Community Action to Promote Healthy Environments

Stuart Batterman, University of Michigan

Simone Sagovac, Southwest Detroit Community Benefits Coalition

Fall Joint Conference

East and West Michigan Chapters of the AWMA and Environmental Law Section of the State Bar of Michigan

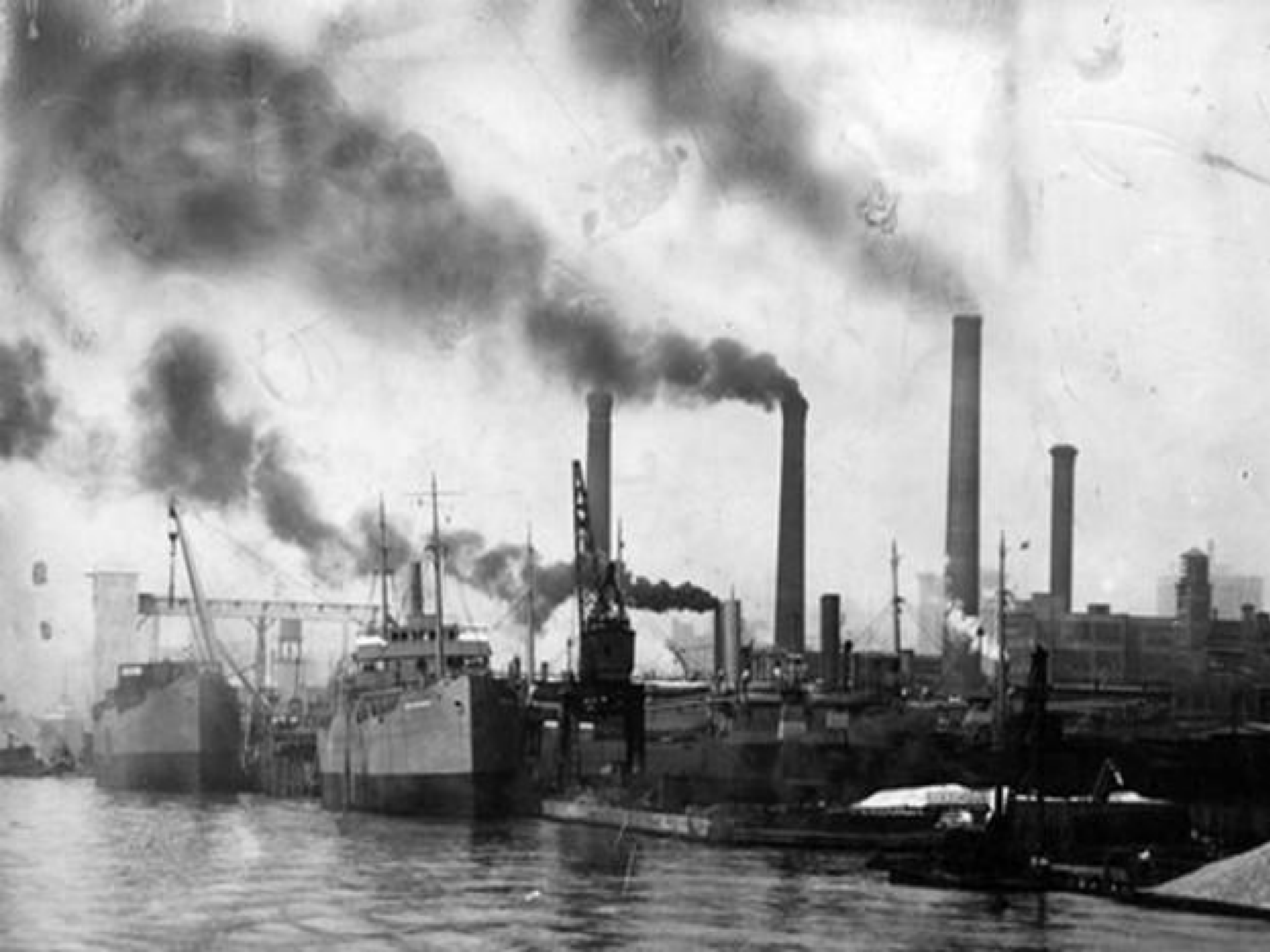
Lansing Community College West Campus

Nov. 8, 2017

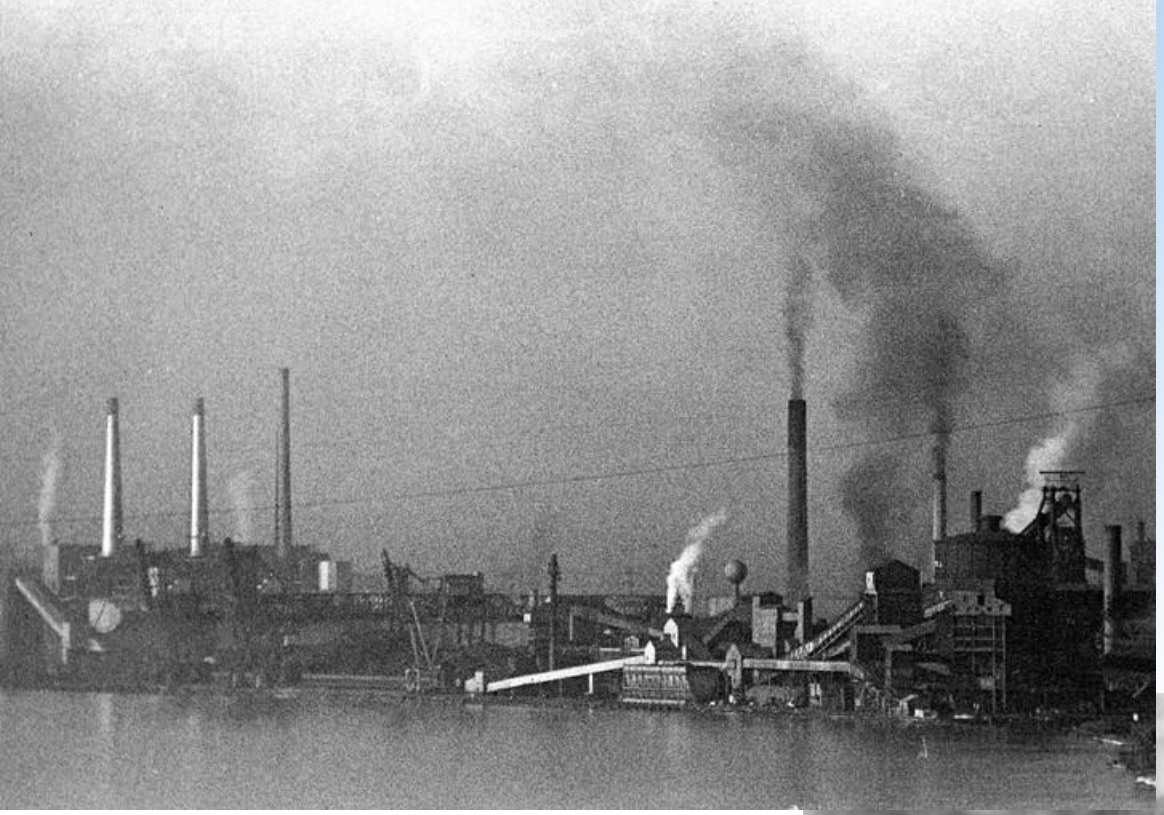
ENVIRONMENTAL HEALTH SCIENCES

Outline of the Presentation

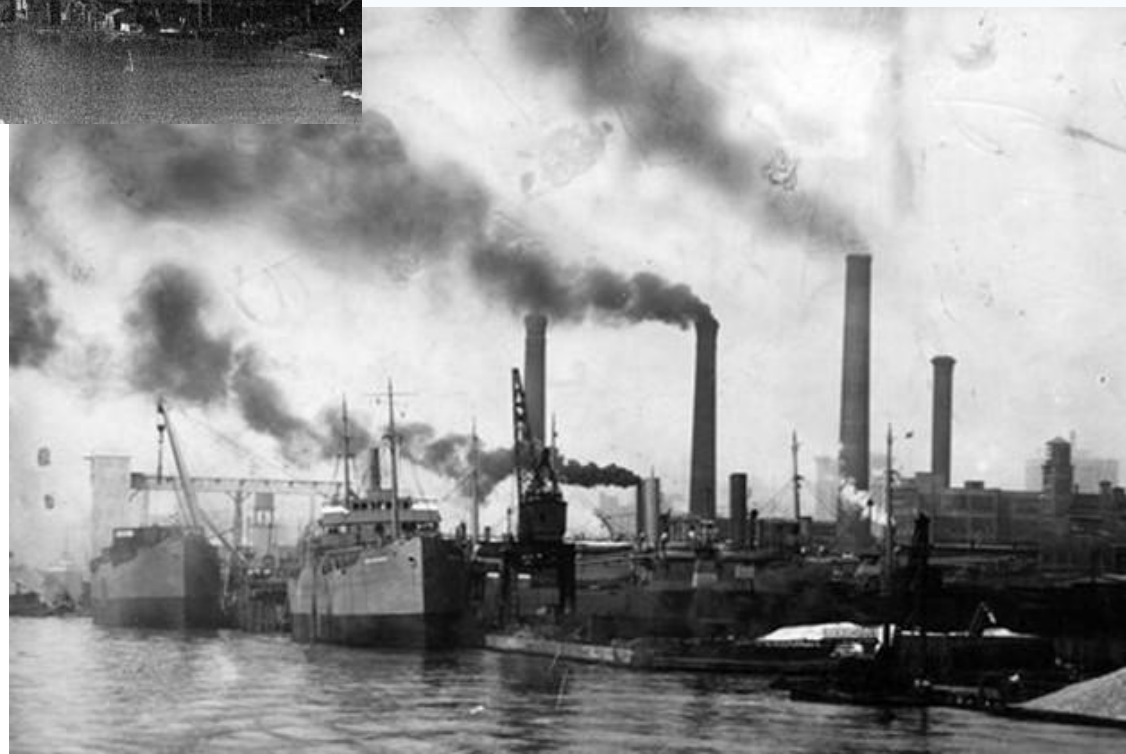
1. Background and CAPHE
   - History and perspectives
   - Community Action to Promote Healthy Environments
   - CAPHE Action Plan, 10 strategies, and priorities
2. Health impact assessment, air pollution burden of disease, inequality
   - HIA approach
   - Example 1: Burden of disease and inequality
   - Example 2: Air quality management using HIA
3. Traffic-related air pollutants and DPM
   - Health effects and epidemiology (DAMAT study, others)
   - Buffers and barriers
4. Monitoring and the Gordie Howe International Bridge
   - Enhanced monitoring, ozone maps
   - Impact area and new agreement
5. Conclusions
   - Policy implications



Where & When?



Zug Island, River Rouge PP
from Ambassador Bridge in 1983.
c/o Alex Sagady



Detroit waterfront in 1927
Detroit News Archives.

A Brief History … Urban Air Quality

1906: International Association for the Prevention of Smoke founded in Detroit.

Subsequently renamed the **Air Pollution Control Association** and then the **Air & Waste Management Association**.

That meeting – 111 years ago – highlighted fundamental sustainability issues:

> *"Clean, pure air, free from smoke, in a city is not incompatible with prosperity and the growth of the manufacturing interests,"* advocated S.T. Douglass, an attorney and member of Detroit's Board of Health.
>
> Newspaper coverage noted that *"housewives have rights"* for clean air, though this probably referred to the soiling and ruin of household furnishings due to particulate air pollution. (Detroit Free Press, 6-30-1907)

1920: Particulate air pollution from coal combustion, steel making, and many other sources rapidly soiled clothing and other indoor and outdoor surfaces, and *white collar workers customarily brought a second shirt to work since the first was usually soiled by midday.* (Frank Uekoetter, Age of Smoke)

1950: PM measured as dustfall averaged about *50 tons of 'solids' per square mile per month* (range from 36 to 83) over the large Detroit-Windsor area. PM concentrations (measured using high volume samplers) averaged 216 $\mu g/m^3$ across 31 sites; maximum daily level exceeded 1000 $\mu g/m^3$. (IJC, 1960)

Air Quality in Detroit

Historically, Detroit has faced challenges with air quality.

Multiple pollutant sources.

Currently out of compliance with SO_2 standard.

Likely out of compliance with O_3 standard.

Large exposed and vulnerable communities.

Adverse health outcomes associated with air pollutants.

Opportunity to improve air quality and reduce health inequities.

Vulnerable populations in Detroit

Heavy health burden of ambient air pollution:
7.3% of annual deaths in Wayne County due to criteria pollutants and air toxics

Susceptibility

- High rates of obesity, diabetes, smoking
- Asthma prevalence among children: 11.3%
  - Hospitalizations and deaths 2x and 3x the state rates

Vulnerability

- 39% of Detroit residents live below the poverty line
- Largely minority population
  - 85% Black
  - 7% Hispanic or Latino
- Multiple point, area and mobile sources

Sources: DeGuire et al. 2016; Fann et al. (2015); MDHHS (2015) MDEQ (2015); SEMCOG (2013); US Census Bureau (2015)

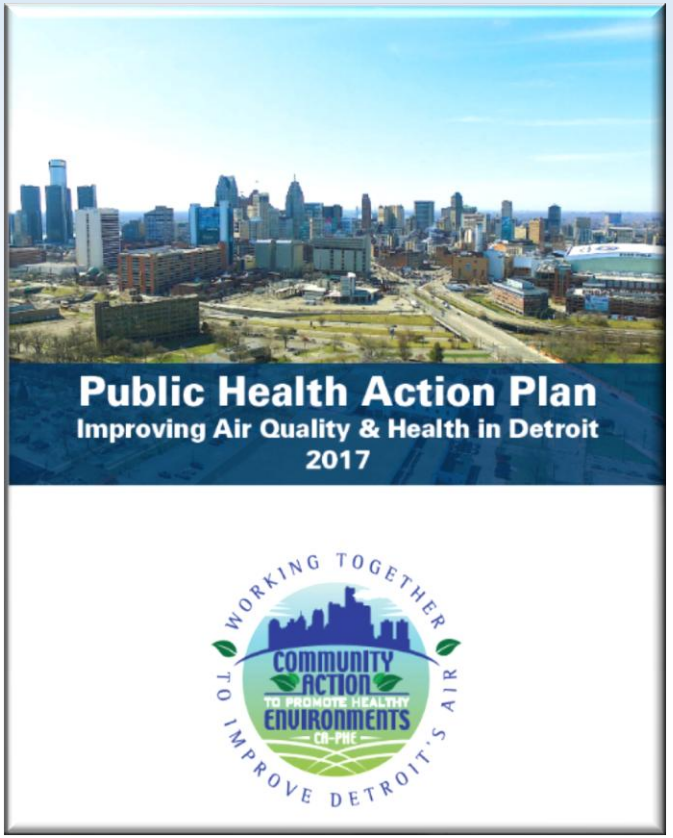
Community Action to Promote Healthy Environments

CAPHE's Overarching Goals

- To develop a multilevel, integrated and scientifically-informed public health action plan designed to reduce adverse effects of air pollution on health
- To promote implementation of components of the plan

CAPHE's Approach

- Builds on three longstanding community-based participatory research (CBPR) partnerships
- Equitable engagement of community and academic partners in all phases of research and action
- Increase knowledge about exposure to air pollution & health effects
- Products: ***Resource Manual*** → translation into ***Public Health Action Plan***
- Implement innovative policy & practice solutions to reduce pollutant exposure & mitigate adverse health effects
- Evaluate process & impact



http://caphedetroit.sph.umich.edu/

Partner Organizations & Partnerships

Partner Roles & Leadership

Community

- Identify priority action areas
- Identify key opinion & policy leaders
- Develop community & youth leadership
- Organize & coordinate with other environmental efforts

Academic

- Conduct background research
- Map vulnerable communities
- Quantify current health impacts
- Estimate health impacts of selected mitigation strategies

Joint Responsibility

- Identify public health problem: air pollution and health
- Identify key priority areas for new research
- Inform strategies for compiling + synthesizing information for PHAP process
- Define components of the public health action plan
- Implement public health action plan components
- Identify funding for continued action on the plan

"Top Ten" CAPHE Public Health Action Plan Strategies

1. **Point source controls** – control and reduce emissions at industrial facilities
2. **Renewable energy** – replace fossil fuels with non-polluting solar and wind energy
3. **Diesel engine retrofits** – fix or replace older and polluting diesel engines in buses and other equipment
4. **Idling controls** – idling engines waste fuel & money and causes emissions
5. **Clean fuels** -- replace fossil fuels with cleaner fuels like biodiesel
6. **Transit and transportation control measures** – improve mobility to reduce congestion and emissions
7. **Indoor air filters** – install filters in buildings to effectively reduce $PM_{2.5}$ levels
8. **Buffers and barriers** –separate schools, residences and other places from highways and industry
9. **Enhanced compliance and enforcement of air quality rules** – enforce stricter laws to reform polluters, use of health impact assessments to focus on protection of public health
10. **Enhanced ambient monitoring** – document pollution problems to raise awareness and identify solutions

Implementation – Prioritized Strategies

Filters in Schools

Vegetative Buffers

Renewable Energy

Health Impact Assessments

Monitoring

Enhanced Compliance and Enforcement

Recommendation 9-1. Increase the coverage, transparency, timeliness and stringency of facility inspections and enforcement activities, and assure compliance with existing permits and regulations.

Recommendation 9-2. Require the use of qualitative and quantitative health impact assessments (HIAs) and cumulative impact assessments as part of the air quality management process, including enforcement actions, SIP development and permitting.

Recommendation 9-3. Increase public input in air quality management, including the development of regulations, permitting and enforcement activities.

HIAs are important because they will **refocus air quality management activities from being compliance-oriented to health-oriented**. HIAs provide a more comprehensive and realistic assessment of health impacts, e.g., they better account for vulnerability and susceptibility factors.

Implementation – Additional components

“Mini Grants” to support action by local groups to improve air quality. Funded three groups working on:

- Anti-idling campaign
- Developing plans/policies for day care centers on use of indoor air filters
- Group working to reduce emissions at a local point source in the city.

Policy advocacy training and working with policy makers

Press conference and outreach

Youth education and outreach, including a schools program

Part 1. Background and CAPHE

Questions

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Emissions Inventory

SE Michigan sources only in tons/year

	SO_2	VOCs	NO_x	PM	CO	Source and Notes
1955	397,850	609,550	160,600	63,550	NA	IJC, 1960 (1)
1967	551,000	489,000	271,000	258,000	1,933,000	IJC, 1971 (1)
Stationary 1999-2011	149,000	15,000	62,000	1,500	264	EPA NEI, MDEQ MAER (2)
Mobile 2011	491	57,000	104,000	4,790	576,000	NEI 2011 (3)

(1) The areas studied in 1955 and 1967 include portions of Canada, but are altogether smaller than the seven-country area reported on for 1999-2011. Also, the methods used in the early studies are less rigorous and likely less accurate.

(2) Includes seven country southeast Michigan area, and represents average from 1999-2014, derived from the MDEQ Michigan Air Emissions Reporting System (MAERS) and the US EPA 2011 National Emission Inventory System (NEI). SO2 now much lower, 39,000 tons

(3) Includes seven county SE Michigan area, including on-road and non-road, from US EPA 2011 NEI.

Enhanced Compliance and Enforcement

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Health impact assessment for air quality management

HIAs for AQM:

- Often done at the national scale with county-level data (e.g., US EPA)
- National scale analyses often focus is on "rollbacks" to new standards
- Local scale analyses focus on specific projects or policies
- Narrow list of health impacts, with less emphasis on inequality
- **Local scale is important**
  - **Gradients in Exposures**
  - **Differences in vulnerability**

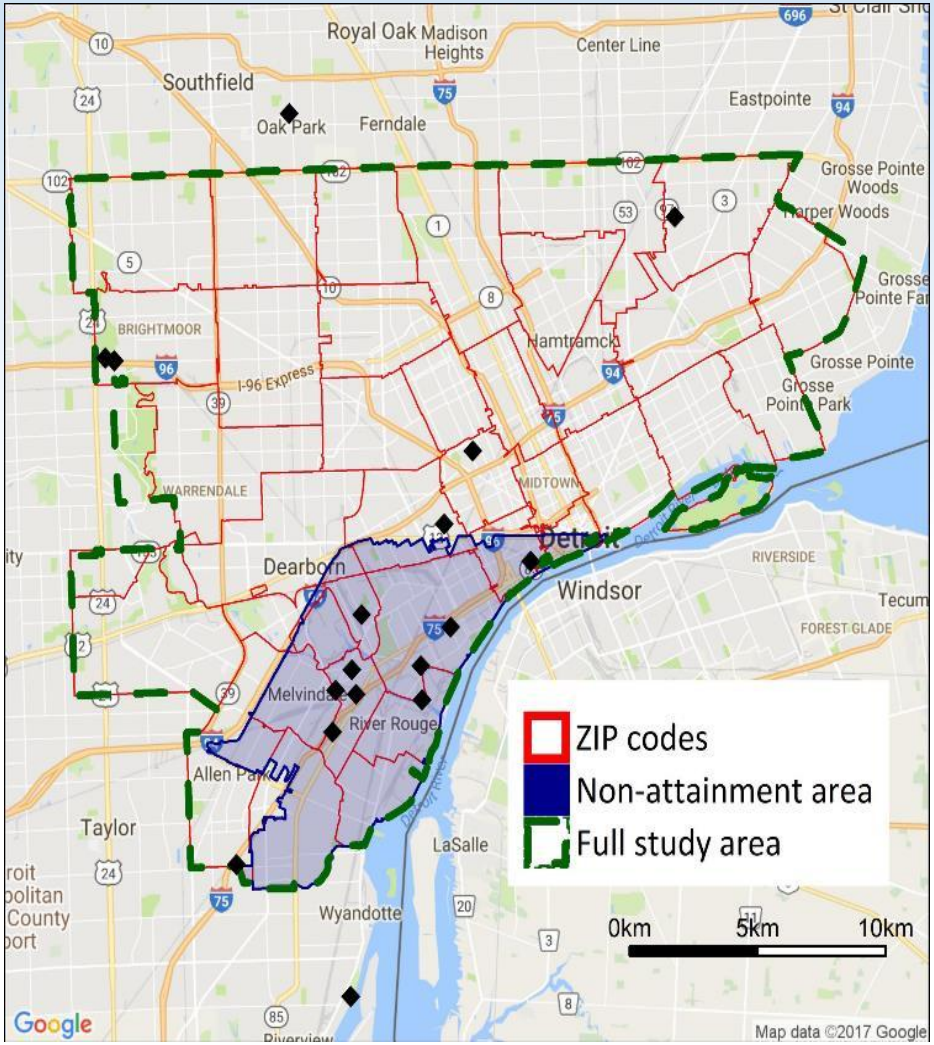
Example 1: Burden of disease and inequality

Example 2: SO2 control approaches

Source: Bhatia et al. (2014); Fann et al. (2012); Hubbell 2012; Rhodus et al. (2013)

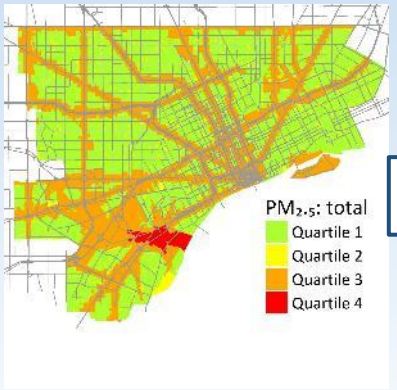
Example 1: Health burden and inequality

- 945,000 residents in Detroit and surrounding cities
- Many point sources and highly-trafficked roads
- SO_2 non-attainment
- Likely O_3 non-attainment
- High degree of susceptibility and vulnerability:
  - 92% non-white population
  - 40.5% of Detroit residents in poverty
  - Higher prevalence of asthma and rates of asthma-related mortality and morbidity

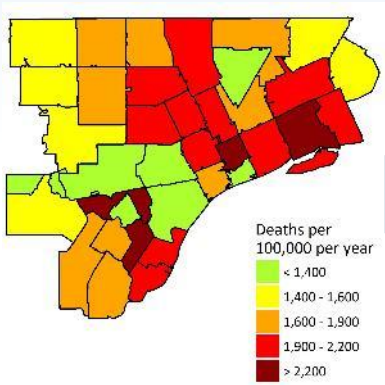


DeGuire et al. (2016); MDEQ (2016); US Census Bureau (2015)

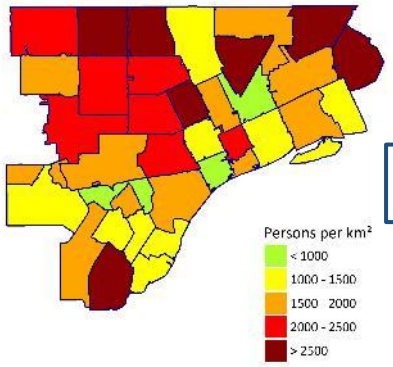
Quantitative health impact assessment (HIA)



Exposure

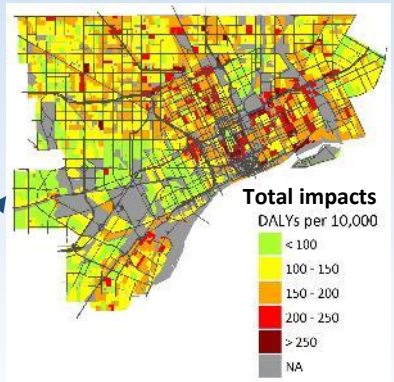


Baseline rates

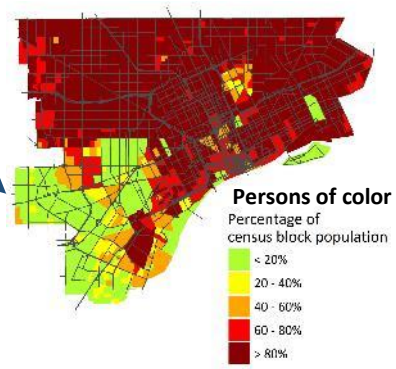


Population

1. **Attributable cases**
2. **DALYs**
3. **Monetized impacts**



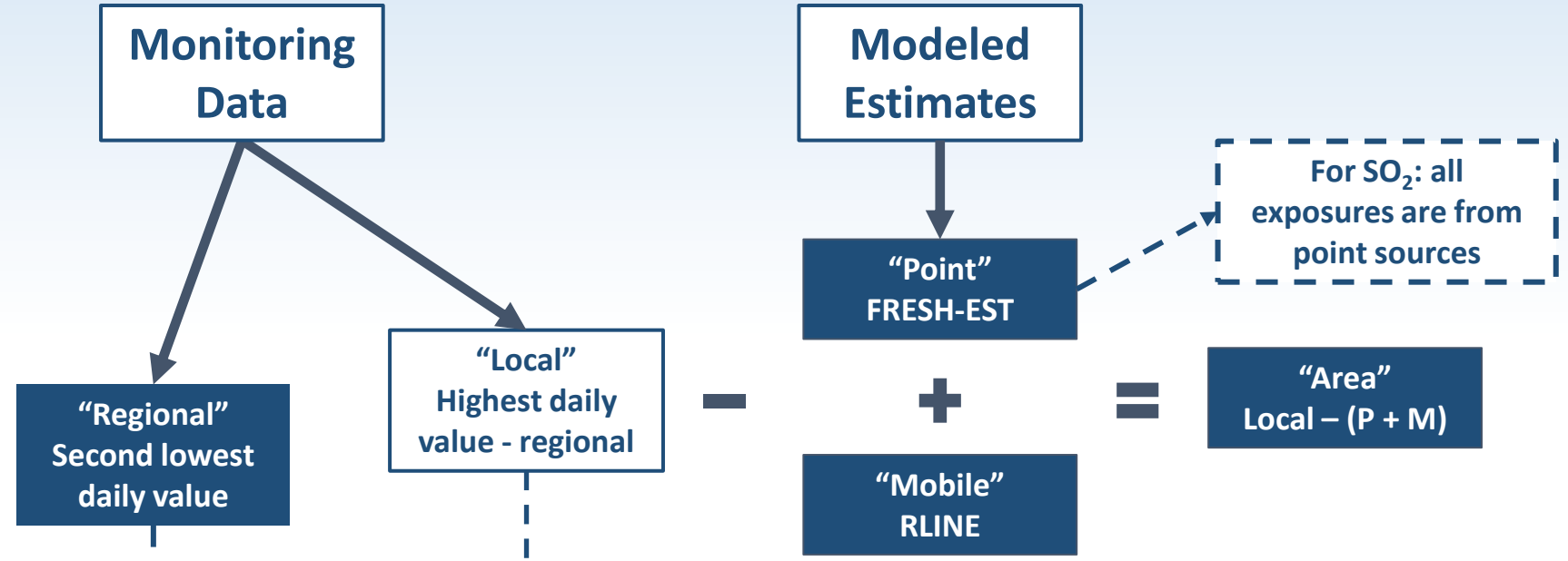
4. Atkinson Index



5. Concentration Index

Exposure assessment for HIA

- Goal is to apportion exposures to different source types
- Need estimates that are temporally and spatially resolved (monitoring network is not dense enough for spatial data techniques, complement with modeling)



Pollutant	Regional	Point	Mobile	Area
$PM_{2.5}$	✔	✔	✔	✔
O_3	✔			
SO_2		✔		
NO_2	✔	✔	✔	✔

Annual health impacts in Detroit from air pollutants

Health impacts attributable to criteria pollutant exposures

Outcome (age group)	Annual incidence	Total (%)	Regional	Point	Mobile	Area
Mortality (cases)						
All-cause (>29)	9,400	520 (5.5)	4			
Non-accidental (>29)	8,800	140 (1.5)				
Infant (<1)	200	6 (4.0)				
Hospitalizations (cases)						
Asthma (<65)	3,200	210 (6.7)	1			
COPD (>65)	1,900	419 (22.4)	3			
CVD (>65)	9,800	160 (1.6)	1			
Pneumonia (>65)	1,500	250 (17.3)	2			
Non-fatal MI (>17)	2,600	60 (2.3)				
Asthma outcomes (cases)						
Asthma ED visit (<18)	9,000	3,300 (36.7)	2			
Day w/ cough (6 – 14)	1,700,000	210,000 (12.5)	1			
Day w/ wheeze (6 – 14)	1,100,000	17,000 (1.6)	13			
Day w/ SoB (6 – 14)	1,000,000	21,000 (2.1)	17			
Two or more symptoms (6 – 14)	2,000,000	180,000 (8.6)	11			
Restricted days						
MRAD (18 – 64)	4,600,000	760,000 (16.7)	700,000	16,000	18,000	18,000
WLD (18 – 64)	1,300,000	59,000 (4.7)	47			
MSD (6 – 14)	2,700,000	570,000 (21.3)	57			
Total DALYs (years)		10,000				
Monetized impact ($million)		6,600	5,			

7% of mortalities attributable to $PM_{2.5}$ and O_3

Previous estimate: 7.3-9.8% (Fann et al. 2012)

Large asthma burden among children

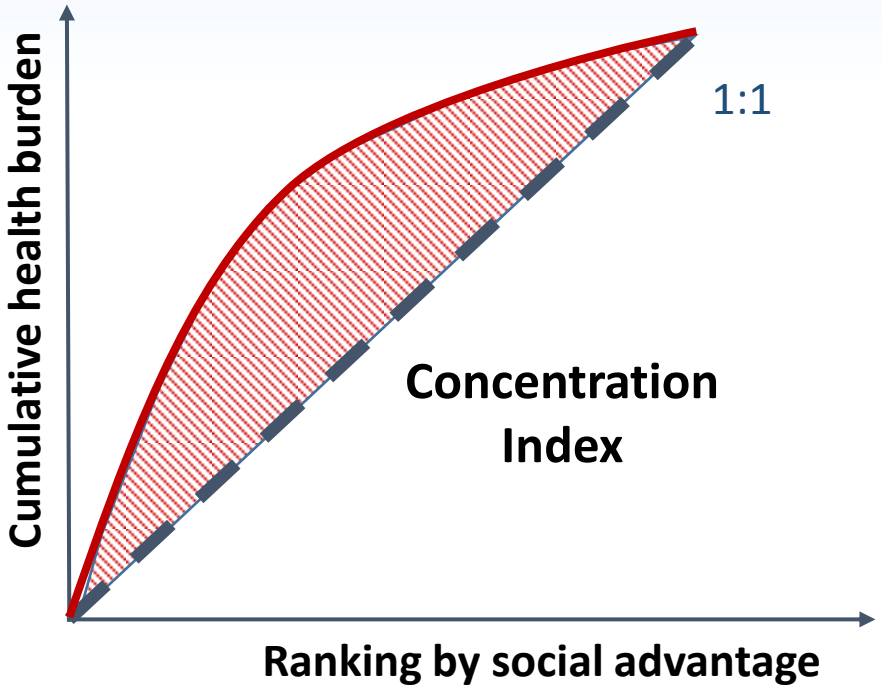
10,000 DALYs per year
$6.6 billion per year

Inequality metrics

- Atkinson index measures inequality across spatial units
  - Uses average risk as a reference group
  - Larger AI indicates more inequality
- Concentration index used to measure inequality across groups
  - Requires population data to rank groups
  - Negative CI indicates lower ranked groups have heavier burden

Atkinson Index

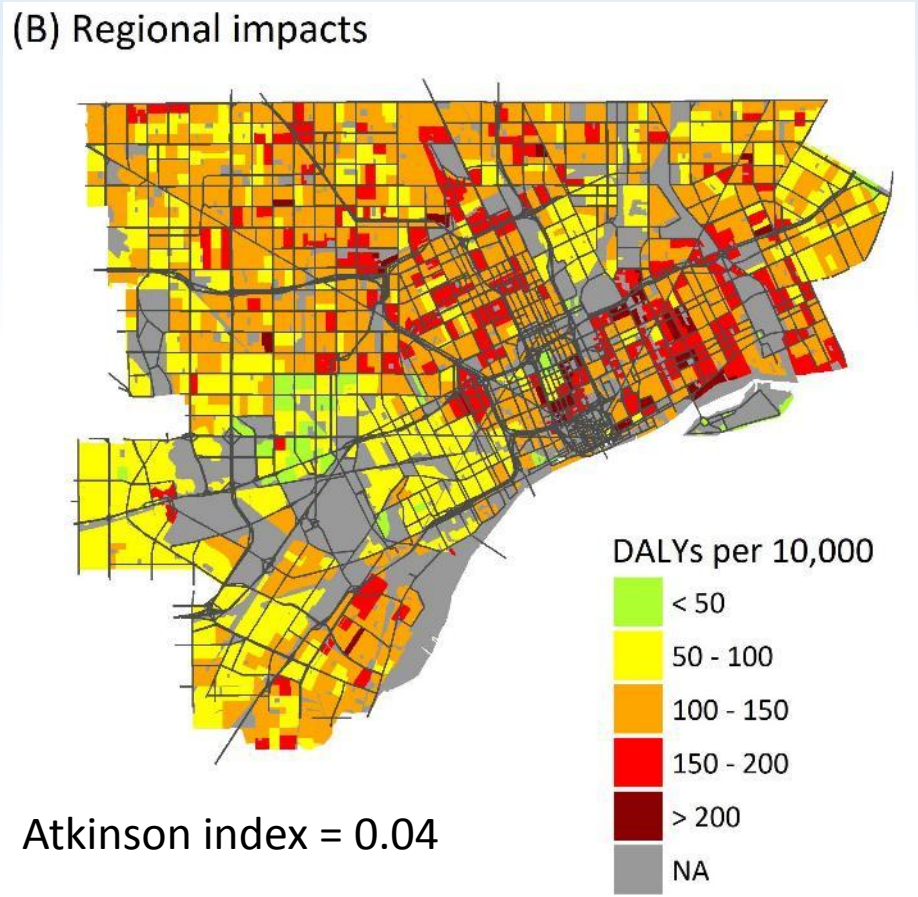
$$AI = 1 - \left[\frac{1}{n}\sum_{i=1}^{n}\left[\frac{x_i}{\overline{x}}\right]^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}$$



Harper et al. (2013); O'Donnell et al. (2008)

Regional sources (most $PM_{2.5}$)

- Health burdens from regional sources are high at 8,100 DALYs yr^{-1})
- Inequality metrics for regional sources are low

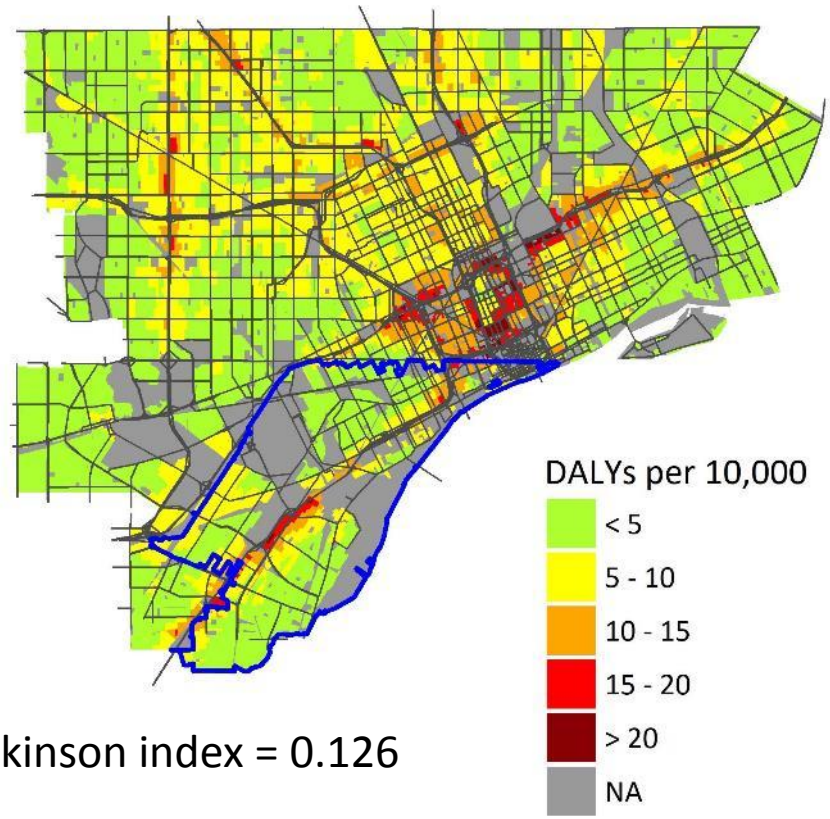


Atkinson index = 0.04

Mobile sources (on-road)

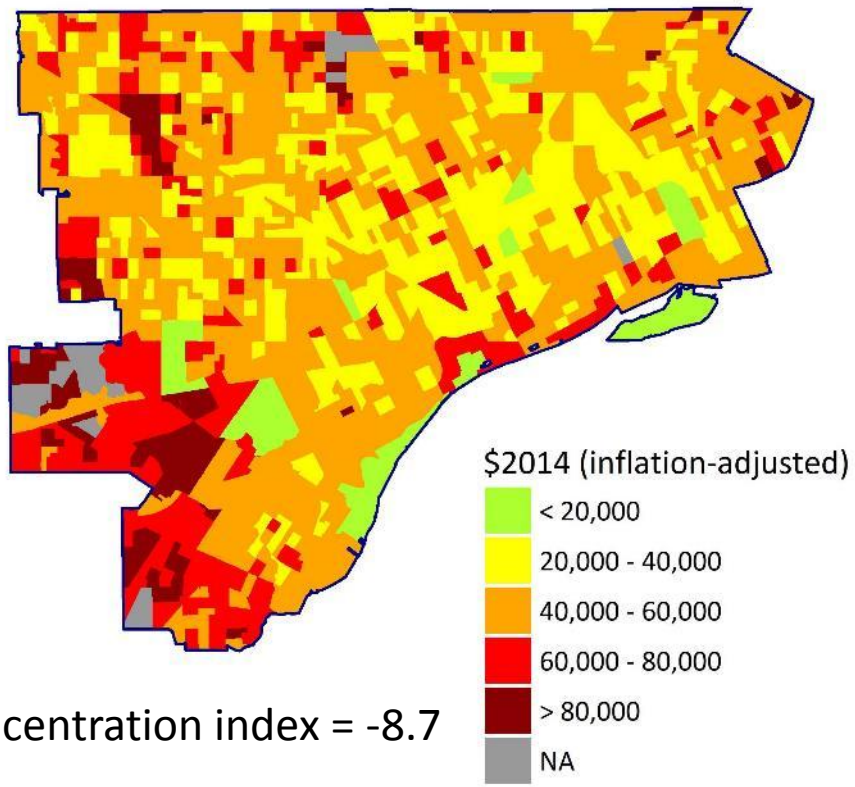
- Impacts from mobile sources are 560 DALYs yr^{-1}
- Inequality metrics for mobile sources are high

(C) Mobile source $PM_{2.5}$ impacts



Atkinson index = 0.126

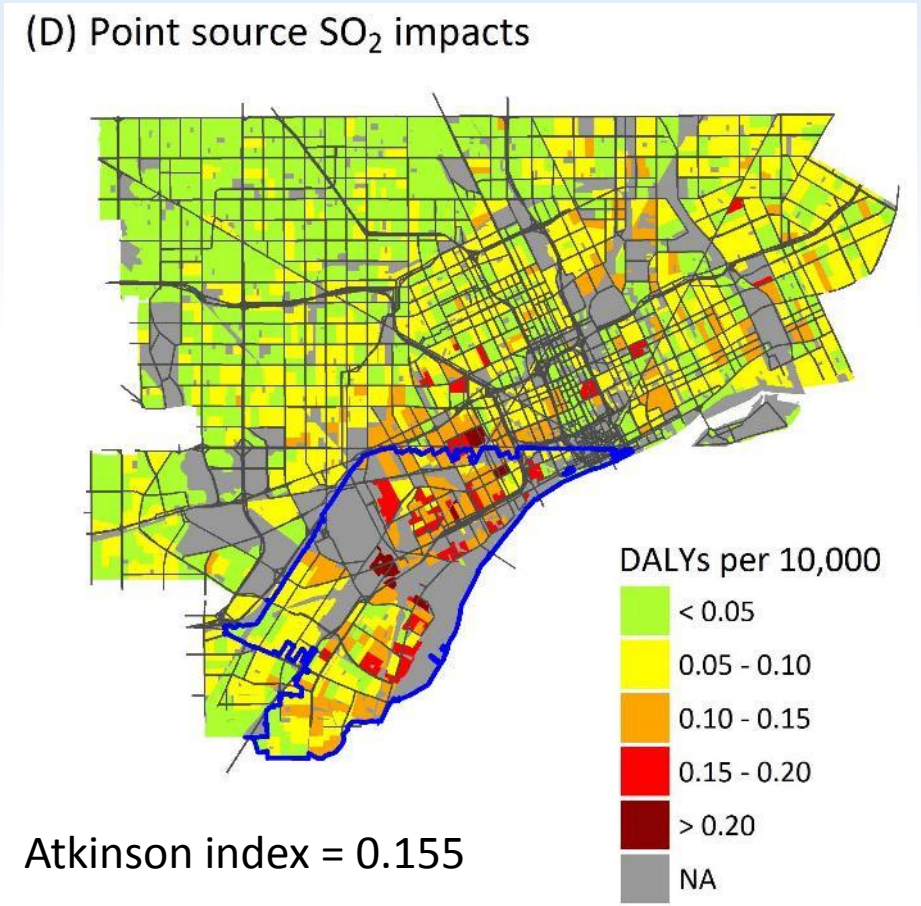
Median household income



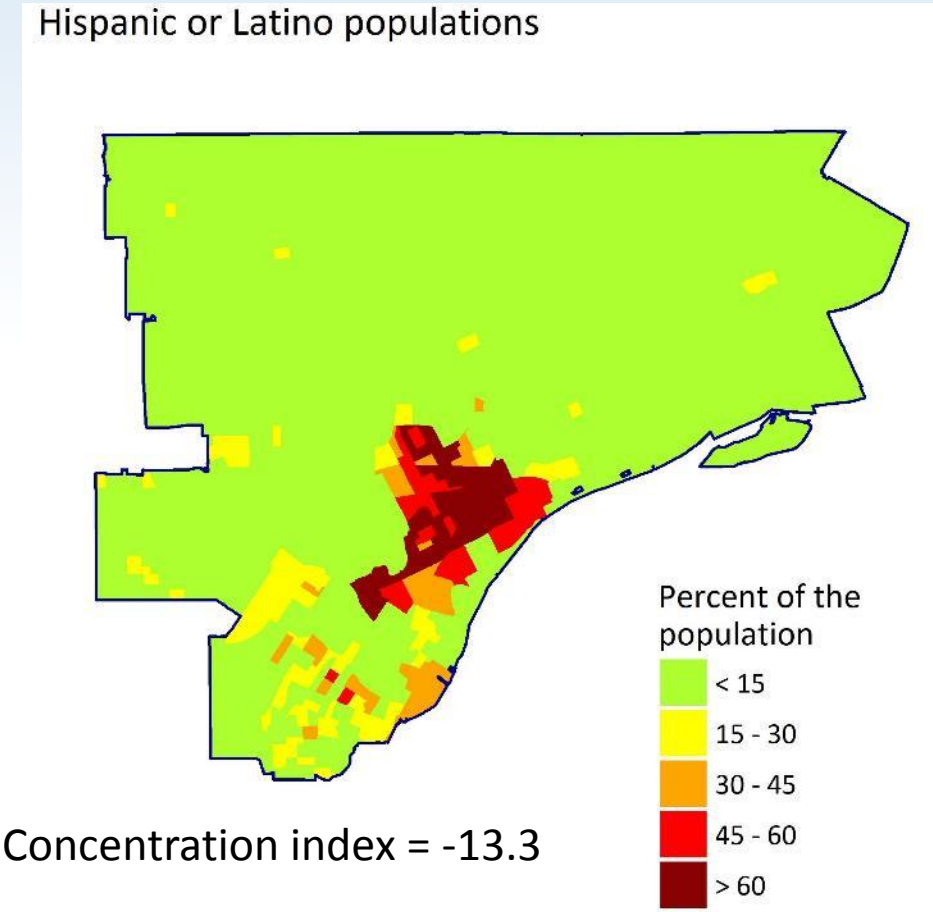
Concentration index = -8.7

Point sources

- Impacts from point sources are 470 DALYs yr^{-1}
- Inequality metrics for point sources are high



Atkinson index = 0.155



Concentration index = -13.3

Summary of burden of disease and inequality

1. Criteria pollutants continue to have a substantial public health impact in the Detroit area
   - 7% of mortalities due to $PM_{2.5}$ and O_3 exposures
   - 2-36% of asthma outcomes due to $PM_{2.5}$, NO_2, and O_3
2. Attributable burdens are largest for regional $PM_{2.5}$ and O_3
3. Inequalities are largest for point and mobile sources of $PM_{2.5}$, NO_2, and SO_2
4. Low income and Hispanic or Latino populations are disproportionately impacted
5. Inequality metrics are sensitive to study boundary and spatial resolution, thus require appropriate data and selections.
   - AI values decrease when using larger spatial units
   - CI indicates different groups are impacted when study boundaries change

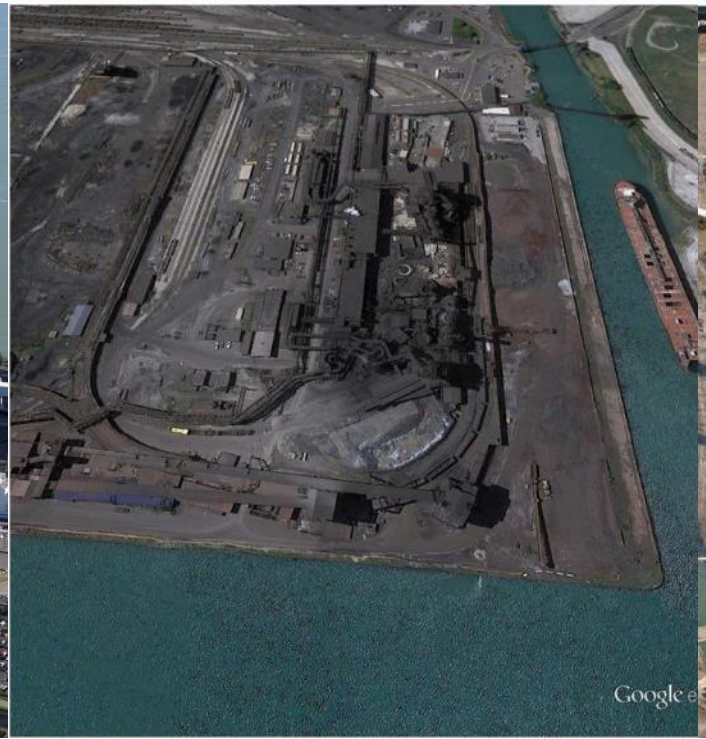
Example 2: Health & inequality implications of pollution controls

What are the health and inequality implications of point source control strategies?

DTE Monroe

Source: www.acmpm.com

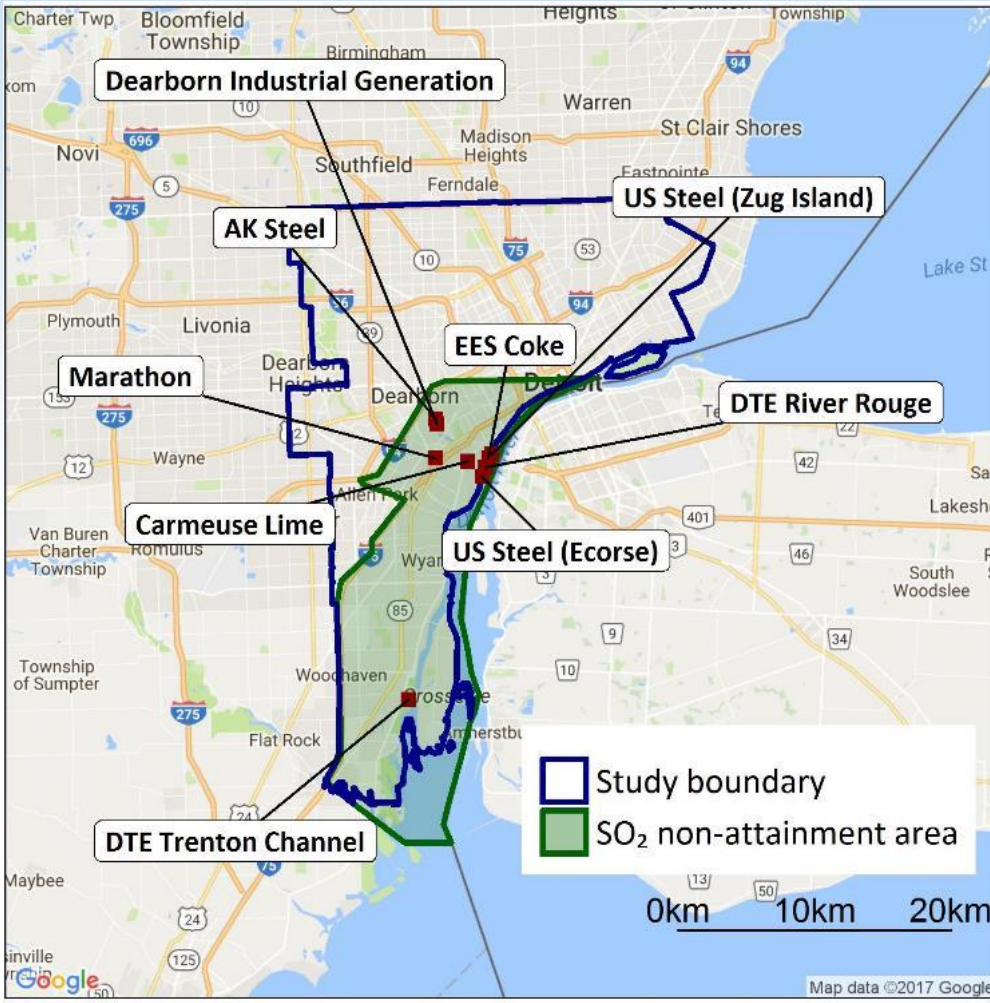
US Steel



DTE Trenton Channel

SO_2 in Detroit

- SO_2 from point sources shown to have disproportionate impacts
- 1.1 million residents in study area
- 9 culpable facilities
  - 39,000 tons SO_2 per year
  - Each emits more than 1 ton per year of SO_2
  - None has SO_2 add-on control technologies
- MDEQ developed a State Implementation Plan (SIP):
  - Reduced emissions at DTE River Rouge, DTE Trenton Channel, US Steel
  - Taller stack at Carmeuse Lime



DeGuire et al. (2016); MDEQ (2016); US Census Bureau (2015)

Approach … going beyond NAAQS attainment

1. Estimate health impacts from emissions at individual point sources

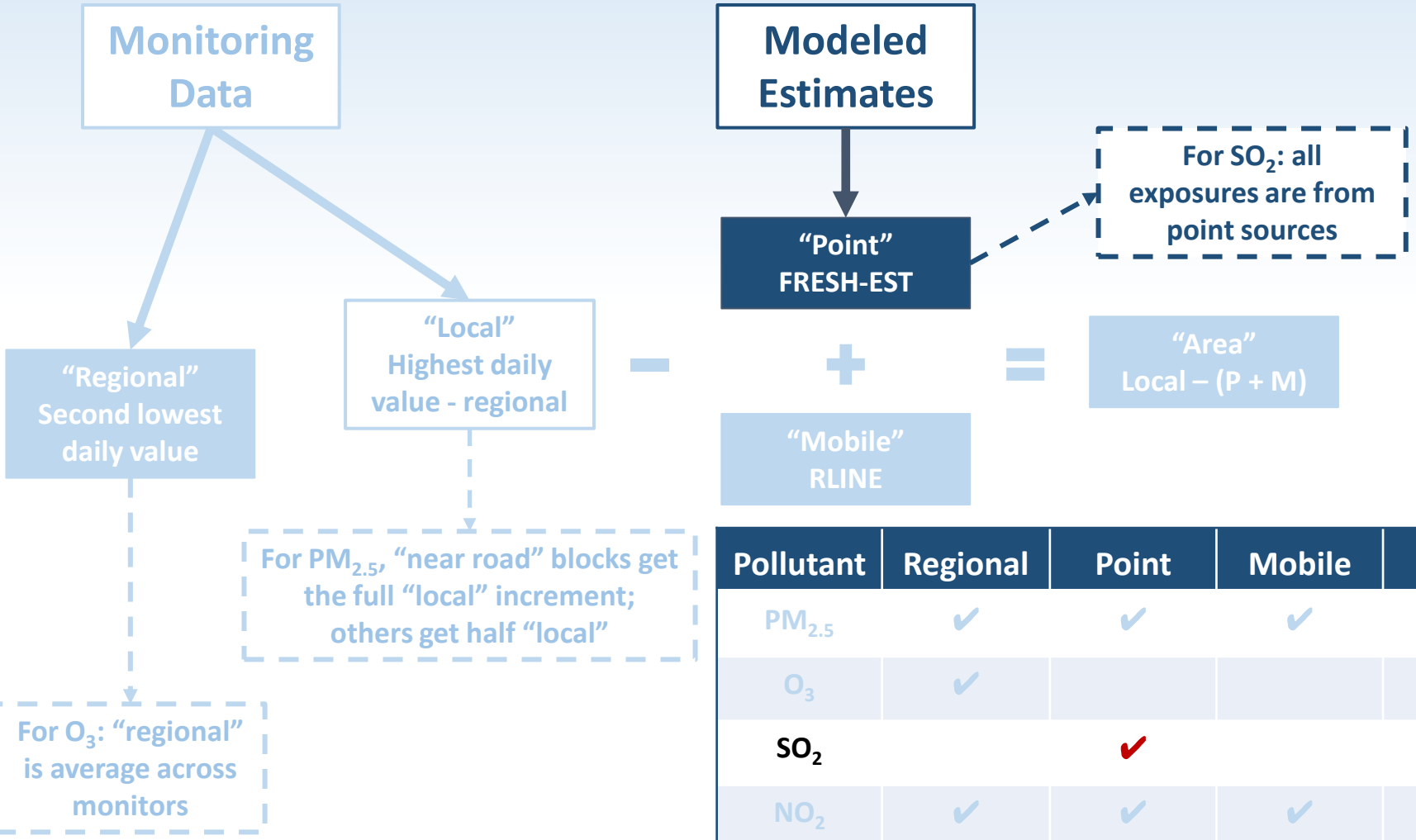
2. Develop alternative strategies to achieve emissions reduction goals
   - Uniform
   - Largest-first
   - Health impact ranking
   - Concentration optimization
   - Health impact minimization

3. Compare MDEQ's SIP to optimized alternatives

4. Evaluate alternatives based on ambient concentrations, health impacts, and inequality

Exposure assessment

- Most SO_2 in the area is from point sources
- Can rely on dispersion modeling for exposure assessment



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O_3	✔			
SO_2		✔		
NO_2	✔	✔	✔	✔

How to prioritize controls?

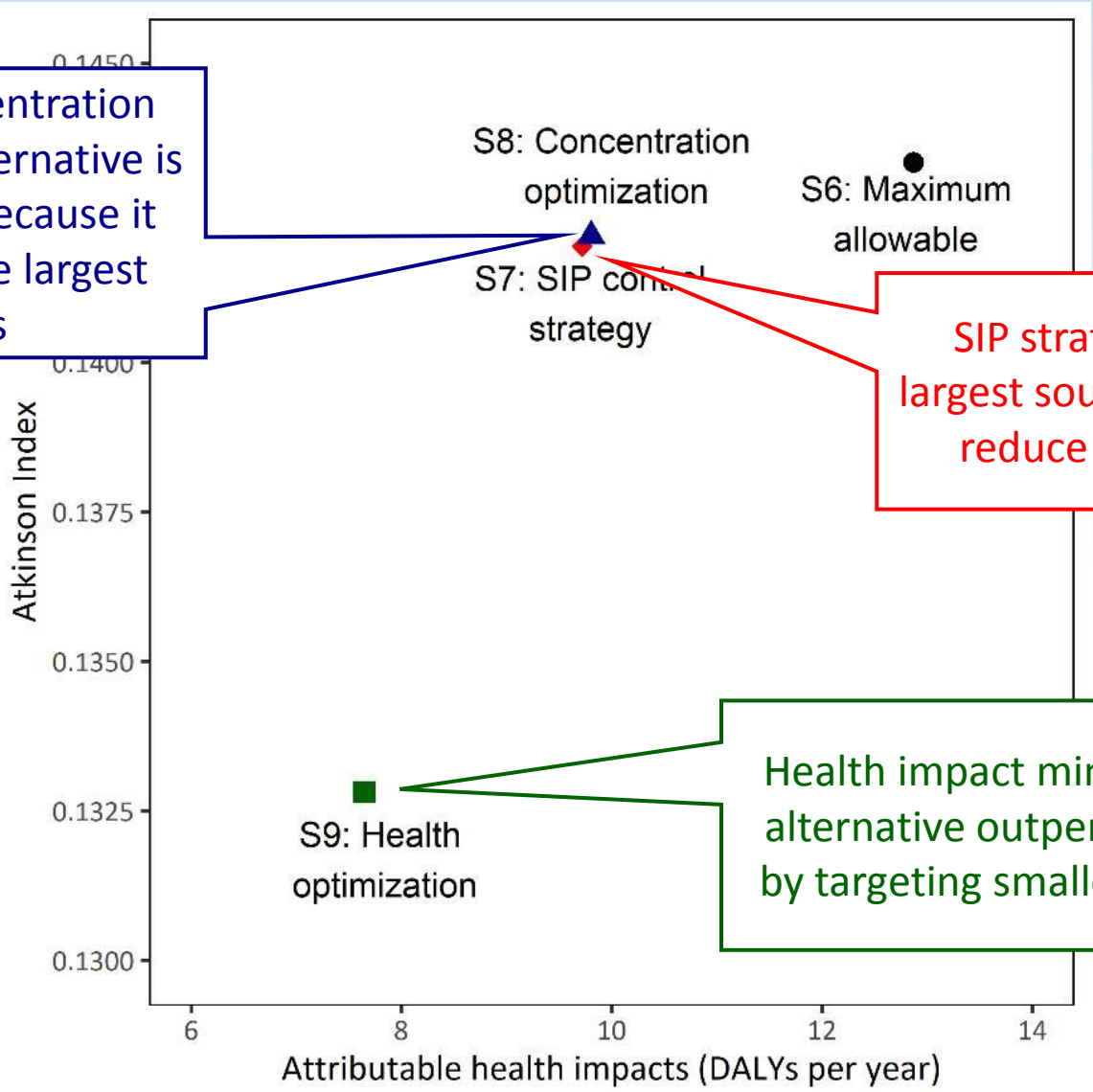
- Ranking of sources depends on metric
- Smaller sources near populations have large impacts per ton
- Results are similar to national studies of health impacts from point, mobile, and area sources (Fann et al. 2009; Levy et al. 2007)

Emissions and health impacts for point sources of SO_2

Facility	Average Emissions (tons/yr) (% of total)	Rank	Attributable DALYs (DALYs/yr) (% of total)	Rank	Health impacts per 100 tons SO_2 per year (DALYs/ 100 tons-yr)	Rank
Carmeuse Lime	640 (0.7)	8	0.40 (5.7)	7	0.062	1
Dearborn Ind. Generation	768 (0.8)	6	0.43 (6.2)	6	0.056	2
Severstal/AK Steel	733 (0.8)	7	0.38 (5.5)	8	0.052	3
Marathon Petroleum	268 (0.3)	9	0.13 (1.8)	9	0.047	4
US Steel Great Lakes Works	2,885 (3.1)	4	1.32 (18.9)	2	0.046	5
EES Coke	2,049 (2.2)	5	0.55 (7.9)	5	0.027	6
DTE River Rouge	10,442 (11.1)	3	0.80 (11.5)	4	0.008	7
DTE Trenton Channel	20,824 (22.2)	2	0.89 (12.7)	3	0.004	8
DTE Monroe	47,409 (50.6)	1	1.33 (19.1)	1	0.003	9
Minor point sources (n=125)	7713 (8.2)	NR	0.75 (10.7)	NR	0.010	NR
All point sources	93,731 (100)	NR	6.95 (100)	NR	0.007	NR

MDEQ's SIP vs. optimized alternatives

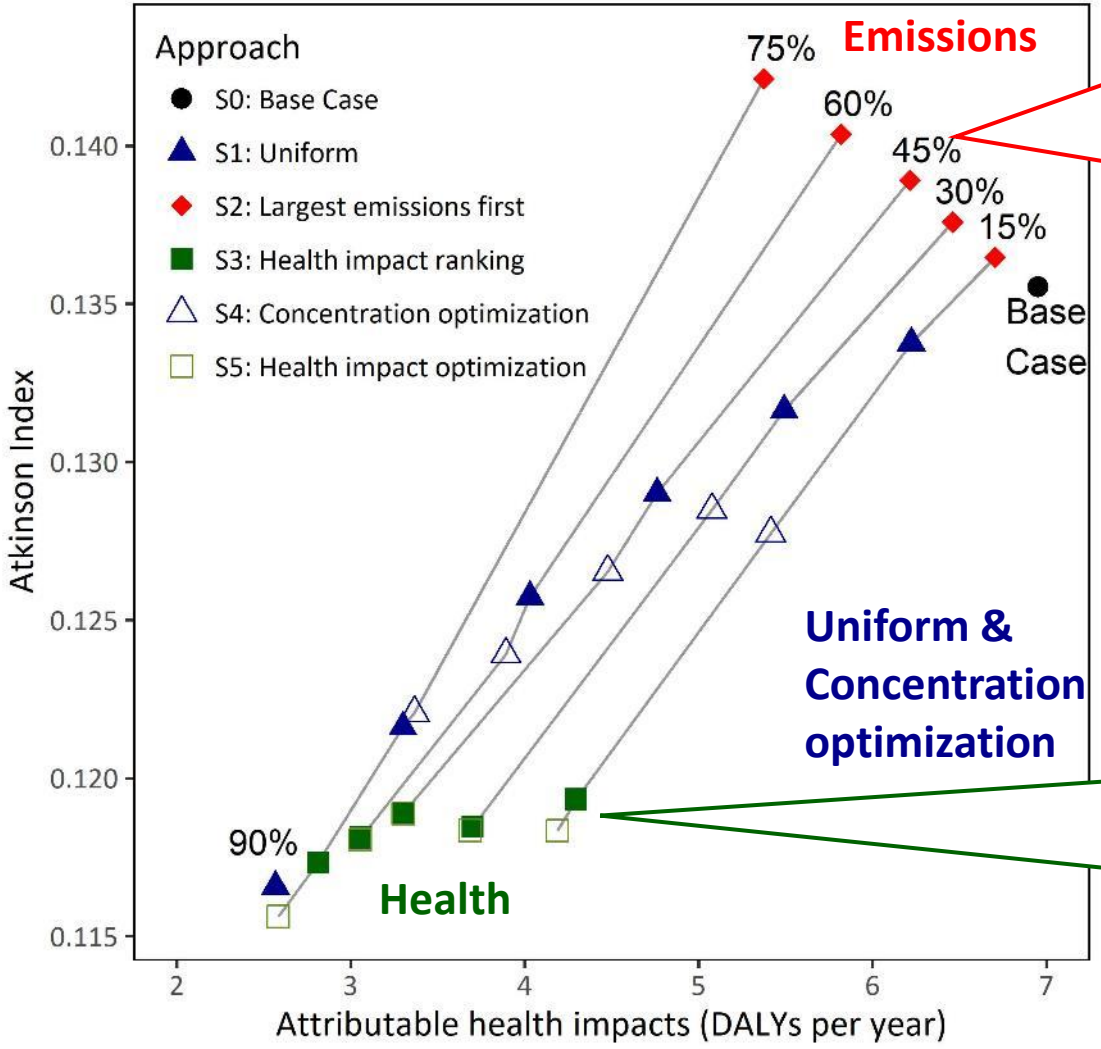
Receptor concentration minimization alternative is similar to SIP because it also targets the largest sources



SIP strategy targets the largest sources in the area to reduce concentrations

Health impact minimization alternative outperforms SIP by targeting smaller sources

Health and inequality tradeoffs



Disproportionate impacts **increase** for:

- Hispanic/Latino populations
- Populations with low educational attainment
- Low income populations

Disproportionate impacts **decrease** for:

- Hispanic/Latino populations
- Populations with low educational attainment
- Low income populations

Summary -- combining HIA and AQM

1. SO_2 from point sources contributes to environmental inequalities experienced by Detroit residents.
2. Health impacts depend on source locations, meteorology, and population characteristics.
3. The greatest reductions in health impacts and inequality come from targeting the sources with larger health impacts per ton emitted first.

Questions?

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Health effects of traffic-related air pollutants

Many epidemiological studies have linked exposure to air pollutants in the vicinity of large roadways to range of health effects:

- **Respiratory symptoms and disease**: wheeze, cough, chronic phlegm production, shortness of breath, asthma onset, asthma attacks, allergic symptoms
- **Lung development**: adverse impacts on children's lung development
- **Cardiac effects**: onset of myocardial infarction, increased blood pressure, stroke mortality
- **Birth & reproductive outcomes**: low birthweight, preterm births
- **Cancer**: leukemia, others
- **Others**, e.g., evidence regarding neurodegenerative diseases

Most epidemiological studies have used indirect or surrogate exposure measures, e.g., distance between residence location and major roadways, rather than direct pollutant measures, e.g., using biomonitoring or personal monitoring. Exposure assessment is a weak point of nearly all studies.

Diesel exhaust particulate matter

Diesel exhaust emissions considered to pose a health threat:

- Emissions occur close to people so high exposures often occur
- DPM readily deposits in the lung and can be absorbed in the body
- Contains compounds known to damage DNA and cause cancer

Health impacts identified include:

- Premature deaths
- Lung cancer
- Decreased lung function in children
- Chronic bronchitis
- Increased respiratory and cardiovascular
- Aggravated asthma
- Increased respiratory symptoms
- Lost workdays
- Reduction in visibility (10 to 75% of total)
- Global warming (2nd to carbon dioxide)

CARB, 2005, Summary of Adverse Impacts of Diesel Particulate Matter

Public Health Impacts

ISSN 1047-3289 J. Air & Waste Manage. Assoc. 50:175-180

TECHNICAL PAPER

Distance-Weighted Traffic Density in Proximity to a Home Is a Risk Factor for Leukemia and Other Childhood Cancers

Robert L. Pearson
Radian International LLC, Denver, Colorado

ORIGINAL ARTICLE

Residence Near a Major Road and Respiratory Symptoms in U.S. Veterans

Eric Garshick,*† Francine Laden,†‡ Jaime E. Hart,†‡ and Amy Caron†

vidence that exposure to motor vehicle respiratory disease. Studies in children with wheeze, hospital admissions for ulmonary function. However, a rela- piratory disease with exposure

Key Words: respiratory symptoms, traffic, GIS, air pollution, mobile sources, adults

(*Epidemiology* 2003;14: 728–736)

JECH ONLINE

Neighbourhood socioeconomic status, maternal education and adverse birth outcomes among mothers living near highways

M Généreux, N Auger, M Goneau and M Daniel

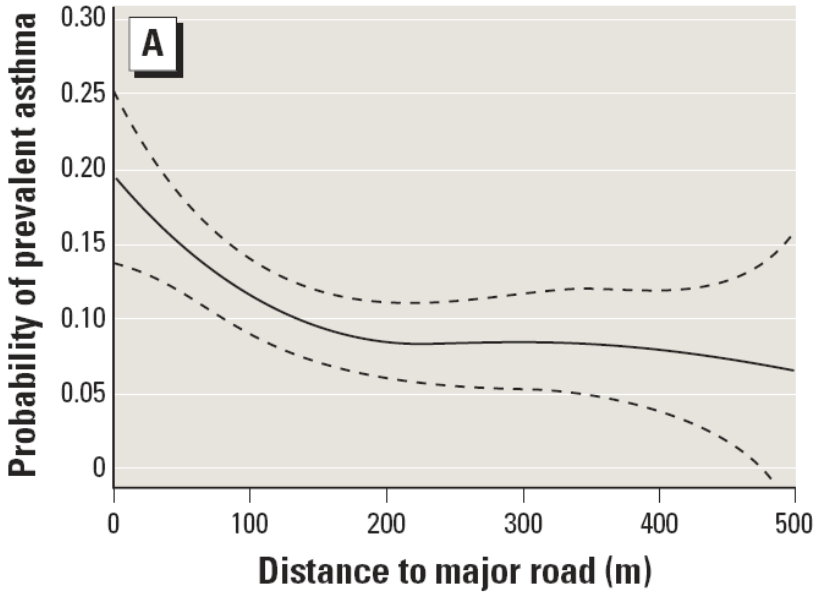
J Epidemiol Community Health 2008;62;695-700
doi:10.1136/jech.2007.066167

VOLUME 114 | NUMBER 5 | May 2006 • Envirc

Research | Children's Health

Traffic, Susceptibility, and Childhood Asthma

Rob McConnell,[1] Kiros Berhane,[1] Ling Yao,[1] Michael Jerrett,[1] Fred Lurmann,[2] Frank Gill
Jim Gauderman,[1] Ed Avol,[1] Duncan Thomas,[1] and John Peters[1]
[1]Department of Preventive Medicine, Keck School of Medicine, University of Southern California, Los
[2]Sonoma Technology Inc., Petaluma, California, USA

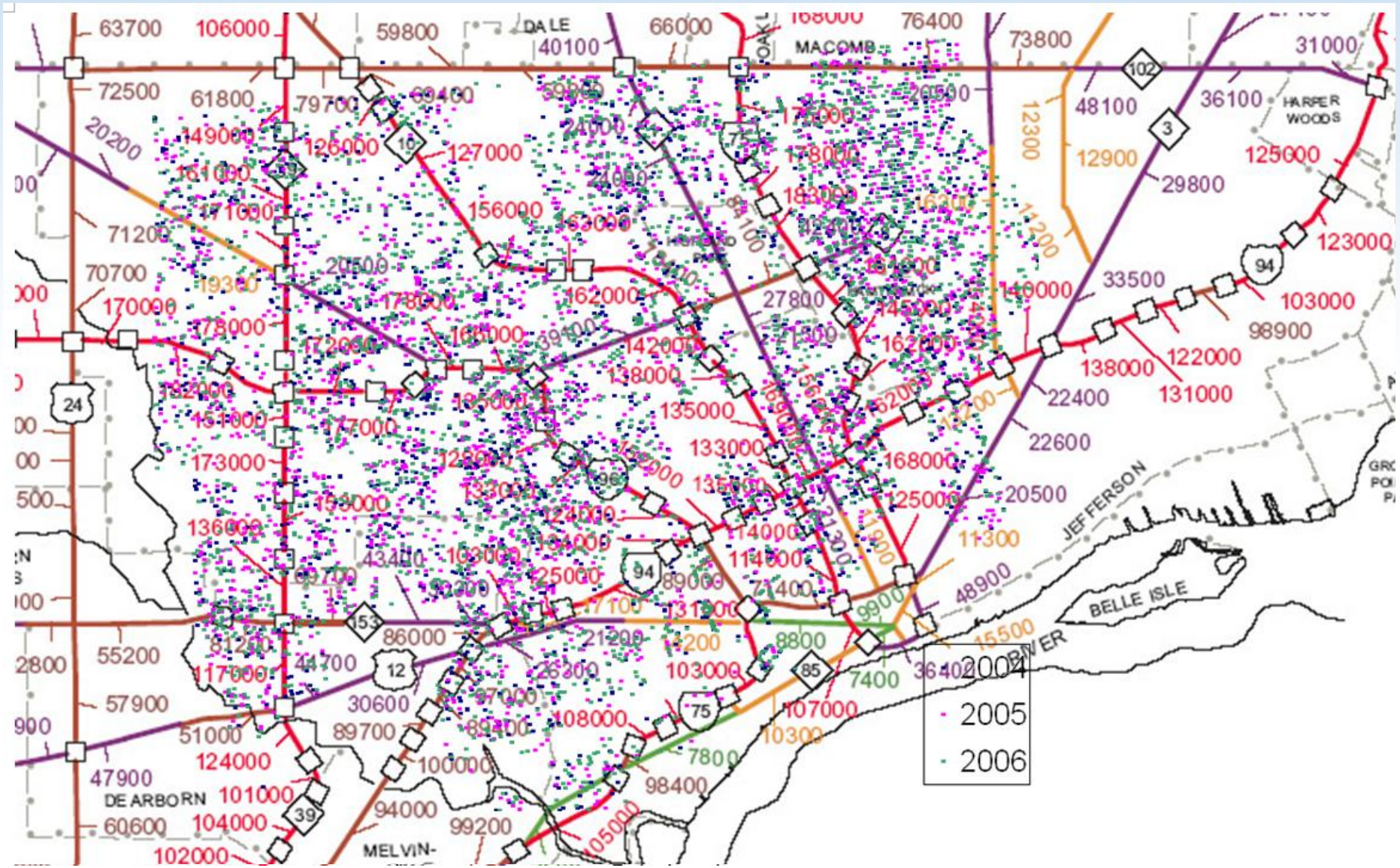


Detroit Asthma Morbidity, Air Quality and Traffic (DAMAT) Study

Annual average daily traffic (AADT) from MDOT, 2004, Detroit area.

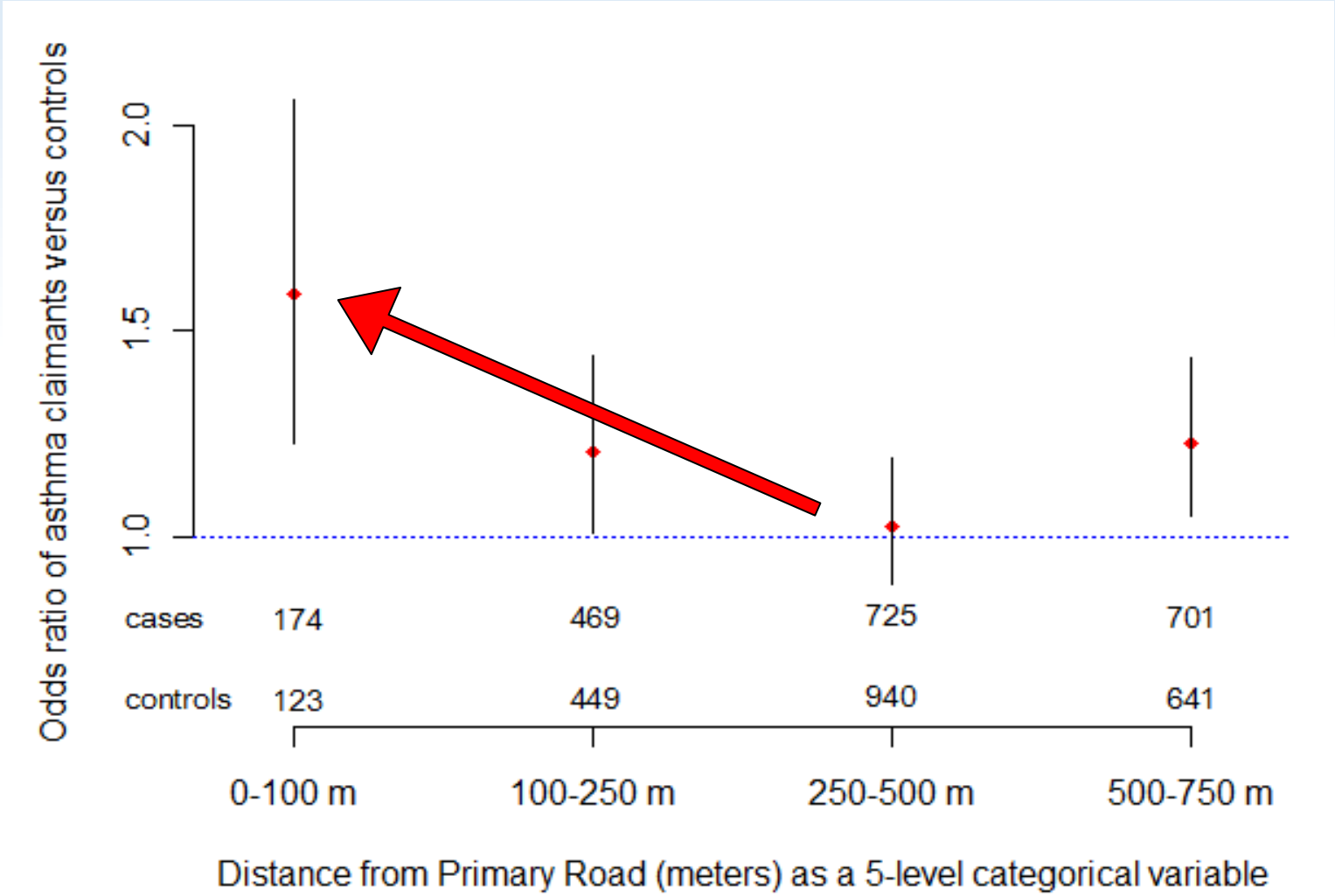
Detroit Asthma Morbidity, Air Quality and Traffic (DAMAT) Study

Dots show 14,000 pediatric Medicaid claims for asthma in Detroit over 2004-2006 period, each geocoded.



Detroit Asthma Morbidity, Air Quality & Traffic (DAMAT) Study

Estimated odds ratios with 95% confidence intervals of asthma for categorized distance with 5 levels from primary road (reference level 750 m or more), restricting the study region buffer to 1 km, and the number of subjects lying in the exclusive intervals from primary road by case-control status. Matched controls based on ED admits for poisoning and injury.



Detroit Asthma Morbidity, Air Quality & Traffic (DAMAT) Study

- Increase in asthma ER visits when concentrations of PM were elevated.
- Association seen for concentrations as low as 11 -13 $\mu g/m^3$ - well below current regulatory standard of 35.
- Asthma exacerbated among children living within 250 m of major roadway.
- Detroit children with asthma affected by roadway pollutants, even at low concentrations.
- Now thousands of studies show such links.

S Li, S Batterman, et al. "Asthma exacerbation and proximity of residence to major roads: a population-based matched case-control study among the pediatric Medicaid population in Detroit, Michigan." *Environmental Health*, April 2011.

S. Li, S. Batterman, et al. "Association of Ambient Air Pollutants with Daily Asthma Emergency Department Visits and Hospital Admissions among the Pediatric Medicaid Population in Detroit: Time-Series and Time-Stratified Case-Crossover Analyses with Threshold Effects," *American Journal of Epidemiology*. April. 2011.

Mortality due to living near heavily trafficked roadways

- People living <150 meters (~500 feet) from heavily trafficked roadways were 12% more likely to die from cardiovascular or respiratory disease compared to those who lived >150 meters distant
  - Accounts for 340 excess deaths due to cardiovascular and respiratory disease over 10 years.
  - These effects visible at levels of PM that are within the current regulatory standards.
  - Many studies show these associations.

Analysis considered deaths due to cardiovascular and pulmonary causes, Detroit metropolitan area, 2006-2010, on heavily trafficked roadways = <10,000 vehicles/24 hours (1-75, I-96, M10, M39, Michigan Avenue, Woodward, 8 Mile Road, Davison, Ford Road, I-275)

Living near large roads increases exposure

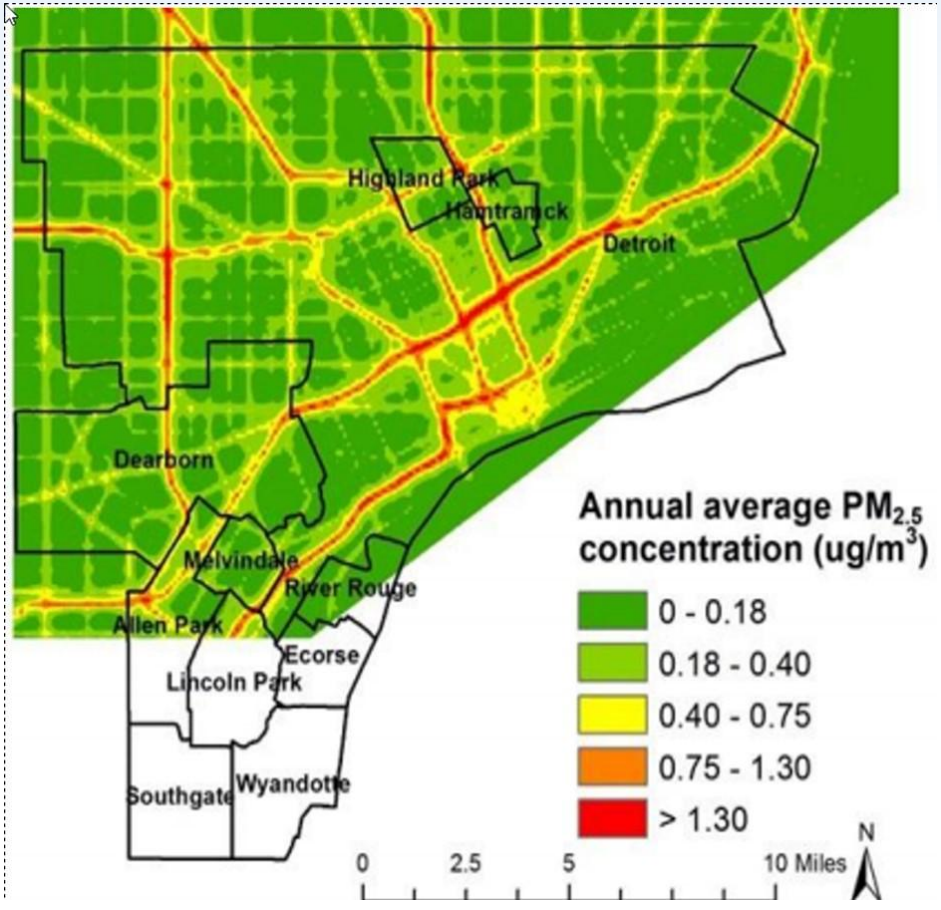
Emissions: Considering point, mobile, & area sources combined, on-road emissions represent a large proportion of emissions:

>50% of CO and NOx 27% of VOCs 15% of $PM_{2.5}$

Place matters: In Detroit, many of the on-road $PM_{2.5}$ emissions occur on freeways (43% of total), other principal arterials (31%), and the balance on smaller arterials, collectors and minor roads.

Concentration trends are relatively flat, i.e., monitoring and emissions data show large decreases in point sources emissions, but NOT in mobile source emissions.

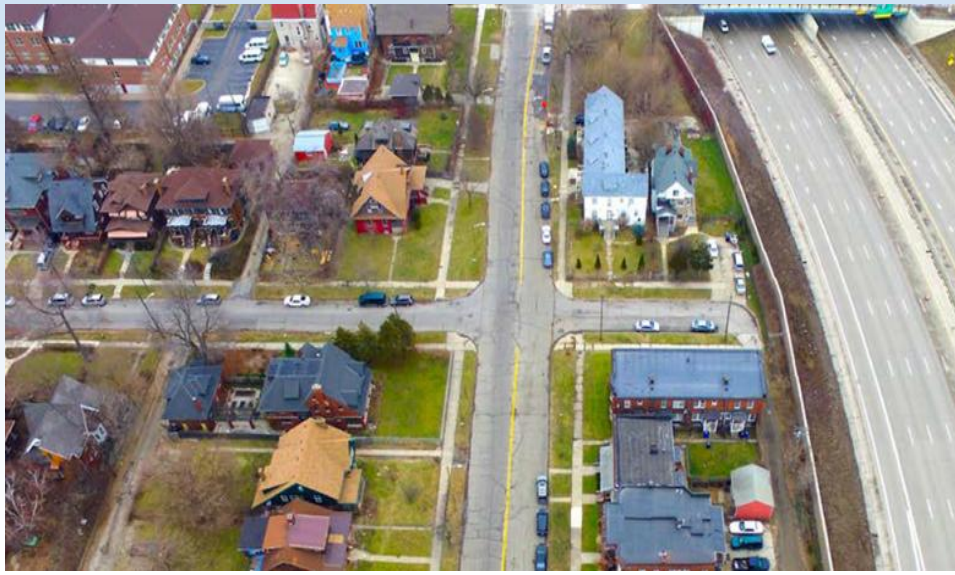
RLINE modeling, 2012 inventory, annual average $PM_{2.5}$ from on-road exhaust emissions only.



Buffers and barriers

- **Recommendation 8-1.** Adopt regulations to create consistent and appropriate minimum setbacks between sensitive land uses and pollution sources.
- **Recommendation 8-2.** Plant vegetative buffers and/or install sound walls where current minimum setbacks are not met.
- **Recommendation 8-3.** Increase tree canopy throughout the City of Detroit.

CAPHE's **Vegetative Buffer Guide**



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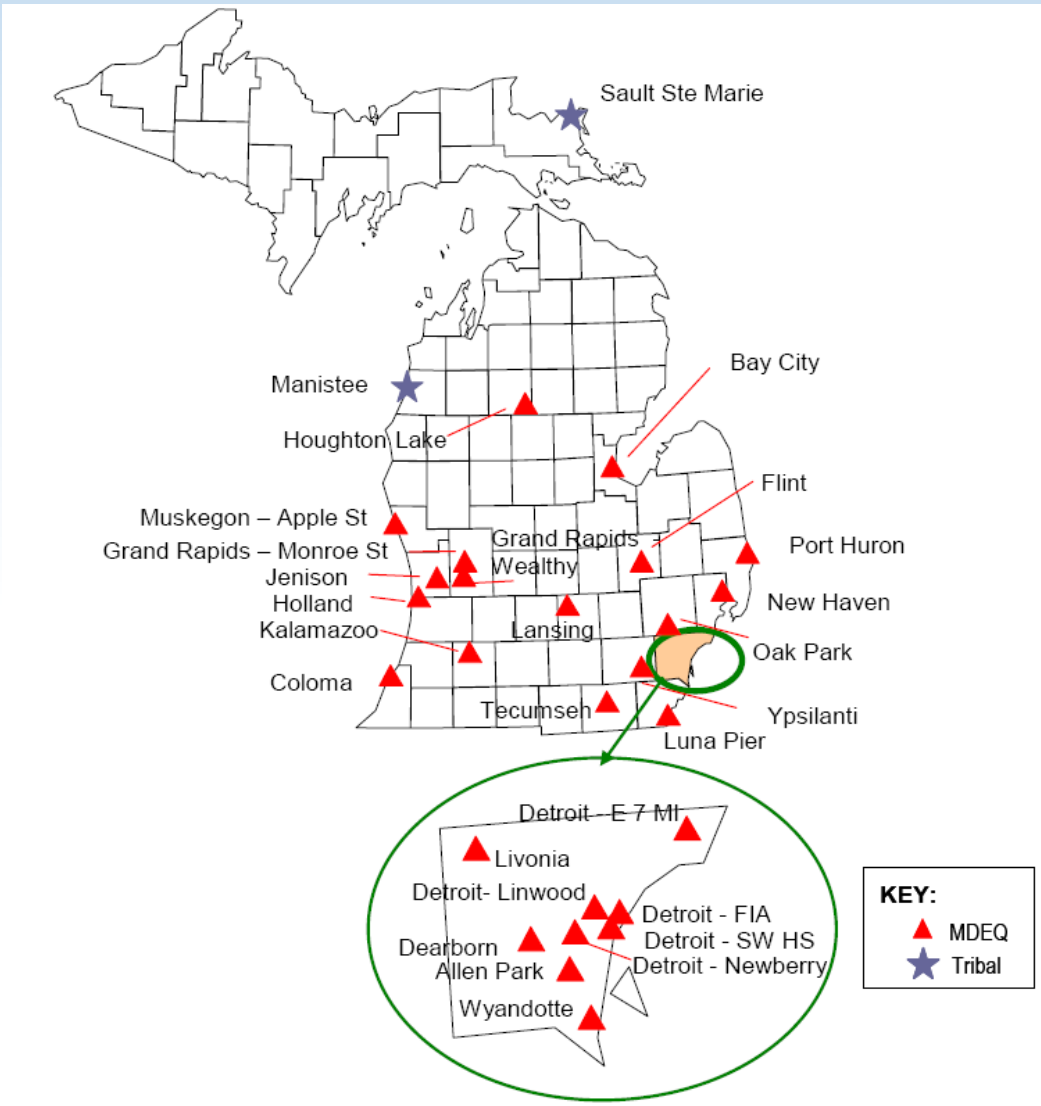
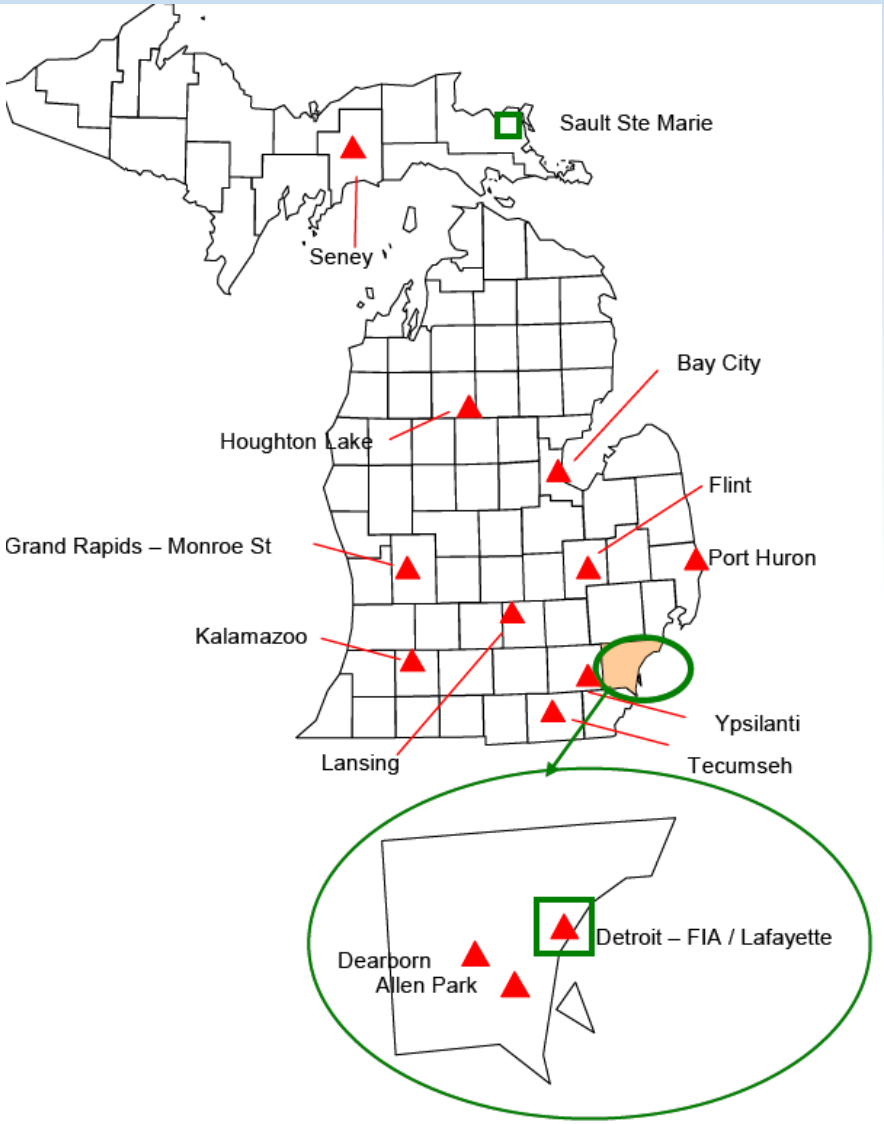
Statewide monitoring

Michigan's PM2.5 Ambient Air Monitoring Network (MDEQ Air Monitoring Network Review)



Federal Reference Method (FRM)

(24-hr samples, every 3 days)

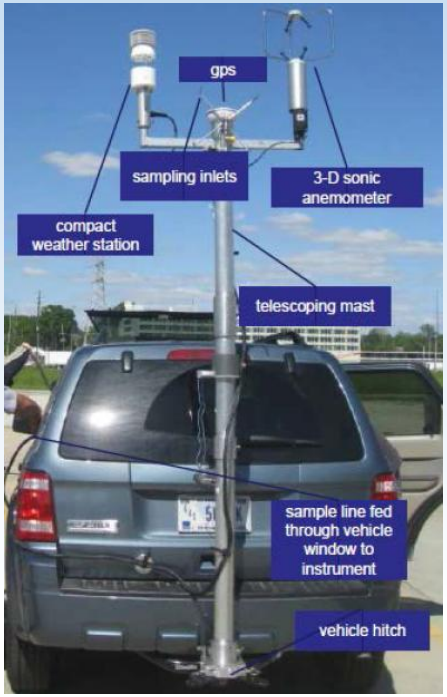


TEOM – continuous

(hourly)

Detroit-area monitoring

Some photos from Susan Kilmer, MDEQ, right from Motria Caudill,EPA

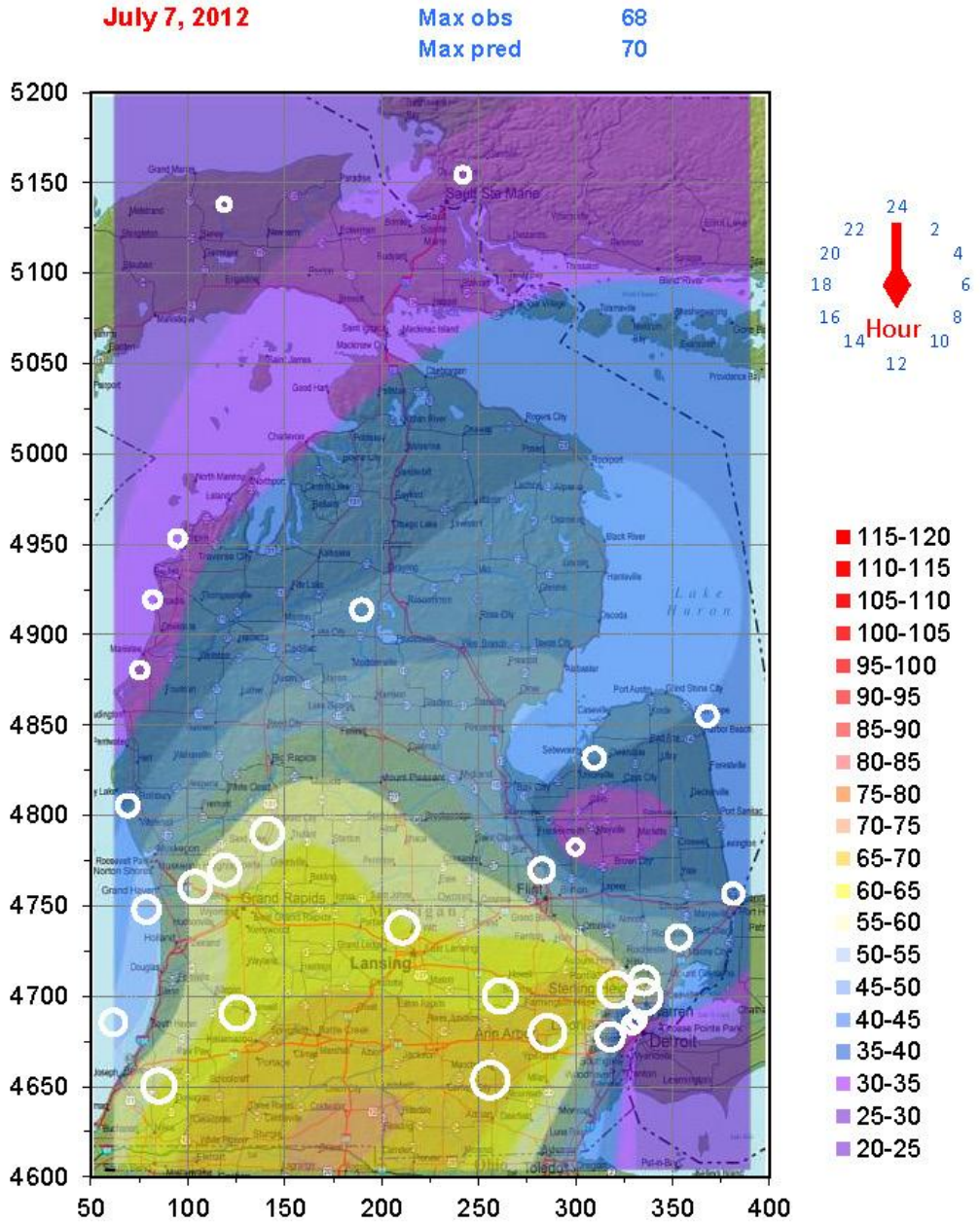


Air quality monitoring

Does it capture spatial and temporal variation?

8-hour O3 statewide

Based on available O3 monitors and kriged surface



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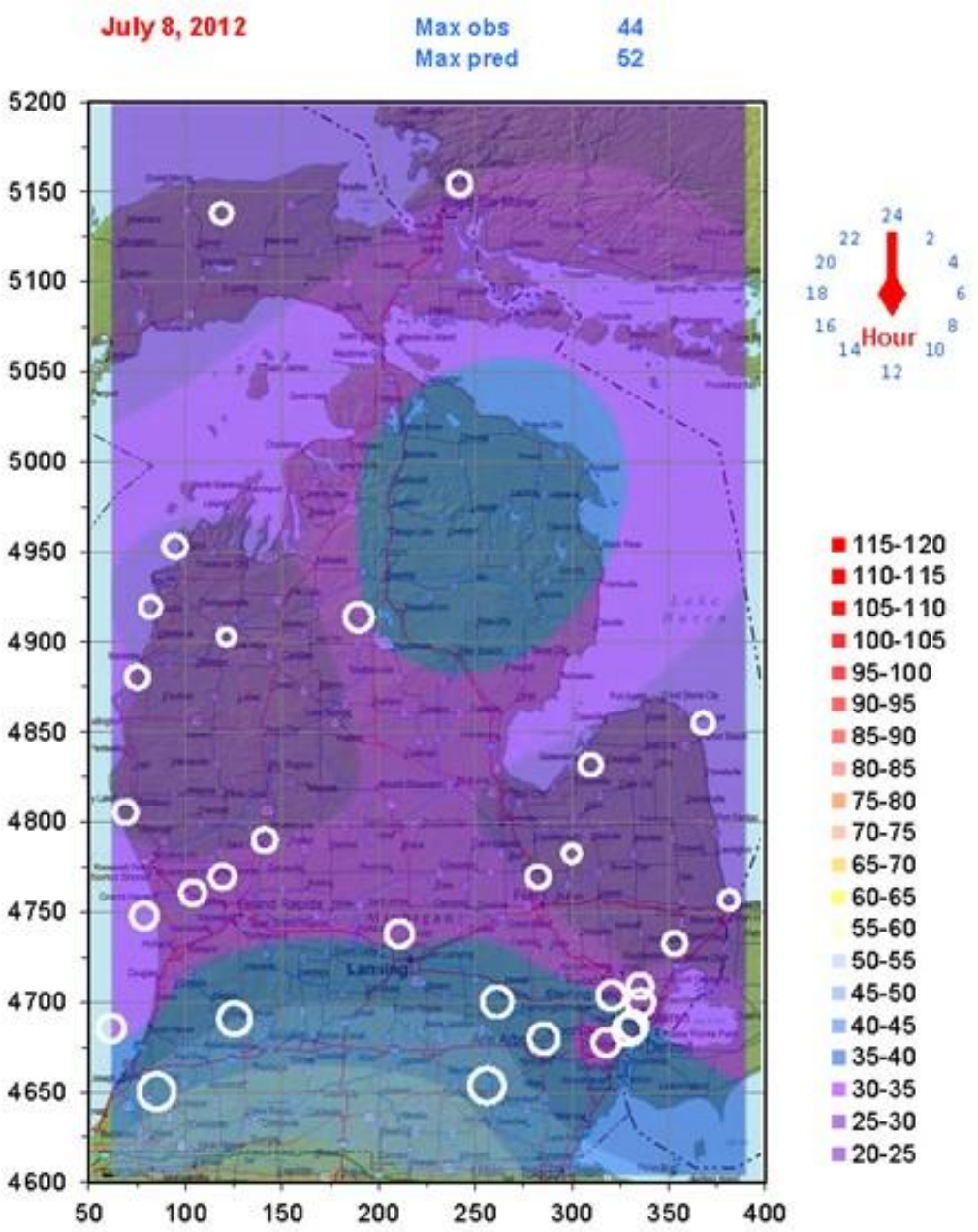

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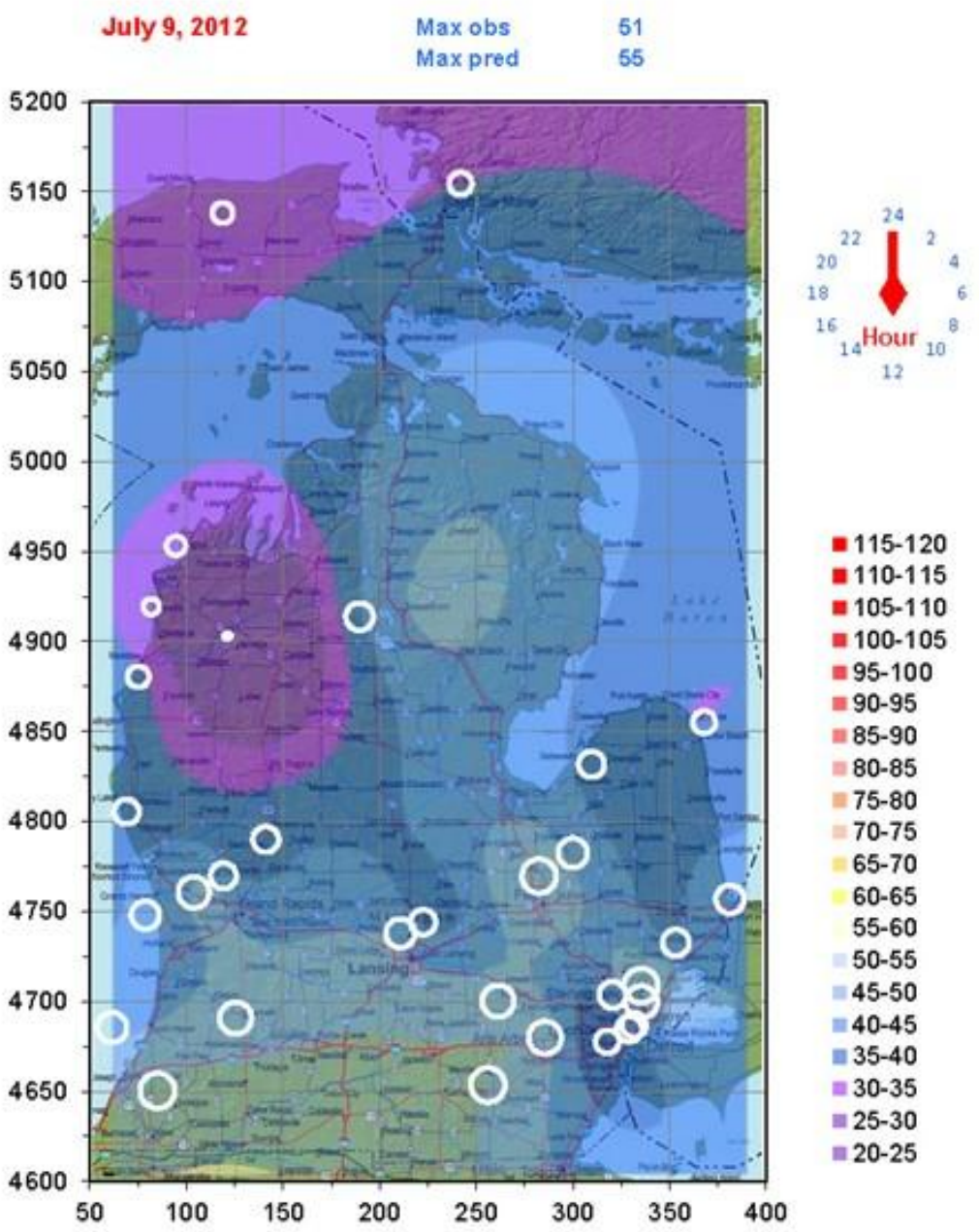

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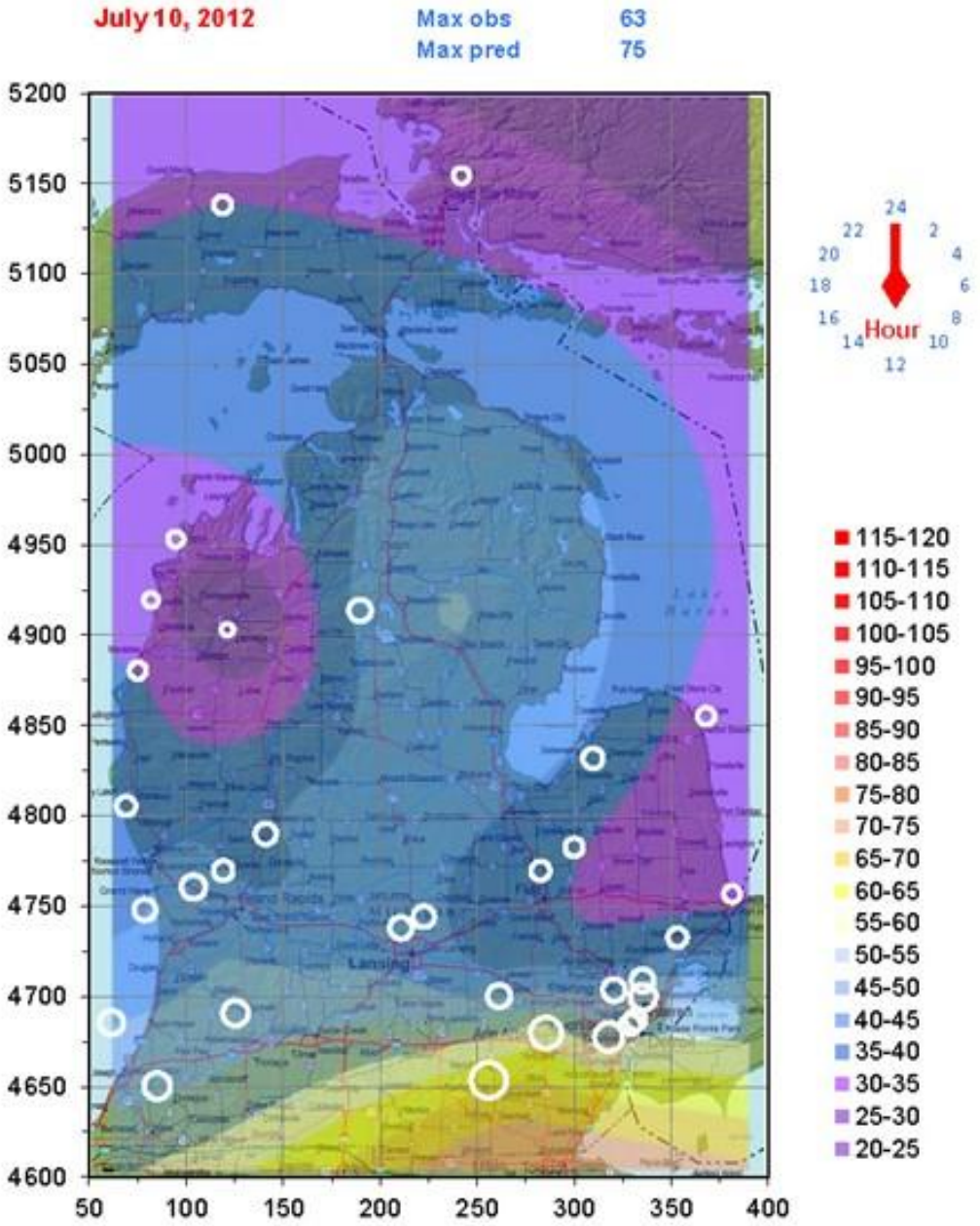

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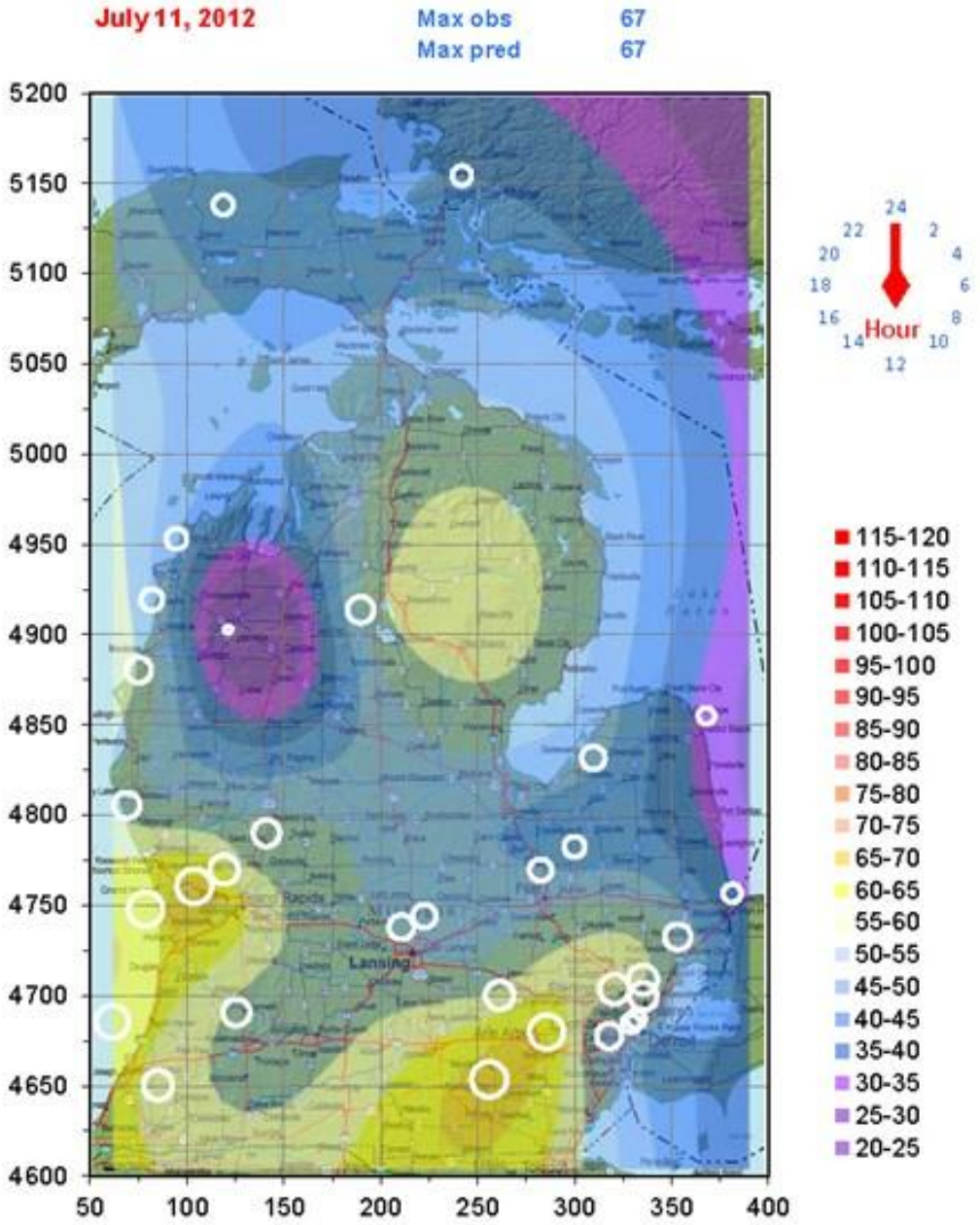

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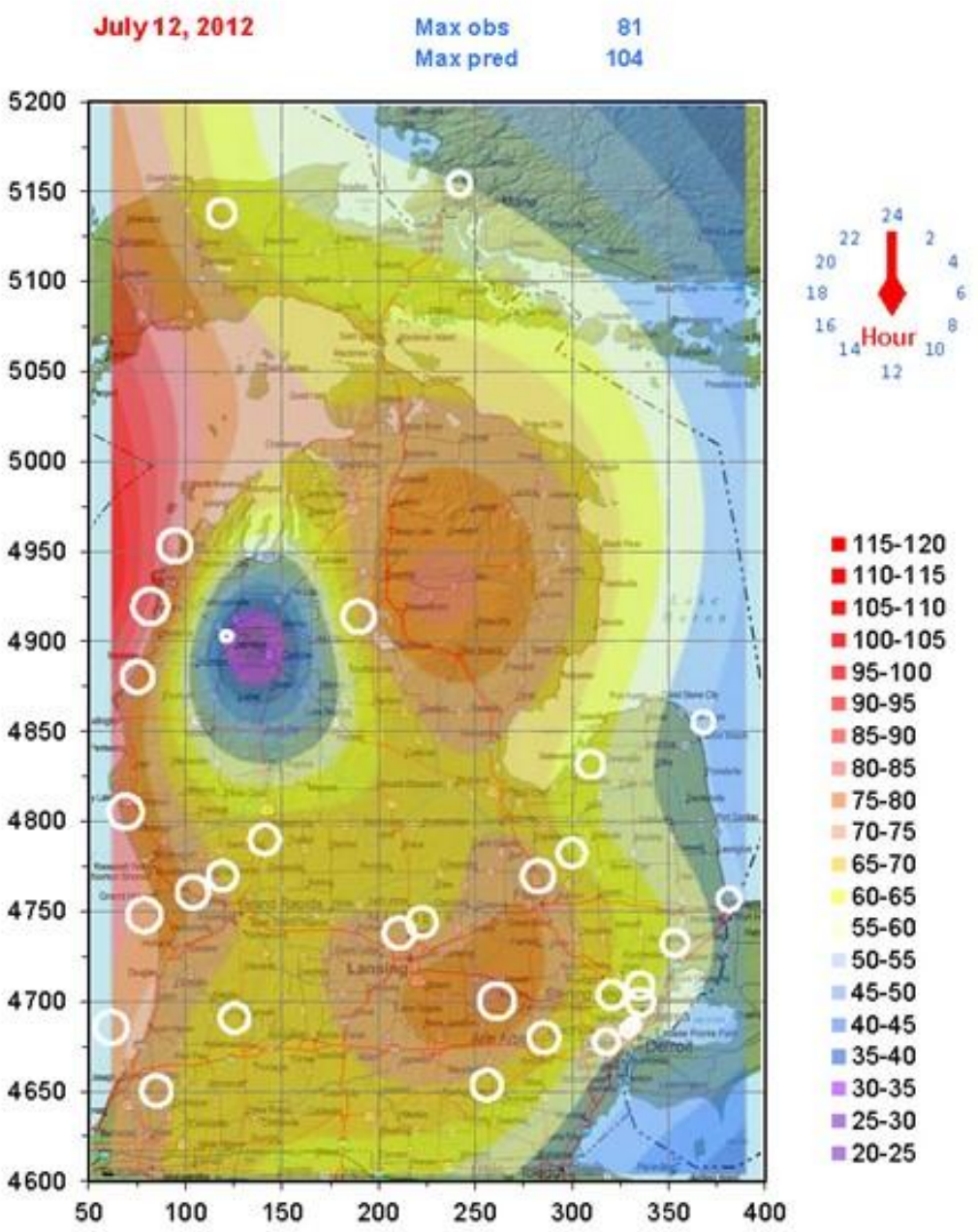

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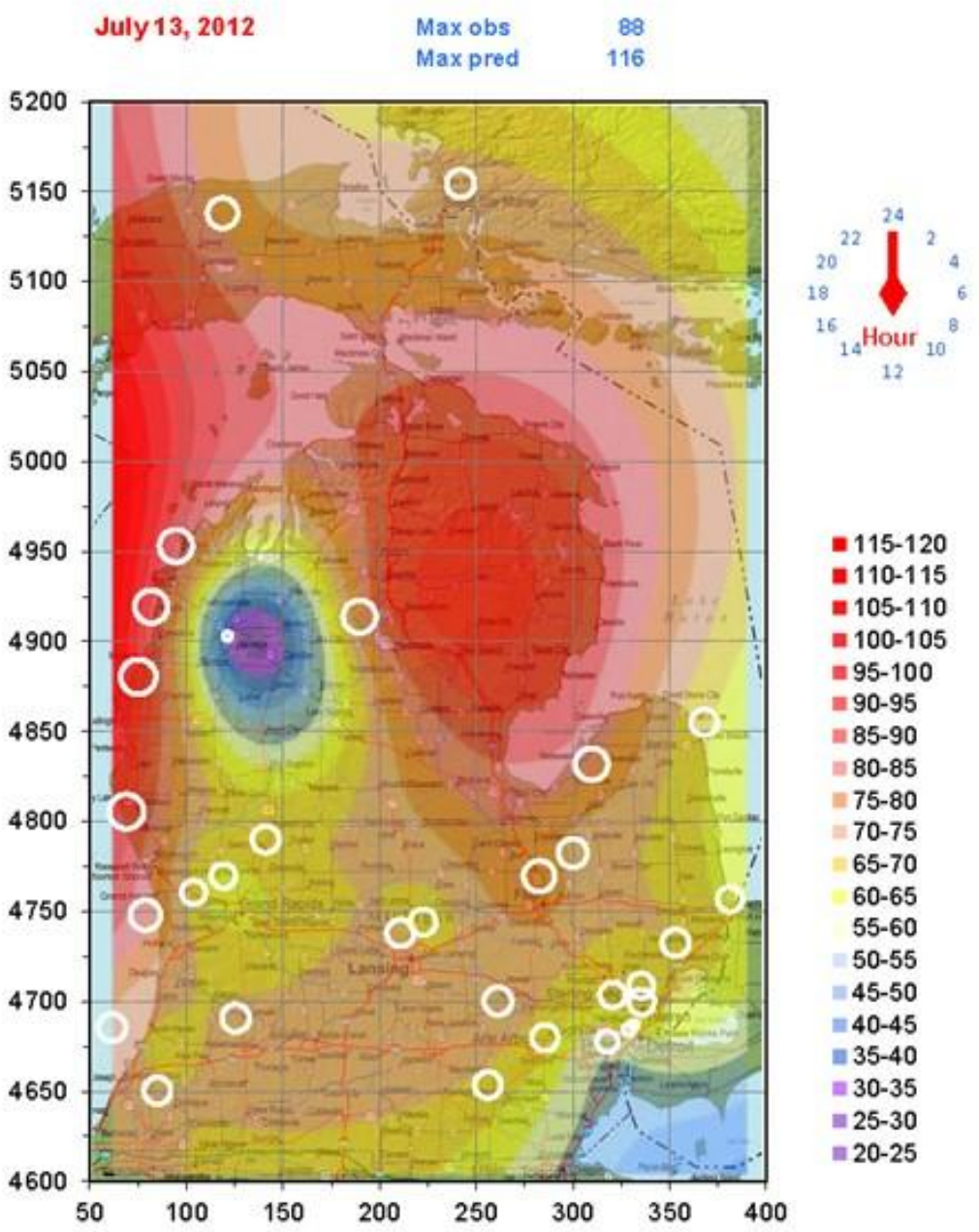
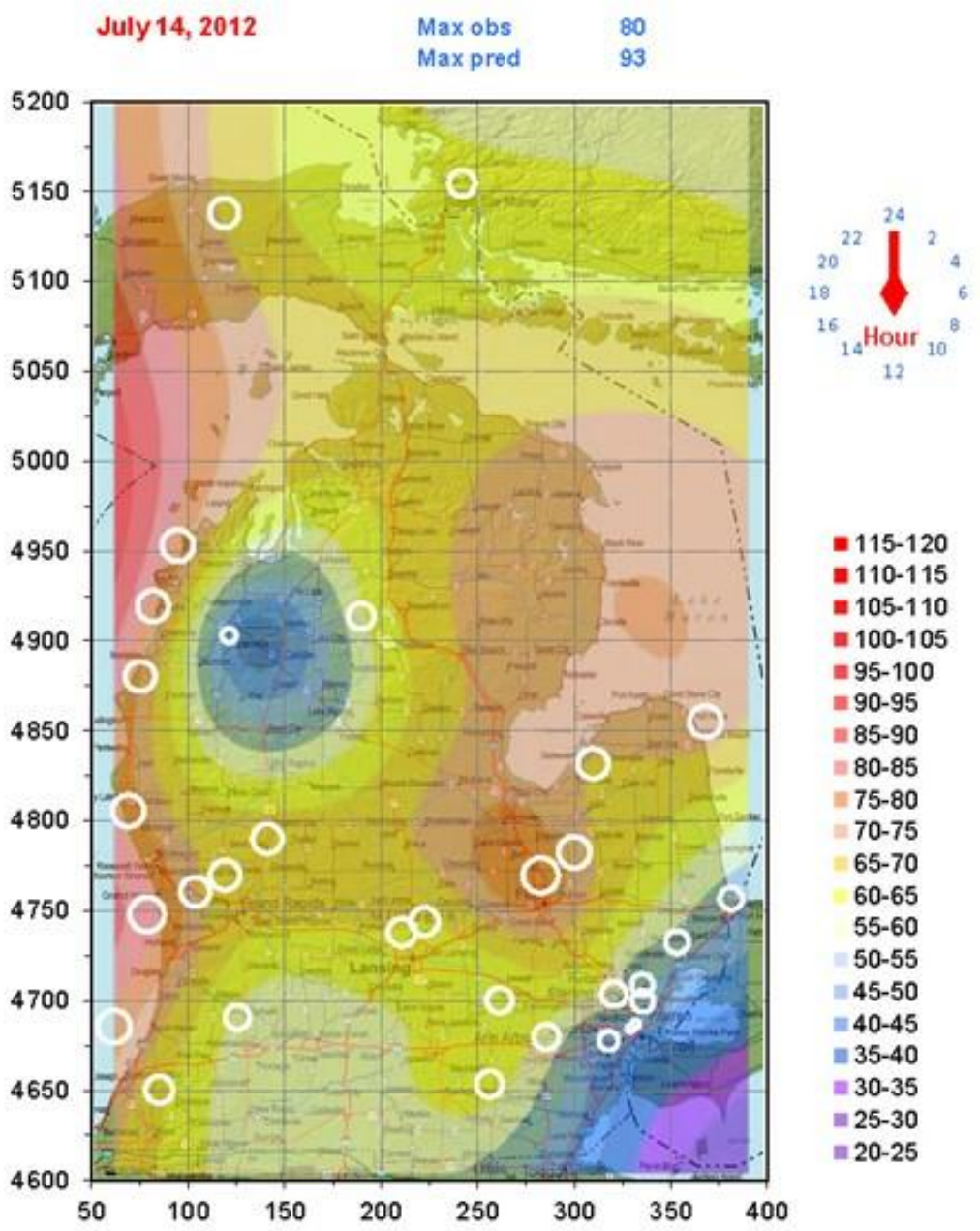


Air quality monitoring

Does it capture spatial and temporal variation?

8-hour O3 statewide

Based on available O3 monitors and kriged surface

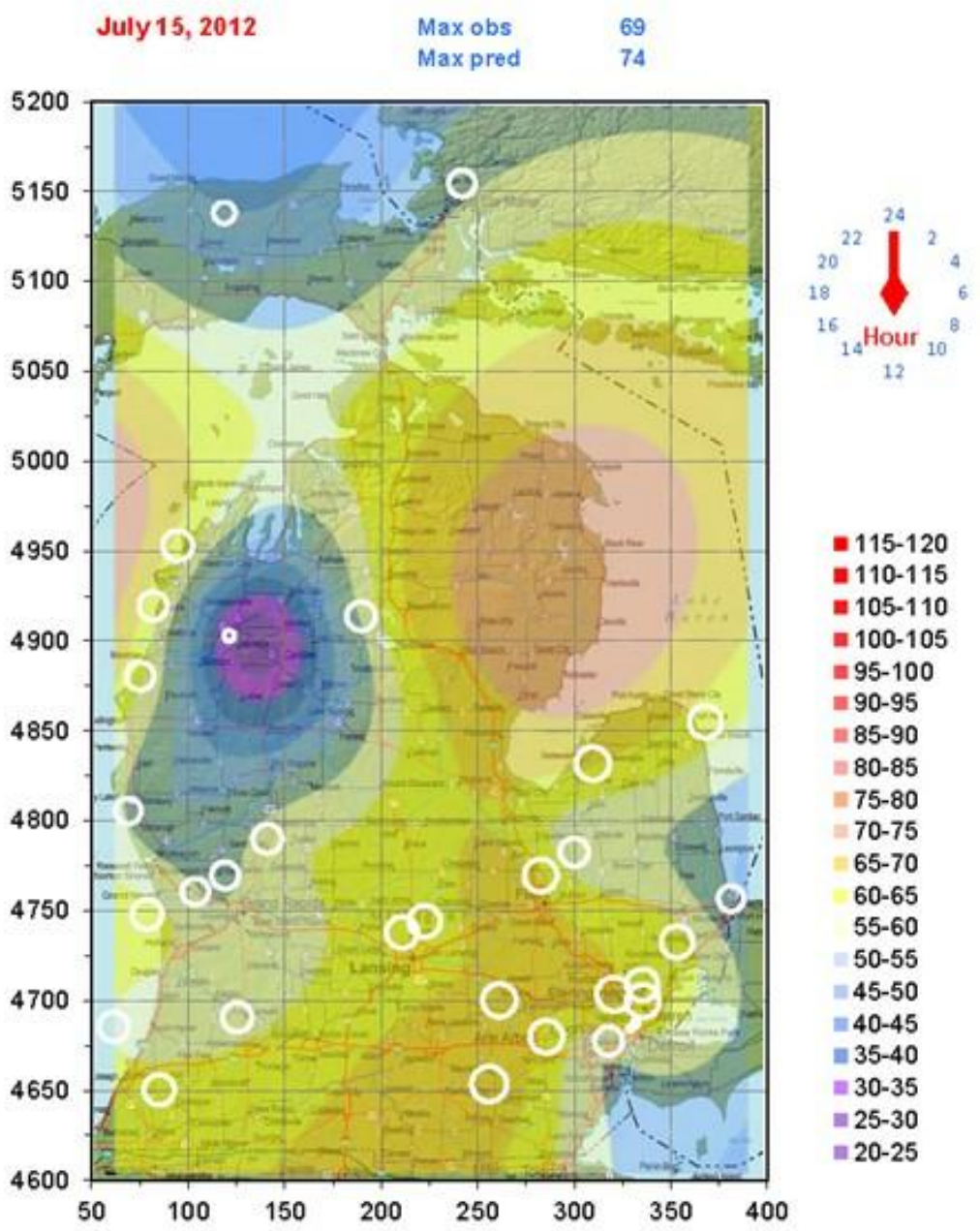


Air quality monitoring

Does it capture spatial and temporal variation?

8-hour O3 statewide

Based on available O3 monitors and kriged surface



Enhanced air quality monitoring

- Recommendation 10-1. **Increase the number of monitoring sites and monitored parameters, and utilize mobile and transportable monitors.**

  Currently, most monitoring is performed at permanent sites; mobile and transportable monitors provide opportunities to increase spatial coverage, provide mapping, and respond to possible hot-spots and community concerns.

- Recommendation 10-2. **Identify and implement targeted air quality monitoring projects.**

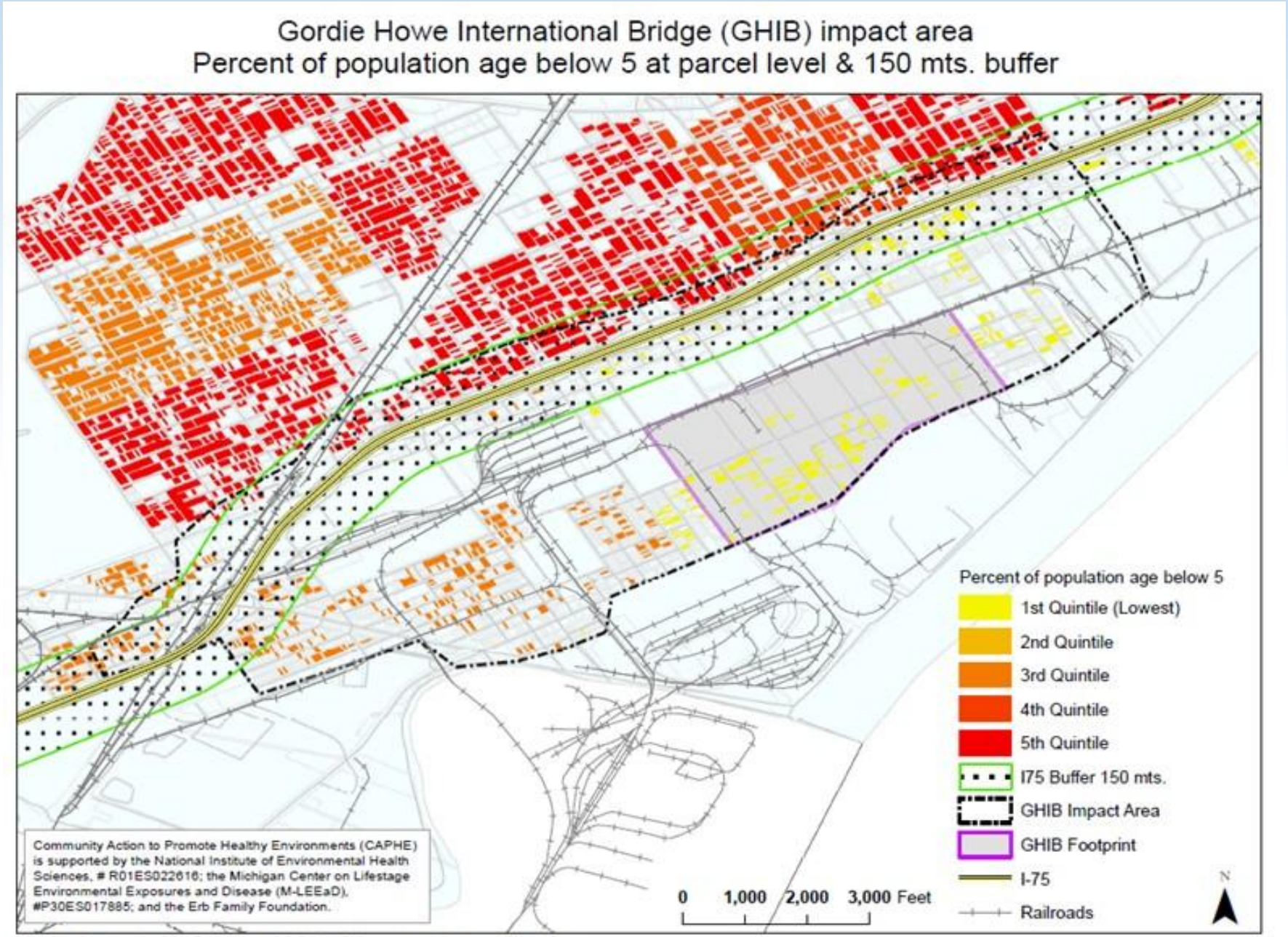
  Currently, air quality monitoring and data analyses performed by MDEQ are oriented toward assuring compliance with standards and evaluating trends. These should continue. Addition studies should investigate exposures, health risks, pollutant hot-spots, fugitive emissions, source apportionment, monitoring system adequacy, efficacy of controls, epidemiological links, health impact analyses, health interventions, and other public health concerns.

  Example 1: traffic-related air pollutants associated with the new international bridge crossing and freeway expansions (I-75 and I-94)

  Example 2: lead and asbestos exposures from Detroit's large scale demolition program, which has an unprecedented target of 5,000 buildings in 2017 alone.

- Recommendation 10-3. **Increase public engagement with air quality monitoring activities.**

Gordie Howe International Bridge Impact Area



Population age below 5. Source:ACS 2013 5-years estimate census data

Gordie Howe International Bridge Impact Area

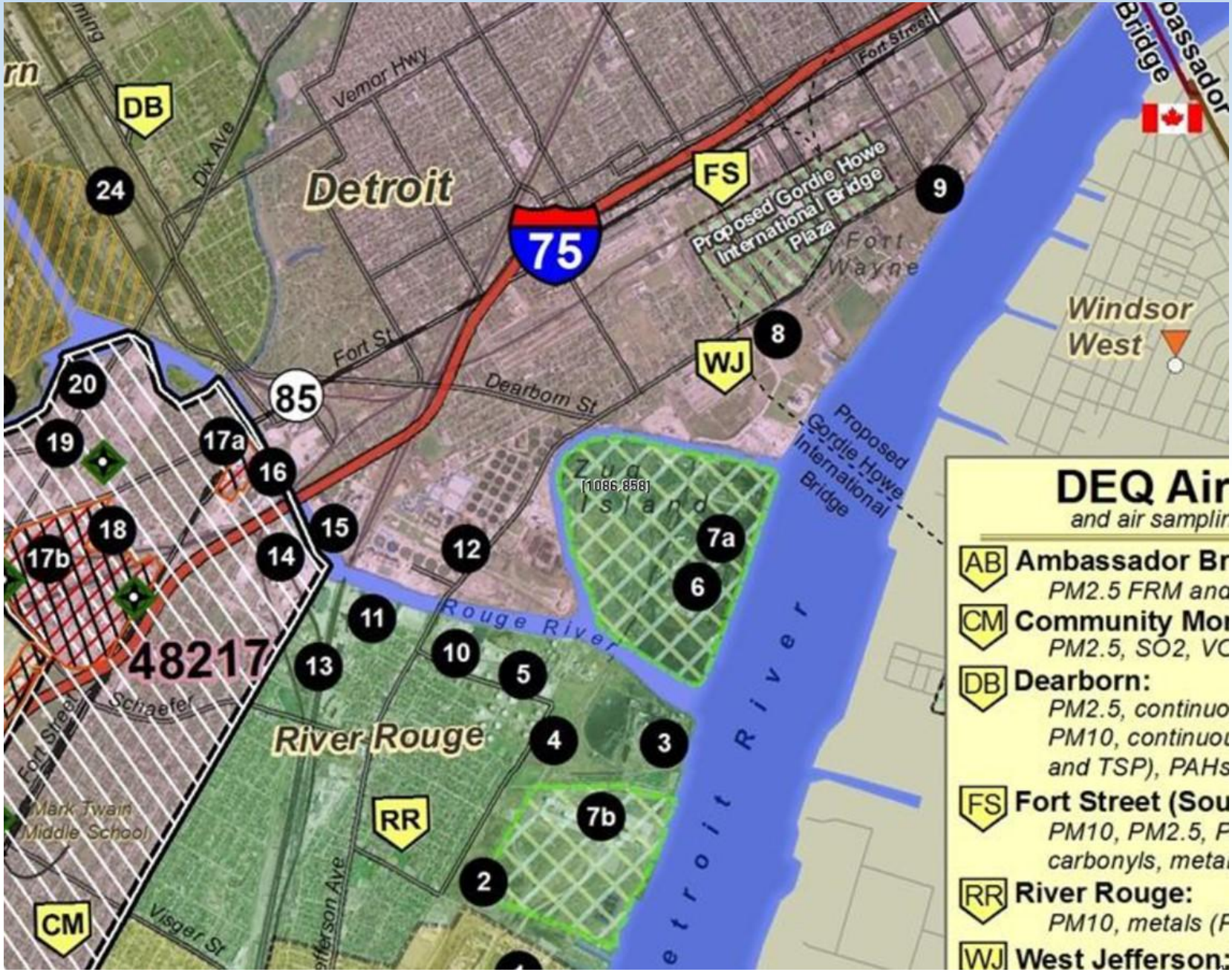
From the FEIS

- Truck traffic is projected to increase 125%, or more than double.
- 75% of all border trucks are expected to choose to use the new bridge for the direct freeway-to-freeway connection
- Local cumulative impacts of the added trucks were not evaluated.
- Logistics industry study suggests trucking-related companies may locate near the new bridge, and 250 acres in 10-20 acre parcels may be developed for new logistics businesses that will bring additional truck traffic to the area.

From a neighborhood survey top three concerns about the neighborhood:

- Outdoor air (emissions/fumes, odors) (74)
- Noise (62)
- Safety with increasing trucks (51)
- Traffic congestion (36)
- Indoor air quality (fumes & dust inside the home) (34)
- Loss of property value (27)
- Other (16)
- Road dust (14)
- None/not concerned (5)

Existing AQ monitoring and emission sources in SW Detroit



New State of Michigan – City of Detroit Agreement

Collaboration between State, City and University. Calls for:

- Additional fixed site monitoring around I75 and terminal area – 3 new sites, plus enhancements to existing sites.
- Mobile monitoring to map pollutant levels and support special studies
- HIA of bridge impact area
- Phased approach: before, during and post-construction

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Conclusions & policy implications

Criteria pollutants continue to have a substantial public health impact in the Detroit area, e.g., 7% of mortalities ($PM_{2.5}$ and O_3), 2-36% of asthma outcomes ($PM_{2.5}$, NO_2, and O_3), $6.6 billion annual cost.

CAPHE identified 10 strategies in public health action plan.

Call to refocus air quality management activities from compliance-oriented to health-oriented to achieve the greatest reductions in health impacts and inequality.

Quantitative health impact (HIA) and inequality assessments go beyond NAAQS compliance strategies and can provide information that may be useful in setting local AQM priorities, and developing or evaluating AQM strategies that avoid missed opportunities ("fair treatment")

Partnerships may be best strategy for improving public health

Detroit. Photo by Lbeck1945 [Public domain], via Wikimedia Commons

Recent Detroit air quality publications

1. Chad Milando, Lei Huang, Stuart Batterman, "Trends in $PM_{2.5}$ emissions, concentrations and apportionments in Detroit and Chicago," *Atmos Environ* , 129, 197-209, 2016.
2. Martenies, S.E., Wilkins, D., Batterman, S.A., 2015. Health impact metrics for air pollution management strategies. *Environ Int* 85, 84–95.
3. Martenies, S.E., Williams, G.O., Batterman, S.A., 2017. Disease and health inequalities attributable to air pollutant exposure in Detroit, Michigan. *Int J Env Res Pub Health, 14, 1283.*
4. Martenies, S.E., Milando, C.W., Batterman, S.A., 2016. Air pollutant strategies to reduce adverse health impacts and health inequalities: a quantitative assessment for Detroit, Michigan. *Under review*
5. Martenies, S. E., Batterman, S.A., Asthma-related health benefits of efficient filters in schools and homes. *submitted*
6. Milando, C., S. Martenies, S. Batterman, "Assessing Concentrations and Health Impacts of Air Quality Management Strategies: Framework for Rapid Emissions Scenario and Health impact ESTimation (FRESH-EST)," *Environment International, 94, 473-81, 2015..*
7. Vesper, Stephen, Thomas Robins, Toby Lewis, Kevin Dombkowski, Larry Wymer, Rebeca Villegas, Stuart Batterman, *"Use of Medicaid and housing data may help target areas of high asthma prevalence," Journal of Asthma, DOI:10.1080/02770903.2016.1212370.*
8. Owais Gilani, Veronica J. Berrocal, Stuart Batterman, "Non-stationary spatio-temporal modeling of traffic-related pollutants in near-road environments," *Spatial and Spatio-temporal Epidemiology,* Feb., 2016.

Acknowledgements

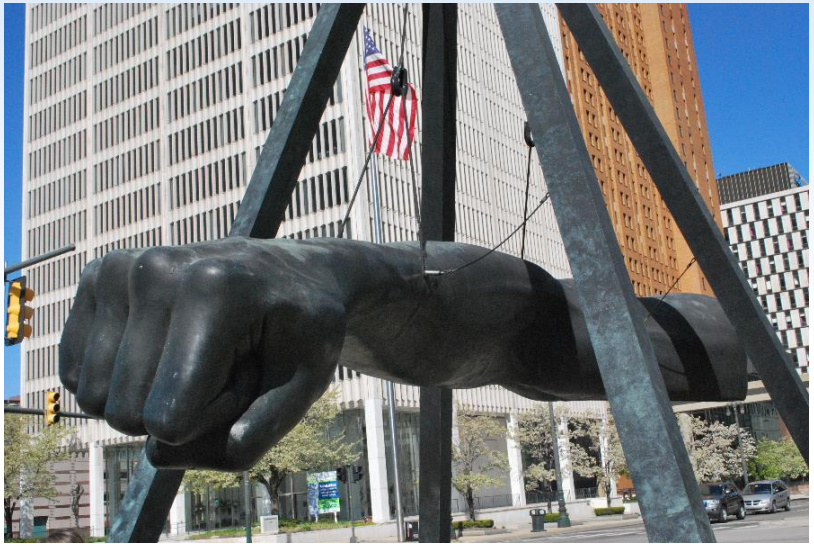
Amy Schulz, Tim Dvonch, Chad Milando, Sheena Martenies, Bhramar Muhkerjee Kristina Rice, Laprisha Berry Vaughn, Sonya Grant, Graciela Mentz and other staff at the University of Michigan.

The CAPHE study involves a community-based participatory research partnership, and we thank our partners.

We also thank collaborators at MDEQ, MDOT, and US EPA.

We thank study participants and their families who assisted us with the collection of data.

Funding: RO1 ES022616 (NIEHS), 5-R01-ESO14677-02, R01 ES016769-01, P30ES017885, T42 OH008455 (NIOSH) R834117 (EPA), HEI, Kresge.



Detroit Joe Lewis Fist of a Champion. Photo by Kaleidico Digital Marketing. https://www.flickr.com/photos/kaleidico/