Air pollution & chronic disease

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McGill

Is your health affected by air pollution?

Is your health affected by air pollution?

- Do you ever change your behaviour to avoid air pollution exposure?
  - Why or why not?

Roadmap

- What is air pollution?
- Acute health impacts of air pollution
- Air pollution exposure and chronic disease
- Policy and prevention

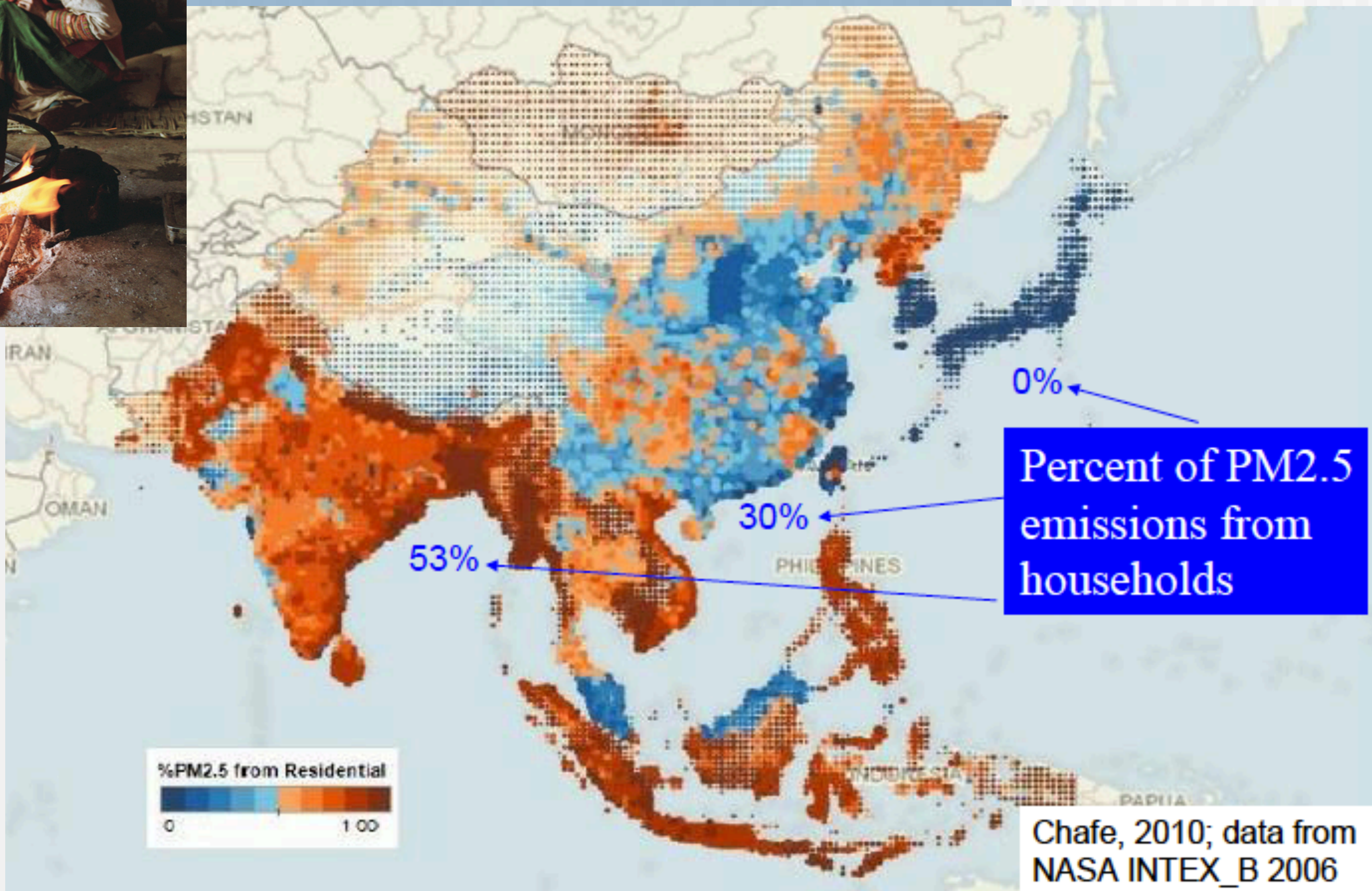
Roadmap

- What is air pollution?

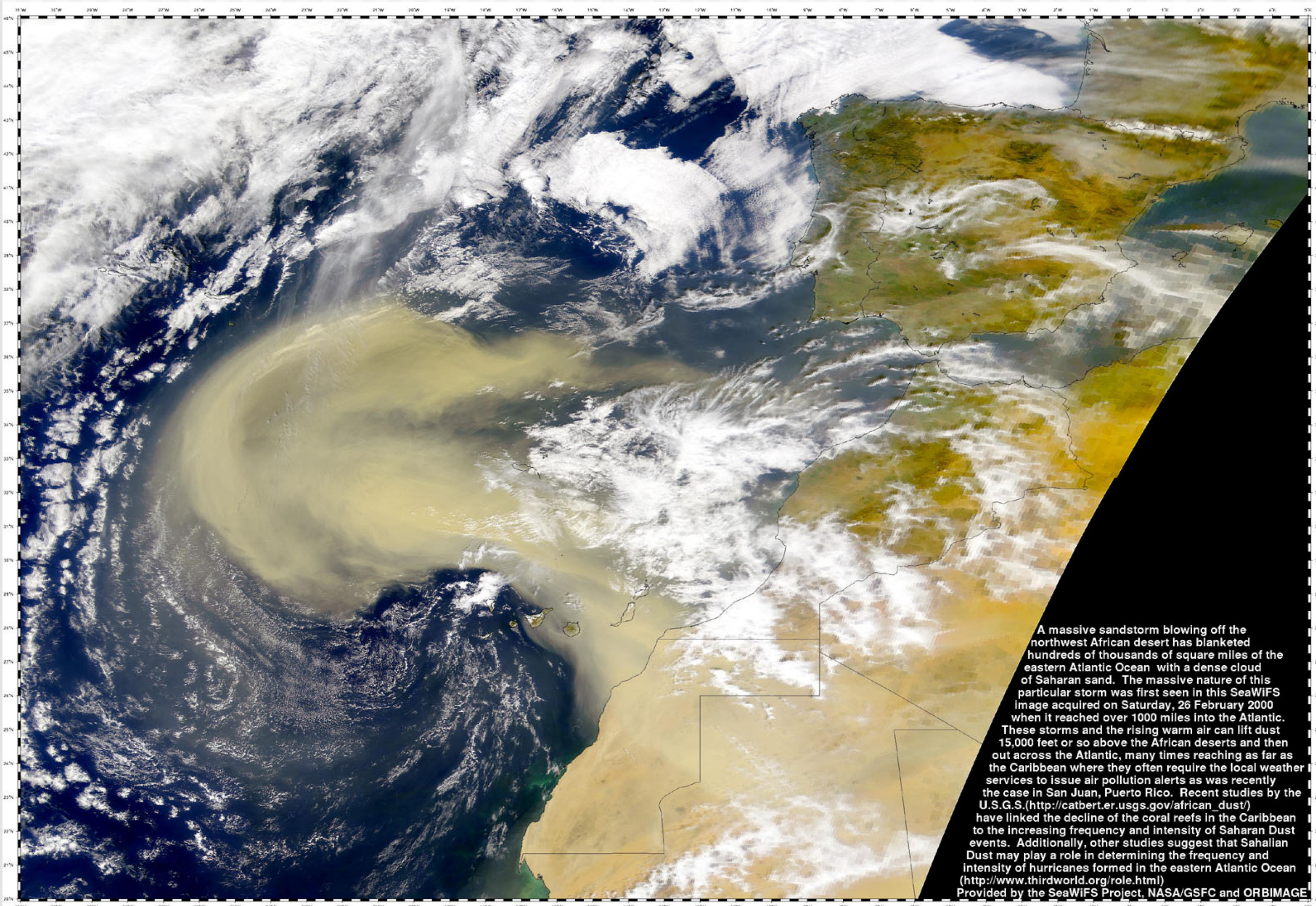
Industrial Sources

Mobile sources: rush hour in Toronto

Household biomass combustion



Dust Storms from Africa



http://earthobservatory.nasa.gov/Newsroom/NewImages/images.php3?img_id=1520

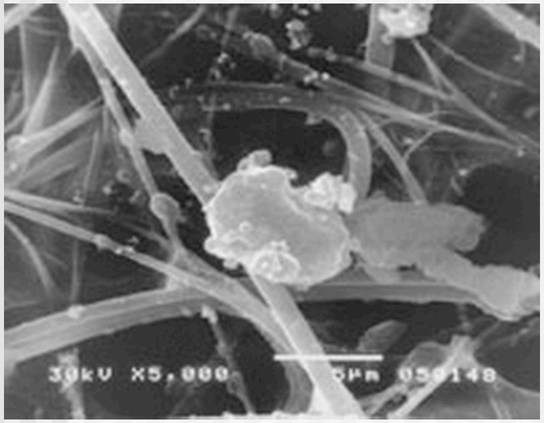
What's the hazard?

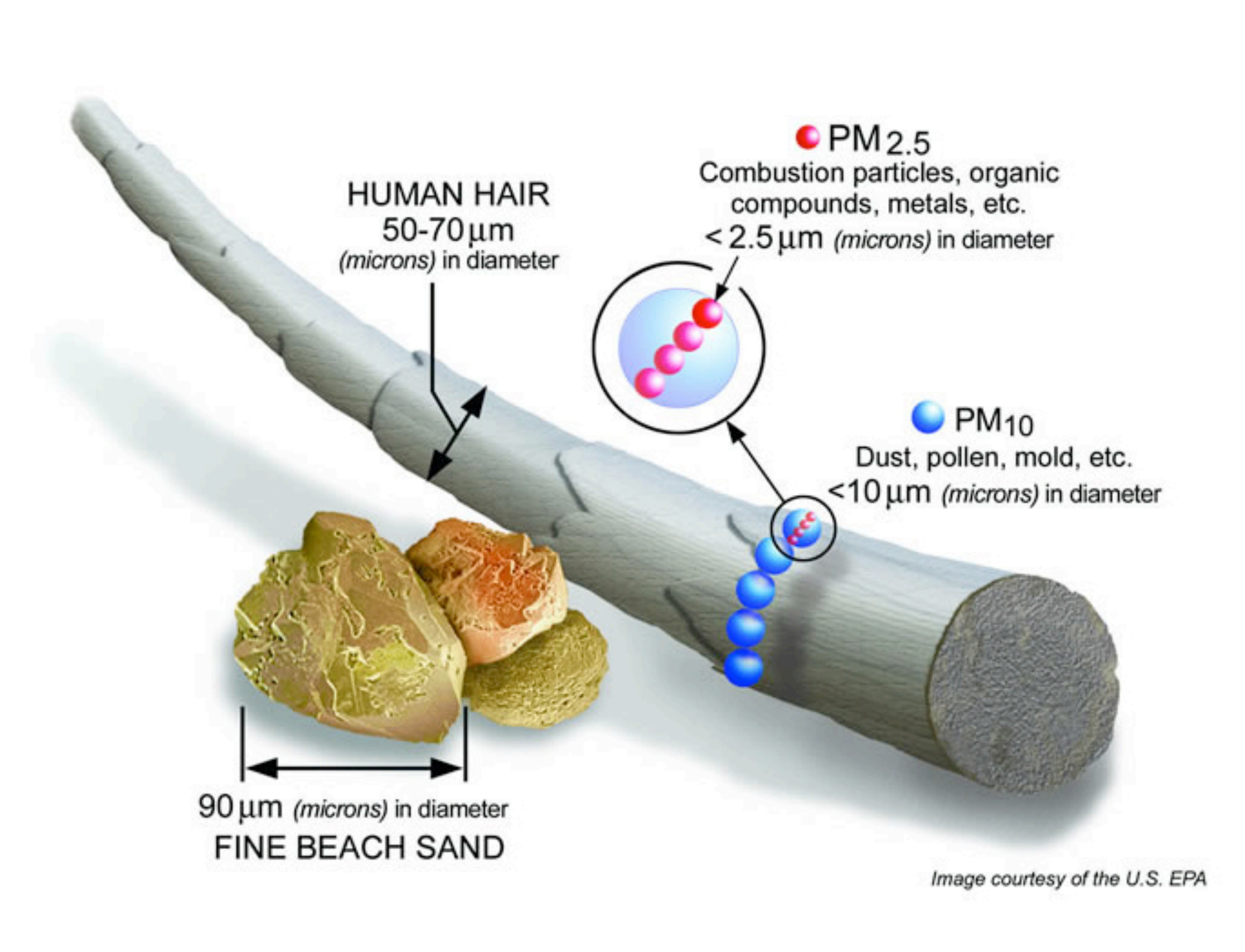
- An individual inhales ~30 m^3 (or 15 kg) of air per day
  - Roughly 6 times more than the food and drink consumed per day
- Exposure to air pollutants is continuous (and, usually, involuntary)

Combustion-related Pollution

- Particulate matter
- Gases: NO_x, CO, SO_x, Ozone (O_3)

Particulate matter





Particulate matter

- Solid or liquid particles
  - 0.01 - 100 µg
- Smallest particles can remain suspended
- PM <2.5 µg are capable of penetrating all sites of the respiratory tract

Some Components of Particulate Matter

- Elemental and organic carbon
- Metals
- Persistent, toxic semi-volatile organic compounds
  - Polycyclic aromatic hydrocarbons (e.g., benzo(a)pyrene)
  - Other toxics (e.g., polychlorinated dibenzo-p-dioxin, furans)

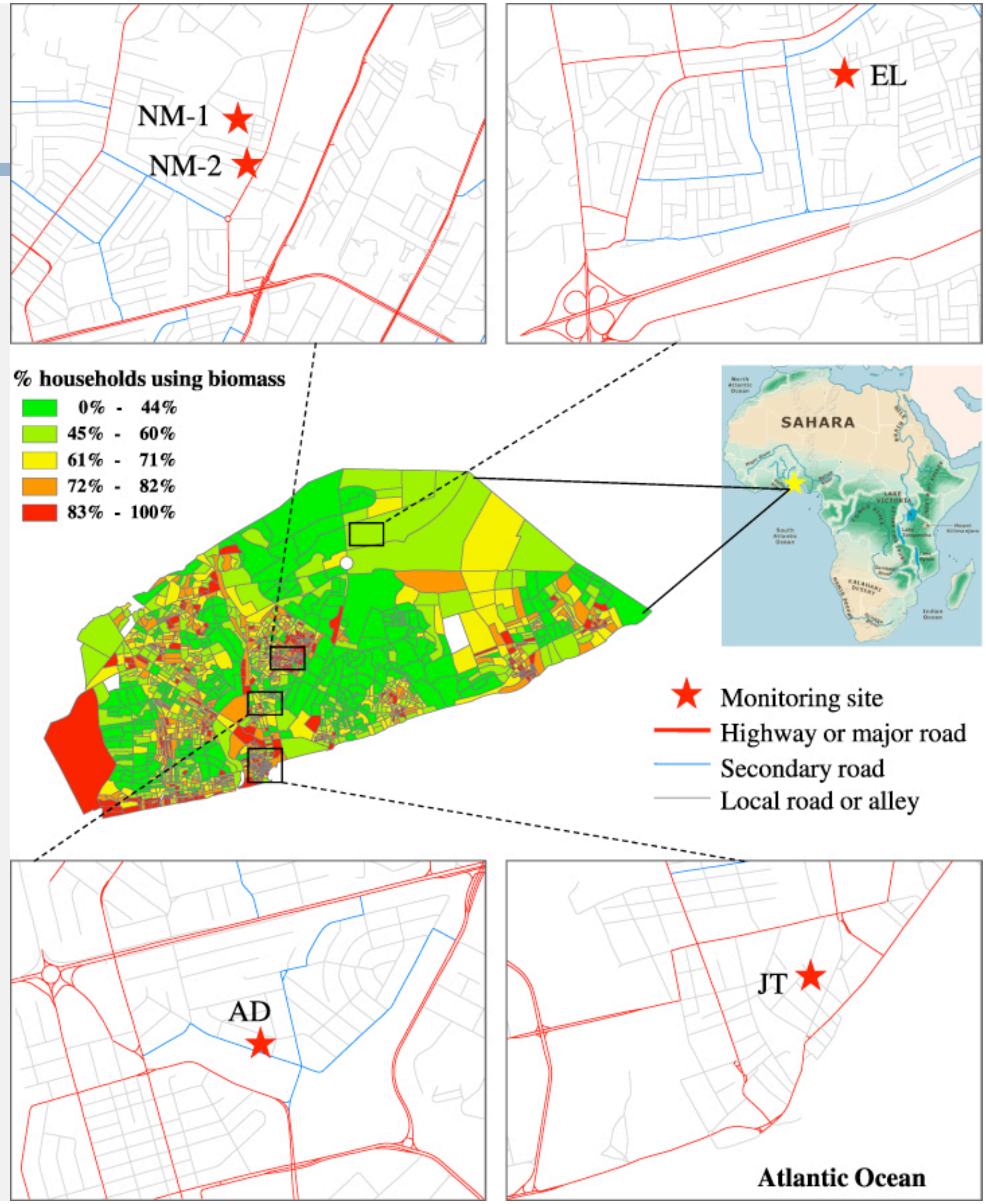
Some Other Pollutants from Various Sources

- Acid aerosols
- Volatile organic compounds
- Toxics and ground-level ozone precursors
- Greenhouse gases (e.g., CO_2, methane)
- Other sulphur compounds (e.g., mercaptans)
- Rubber dust, salt
- Pollen, fungi

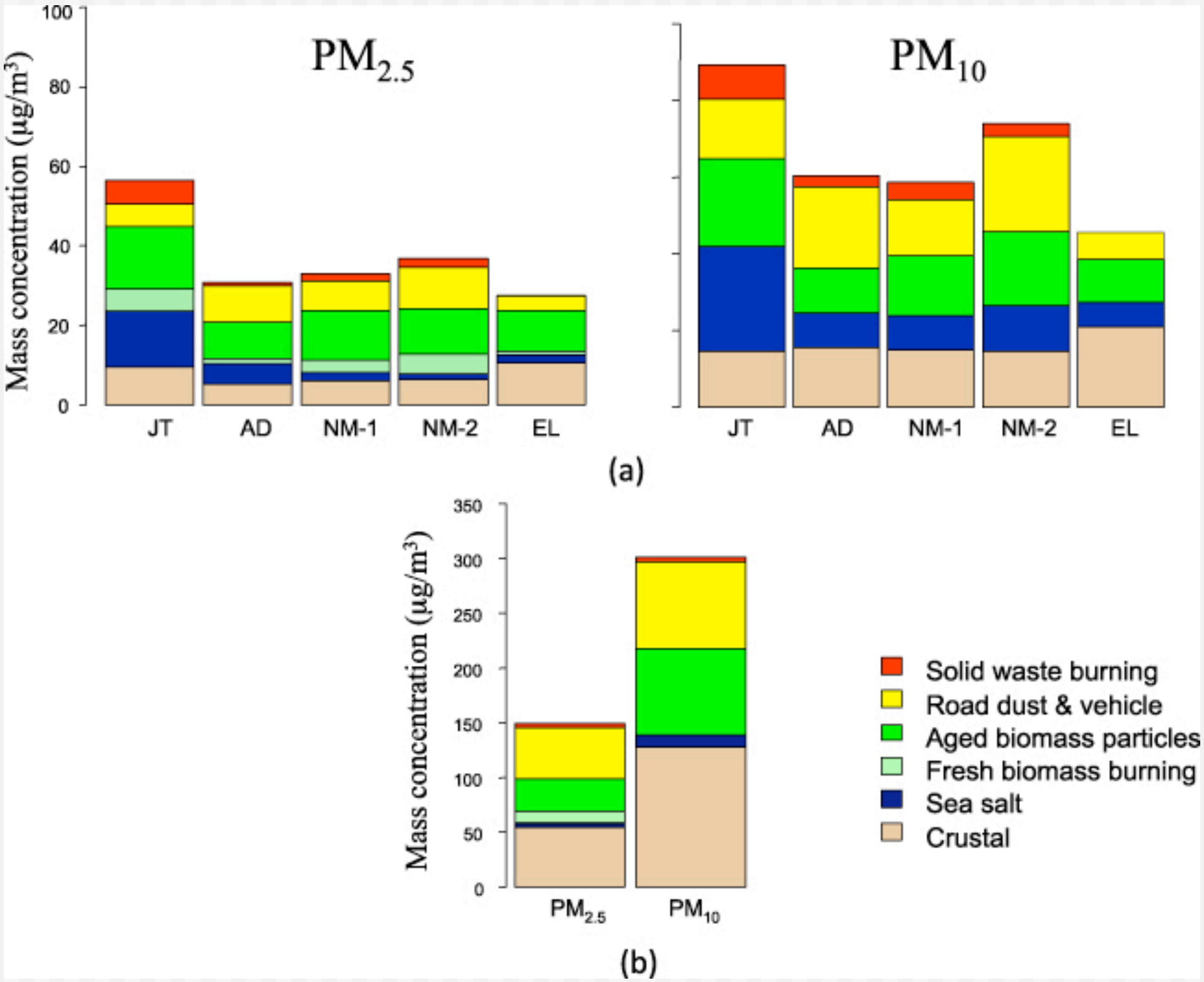
Air pollution composition and sources in Accra, Ghana

(Zhou et al, *Environ Res Lett*, 2013)

Study areas and measurement sites



Ambient PM sources in urban neighborhoods in Accra



Roadmap

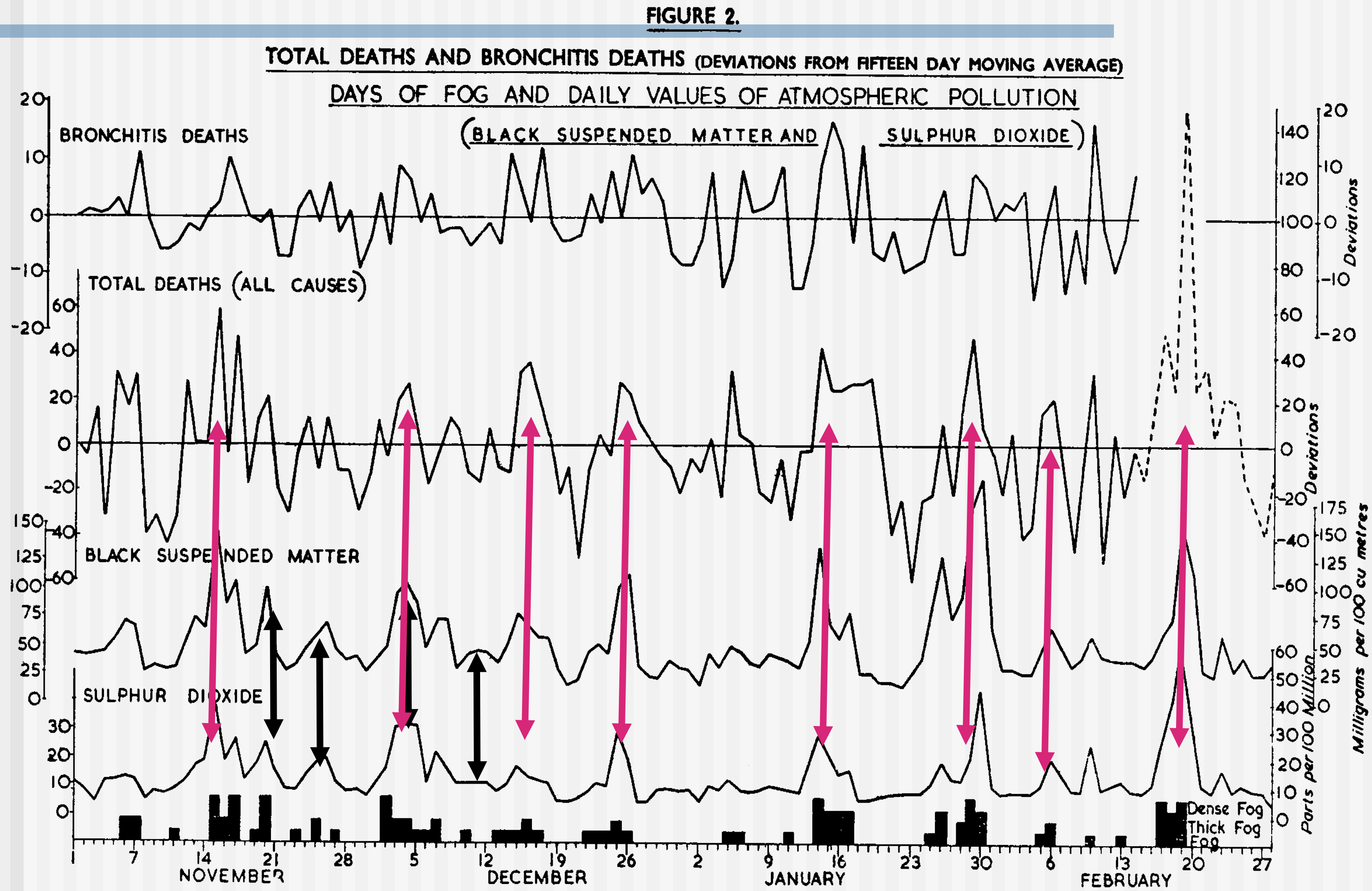
- What is air pollution?
- Acute health impacts of air pollution

Two Acute Smog Episodes

- Donora, Pennsylvania (Oct 26-31, 1948)
- 14,000 residents
- 20 people died and over 7,000 were hospitalized

- London, UK (Dec 5-9, 1952)
- 3,000 more deaths

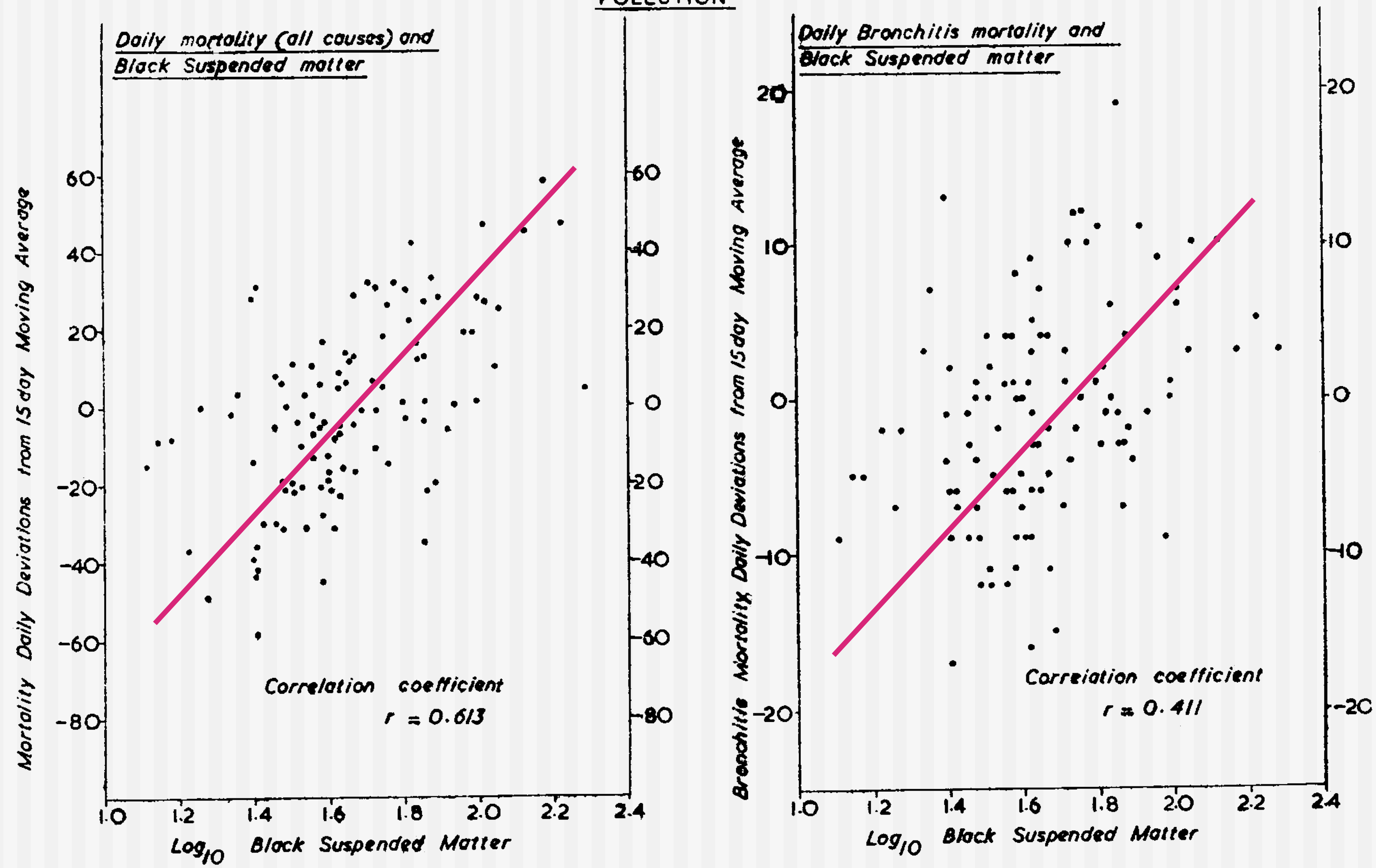
Air Pollution Episode London, 1958-1959



Mortality after removing 15-day running average

FIGURE 3

SCATTER DIAGRAM ILLUSTRATING THE ASSOCIATION BETWEEN THE DAILY MORTALITY AND LOGARITHMS (Log10) OF ATMOSPHERIC POLLUTION



Meaning

- Increases in air pollution on a specific day are associated with increased number of deaths on the same day or a few days later
- These represent "acute" health effects

Public Health Actions

- British Clean Air Act, 1956
- 5-6 years to convert to less polluting fuels and to improve combustion technologies
- Ambient levels were much reduced
- The composition of air pollutants changed
- Maximum levels during air pollution episodes were 70-80 times higher than maximum levels found today

Roadmap

- What is air pollution?
- Acute health impacts of air pollution
- Air pollution exposure and chronic disease

Relevant Research Questions

- Does the rate of developing or dying from selected chronic disease increase with past exposures to ambient air pollution?
  - Focus: cardiovascular diseases and lung cancer

- Cohort studies have relied on between-city comparisons.
  - New studies: exposure within cities to estimate risks

- Are certain populations more susceptible to air pollution?

Selected Important Cohort Studies

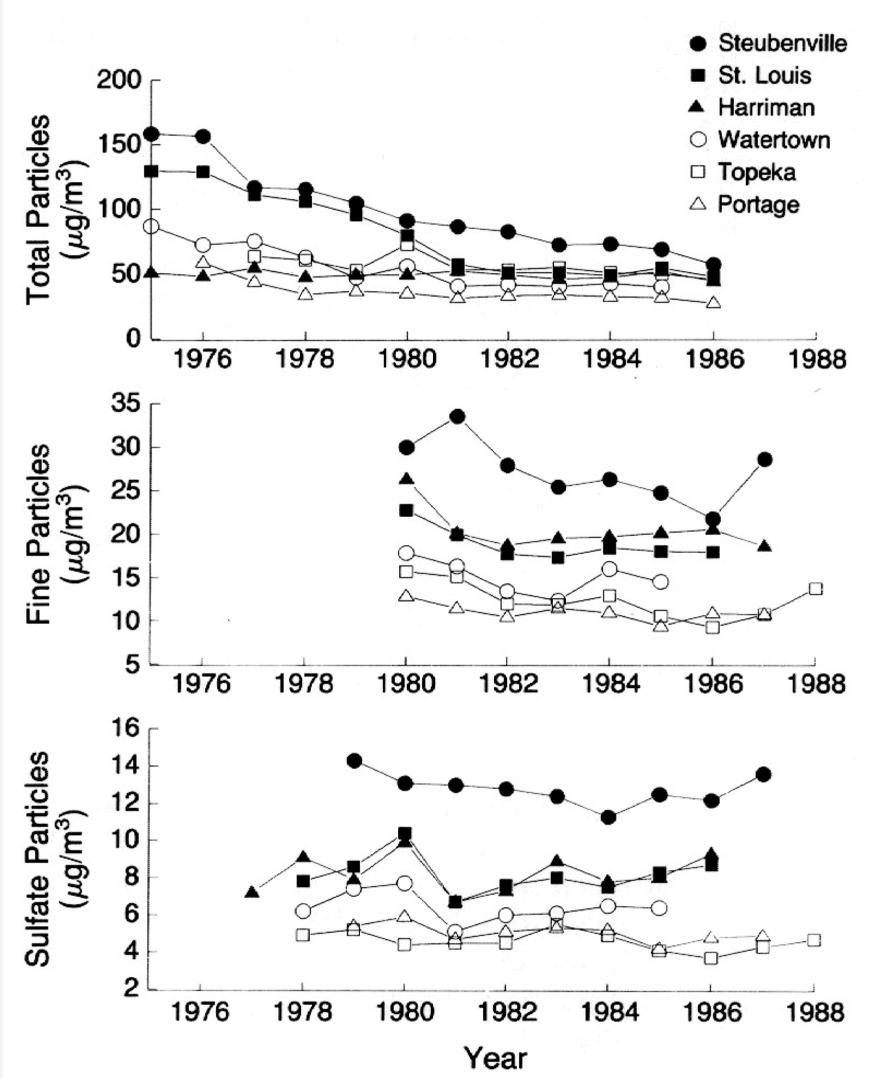
- The Harvard Six Cities Study
- The American Cancer Society Study
- The Canadian Census Cohort
- California Adventist Health Study of Smog
- Netherlands Study of Diet and Health

Harvard Six Cities Study

Harvard Six Cities Study

- Dockery and colleagues (1993)
- Prospective cohort of 8,111 adults living in six U.S. cities
- 14-16 yrs of follow-up beginning in mid-1970s
- 1st comprehensive study of PM pollution and human health

Annual Average Concentrations of Total Particles, Fine Particles, and Sulfate Particles in the Six Cities.



Dockery DW et al. N Engl J Med 1993;329:1753-1759.

Harvard Six-Cities Study: Concentrations of fine particles in the early 1980s

	Fine particles, $PM_{2.5}$ ($\mu g/m^3$)
Portage (WI)	11.0
Topeka (KS)	12.5
Watertown (MA)	14.9
Harriman (TN)	20.8
St. Louis (MO)	19.0
Steubenville (OH)	29.6

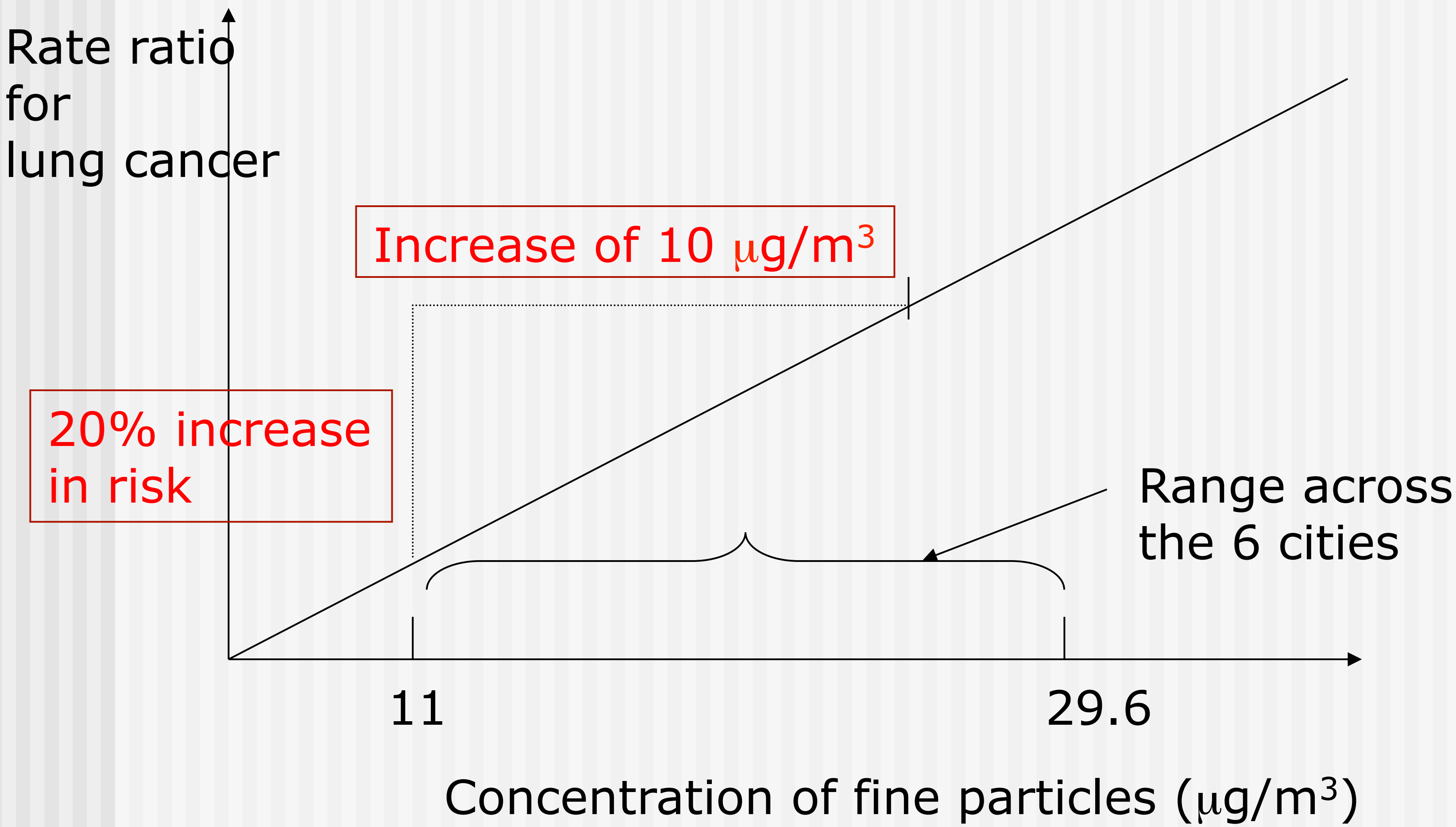
Montreal- 1980s: 20 $\mu g/m^3$
1990s: 15 $\mu g/m^3$

The Harvard Six-cities Study: Results for Fine Particles (From Reanalysis)

Mortality from:	Rate Ratio (95% CI) for a 20 $\mu g/m^3$ increase	RR for a 10 $\mu g/m^3$ increase
All causes	1.28 (1.10-1.48)	1.13
Cardiopulmonary	1.38 (1.12-1.69)	1.18
Lung cancer	1.43 (0.85-2.41)	1.20
Other causes	1.01 (0.79-1.30)	1.01

Krewski et al. 2000 Health Effects Institute Report (Boston)

Exposure-response for Fine Particles and Lung Cancer



Harvard Six-cities Study: major findings

- Residents of Steubenville, Ohio—the city with the dirtiest air—were 26% more likely to die prematurely than were residents of Portage, Wisconsin, the city with the cleanest air.
- $PM_{2.5}$ difference of 18.6 µg/m^3 between the two cities

Clean Air Act: $PM_{2.5}$ regulations

- 1997: Used Six Cities Study and others as foundation for the first-ever Clean Air Act regulation on $PM_{2.5}$
- Lowered the allowable 24-hr ambient concentrations of $PM_{2.5}$ from 65µg/m^3 to 35 µg/m^3.
- New standards forced dramatic changes on industry

Call for public release of the raw data

- Primarily led by industry, members of Congress, and governors
- *"How can the EPA minimize the effects of particulates if it does not know what they are or which, if any, have deleterious physiological effects?"* -- Philip H. Abelson, former *Science* Editor (1998)
- Harvard bound by human subjects protection

Re-analysis

- Feb. 1997: EPA urges Harvard to release data
- Compromise reached: an independent scientific panel to audit SCS findings.
- Data shared with the Health Effects Institute (HEI), an organization jointly funded by the automotive industry and US-EPA.
- 3-yr re-analysis of the Six Cities and ACS Studies by Canadian investigators (Krewski, Burnett, Goldberg, Siemiatycki)

Harvard Six Cities Study: Fine Particles (From Reanalysis)

Mortality from:	Rate Ratio (95% CI) for a 20 μg/m^3 increase	RR for a 10 μg/m^3 increase
All causes	1.28 (1.10-1.48)	1.13
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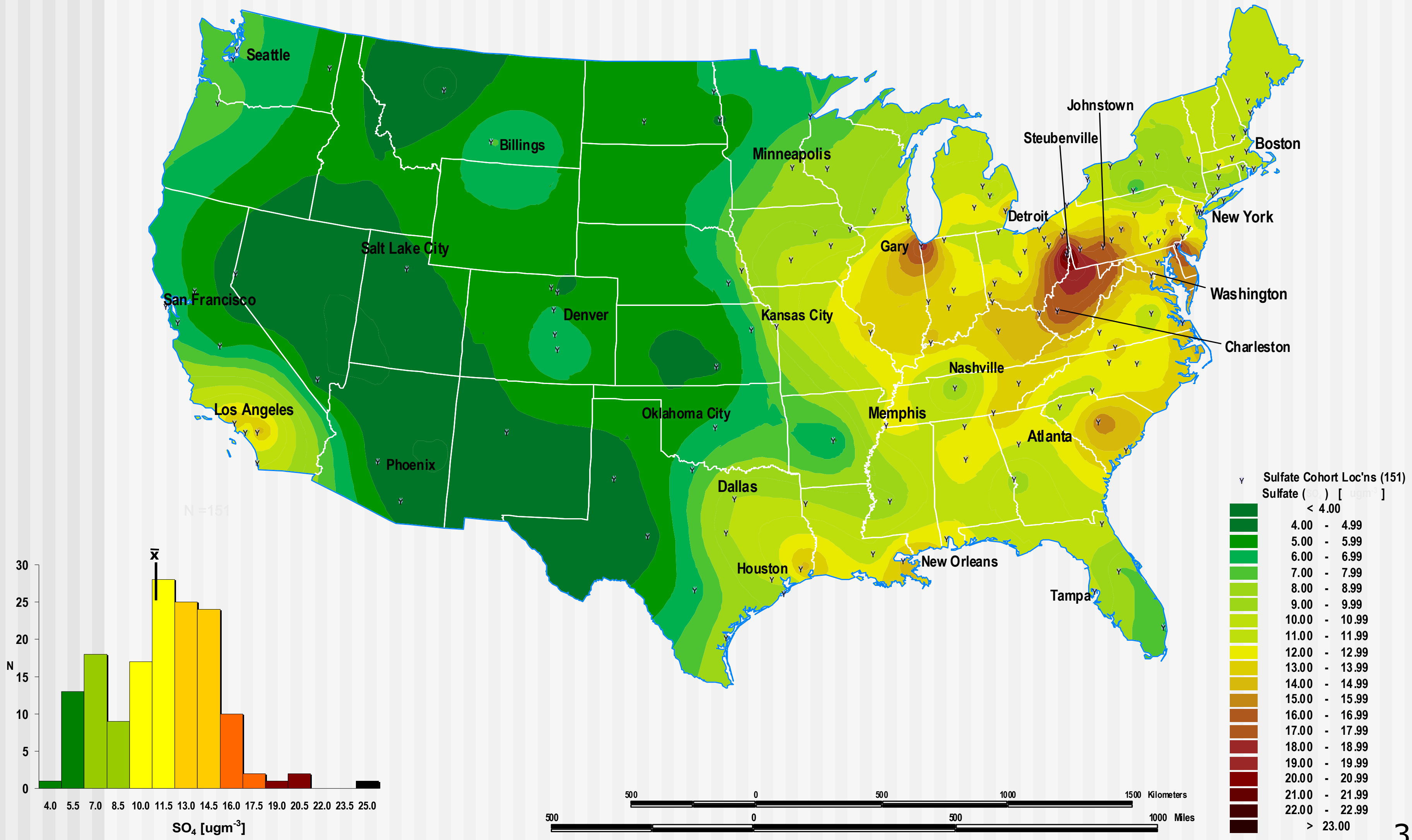
Krewski et al. 2000 Health Effects Institute Report (Boston)

The American Cancer Society Study

Modeled (Kriged) Sulfate (SO_4) Surface



The American Cancer Society Study: Fine Particles

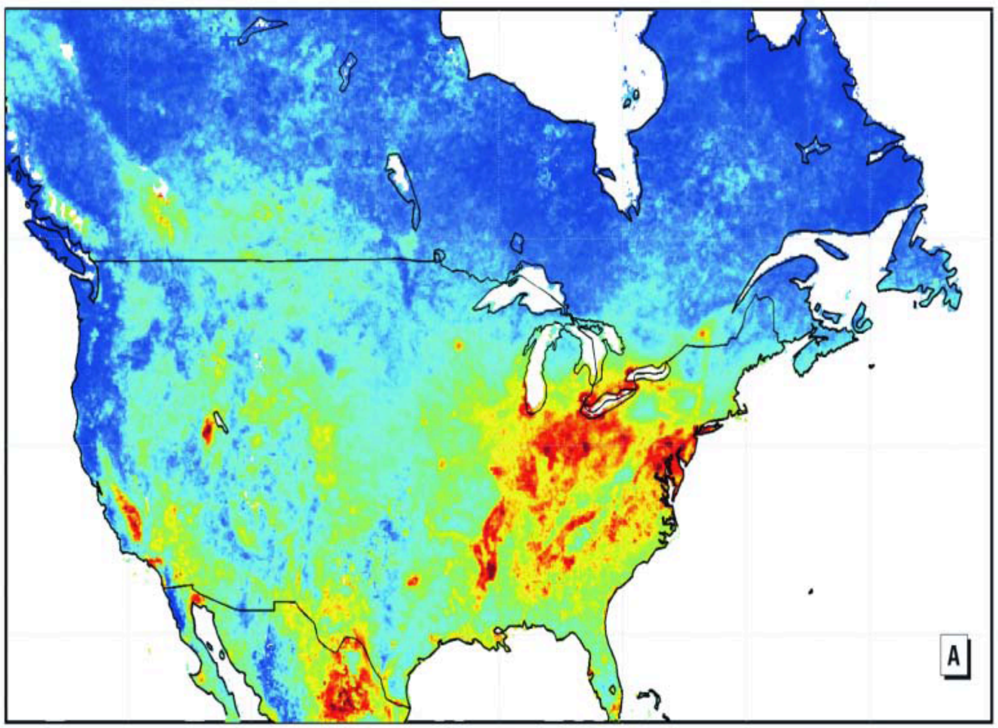
Mortality from:	Rate Ratio (95% CI) for a 10μg/m^3 increase (6-Cities)
All causes	1.06 (1.02-1.11) (1.13)
Cardiopulmonary	1.09 (1.03-1.10) (1.18)
Lung cancer	1.14 (1.04-1.23) (1.20)
Other causes	1.01 (0.95-1.06) (1.01)

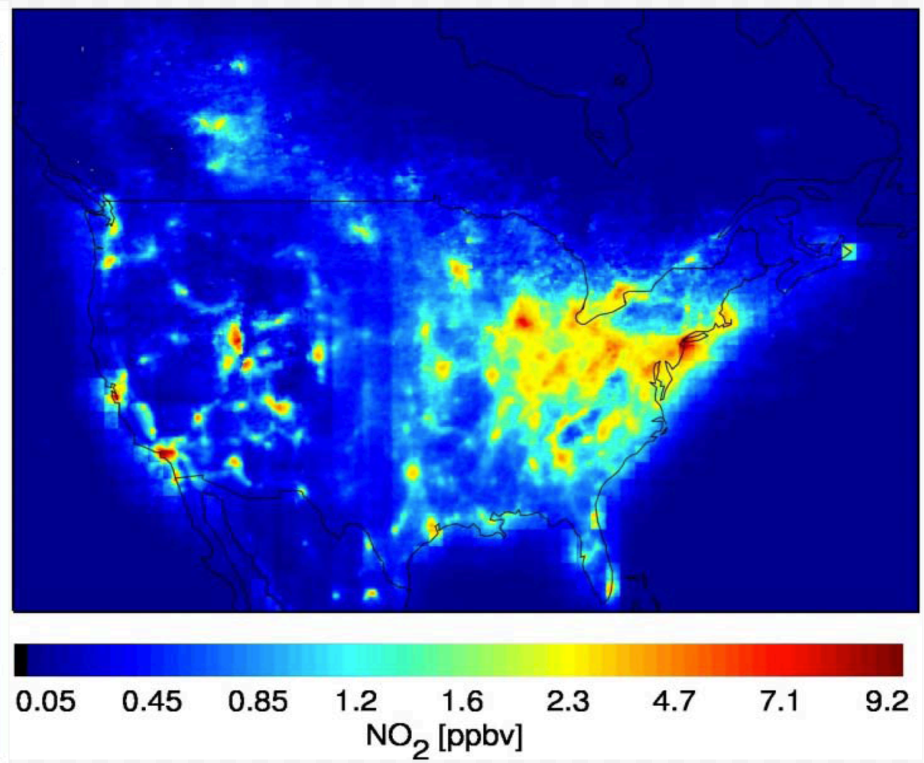
Pope et al. JAMA 2002;287:1132-41

Refinements in Exposure Assessment: Satellite Data

- Randall Martin (Dalhousie), Amir Hakami (Carleton)
- NASA satellites measure optical depth
- Coupled with simulations from a global chemical transport model
- Estimates:
  - Fine particles: 10km X 10km grid (soon to be 3km)
  - Ozone: 24 X 24km grid
  - NO_2: 10 X 10km grid

Satellite-based $PM_{2.5}$ average of 2001-2006 and afternoon surface NO_2 concentrations 2005



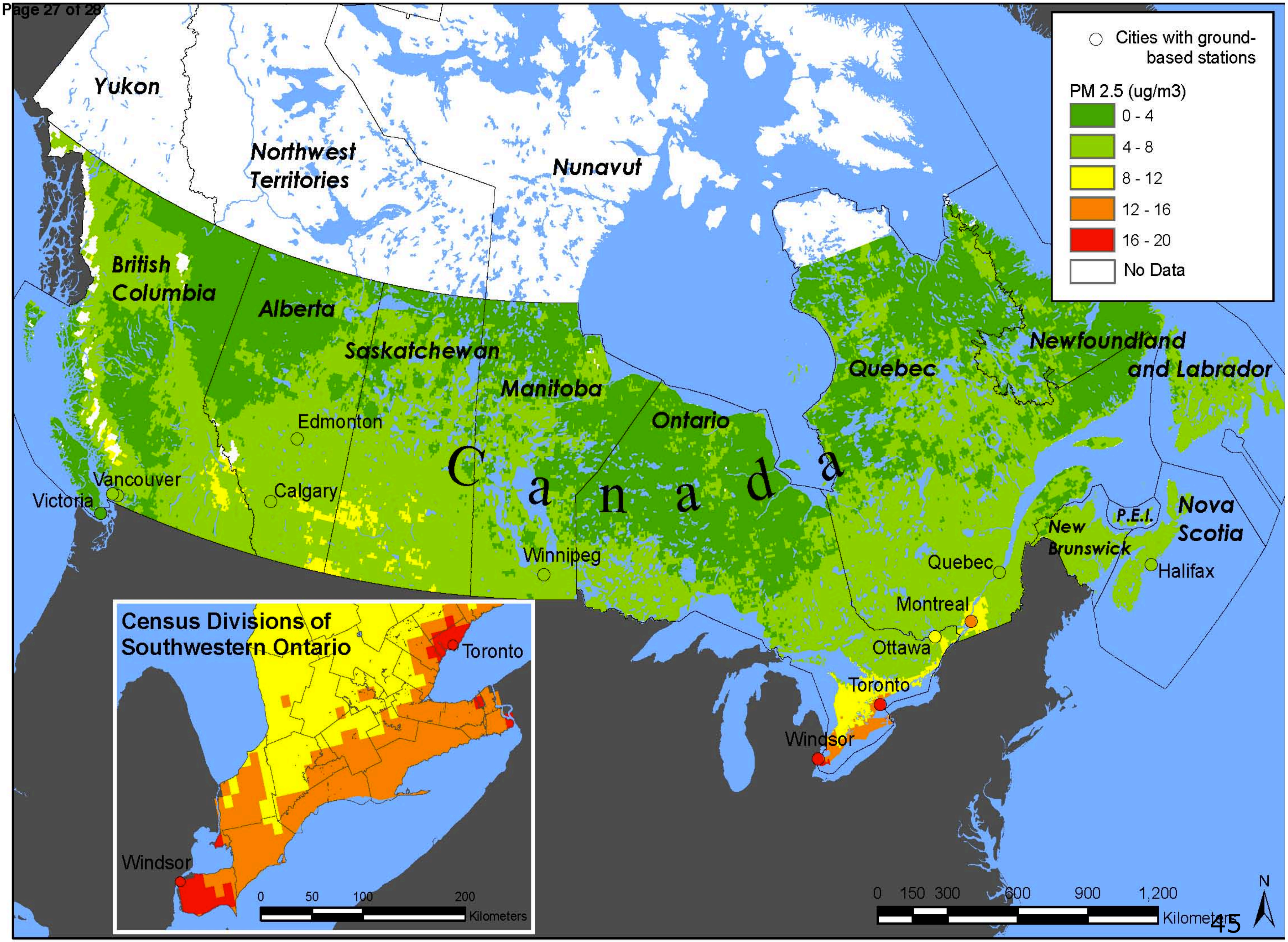


Fine particles 10X10km NO_2

Canadian Census Cohort (1991)

Canadian Census Cohort (1991)

- PIs: Paul Peters, Rick Burnett
- Population: 1.2 million, age ≥25
  - 15% sample of those who completed long form in 1991
- Follow-up: 1991-2009
- Mortality and cancer incidence
- Linked to Federal income tax files➔address information 1984-2007


Cities with ground-based stations
PM 2.5 (ug/m3)
0 - 4
4 - 8
8 - 12
12 - 16
16 - 20
No Data
Yukon
Northwest Territories
Nunavut
British Columbia
Alberta
Saskatchewan
Manitoba
Ontario
Quebec
Newfoundland and Labrador
New Brunswick
P.E.I.
Nova Scotia
Canada
Edmonton
Calgary
Vancouver
Victoria
Winnipeg
Quebec
Montreal
Ottawa
Toronto
Windsor
Halifax
Census Divisions of Southwestern Ontario
Toronto
Windsor
0 50 100 200
Kilometers
0 150 300 600 900 1,200
Kilometers
N

Canadian Census Cohort: Rate ratios for an increase of 10μg/m^3 in $PM_{2.5}$, fully-adjusted

	Standard Cox model
Non-accidental deaths	1.15 (1.13-1.16)
Cardiovascular disease	1.16 (1.13-1.18)
Ischemic heart disease	1.31 (1.27-1.35)
Cerebrovascular disease	1.04 (0.99-1.10)

Excludes recent immigrants

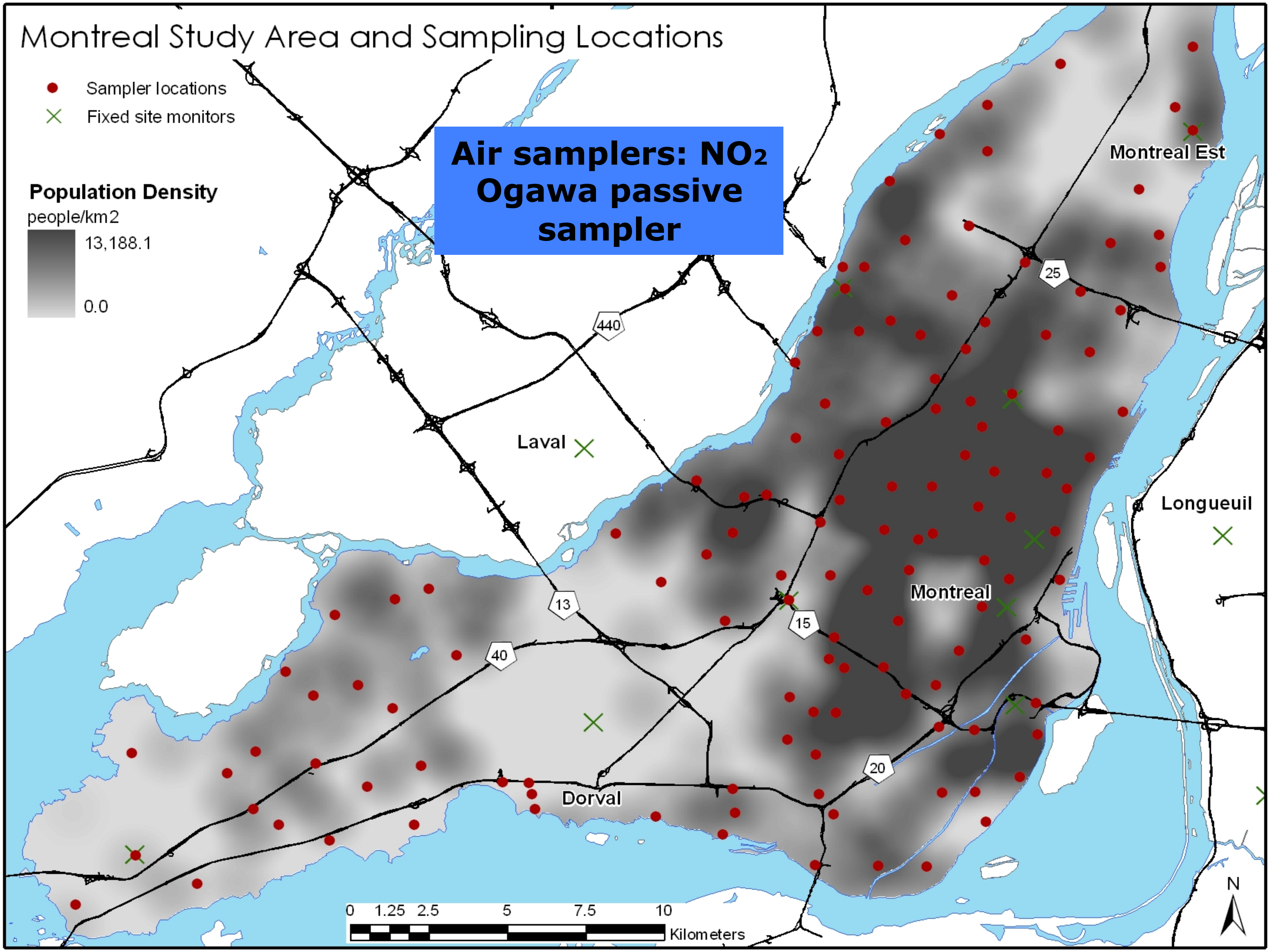
Comparison of mortality rate ratios for cardiovascular disease between the ACS, 6-Cities, and Canadian Census Cohorts, for an increase of 10µg/m^3 in $PM_{2.5}$

	ACS	6-Cities	Census Cohort
Cardiovascular	1.09	1.18	1.15
Non-accidental	1.06	1.13	1.10
Pooled estimate across studies (2008)		**1.12 (95%CI: 1.09-1.15)**	

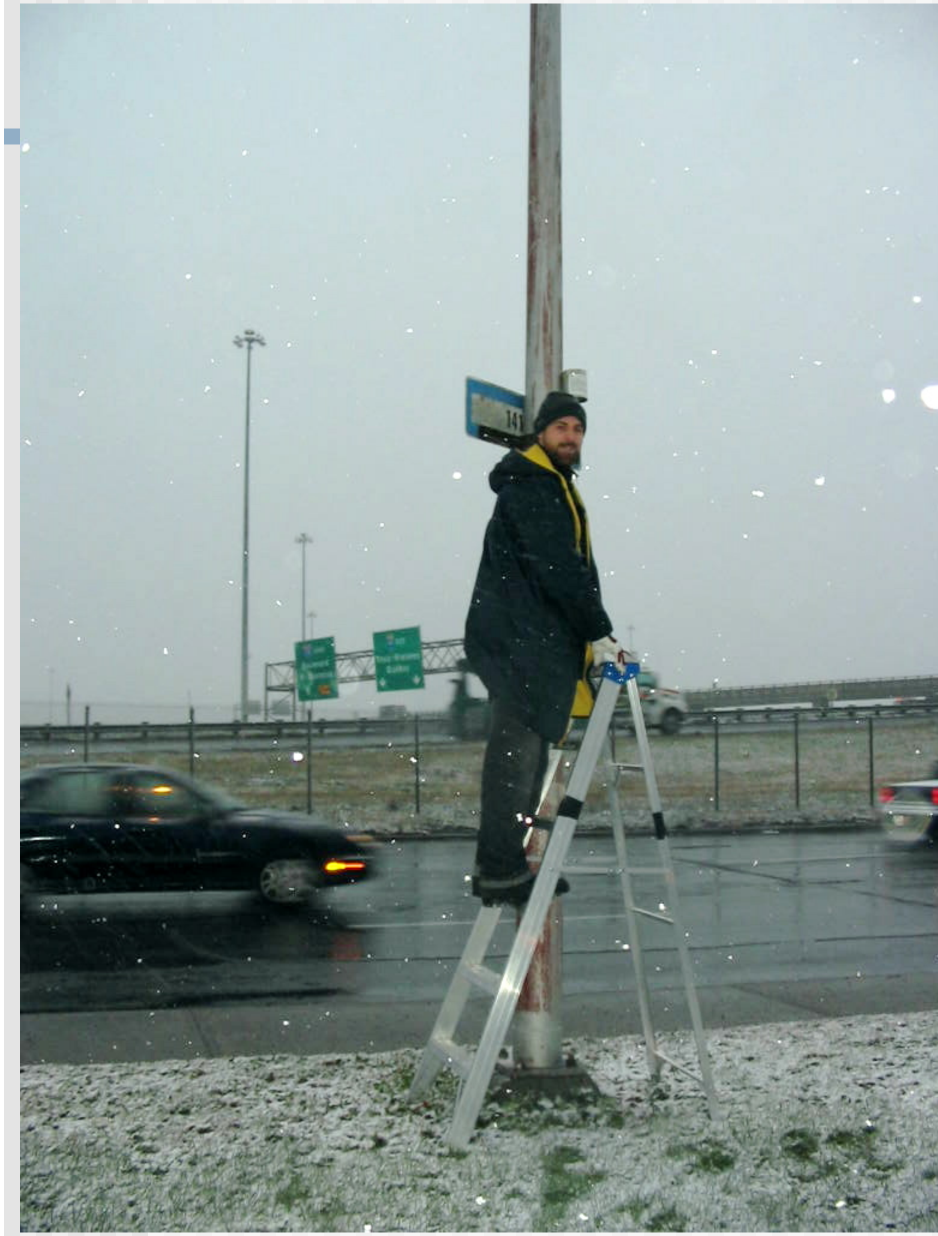
Case-control studies on air pollution and cancer, Montreal

Objective

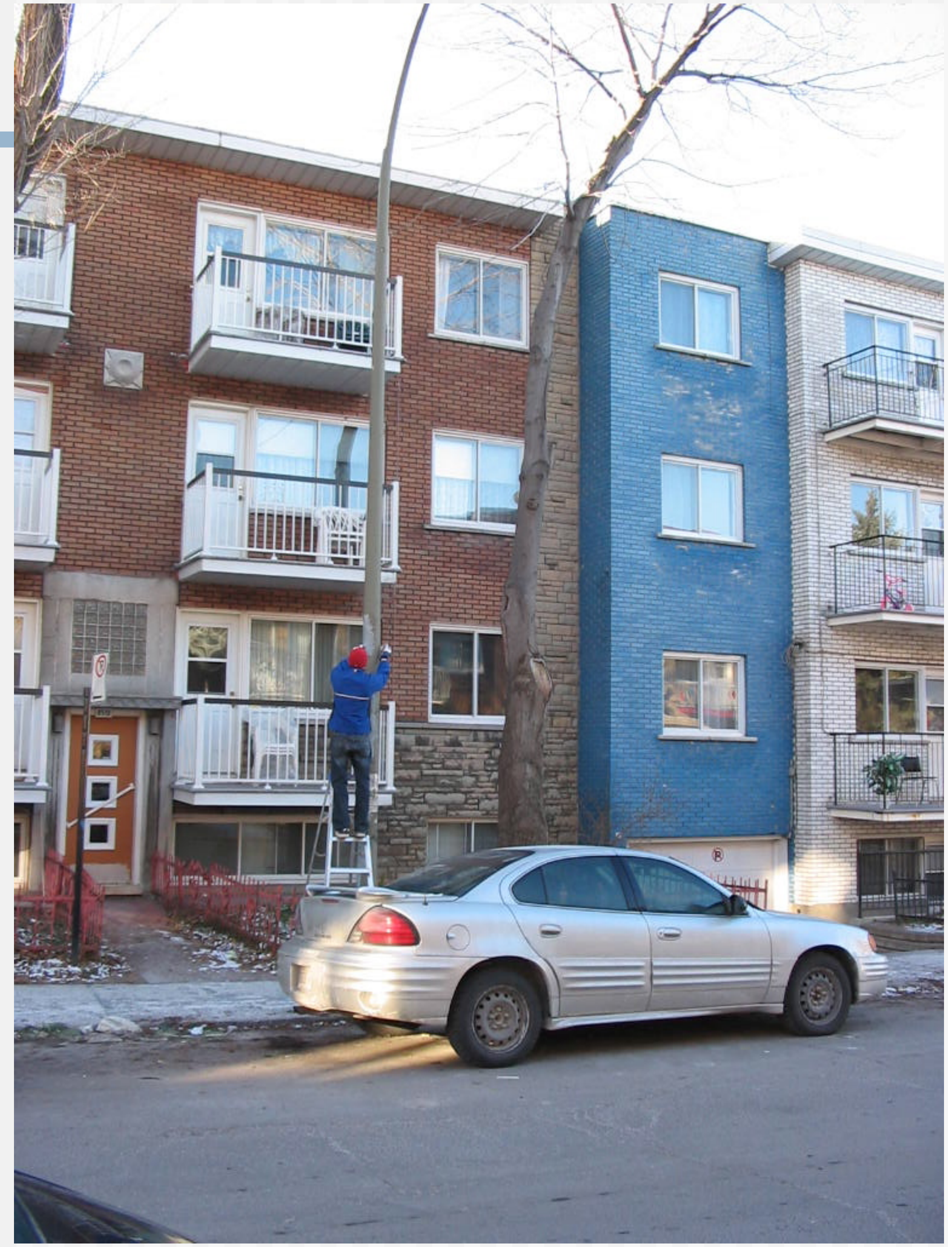
- To determine whether long-term exposure to urban air pollution in Montreal is associated with the incidence of selected types of cancer
- Requires an intra-urban exposure assessment



Montreal Study Area and Sampling Locations
Sampler locations
Fixed site monitors
Population Density
people/km2
13,188.1
0.0
Air samplers: NO2
Ogawa passive
sampler
Laval
Montreal Est
Longueuil
Montreal
Dorval
440
25
13
15
40
20
0
1.25
2.5
5
7.5
10
Kilometers
N



Anjou, Boul. Metropolitain

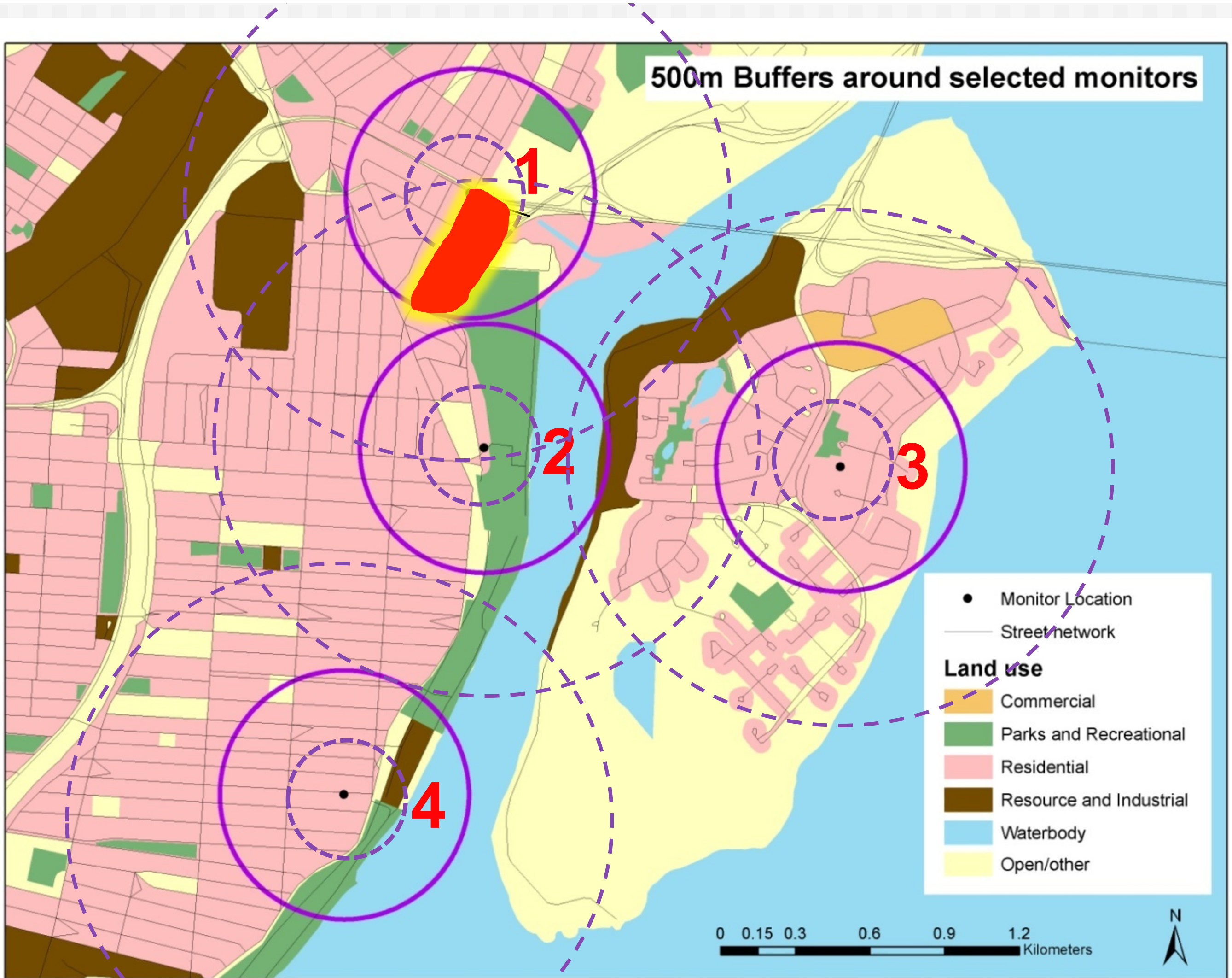


Park-Extension

NO_2 Observations (ppb) n = 134			
Min	Max	Mean	Std. Dev
6.7	20.1	12.6	2.6

Creating a Spatial Surface

- Land use regression:
  - Predicts concentrations of air pollution at individual points in space
  - Predictors: land use, population density, road density, traffic of surrounding areas



ID	NO_2	Parks (m^2)	Res (m^2)	Water (m^2)	Indust. (m^2)	Hwy (m)
1	11.85	25,000	375,000	10,000	125,000	1,200
2	4.56	190,000	300,000	240,000	100	0

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A prediction-based approach to modelling temporal and spatial variability of traffic-related air pollution in Montreal, Canada

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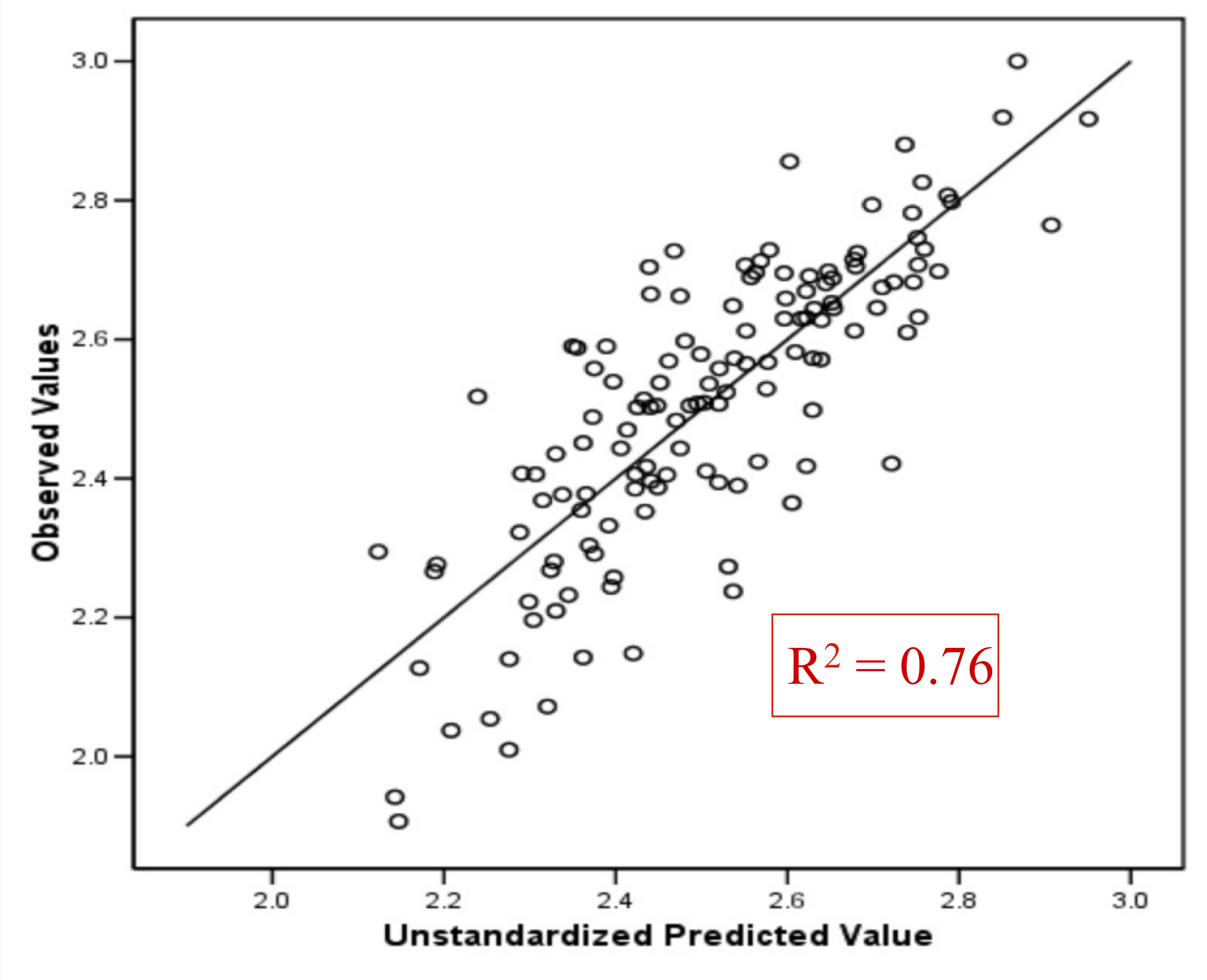
[a] Department of Geography, McGill University, 805 Sherbrooke St. West, Burnside Hall, Room 705, Montreal, Quebec H3A 2K6, Canada
[b] Department of Medicine, McGill University, Canada

Selected Predictor Variables

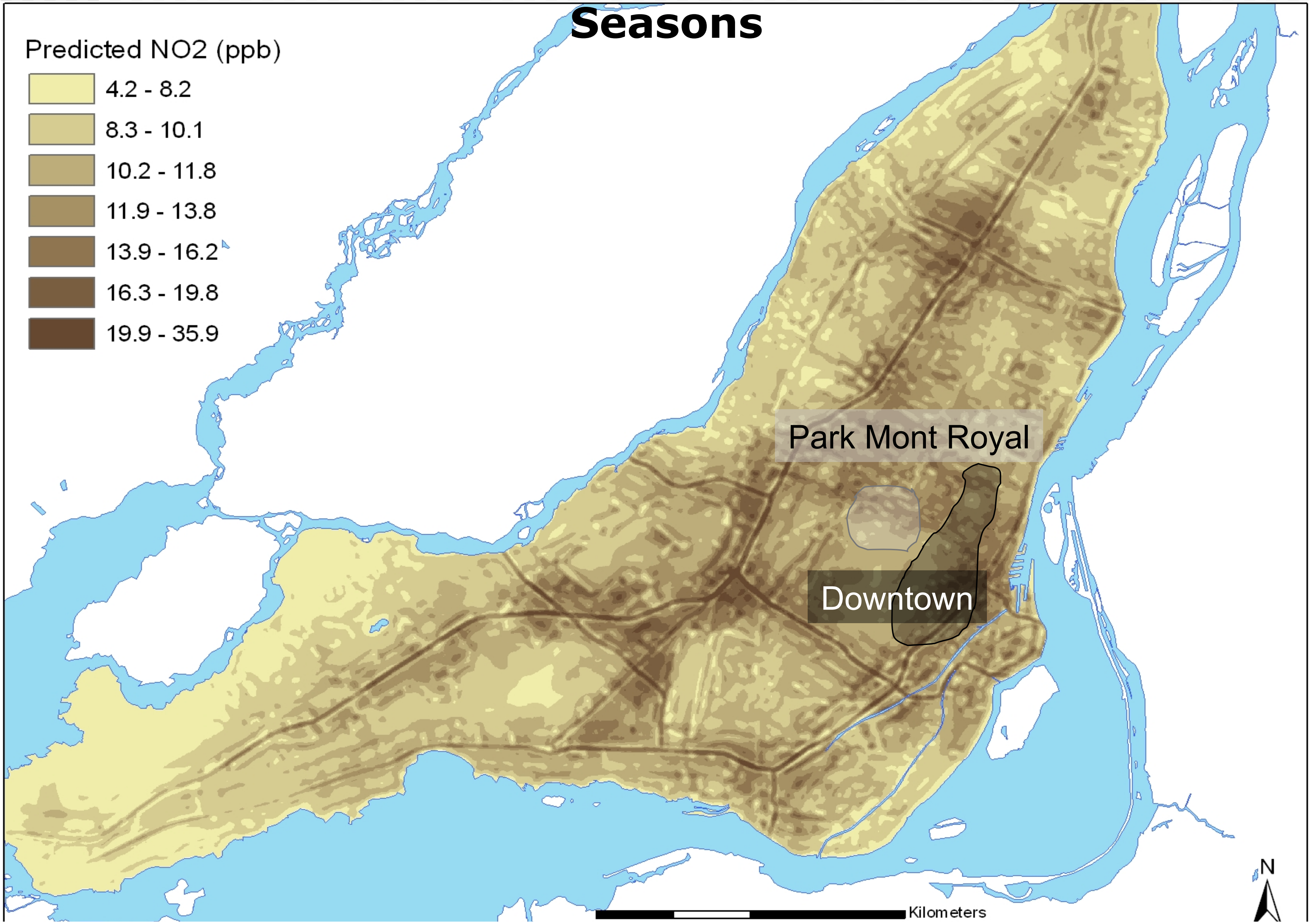
- Distance from nearest highway
- Traffic count on nearest highway
- Length of major roads within 100m
- Area of industrial space within 500m
- Population density within 1000m

Model $R^2 = 0.8$

Multivariable Model



Land Use Regression Map Averaged over three Seasons



Associations between postmenopausal breast cancer and NO_2; Montreal: ORs for an increase of 5 ppb

Exposure surface	All subjects OR (95% CI)	$\geq$10 years residency OR (95% CI)
2006	1.35 (0.94-1.94)	1.52 (0.82-2.81)
1996	1.36 (0.99-1.88)	1.42 (0.81-2.48)
1985	1.17 (0.91-1.50)	1.28 (0.84-1.93)

Adjusted for all accepted and suspected risk factors for breast cancer as well as selected occupational exposures

Crouse et al., *Environ Health Perspect*, 2010

Comparing Worst Exposed to Least Exposed Areas

Year of estimate of exposure	Fully adjusted OR	95%CI	Upper quartile (ppb)
2006-LUR	1.87	1.05-3.33	12.2
1996-estimate	2.33	1.29-4.21	18.0
1985-estimate	1.75	1.00-3.11	23.1

LUR: Land use regression model

Crouse et al., *Environ Health Perspect*, 2010

Associations between postmenopausal breast cancer and NO_2; Montreal and eight other provinces: ORs for an increase of 5 ppb

	Montreal study OR (95% CI)	8-Province study OR (95% CI)
Postmenopausal	1.35 (0.94-1.94)	1.06 (0.99-1.14)
Premenopausal	-------	1.12 (1.04-1.23)

Adjusted for all accepted and suspected risk factors for breast cancer

Crouse et al., *Environ Health Perspect*, 2010

Roadmap

- What is air pollution?
- Acute health impacts of air pollution
- Air pollution exposure and chronic disease
- Policy and prevention

Outdoor air pollution & lung cancer

- Classified as *carcinogenic to humans* (Group 1) by the International Agency for Research on Cancer (IARC) in Oct, 2013.
- 223,000 yearly premature deaths from lung cancer
- >1/2 lung cancer deaths in China and other East Asian countries are attributable to outdoor fine PM

Disability Adjusted Life Years lost (DALY)

DALYs =

Years of life lost due to premature mortality

plus

Years lived with disability

Number of deaths attributable to air pollution and disability-adjusted life years

	Attrib. deaths 1990	Attrib. deaths 2010	DALY 1990 (X 1000)	DALY 2010 (X 1000)
Ambient particulate matter pollution	2,910,161	3,223,540	81,699	76,163
Household air pollution from solid fuels	4,579,715	3,546,399	175,909	110,962
Ambient ozone pollution	143,362	152,434	2,534	2,456

Recent policy changes

- Beijing
  - Changes in air quality policy and enforcement of that policy
- Considerations for Canadian “regulations” and US Clean Air Act and

Additional slides

RADIATION AND RADIOACTIVE MATERIALS

14. Was radiation or radioactive materials (X-rays, U.V., microwave, radar, laser, etc.) used by you or near where you worked?

- ❍ YES ⇒ GO TO QUESTION 14A
- ❍ NO ⇒ GO TO QUESTION 15
- ❍ UNKNOWN ⇒ GO TO QUESTION 15

14A. What type(s) of radiation was(were) used?

____

____

❍ UNKNOWN

14B. How did you work with it and how often (hours per day)?

____

____

|___|___| hours per day

❍ UNKNOWN

14C. How far were you from the radiation source?

|___|___|___| metres or |___|___|___| feet

❍ UNKNOWN

14D. Did you wear a radiation badge (dosimeter)?

- ❍ YES
- ❍ NO

PROTECTIVE EQUIPMENT

15. Did you have to wear any protective equipment while at work?

- ❍ YES ⇒ GO TO QUESTION 15A
- ❍ NO ⇒ GO TO QUESTION 16
- ❍ UNKNOWN ⇒ GO TO QUESTION 16

15A. Please specify what protective equipment was used and the task for which it was used?

PROTECTIVE EQUIPMENT	ACTIVITY FOR WHICH IT WAS USED?
GOGGLES	
FOOTWEAR	
APRON	
SIMPLE DUST MASK (PAPER MASK)	
FILTER CARTRIDGE RESPIRATOR	
AIR-SUPPLIED RESPIRATOR OR SELF-CONTAINED BREATHING APPARATUS	
RUBBER OR PLASTIC GLOVES	
ASBESTOS GLOVES	

WORK AREA

We would like to know about your main worksite, work area or office (or the most typical if there were many).

17. What was the size of your general work area?

☐ WORKED OUTDOORS ⇒ IF WORKED OUTDOORS, GO TO QUESTION 17A

ROOM SIZE

○ TYPICAL OFFICE / LIVING ROOM	100 FT^2 OR 9 M^2
○ SMALL STORE / CLASSROOM	600 FT^2 OR 55 M^2
○ DRUGSTORE	1000 FT^2 OR 81 M^2
○ LARGE GROCERY STORE	METRO/PROVIGO
○ WAREHOUSE STORE	COSTCO/WAL-MART
○ UNKNOWN	

CEILING HEIGHT

○ TYPICAL OFFICE / LIVING ROOM	10 FT OR 3 M
○ LARGE GROCERY STORE (METRO/PROVIGO)	15 FT OR 4.5 M
○ WAREHOUSE STORE	20 FT OR 6 M
○ UNKNOWN	

17A. How many people were performing the same tasks as you in your work area?

|____|____|____|____|
NUMBER OF PEOPLE

☐ UNKNOWN

18. What other work was being done around you?

____
____
____
____
____
____

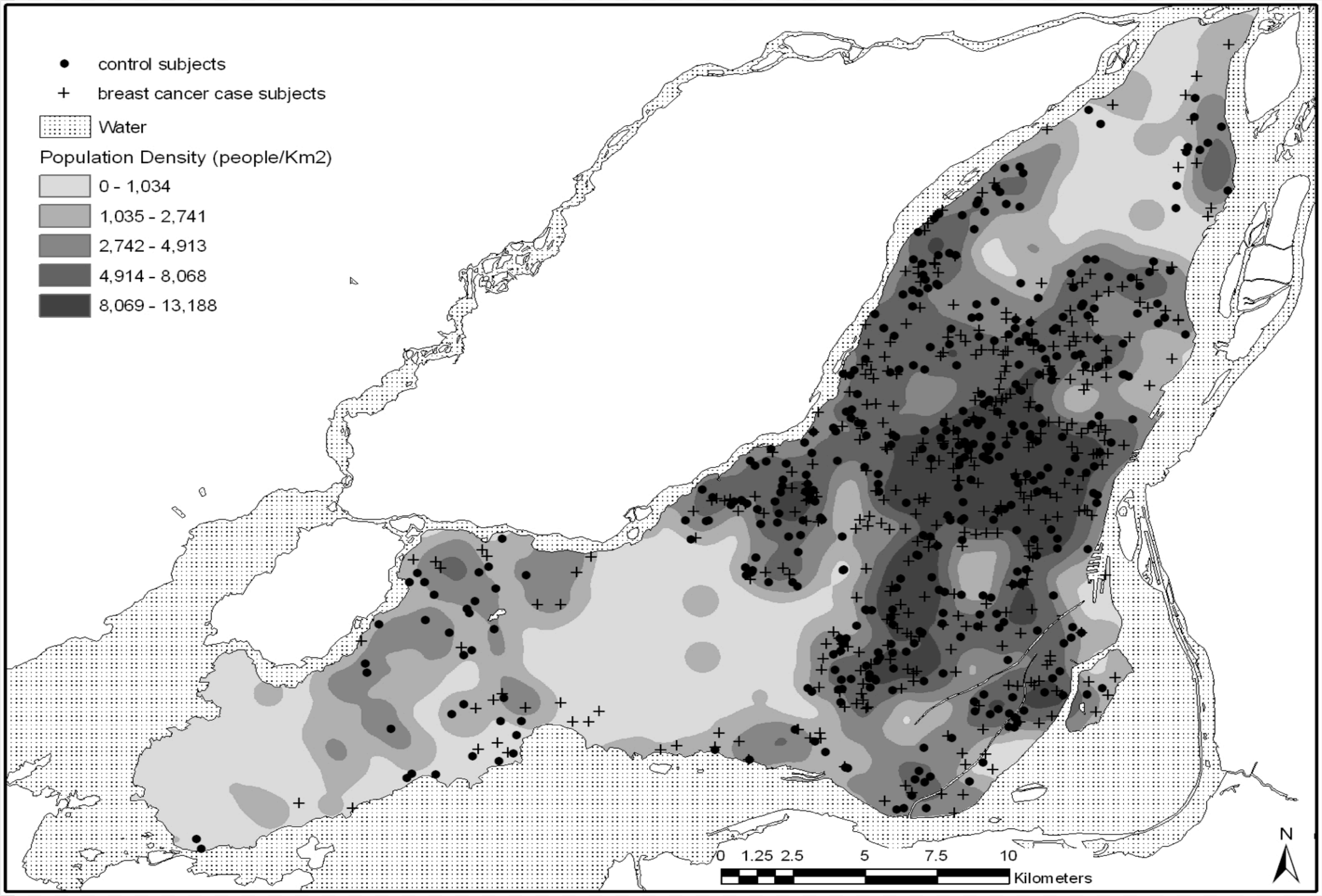
19. What machines or processes were used by others in your work area?

____
____
____
____

Estimated Attributable Number of Deaths in Various Smog Episodes Occurring in London, England, 1948-1962

Year	Dates of episode	Number of days	Estimated attributable deaths	Maximum 24-hour pollution ($\mu g/m^3$)	
				British smoke	SO_2
1948	Nov 26 – Dec 1	6	700-800	2780	2150
1952	Dec 5 – Dec 8	4	4,000	4460	3830
1956	Jan 3 – Jan 6	4	1,000	2830	1430
1957	Dec 2 – Dec 5	4	700-800	2417	3335
1959	Jan 26 – Jan 31	6	200-250	1723	1850
1962	Dec 3 – Dec 7	5	700	3144	3834

Spatial distribution of cases and controls



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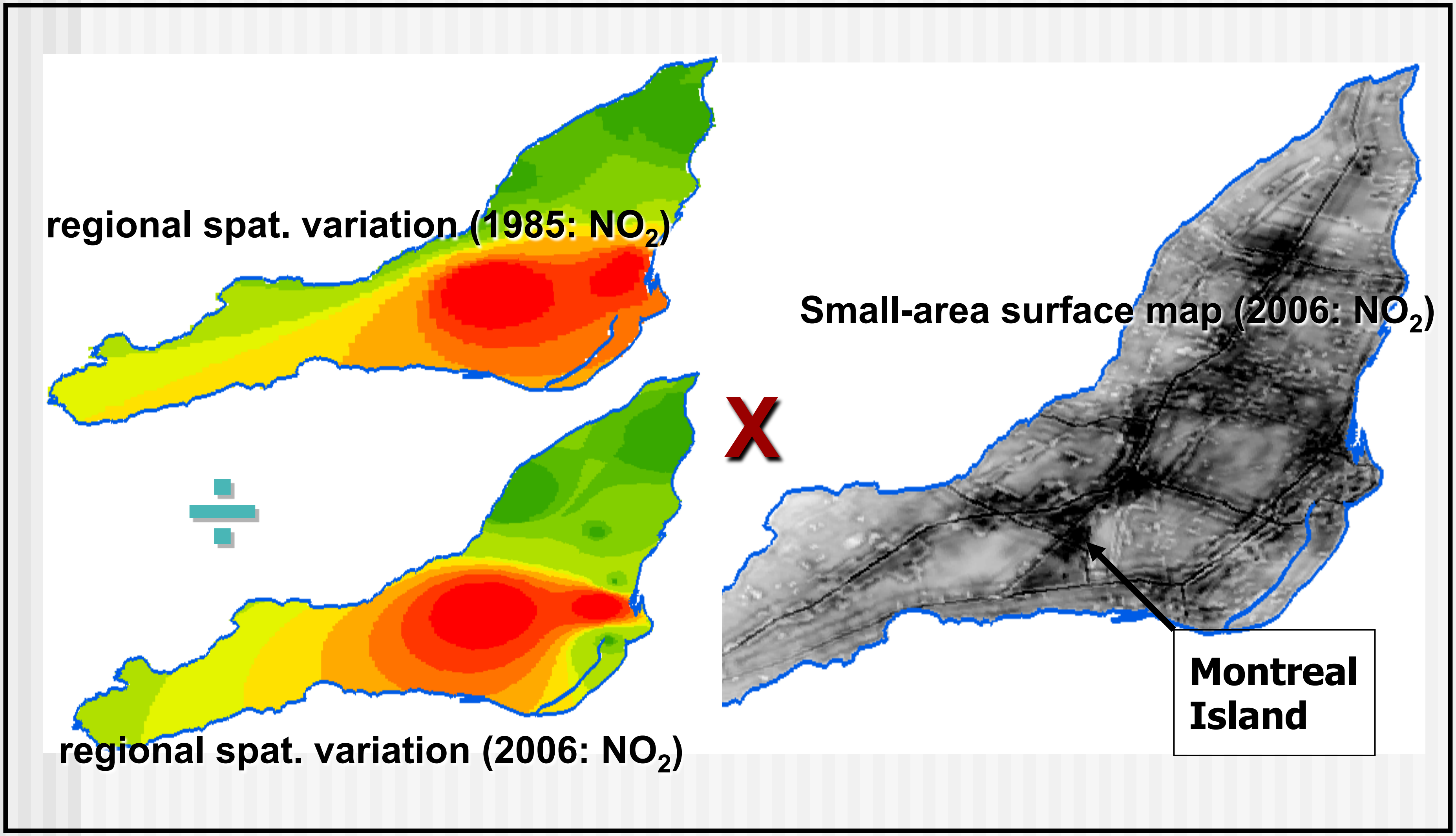
Back-extrapolation of estimates of exposure from current land-use regression models

Hong Chen[a,*], Mark S. Goldberg[b,c], Dan L. Crouse[d], Richard T. Burnett[e], Michael Jerrett[f], Paul J. Villeneuve[g,h], Amanda J. Wheeler[i], France Labrèche[j], Nancy A. Ross[d]

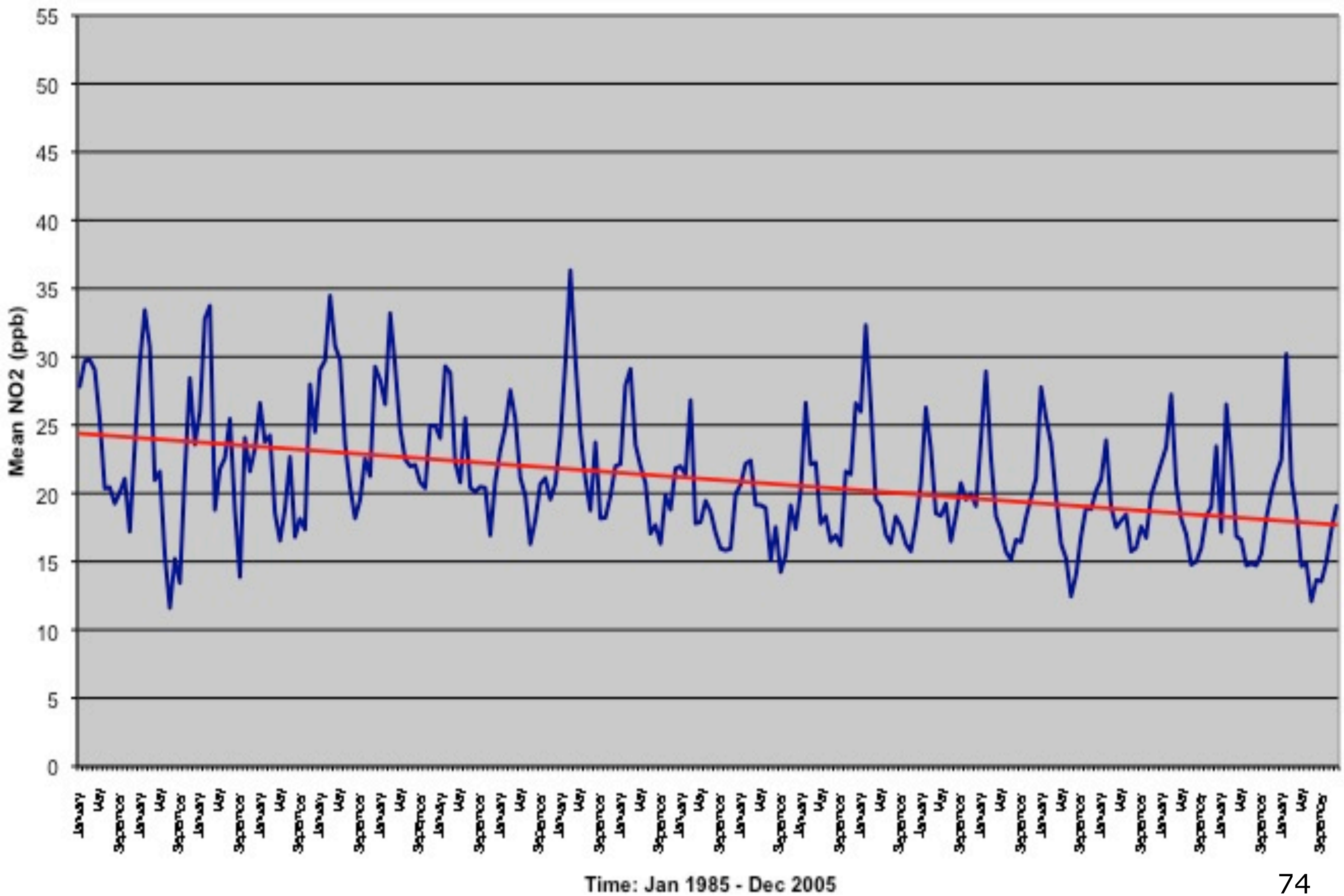
Back-Extrapolation of 2006 LUR to 1980s and 1990s

Work conducted by Hong Chen

Back Extrapolation of the LUR Map for NO_2



20-year Historical Trend of Monthly Levels of NO2 in Montreal: Mean of 9 NAPS Stations



Distribution of Estimates of Exposure to NO_2 (ppb)

	Minimum	Mean	Maximum
2006 LUR	4.2	10.8	35.9
1996 back-extrapolated	5.9	15.7	44.5
1985	7.9	20.1	66.8

The Canadian Census Cohort Study

Rick Burnett (HC)
Dan Crouse (HC)
Paul Peters (StatCan)
Randall Martin (Dalhousie)
Aaron van Donkelaar (Dalhousie)
Paul Villeneuve (HC)
Mike Jerrett (UC Berkeley), et al.

Urban Population (41%)

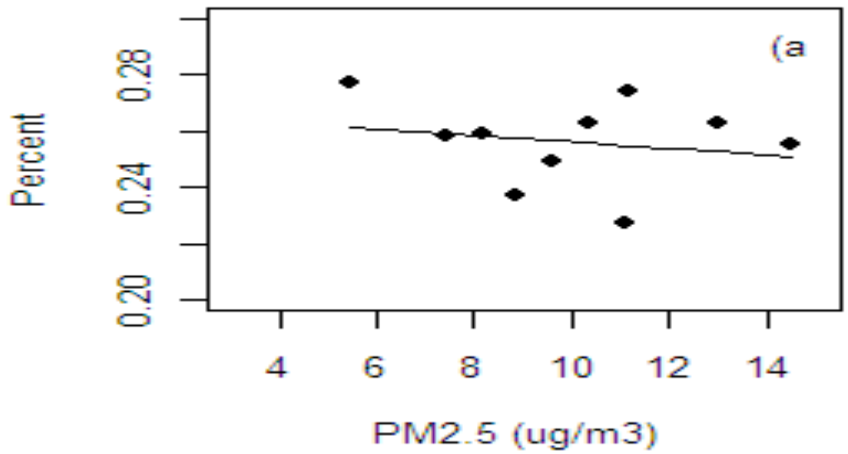
City	Cohort population	Number of deaths	Mean annual $PM_{2.5}$ ($\mu g/m^3$) 1987-2001	
			Ground-based observation	Adjusted satellite-derived estimate
Halifax	29,678	2,412	10.1	9.7
Windsor	23,186	2,338	14.9	14.3
Edmonton	63,878	4,212	9.5	8.9
Victoria	23,077	2,481	8.8	7.9
Ottawa	53,237	4,402	10.5	10.1
Calgary	58,022	3,387	9.7	9.7
Vancouver	92,066	8,421	10.4 or 10.8[a]	9.7
Quebec	49,813	4,483	12.4	12.5
Winnipeg	49,392	5,045	8.6	8.5
Montreal	129,855	14,871	14.3	13.5
Toronto	102,412	10,869	14.2	14.4

Results of Adjusted Cox Models

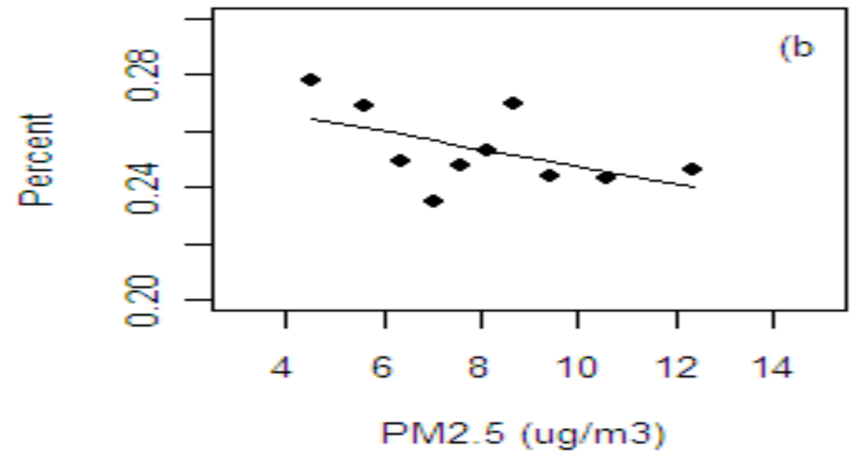
Model	RR per 10 µg/m^3 increase in $PM_{2.5}$	95% CI
Non-accidental deaths		
Standard Cox	1.10	1.08 – 1.12
Random effects	1.07	1.03 – 1.12
Lung cancer		
Cox	1.06	1.02 – 1.11
Circulatory		
Cox	1.11	1.07 - 1.14
R.E.	1.11	1.05 - 1.17
Cardiovascular		
Cox	1.10	1.07 – 1.14
R.E.	1.11	1.05 – 1.17

Confounding? (Cdn Comm Health

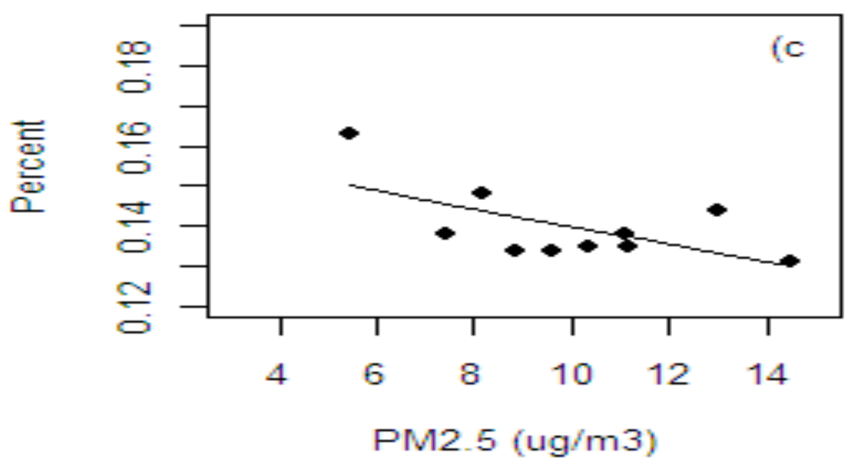
% Current smokers in CMA



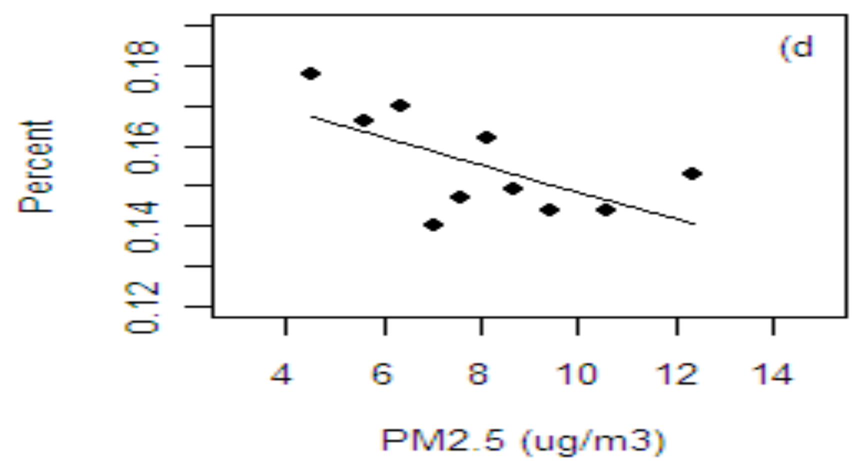
Not in CMA



% BMI > 30 in CMA



Not in CMA



Ontario Tax Cohort Study

- Paul Villeneuve (PI), Rick Burnett, Mike Jerrett, Amanda Wheeler, Mark Goldberg
- Hong Chen: Analysis of cardiovascular disease and intra-urban NO_2

Ontario Tax Cohort

- Hamilton, Kingston, London, Ottawa, Sarnia, St. Catharines, Sudbury, Thunder Bay, Toronto, Windsor + some rural areas
- Federal tax files: >1 filing in 1982-86
- Population: 660,000, age ≥35
- Follow-up: 1982-2009
- Mortality and cancer incidence

Traffic-related air pollution and cardiovascular disease in the Ontario Tax Cohort

Cause of Death	City: Hamilton RR$_{5ppb}$ (95% CI)	City: Toronto RR$_{5ppb}$ (95% CI)	City: Windsor RR$_{5ppb}$ (95% CI)	Pooled estimate [e] RR$_{5ppb}$ (95% CI)
All Cardiovascular Disease				
Age and sex adjusted [b]	1.28 (1.22 - 1.35)	1.05 (1.02 - 1.08)	1.25 (1.17 - 1.34)	-
+ All personal covariables [c]	1.16 (1.10 - 1.22)	1.01 (0.98 - 1.05)	1.13 (1.06 - 1.22)	-
+ All ecological covariables [d]	1.12 (1.06 - 1.19)	1.05 (1.00 - 1.09)	1.10 (1.02 - 1.19)	1.08 (1.05 - 1.11)
Ischemic Heart Disease				
Age and sex adjusted	1.32 (1.22 - 1.42)	1.07 (1.02 - 1.12)	1.25 (1.14 - 1.36)	-
+ All personal covariables	1.18 (1.09 - 1.27)	1.03 (0.98 - 1.08)	1.12 (1.02 - 1.23)	-
+ All ecological covariables	1.12 (1.02 - 1.21)	1.06 (1.00 - 1.13)	1.11 (1.00 - 1.23)	1.09 (1.04 - 1.14)
Cerebrovascular Disease				
Age and sex adjusted	1.17 (1.03 - 1.31)	0.96 (0.90 - 1.03)	1.12 (0.96 - 1.30)	-
+ All personal covariables	1.06 (0.93 - 1.19)	0.92 (0.86 - 1.00)	1.04 (0.89 - 1.18)	-
+ All ecological covariables	1.06 (0.92 - 1.22)	0.91 (0.83 - 1.00)	0.96 (0.82 - 1.18)	0.95 (0.89 - 1.02)

Cardiovascular deaths: 19,380

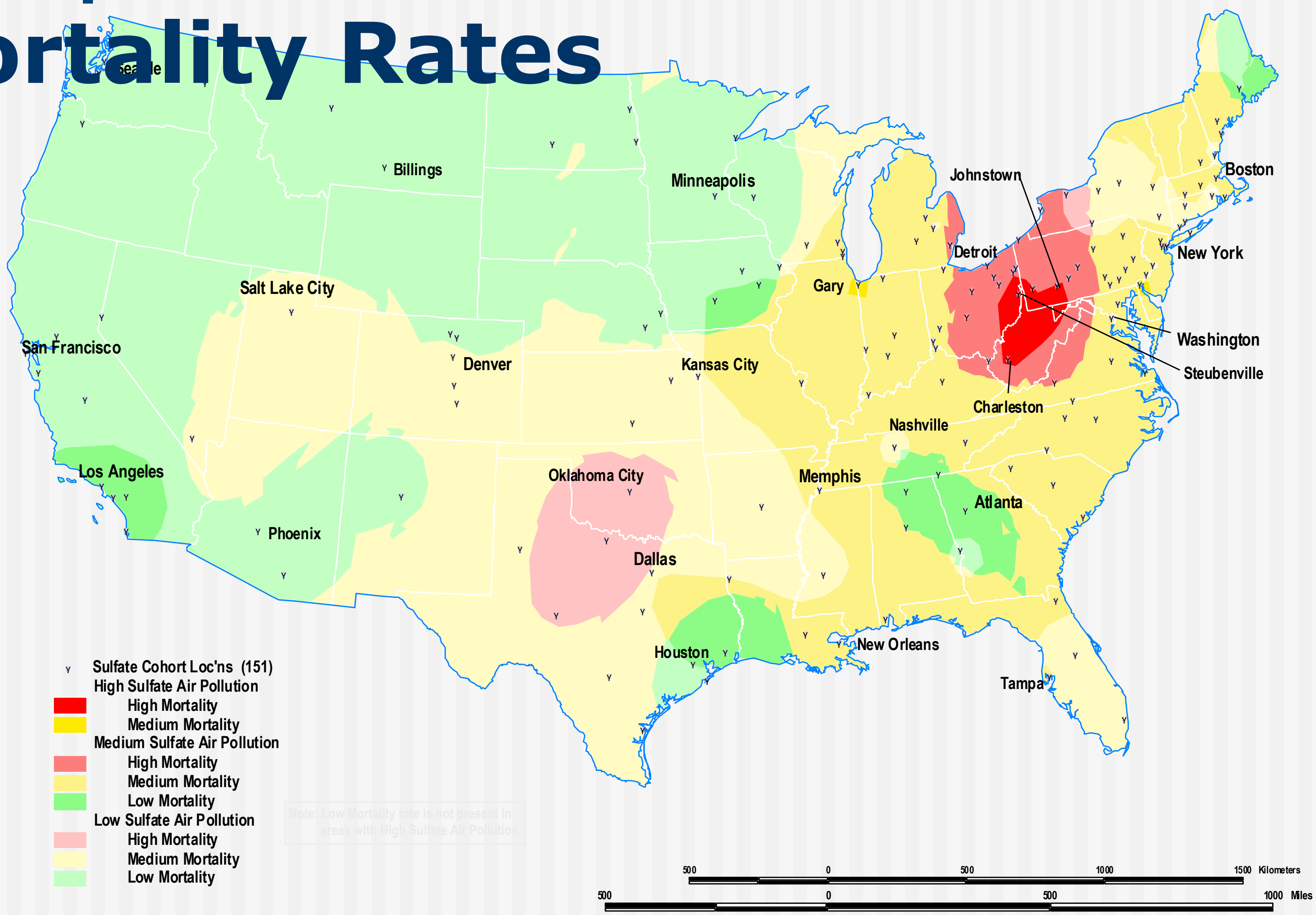
Accounting for Unmeasured Covariates

- Smoking, body mass index and other personal risk factors not available
- Canadian Community Health Survey provides estimates of the prevalence of these variables by area (exposure)
- Knowing rate ratios for smoking and cardiovascular disease allows one to account for these unmeasured risk factors

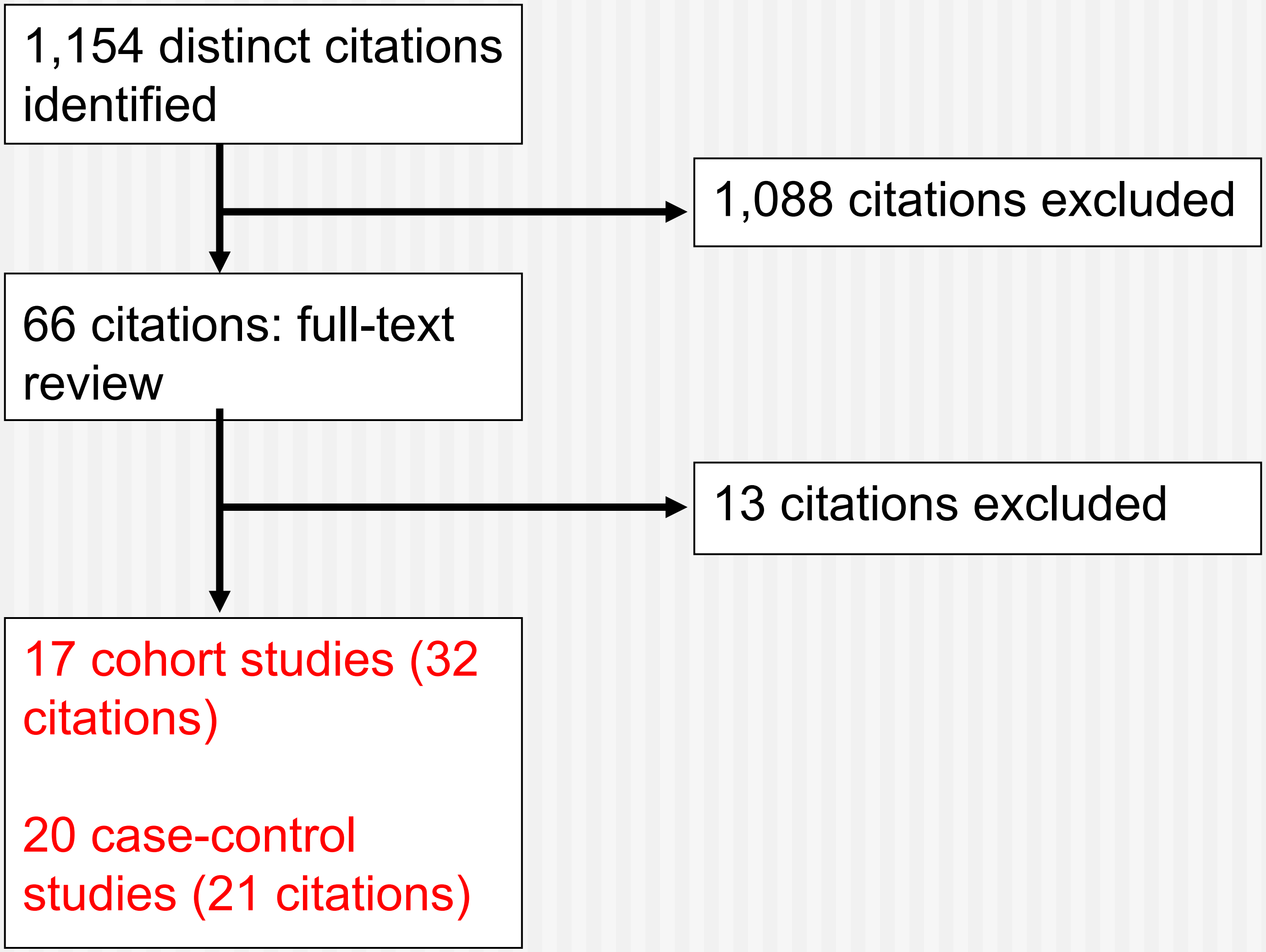
Indirectly adjusted estimates for smoking for mortality from all cardiovascular diseases, Ontario Tax Cohort, for an increase of 5ppb of NO_2

	Hamilton	Toronto	Windsor	Pooled
Regression model	1.12 (1.06-1.19)	1.05 (1.00-1.09)	1.10 (1.02-1.19)	1.08 (1.05-1.11)
Indirectly adjusted	1.10 (1.01-1.20)	1.05 (0.99-1.10)	1.10 (0.98-1.23)	1.07 (1.02-1.11)

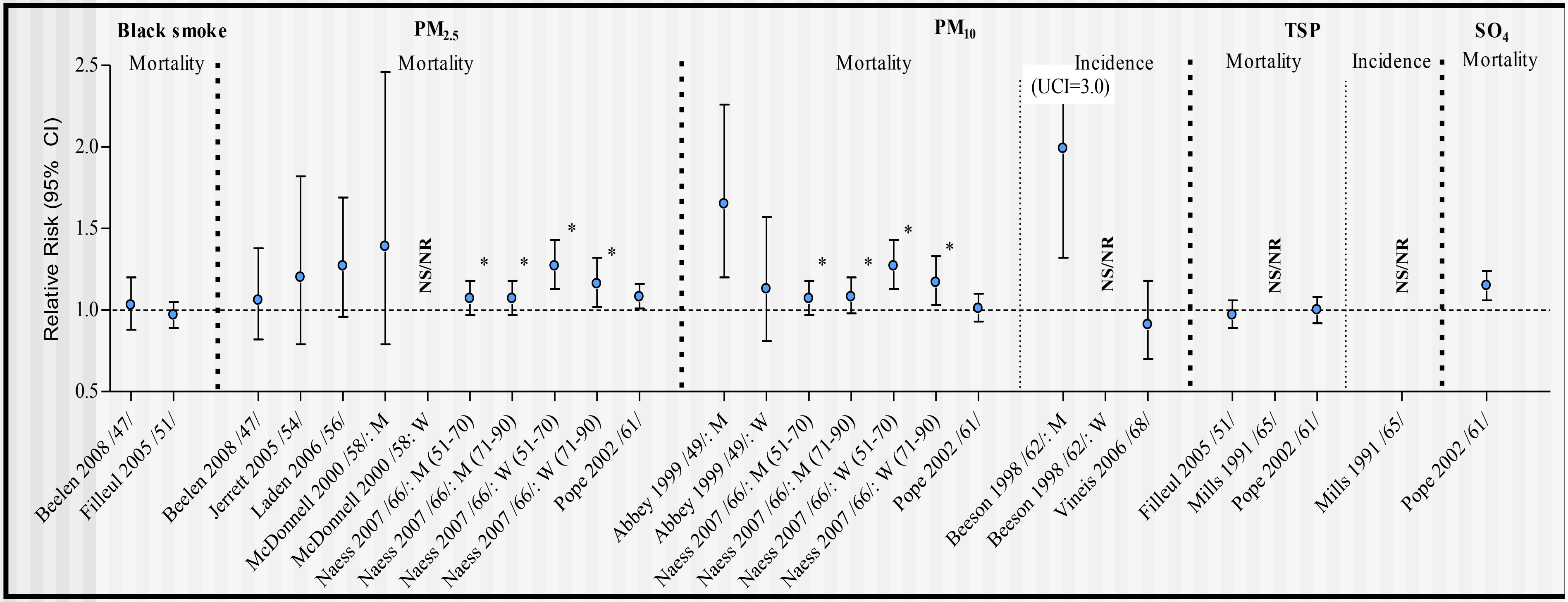
Concentrations of Sulphates (SO_4) and Nonaccidental Mortality Rates



Chen, Goldberg, Villeneuve *Reviews on Environmental Health, 2008*

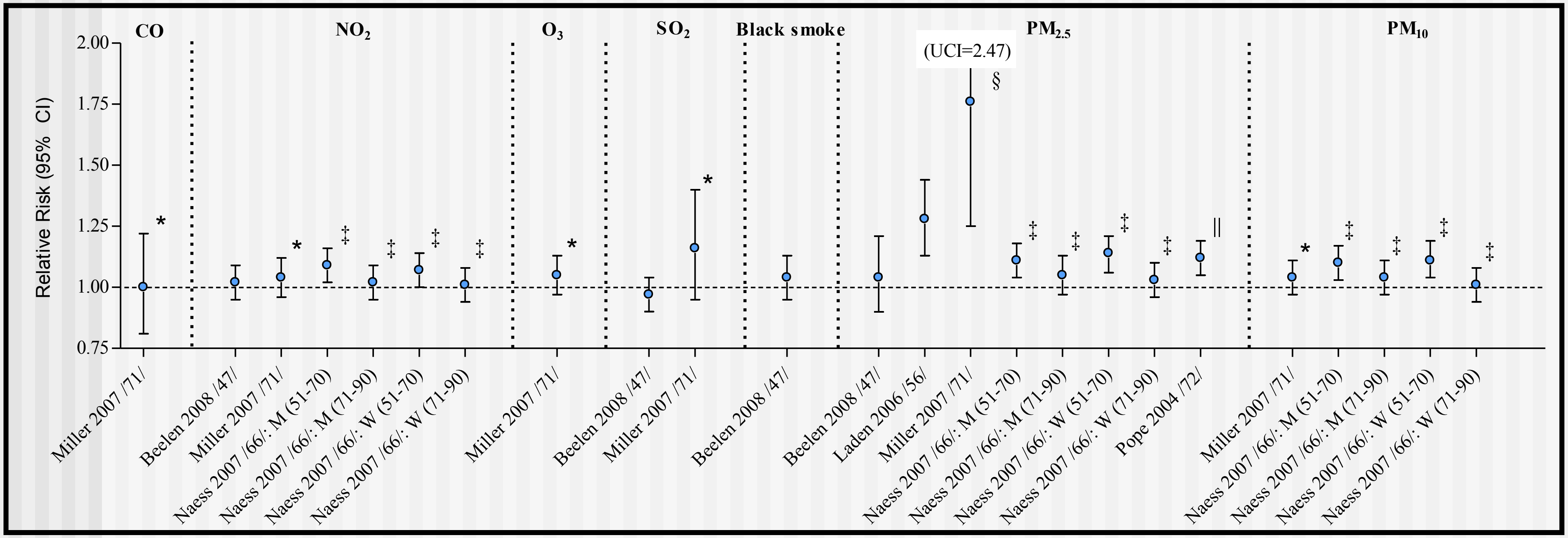


Incidence/mortality from Lung Cancer



- **$PM_{2.5}$**: Rate ratio of 1.15 (95%CI: 1.06-1.24) increase in mortality rate for an increase of 10 µg/m^3
- Other pollutants: no strong evidence of association

Total Cardiovascular Mortality



- **Findings:**
  - **PM$_{2.5}$: Rate ratio of 1.12 (95%CI: 1.09-1.15) increase in mortality rate for an increase of 10 µg/m^3**
  - **Other pollutants: no strong evidence of association**

Prostate Cancer and Exposure to Traffic-related Air Pollution in Montreal, Canada

Marie-Élise Parent
Mark Goldberg
Dan L. Crouse
Nancy A. Ross
Hong Chen
Marie-France Valois

Methods

- Recruitment: 2005-2007
- Face-to-face interviews, Montreal/Laval
- 1,772 men, age 42 – 79, in Montreal
  - 803 incident cases
  - 960 controls, from electoral lists
    - ~frequency-matched by age (±5 years)

Analysis and Results

Personal covariables:

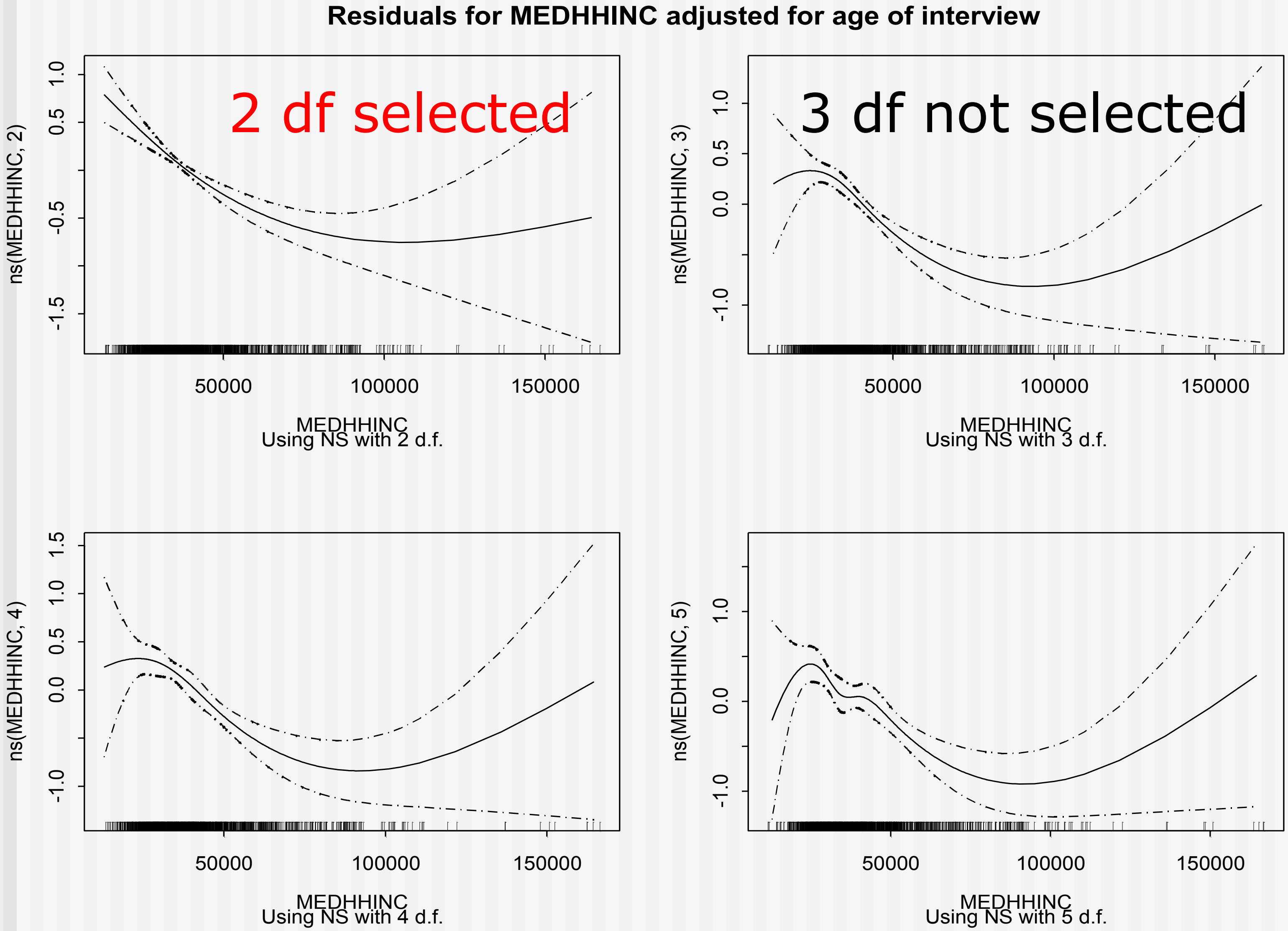
- age of interview (linear)
- ethnicity (black, asian, other)
- education level (6 categories)
- family income (9 categories)
- body mass index 2 years ago (natural cubic spline smoother, 2 d.f.)
- first-degree family history of prostate cancer (yes, no, do not know)

Analysis and Results

Ecological covariables (from 2001 census, census tract area):

- % adults who did not complete high school (linear)
- median household income (natural cubic spline smoother (ns), 2df)
- % households with total income <$20k and ≥$90k (ns, 2df)
- % unemployed (ns, 2df)
- % recent immigrants (ns, 2df)
- % visible minorities (linear)
- % lone-parent families (linear)

Response Function for Median Household Education



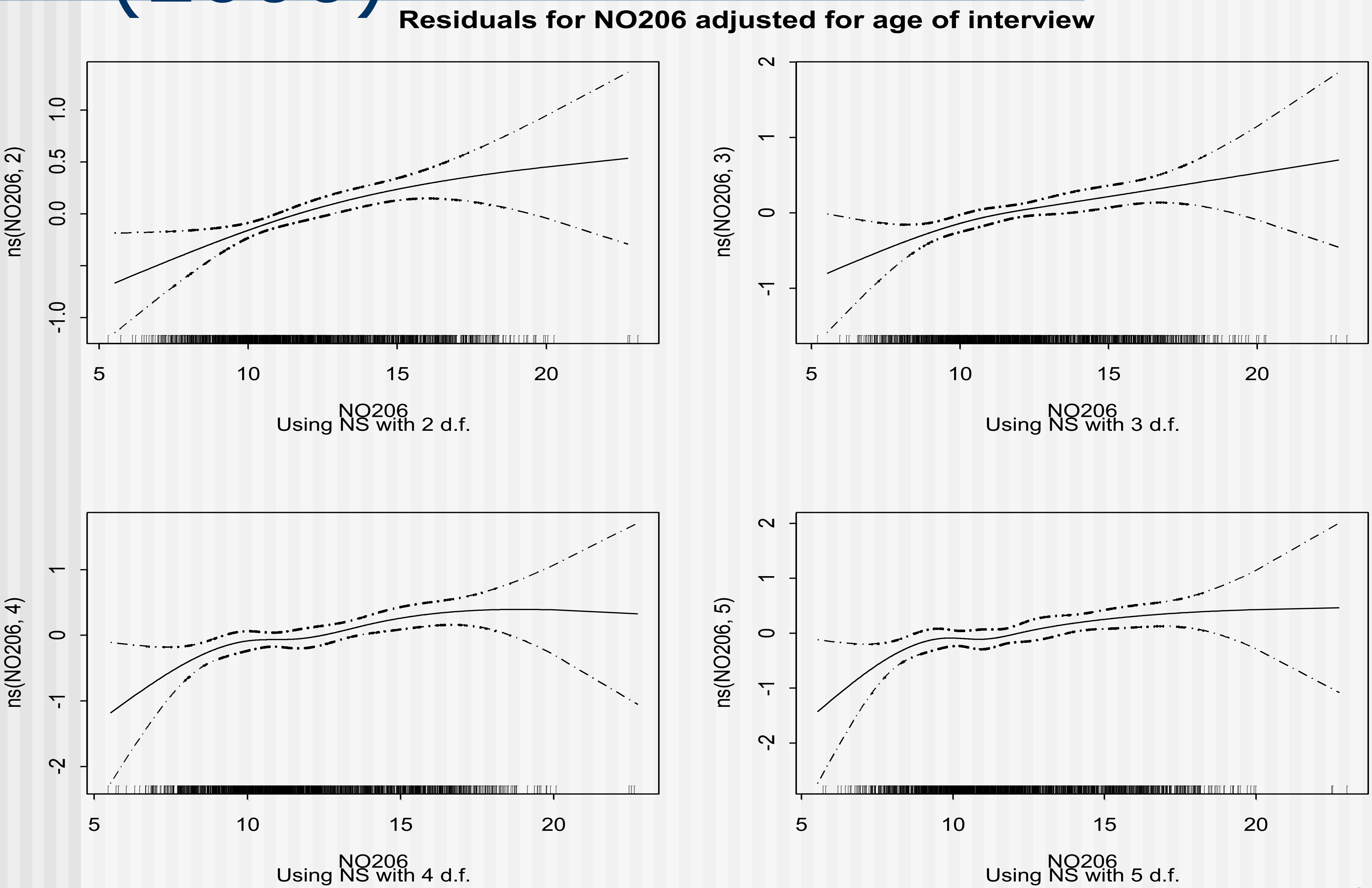
Predictors for Prostate Cancer

- First degree family relatives OR=2.04 (95%CI:1.56-2.66)
- No other variable was strongly associated

Results for All Subjects (n=1,759) (per 5ppb)

Year of estimate of exposure	Adjusted for all personal risk factors OR 95%CI	+ ecological covariates OR 95%CI
2006-LUR	1.44 1.20–1.73	1.32 1.07 – 1.64
1996-back-extrapolated	1.40 1.22–1.61	1.33 1.14 – 1.55
1985-back-extrapolated	1.15 1.04–1.28	1.10 0.97 – 1.16

Response Function for NO_2 (2006)



Results for All Cases and Controls who were "Screened" for Prostate Cancer (n=1,655) (per 5ppb)

Year of estimate of exposure	Adjusted for all personal risk factors OR 95%CI	+ ecological covariates OR 95%CI
2006-LUR	1.41 1.17–1.71	1.31 1.05 – 1.64
1996-back-extrapolated	1.38 1.20–1.59	1.32 1.13 – 1.56
1985-back-extrapolated	1.14 1.02–1.27	1.10 0.97 – 1.24

Summary of chronic effects

- Consistent evidence of an effect of air pollution for cardiovascular disease and lung cancer (Pooled mortality rate ratios of 1.12 and 1.15, respectively, for an increase of $PM_{2.5}$ of 10 $\mu g/m^3$)
- Particulates and diesel are now accepted as carcinogens (IARC)
- This is for "general air pollution" and "traffic-related air pollution"

Summary of chronic effects

- No conclusions can be drawn from the studies of breast cancer and prostate cancer
- Other cancer sites need to be investigated
- Diabetes is also an important factor for acute affects of air pollution
- Mortality from diabetes has been found to be associated with air pollution

Statistical Analysis

- Link residential addresses of subjects to estimates of air pollution
  - NO_2 serves as a general marker for traffic-related air pollution
- Conduct standard c-c analyses (logistic regression), adjusting for individual and contextual risk factors

Analytic Strategy

- Link addresses at time of interview to estimates of air pollution
- Conduct standard c-c analyses, adjusting for individual and contextual risk factors

Producing an Air Pollution Map: Detailed Monitoring of NO_2 Using Ogawa Passive Monitors, 2005-6

Work conducted by Dan Crouse,

Hong Chen, et al.

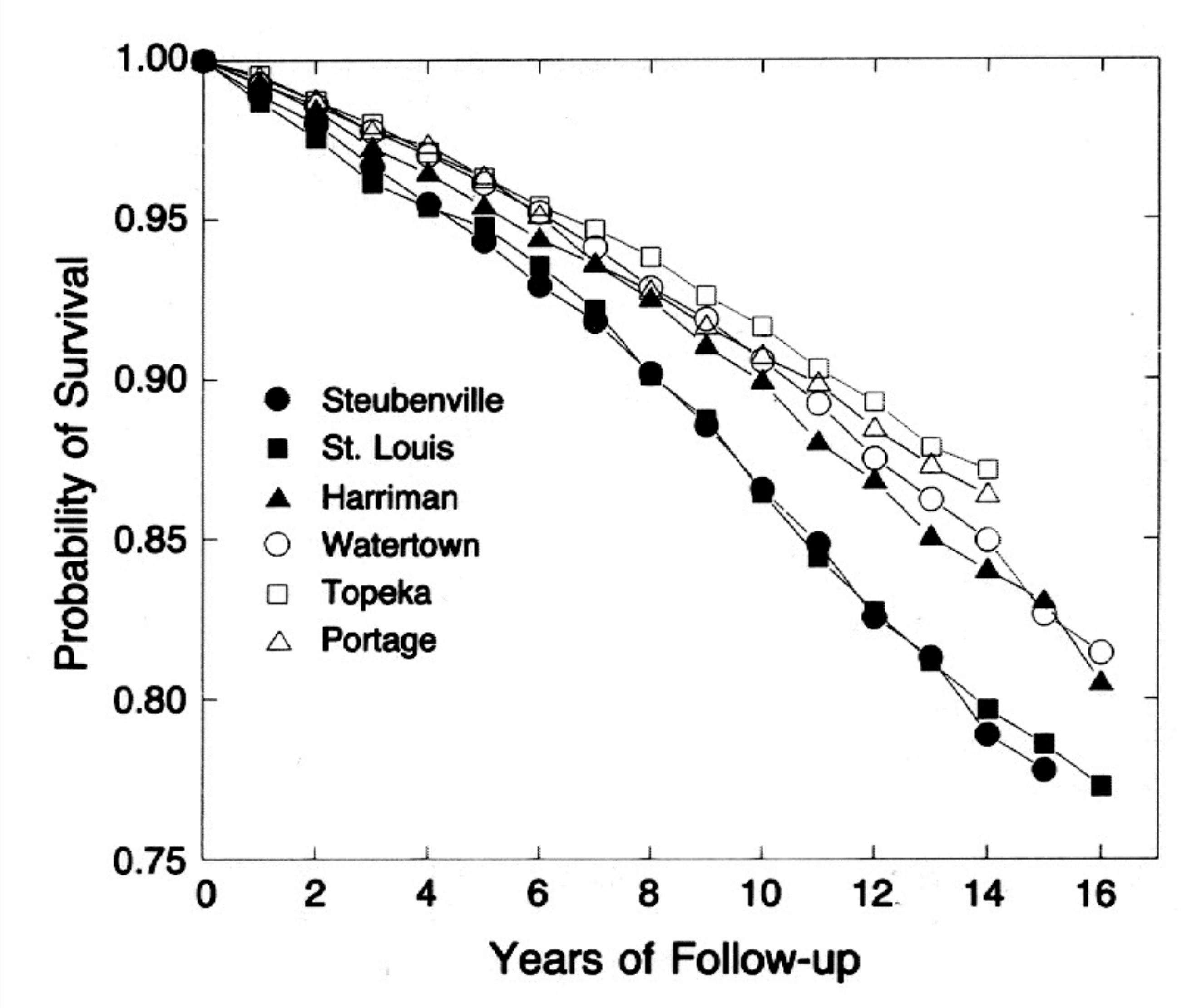
Postmenopausal Breast Cancer Study (1996-97)

Postmenopausal Breast Cancer Is Associated with Exposure to Traffic-Related Air Pollution in Montreal, Canada: A Case–Control Study

Dan L. Crouse,[1] Mark S. Goldberg,[2,3] Nancy A. Ross,[1] Hong Chen,[4] and France Labrèche[5]

Environmental Health Perspectives, 118(11), p 1578ff, November 2010

Crude Probability of Survival in the Six Cities, According to Years of Follow-up.



Dockery DW et al. N Engl J Med 1993;329:1753-1759.