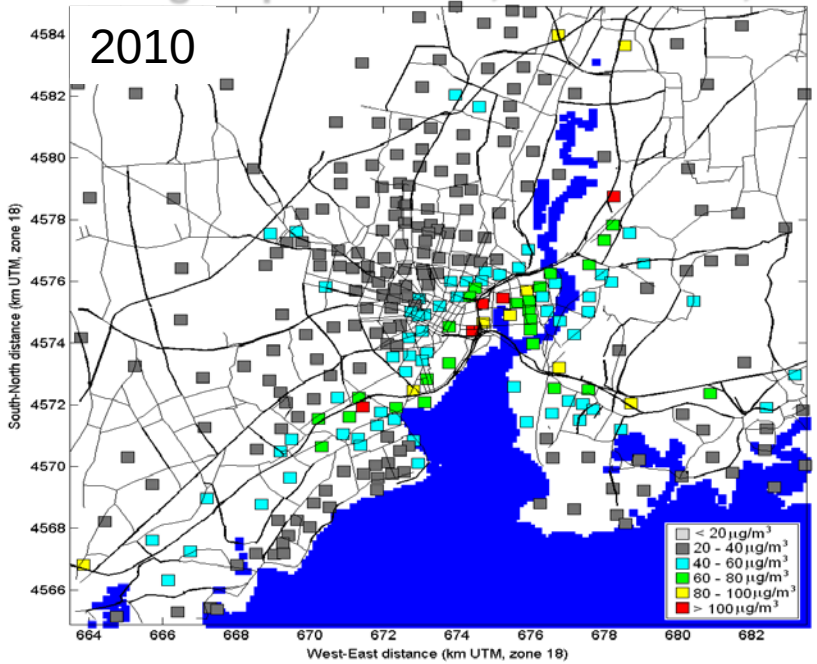
EPA United States Environmental Protection Agency

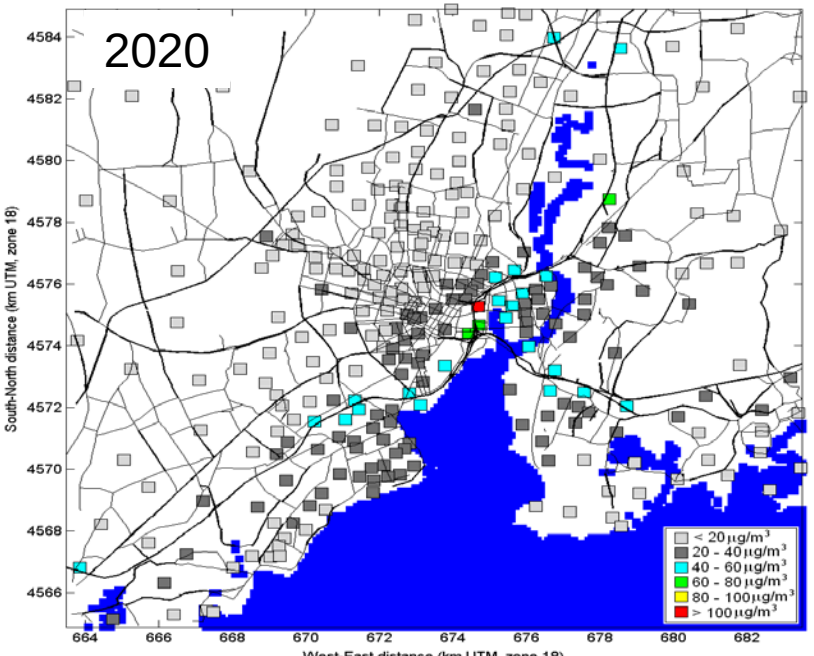
Presentation will focus on…

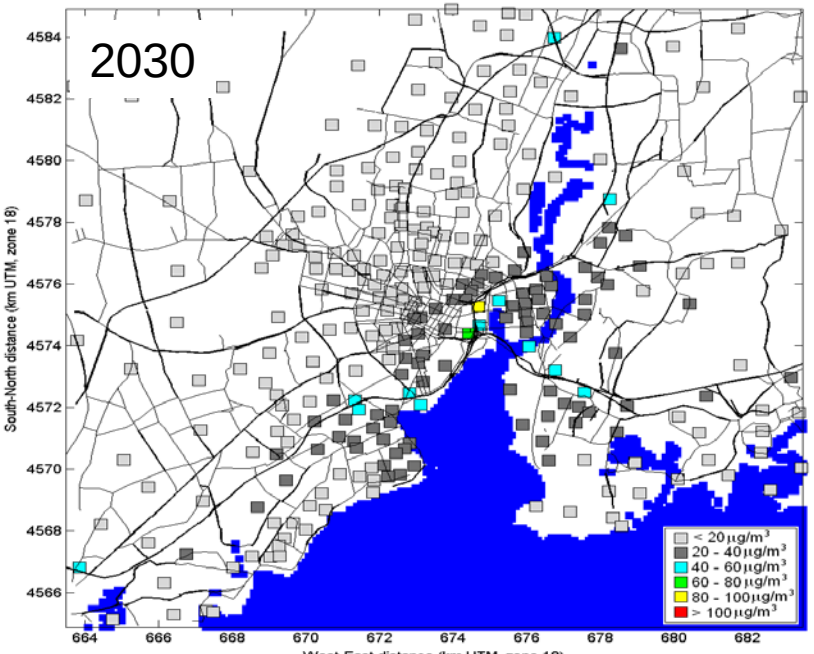
- Pollutants
  - NO_x
  - $PM_{2.5}$
- Health outcomes
  - cardiovascular disease hospitalization and mortality
  - respiratory disease hospitalization and mortality
  - chronic obstructive pulmonary disease (COPD) mortality and hospitalization
  - asthma prevalence, diagnosis and hospitalization

Annual Average NOx concentrations at the census block group centroids, New Haven, CT

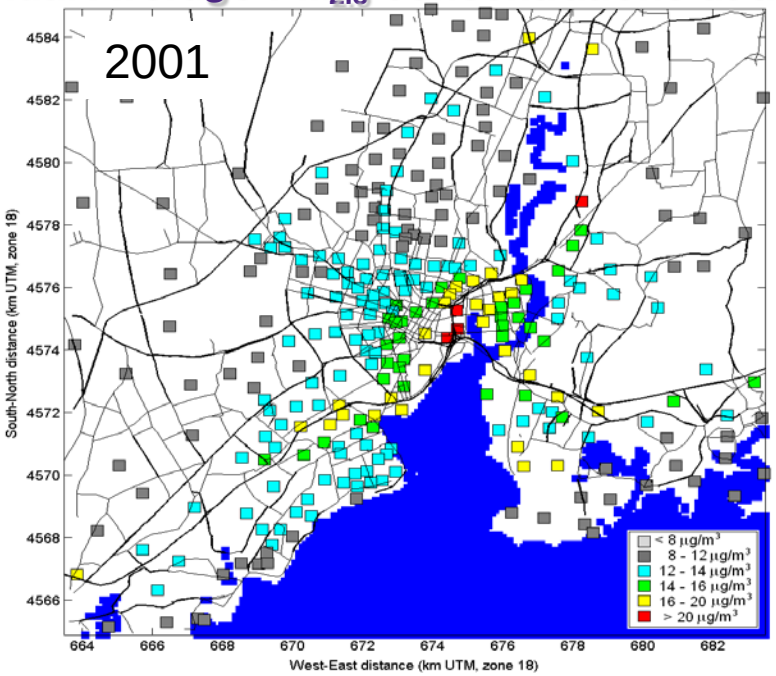


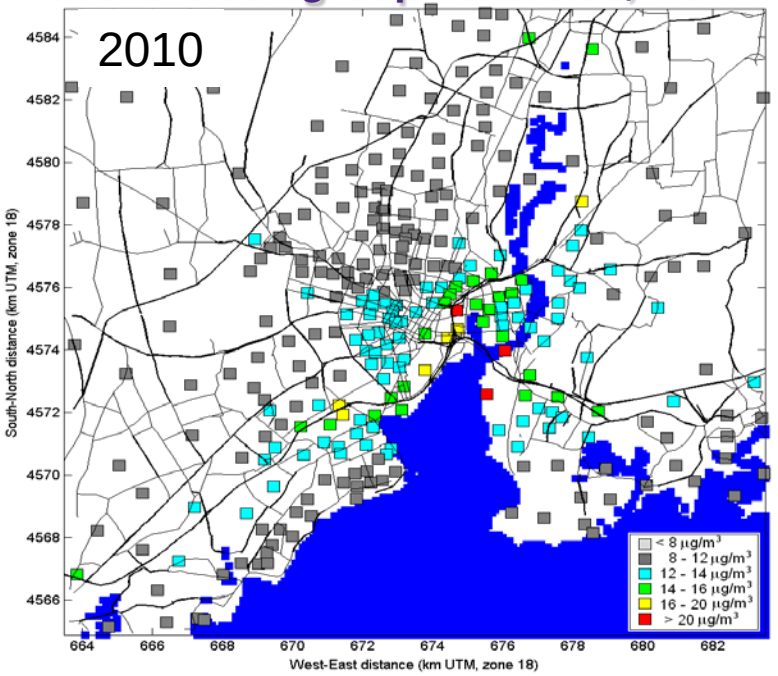


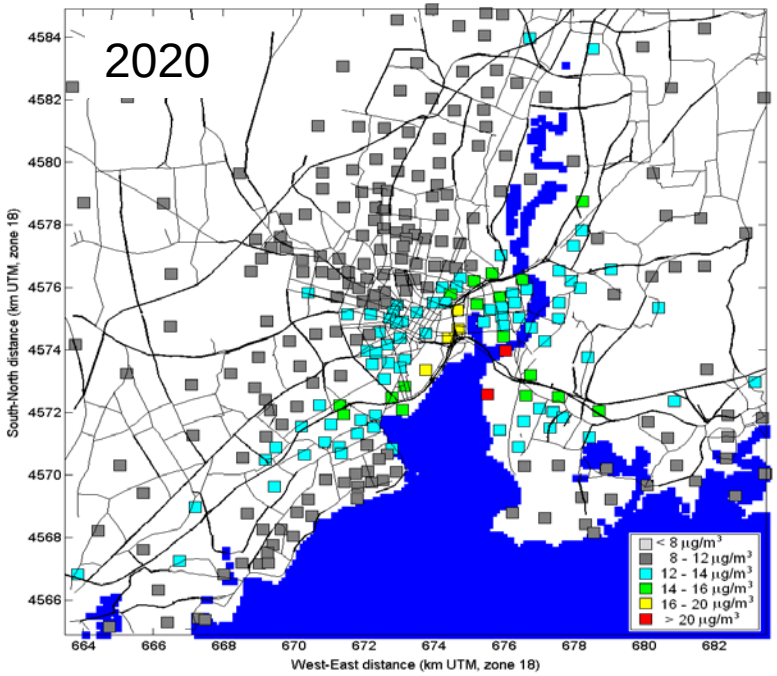


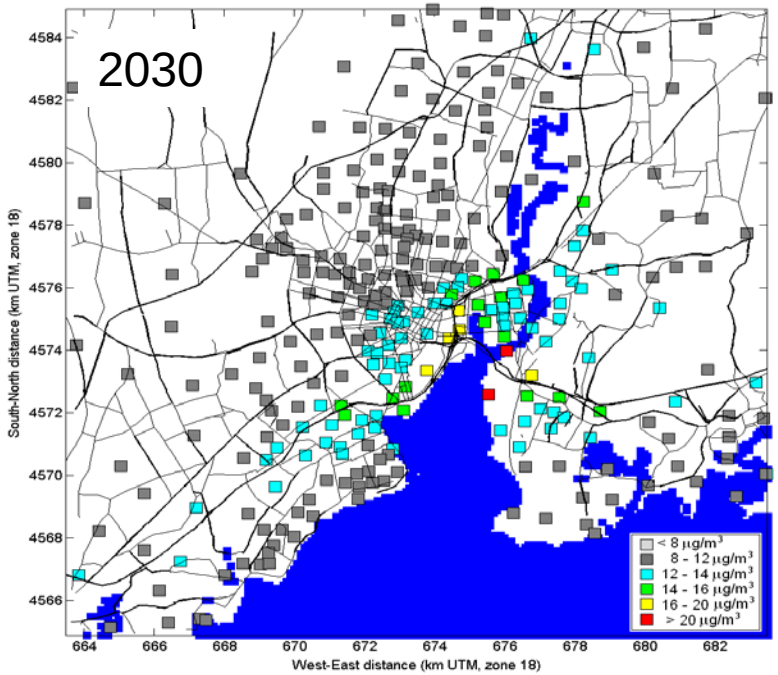


Annual Average $PM_{2.5}$ concentrations at the census block group centroids, New Haven, CT









Assessing Feasibility

Air Pollutant	Percent Reduction (from 2001) for Predicted Year		
	2010	2020	2030
NO_x	61%	78%	81%
$PM_{2.5}$	8%	9%	9%

Percent air pollution reduction needed to reduce risk of an outcome

% Reduction in Health Outcome	RR=1.05	RR=1.10	RR=1.15	RR=1.20
5 %	≥100	54	37	28
10 %	≥100	≥100	75	58
15 %	≥100	≥100	≥100	89

Feasibility – None for $PM_{2.5}$ and a few for NO_x

Outcome	Minimum Statistically Detectable % Decrease	NO_x Feasible Based on Sample Size
All Cause Mortality (except injury)	10	2020, 2030 (RR ≥1.15); 2010 (RR 1.20)
Cardiovascular Disease		
Mortality (ICD-10 I00-I87)	15	Not Feasible
Hospitalization Discharge (ICD-9 390-459)	10	2020, 2030 (RR ≥1.15); 2010 (RR 1.20)
Respiratory Disease		
Mortality (ICD-10 J00-J98)	20	Not Feasible
Hospitalization Discharge (ICD-9 460 - 519)	10	2020, 2030 (RR ≥1.15); 2010 (RR 1.20)
Chronic Obstructive Pulmonary Disease and Related Disorders		
Mortality (ICD-10 J40-44)	30	Not Feasible
Hospitalization Discharge (ICD-9 490-496)	15	Not Feasible
Asthma		
Current Prevalence, Adult (≥18 years old)	2.5	2010 2010, 2020, 2030 (RR≥1.05)
Current Prevalence, Children (<18 years old)	5	2010 , 2020, 2030 (RR≥1.10)
Hospitalizations (ICD -9 493), Adult (≥18 years old)	15	Not Feasible
	20	Not Feasible
Hospitalizations (ICD -9 493), Children (<18 years old)	15	Not Feasible

Intra-urban gradient – $PM_{2.5}$ simulation

- Used an epidemiologic simulation-based approach similar to Pope et al. (2009), which examined life expectancy and $PM_{2.5}$ between 1980 and 2000
  - life expectancy improved 0.61 years per 10 μg/m^3 decrease in $PM_{2.5}$
- Examined differences between # hospitalizations for 2001 and 2010 (estimated based on 2007 hospitalization data)
- #CHD hospitalizations decreased with increasing reductions in $PM_{2.5}$
- Asthma suggestive – rates increased over time period, but seemed to increase less in areas with greater reduction on $PM_{2.5}$
  - Need to consider intra urban gradients further, ideally with epidemiological analysis using detailed local health data collected between 2001 and 2010 and the latest 2010 census information

Pope CA, 3rd, Ezzati M, Dockery DW. 2009. Fine-particulate air pollution and life expectancy in the United States. N Engl J Med 360(4): 376-386.

Benefits to New Haven

•We went to New Haven and presented our models

•Based on the models, New Haven has taken actions to define requirements for power plants and schools in order to reduce human exposures to air pollution

•New Haven is mentoring other cities such as Bridgeport, CT and Springfield, MA, EPA CARE (Community Action for a Renewed Environment) and EJ Showcase Communities, on the benefits and methods to negotiate for no new net emissions during siting of facilities

References

Combining regional- and local-scale air quality models with exposure models for use in environmental health studies.
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