St George's University of London

MRC-PHE Centre for Environment & Health

Public Health England | MRC Medical Research Council | Imperial College London | King's College London

A journey through time – series analyses

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Frontiers in Air Quality Science Programme: 24th June 2014

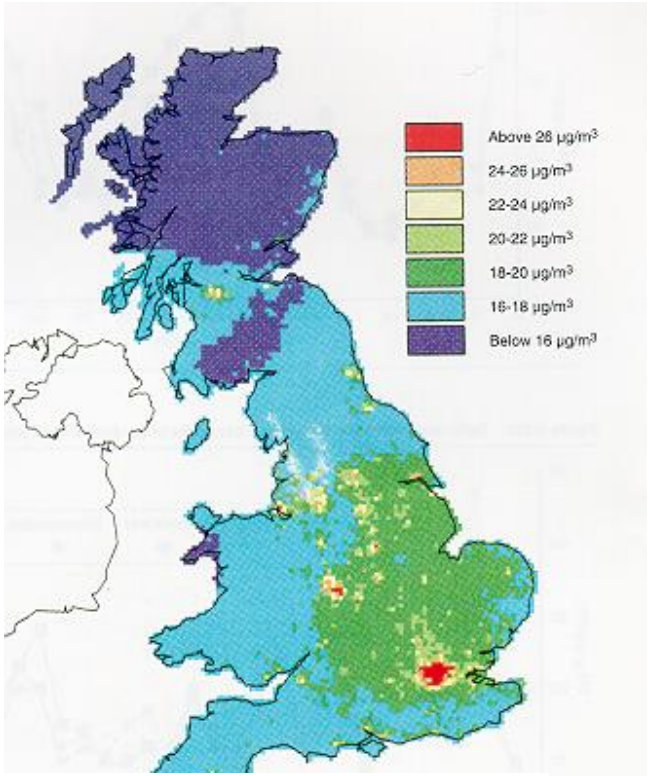
Contents

1. Concept
2. Literature
3. Methodological
   - Seasonal control
   - Lag structure
   - Multi-centre studies
4. Systematic review
5. Traffic study
6. Developments

Exposure and effect

	Short term effect	Long term effect
Short term exposure	√	√
Long term exposure		√

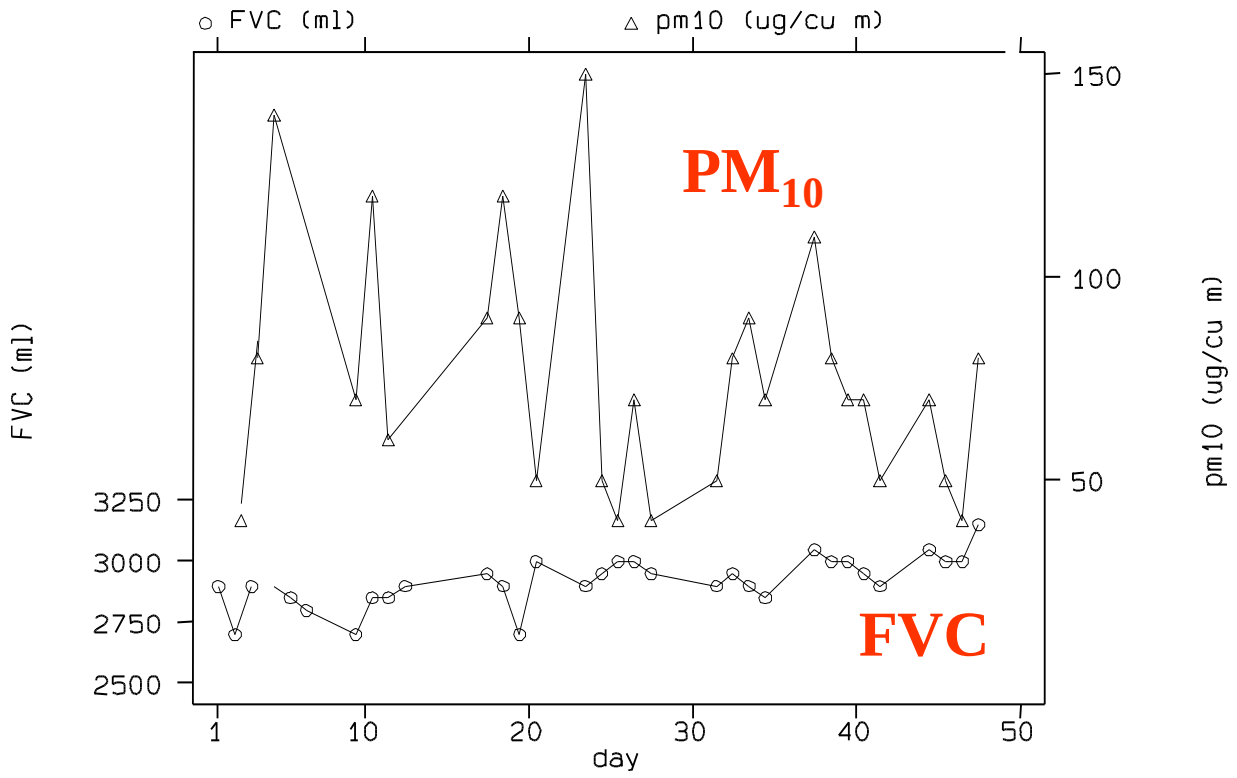
LONG-TERM EXPOSURE STUDIES:
(1) Spatial correlations (regions, cities, point or line (e.g. road) sources
(2) Long term time trends (over years)



SPATIAL VARIATION IN ANNUAL MEAN PM_{10} IN UK 1991

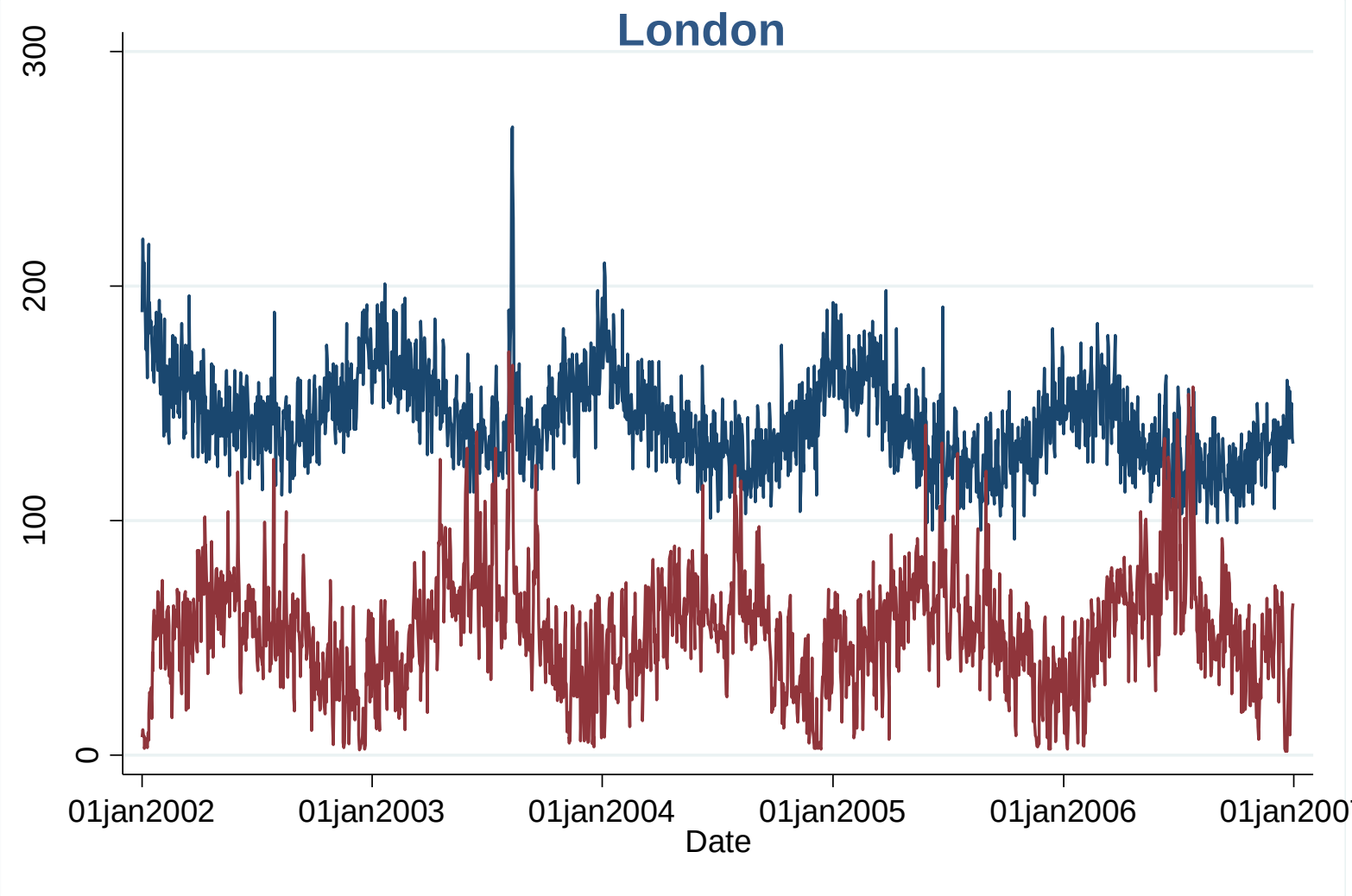
- **mortality or utilisation rates (ecological studies)**
- **prevalence (cross-sectional studies)**
- **incidence (cohort studies)**

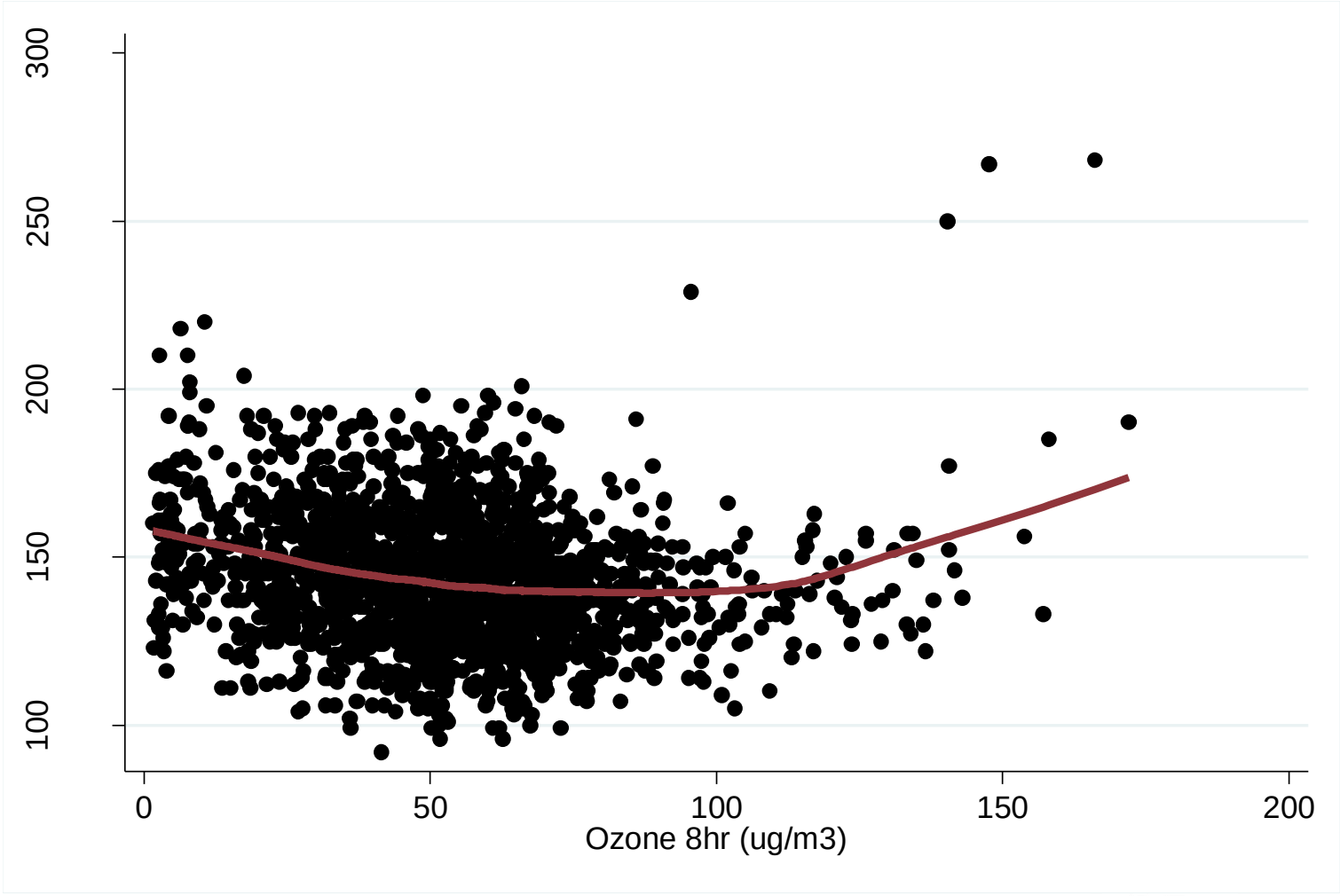
Short-term exposure studies - Panel

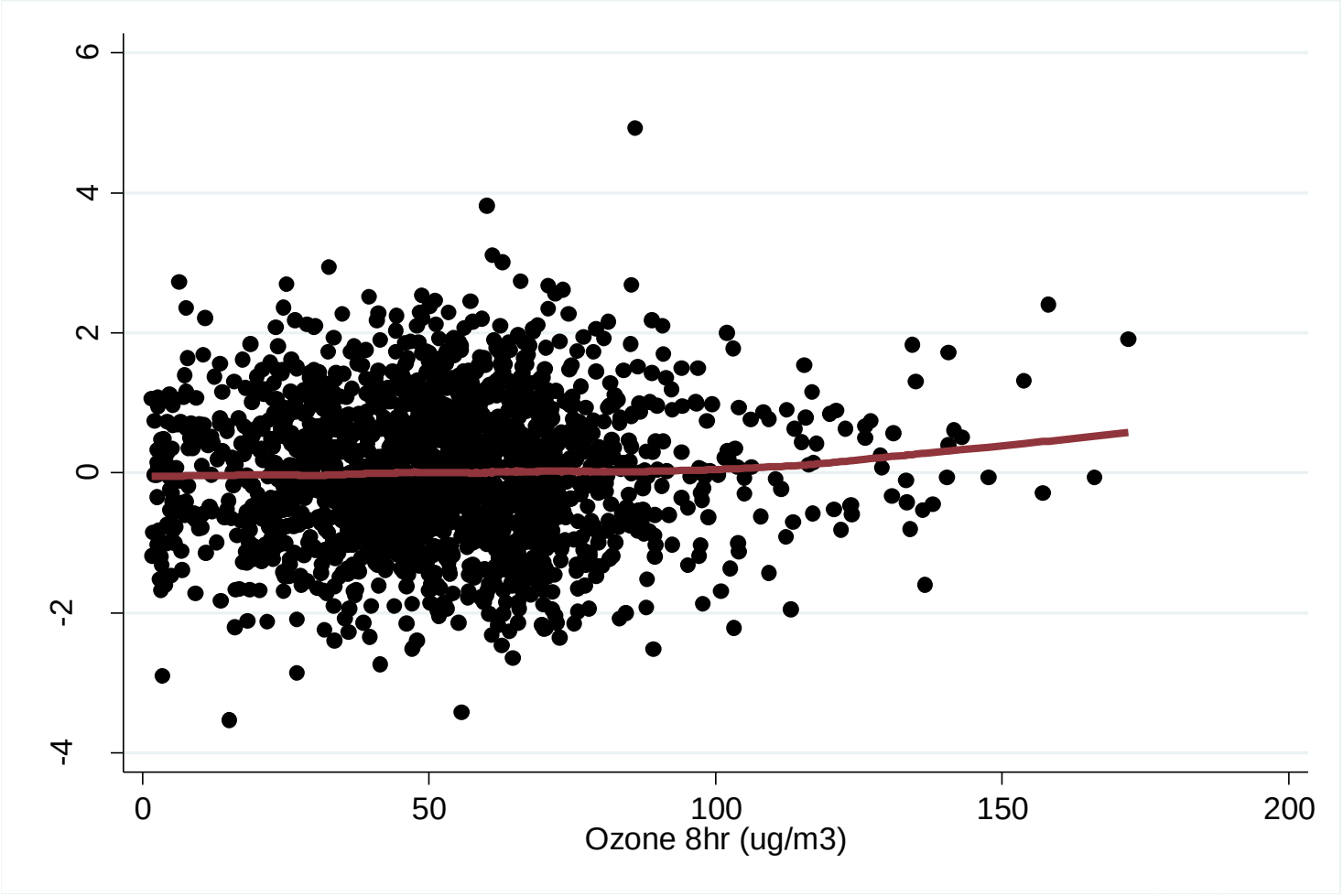


FVC and PM_{10} daily over 46 days Surrey UK, June 1994
(Scarlett et al 1996)

Short-term exposure studies – Ecological




300
250
200
150
100
0
50
100
150
200
Ozone 8hr (ug/m3)



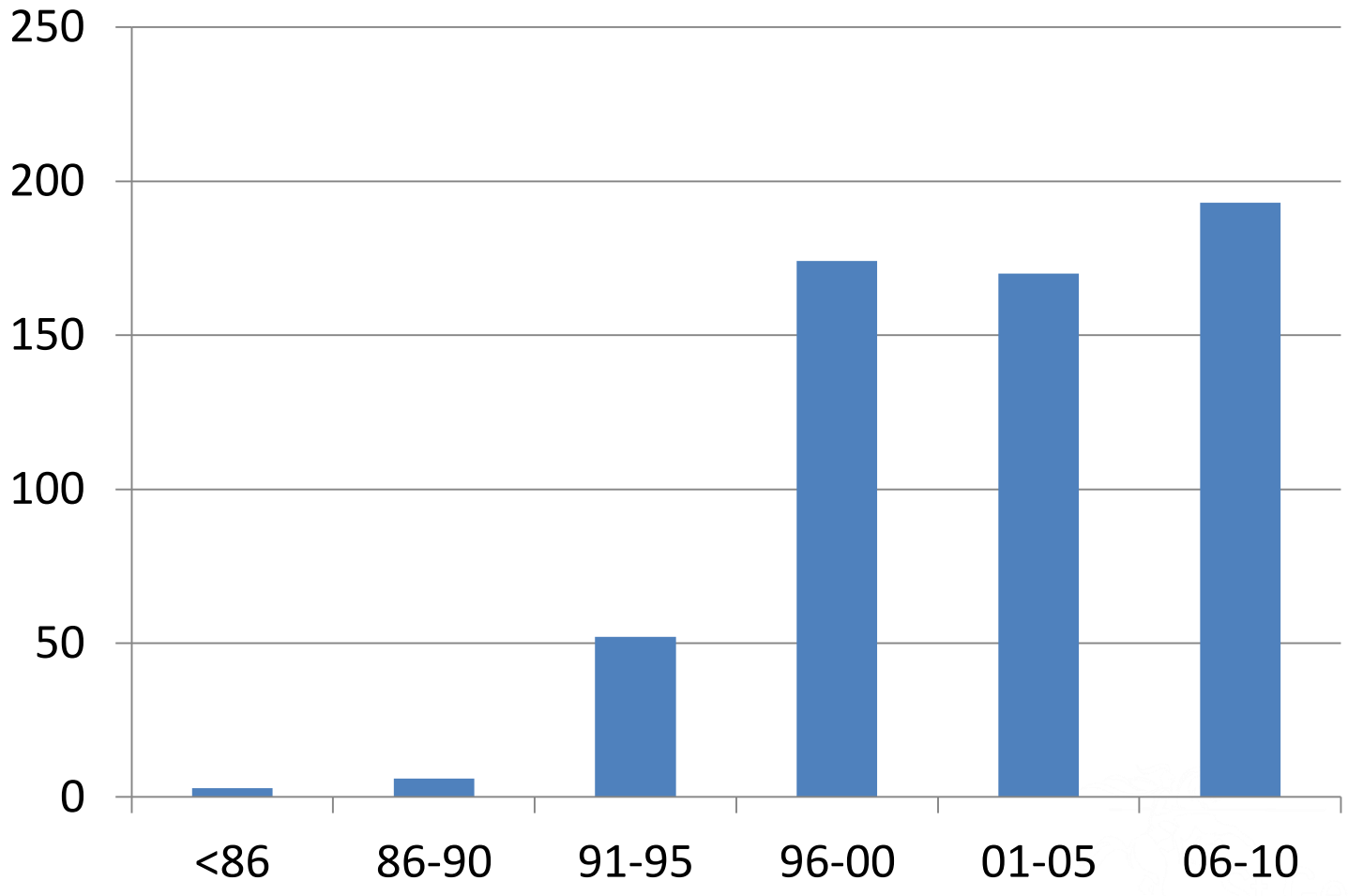
RR=1.0025 per 10 μg/m^3

Contents

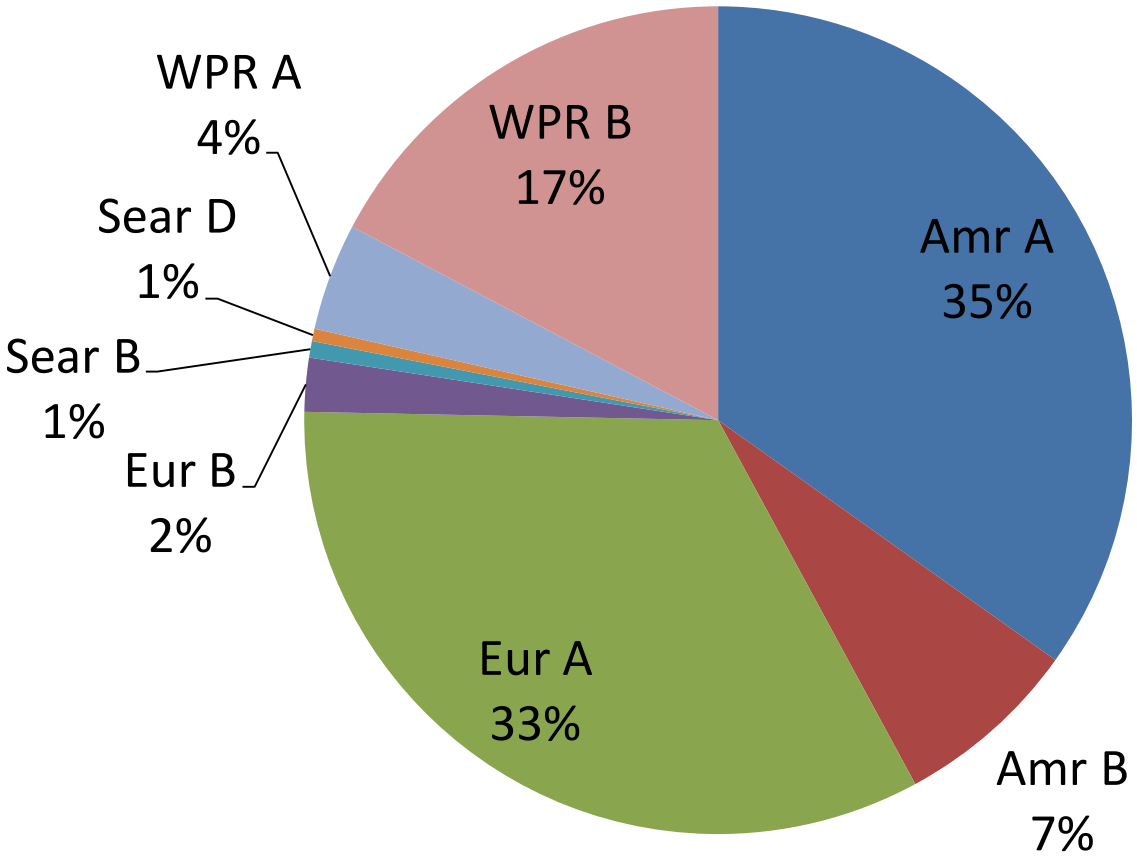
Air Pollution Epidemiology Database

- >600 studies since 1980s
- > 21,000 effect estimates (protocol)
- 470 single-city studies
- 141 multi-city studies
- Mortality (52%) / Admissions (33%) / Other (15%)
- Particles (PM10, PM2.5, BS, BC etc.)
- Gases (NO2, O3, SO2, CO)
- Elemental composition

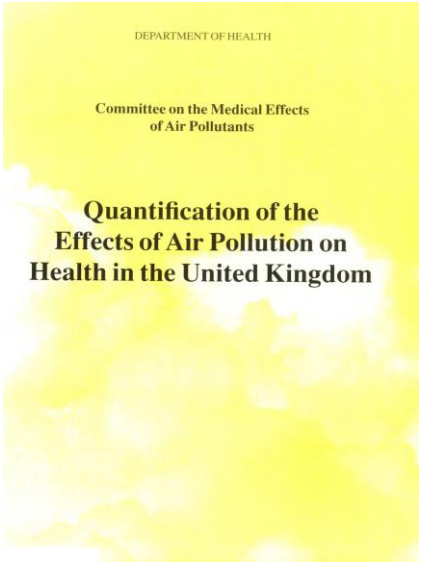
published studies by lustrum



Studies by WHO Region



Policy interface



World Health Organization
REGIONAL OFFICE FOR Europe

Review of evidence on health aspects of air pollution – REVIHAAP Project

Technical Report

This publication arises from the project REVIHAAP and has received funding from the European Union.

Contents

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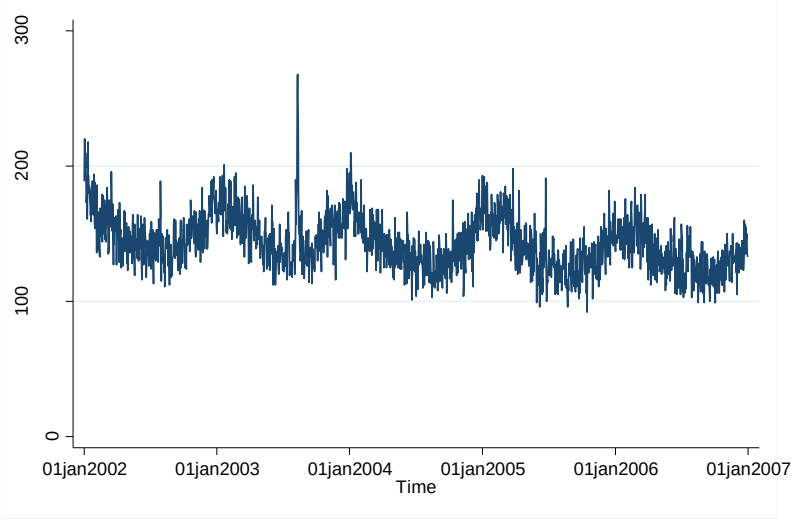
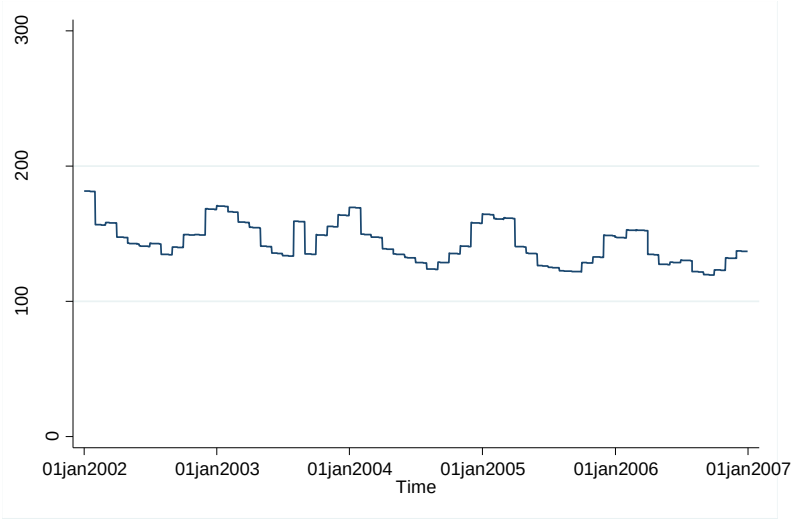
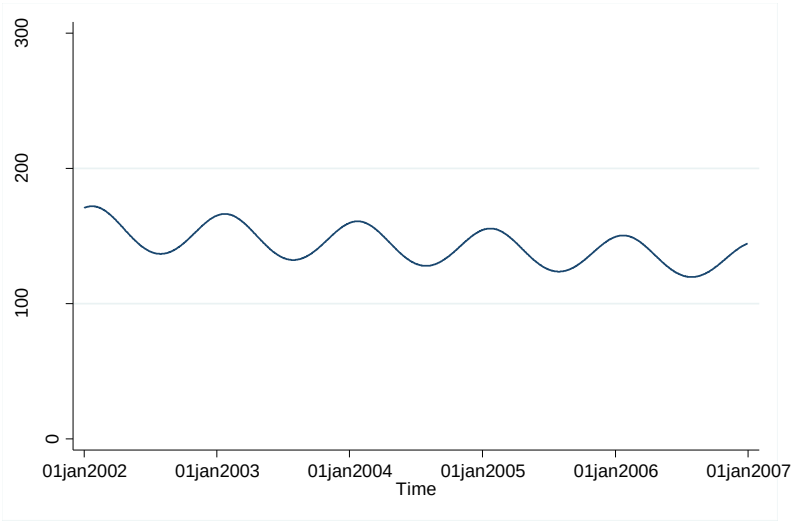
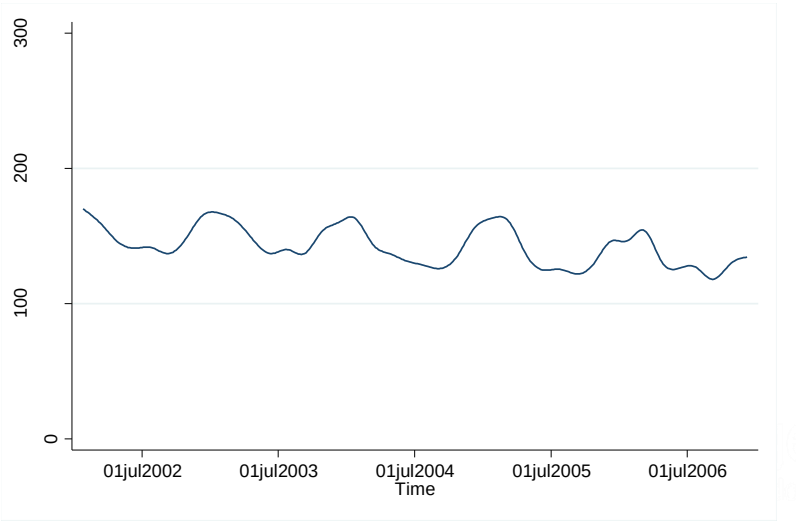
Methodological Developments

Seasonal control



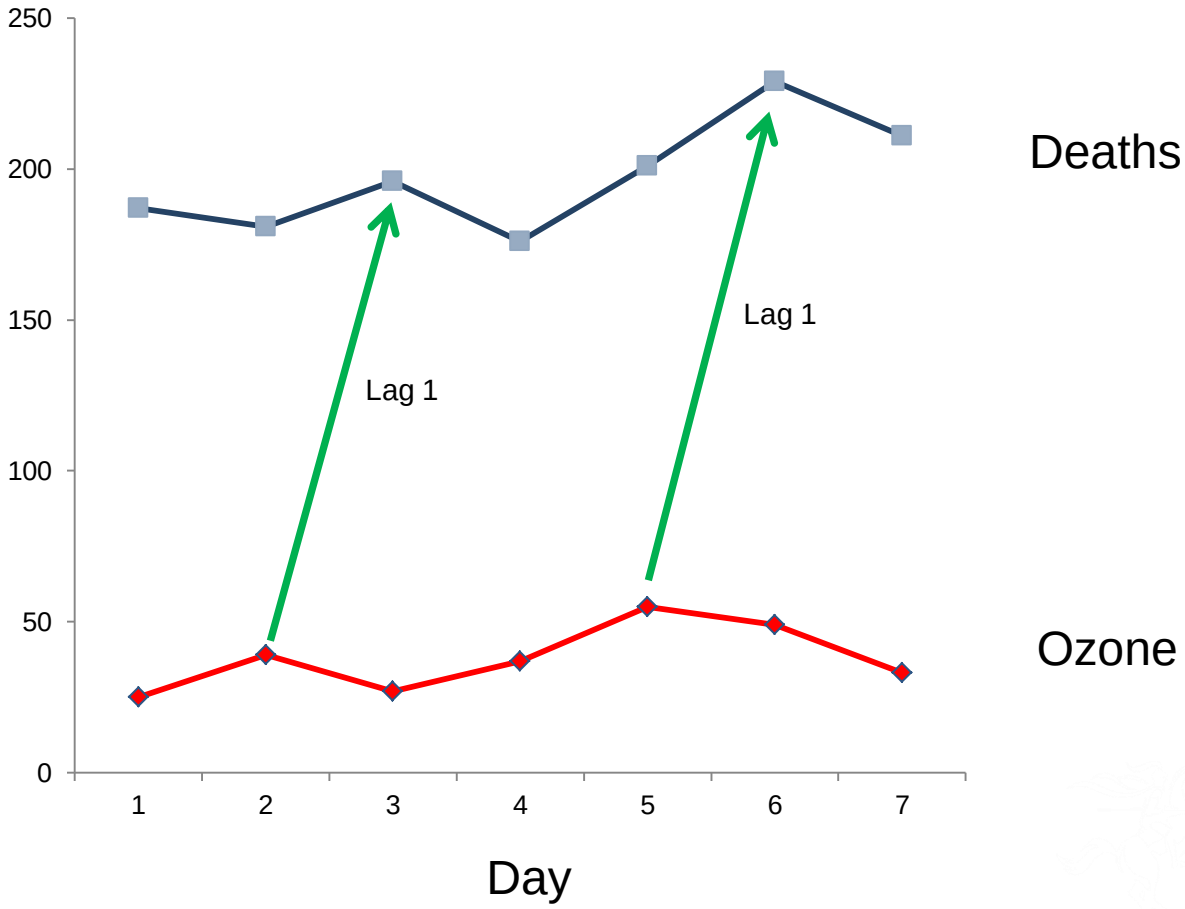






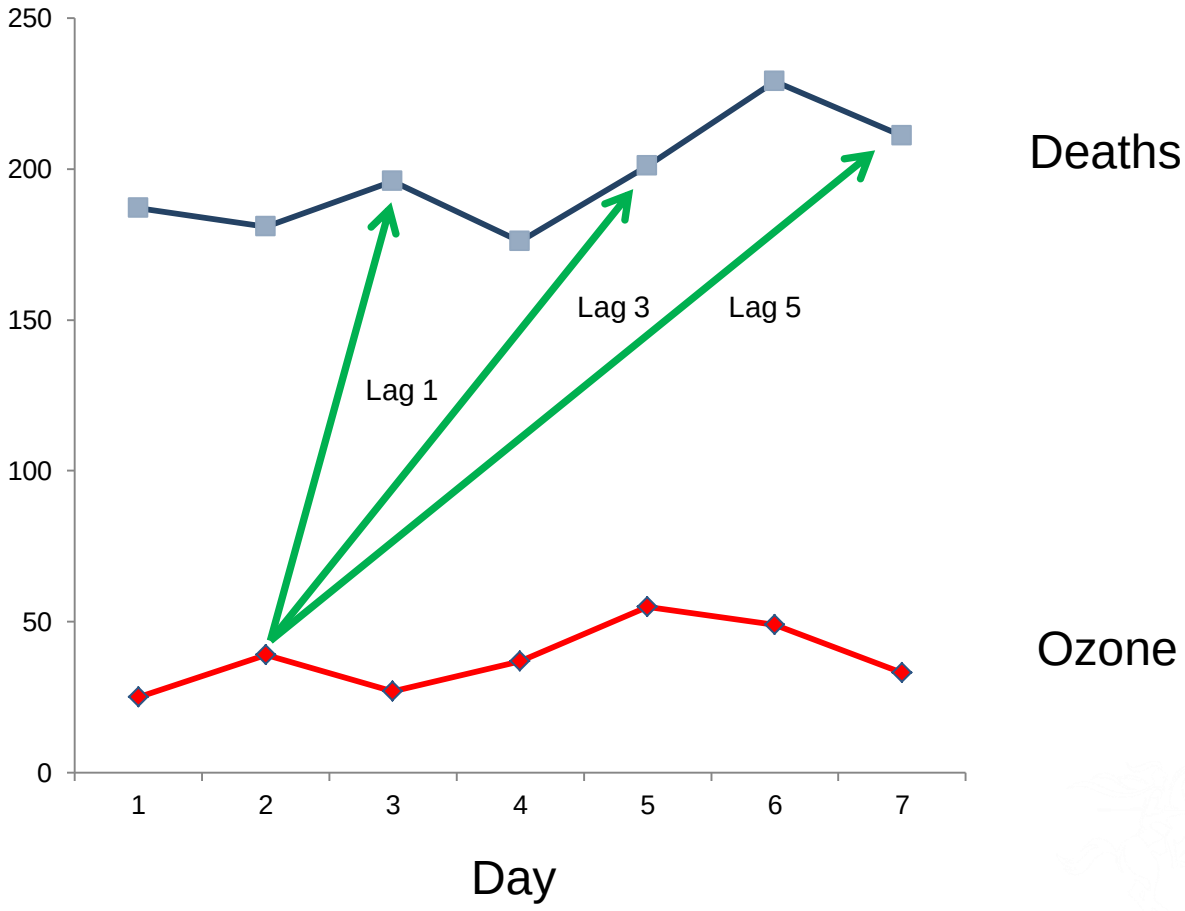
Methodological Developments

Lag structure



Methodological Developments

Lag structure



Methodological Developments

Lag structure

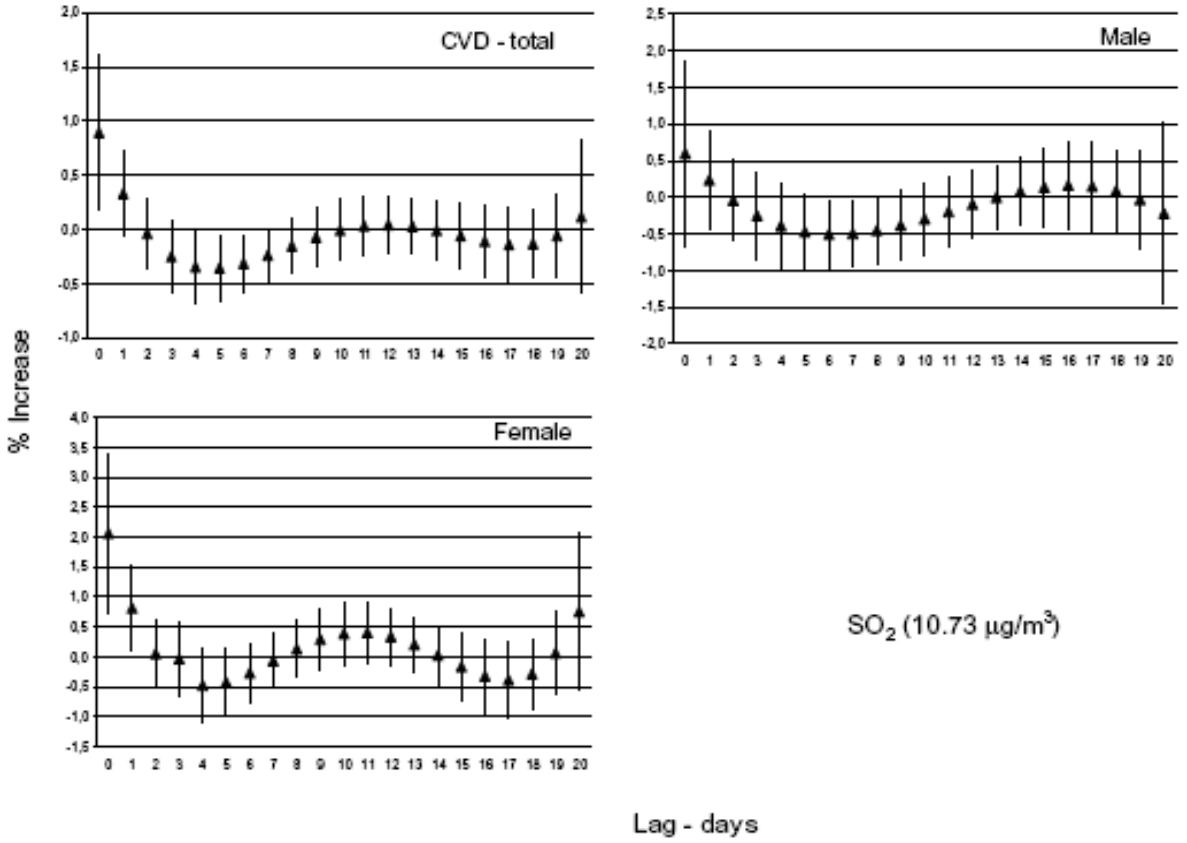


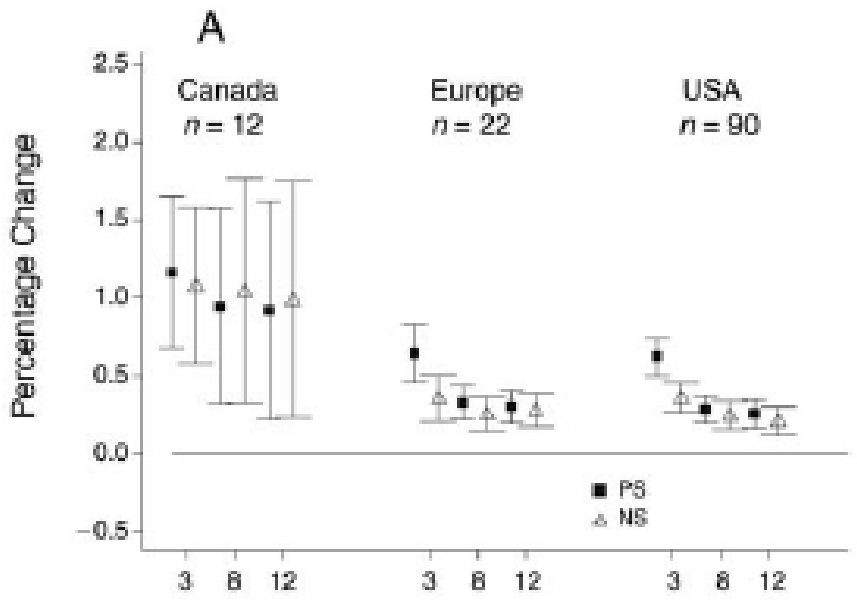
Figure 1 - Lag structure of the effects of an interquartile range increase in SO_2 (10.73 µg/m³) on total, male, and female cardiovascular disease (CVD) hospital admissions. São Paulo, Brazil, 1996-2001.

Methodological Developments

Multi-city studies

- Multiple locations included
- Common approach
  - Exposure
  - Statistical models
- Increased power
- Sources of heterogeneity
- APHENA: 90 US cities, 12 Canadian cities, 32 European cities.

APHENA Study



PM_{10} and all cause mortality

Contents

Contents

Traffic Pollution and Health in London

- Research Council Environmental Exposure and Health Initiative
- NERC/MRC/DOH - £2m
- KCL, ICL, SGUL, LSHTM, UoB, UoA
- To describe and understand the patterns of exposure of the population to traffic pollution and their relationships to health

TPHL – Work Packages

1. PM oxidative potential and exploitation of the NERC ClearfLo project

2. Modelling of population exposure to traffic pollution

3. Epidemiological studies of health effects of long-term exposure to traffic pollution

TPHL – Time series (WP1.3)

- SGUL, University of Athens
- Aim: “…to investigate the relative effects of different particle metrics and components, including oxidative potential on daily mortality and hospital admissions for cardiorespiratory conditions”.

- Clearflo & Defra data sets
- London, 2011-2012

TPHL – Pollutant Metrics

- PM10, PM2.5, PM10-2.5
- BC/EC/OC
- PNC
- Elemental composition
- PMF
- Background/Urban increments
- Oxidative Potential
- Gases

Challenges

100+ pollutant metrics

x 2 outcomes x 3 disease x (? age groups)

x 2 seasons x ? lags x ? multi-pollutants

= LOT OF MODELS

= BIG HEADACHE

- Characterise markers of traffic sources
- *A priori* list for epidemiological analyses

Rationale	Metric
Source	
Traffic - general	NOX
Traffic – general	PMF Traffic source - Composition - Particle size
Traffic - exhaust – Diesel	BC/EC in $PM_{2.5}$
Traffic - exhaust – Petrol	CO
Traffic - non-exhaust – Brake	Cu
Traffic - non-exhaust – Tyre	Zn
Traffic - non-exhaust - Re-suspension	Al

Rationale	Metric
Regulated	
Particles	PM_{10}
Particles	$PM_{2.5}$
Gaseous	NO_2
Gaseous	SO_2
Gaseous	O_3
Novel	
Oxidative Potential	OP1A, OP1G, OP1T OP2A, OP2G, OP2T
Wish List	
Heavy fuel oil combustion	Ni, V
Regional secondary particles	SO4, NO3
Carbon source apportionment	

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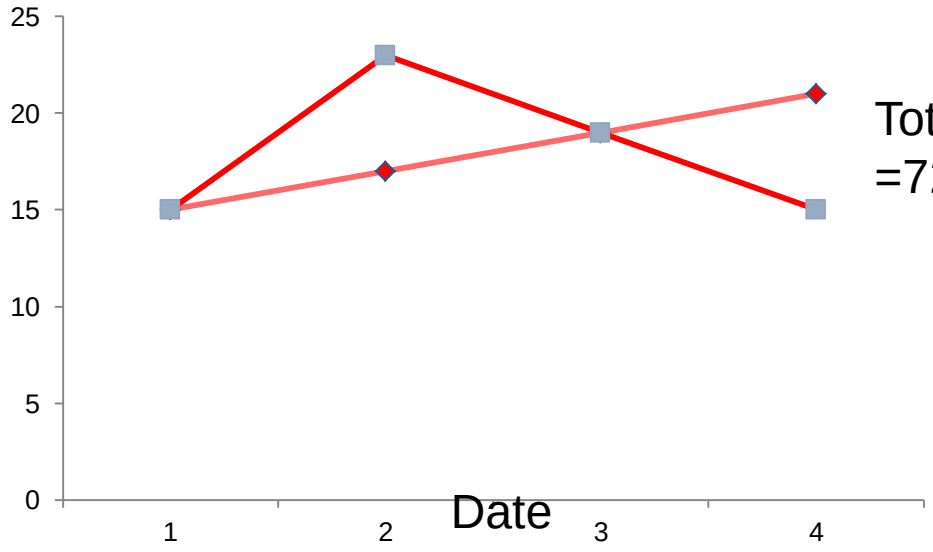
Delta study

- Nuredin Mohammed, Jon Ayres, Hubert Lam (UoB)
- Hypothesis: delta not concentration
- Pattern analysis



Total ozone exposure =72 µg/m^3

Air pollution and weather-related health impacts: methodological study based on spatio-temporally disaggregated multi-pollutant models for present-day and future **(AWESOME)**

- PI Paul Wilkinson, LSHTM, UoE, SGUL
- Modelled daily pollution concentrations at 5x5km spatial resolution
- National coverage

Comparative evaluation of Spatio-Temporal Exposure Assessment Methods for estimating the health effects of air pollution (STEAM)

- MRC Methodology panel (PI: Katsouyanni)
- KCL, SGUL, UOA, Harvard
- Fine spatial and temporal resolution
- Range of modelling techniques/data sources
- Simulation
- Integration of long and short term exposures and long and short term health effects

In conclusion:

- Extensive literature
- Greater geographical coverage
- Ever increasing sophistication
- Ever more searching (policy related) questions
- Modelling developments

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Thank you

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