

A journey through time – series analyses

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

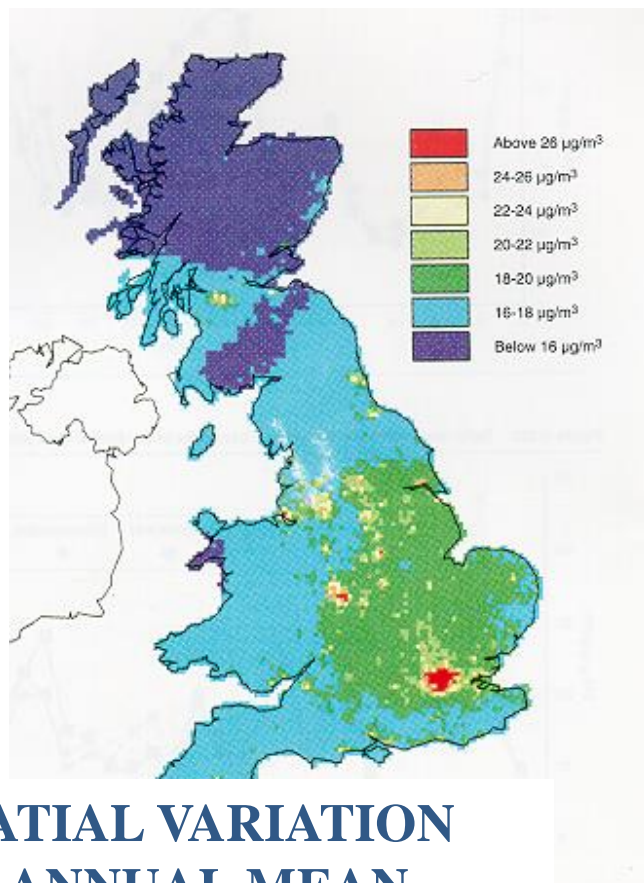
Exposure and effect

	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)



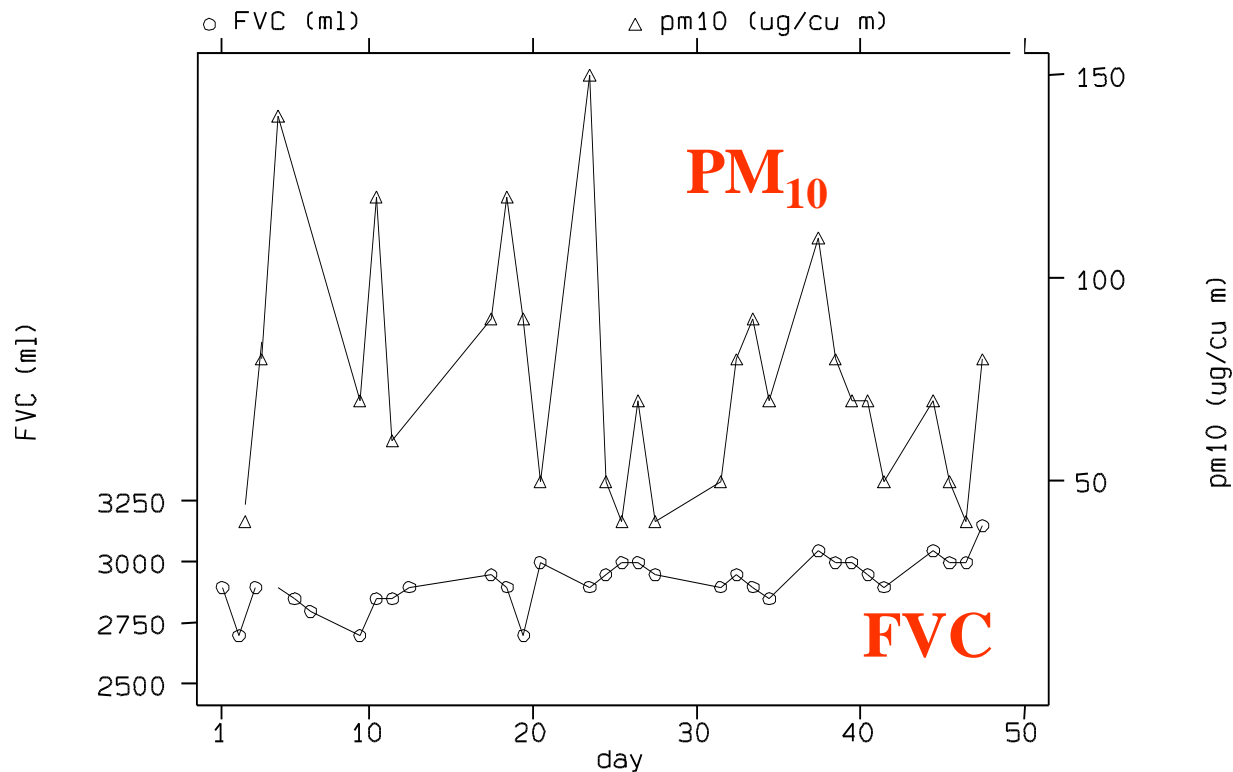
**SPATIAL VARIATION
IN ANNUAL MEAN
PM₁₀ IN UK 1991**

•mortality or utilisation rates (ecological studies)

•prevalence (cross-sectional studies)

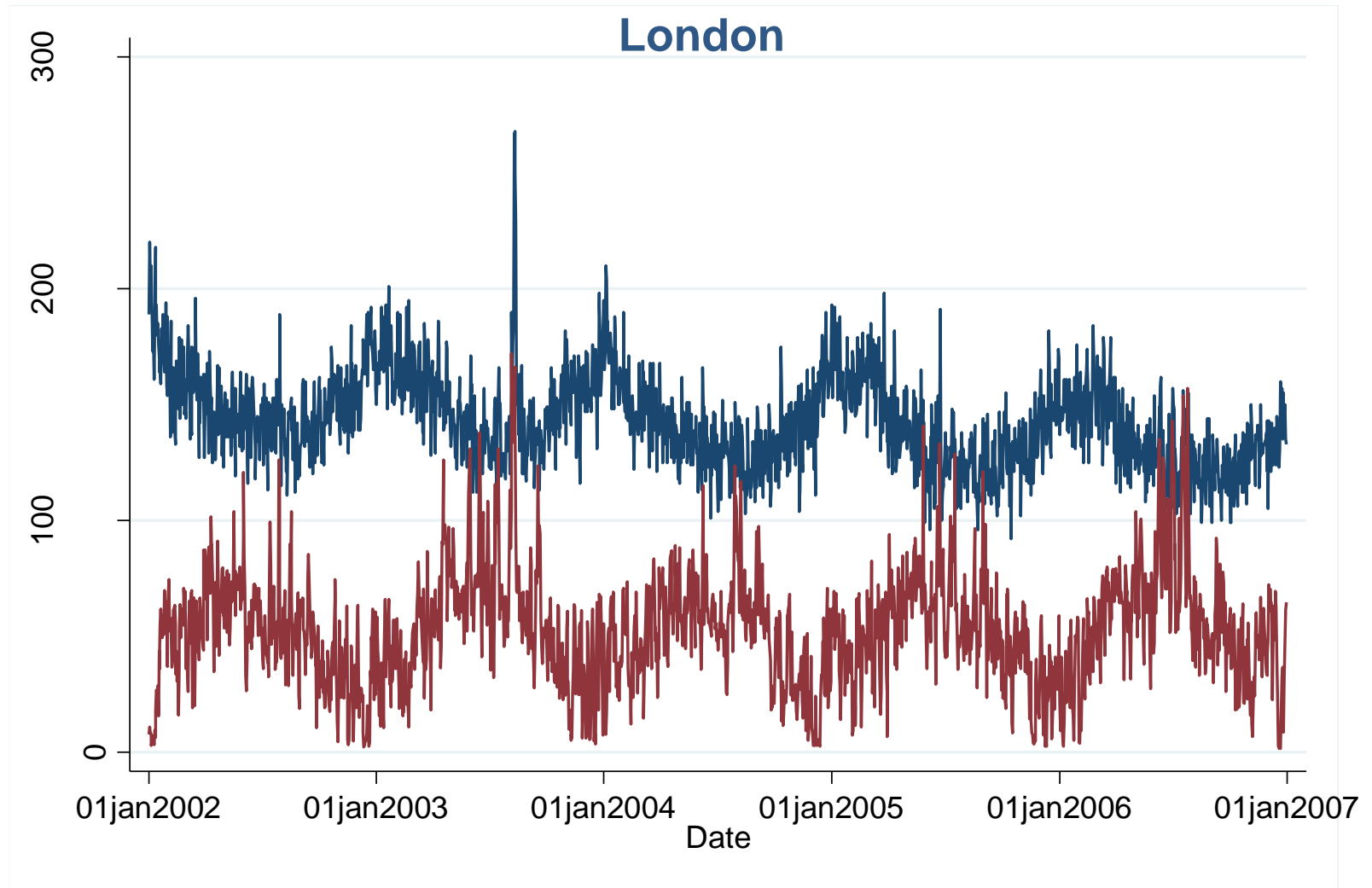
•incidence (cohort studies)

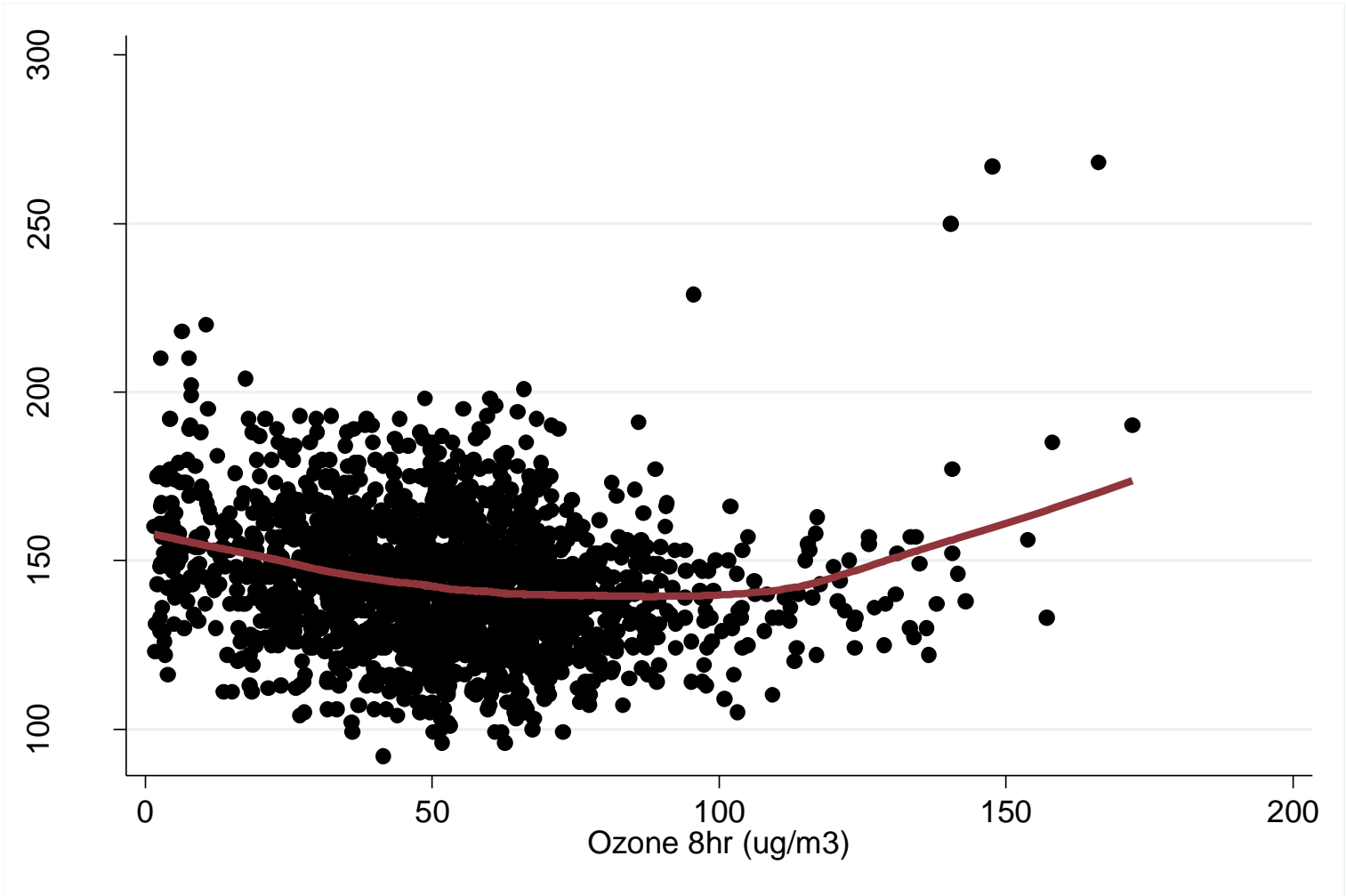
Short-term exposure studies - Panel

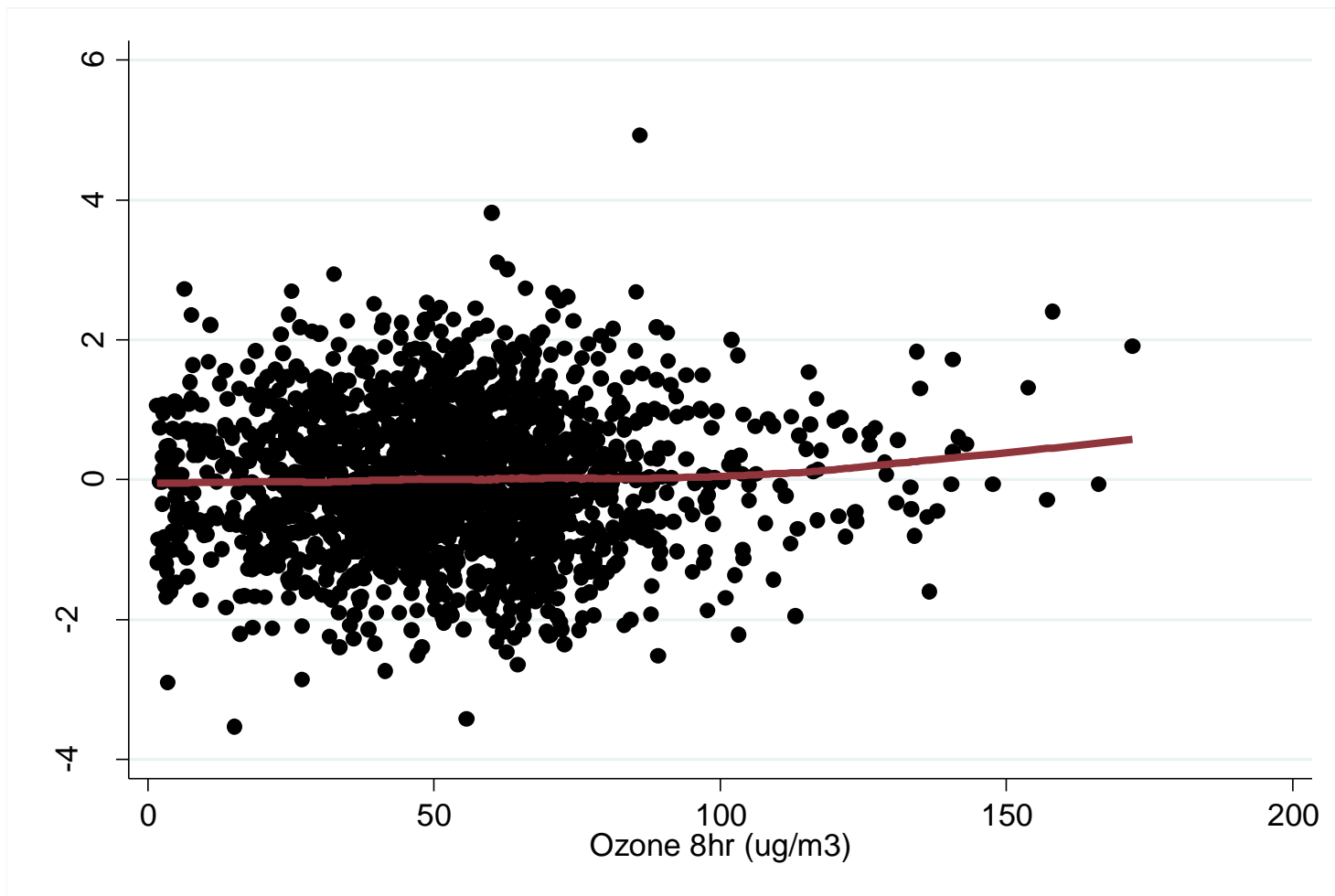


FVC and PM₁₀ daily over 46 days Surrey UK, June 1994
(Scarlett et al 1996)

Short-term exposure studies – Ecological







RR=1.0025 per 10 $\mu\text{g}/\text{m}^3$

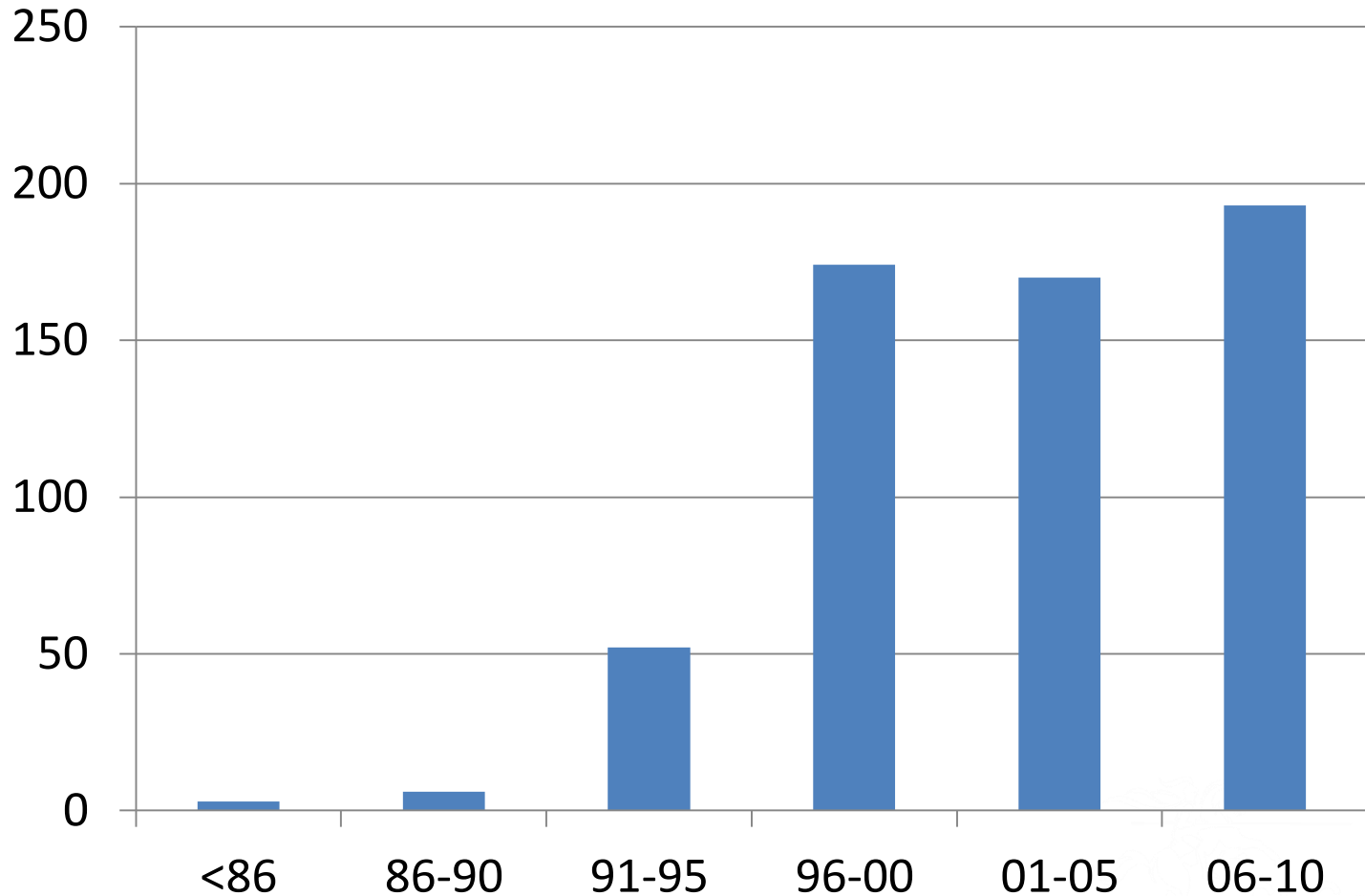
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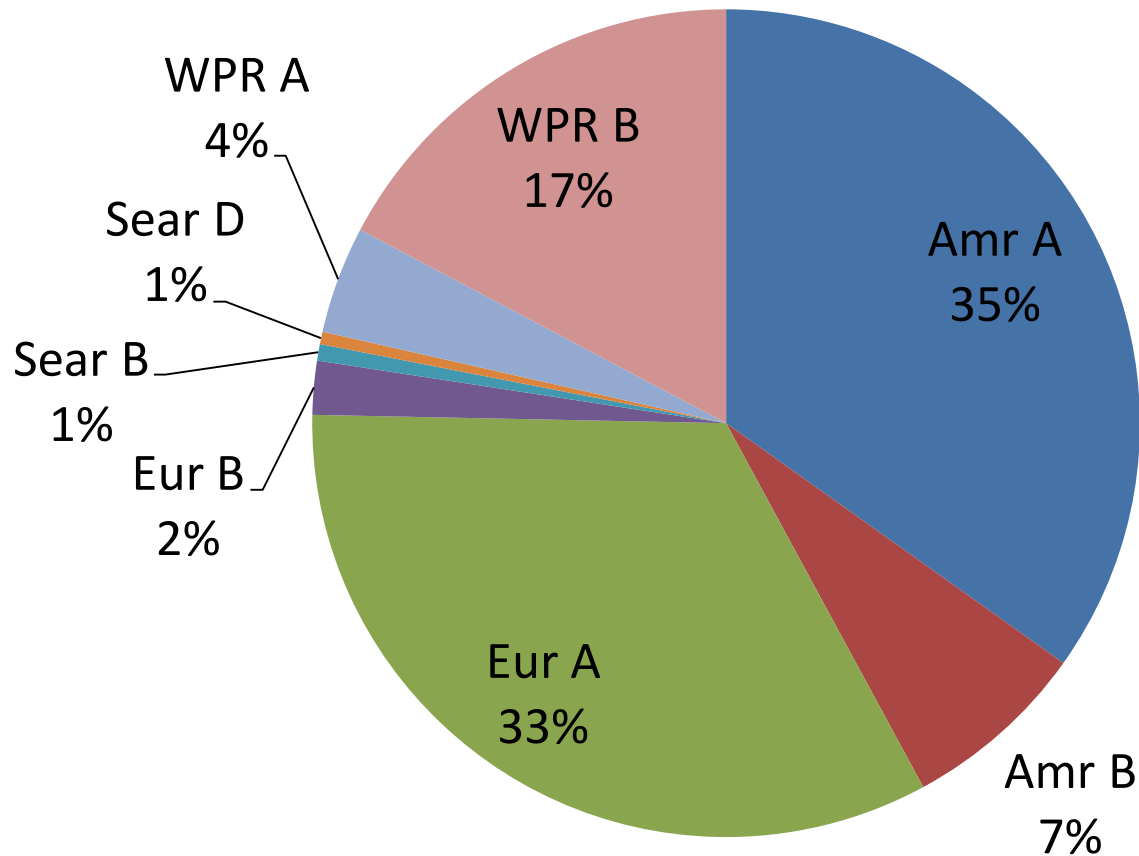
Air Pollution Epidemiology Database

- >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

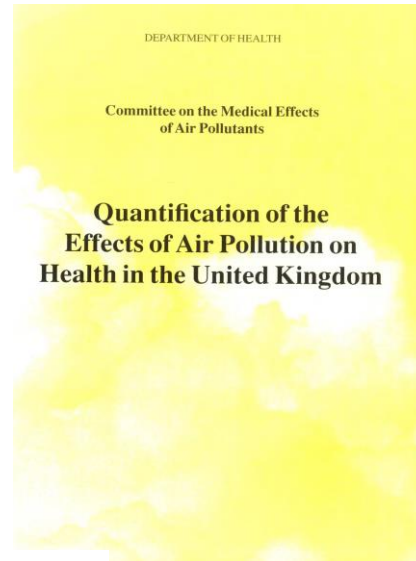
published studies by lustrum



Studies by WHO Region



Policy interface



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.

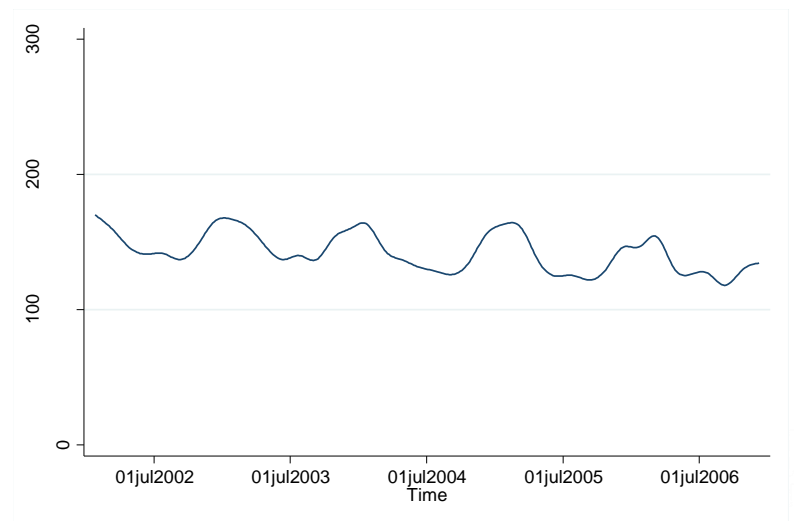
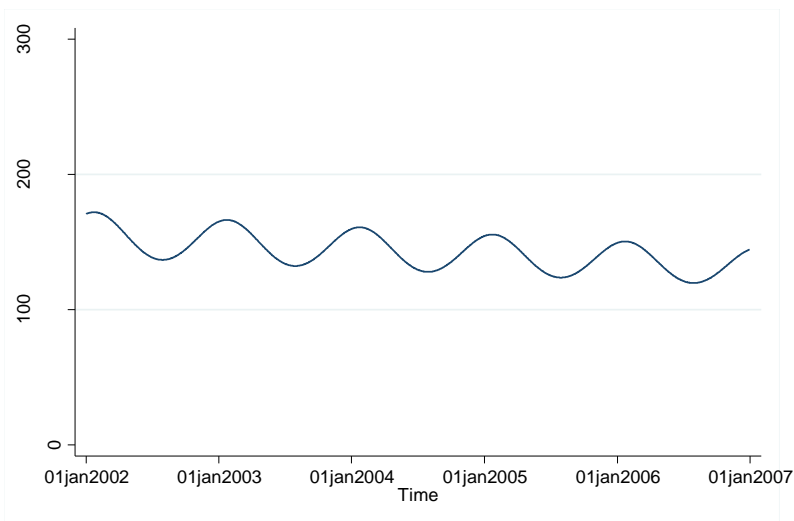
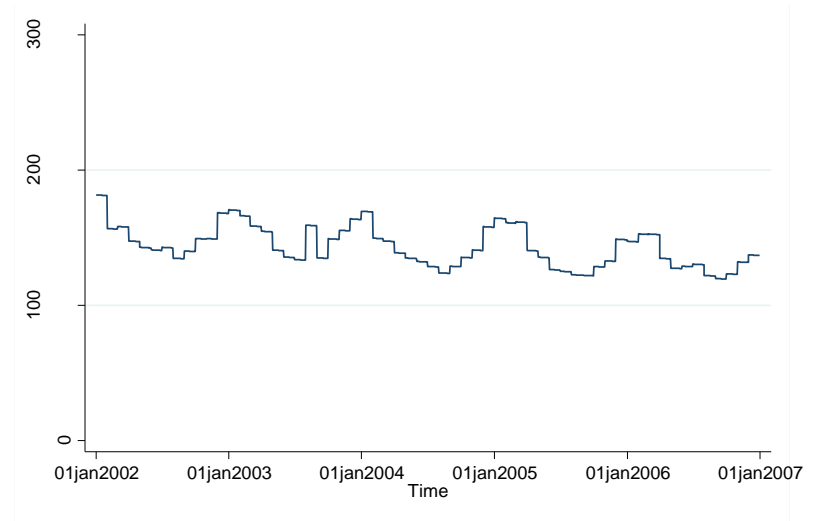
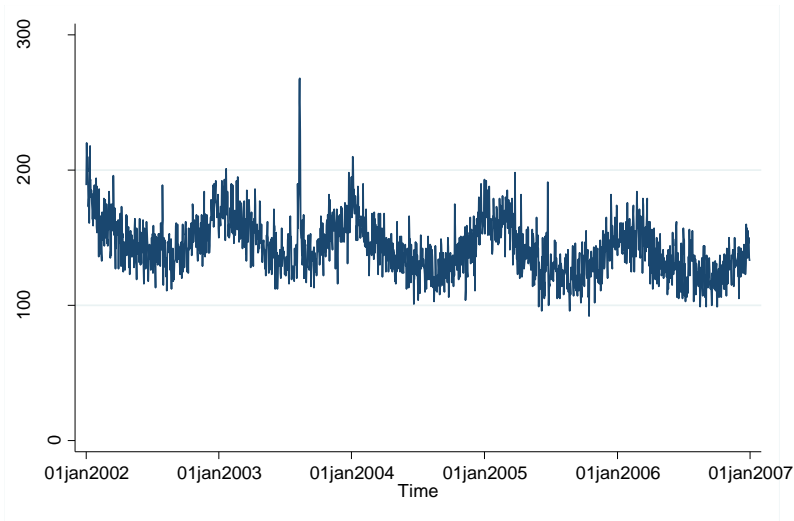


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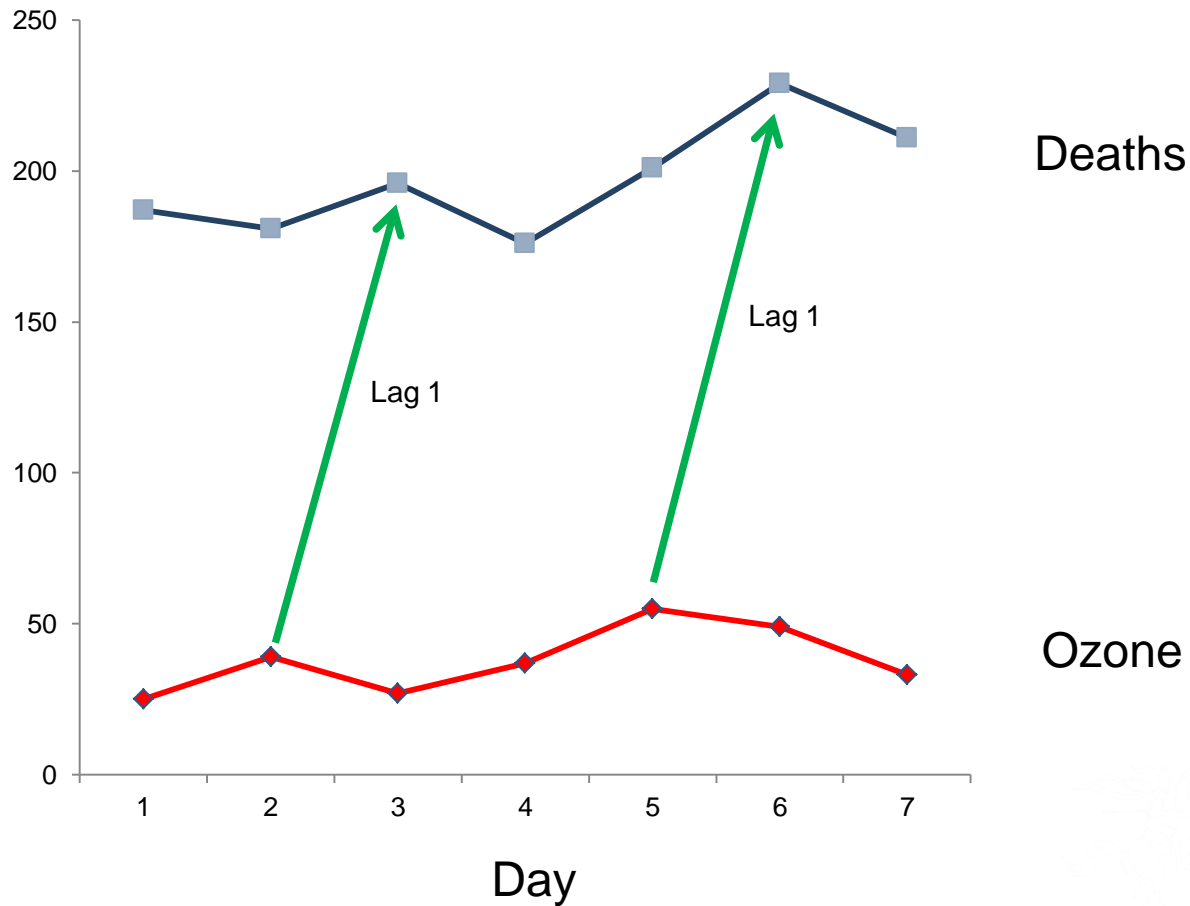
Methodological Developments

Seasonal control



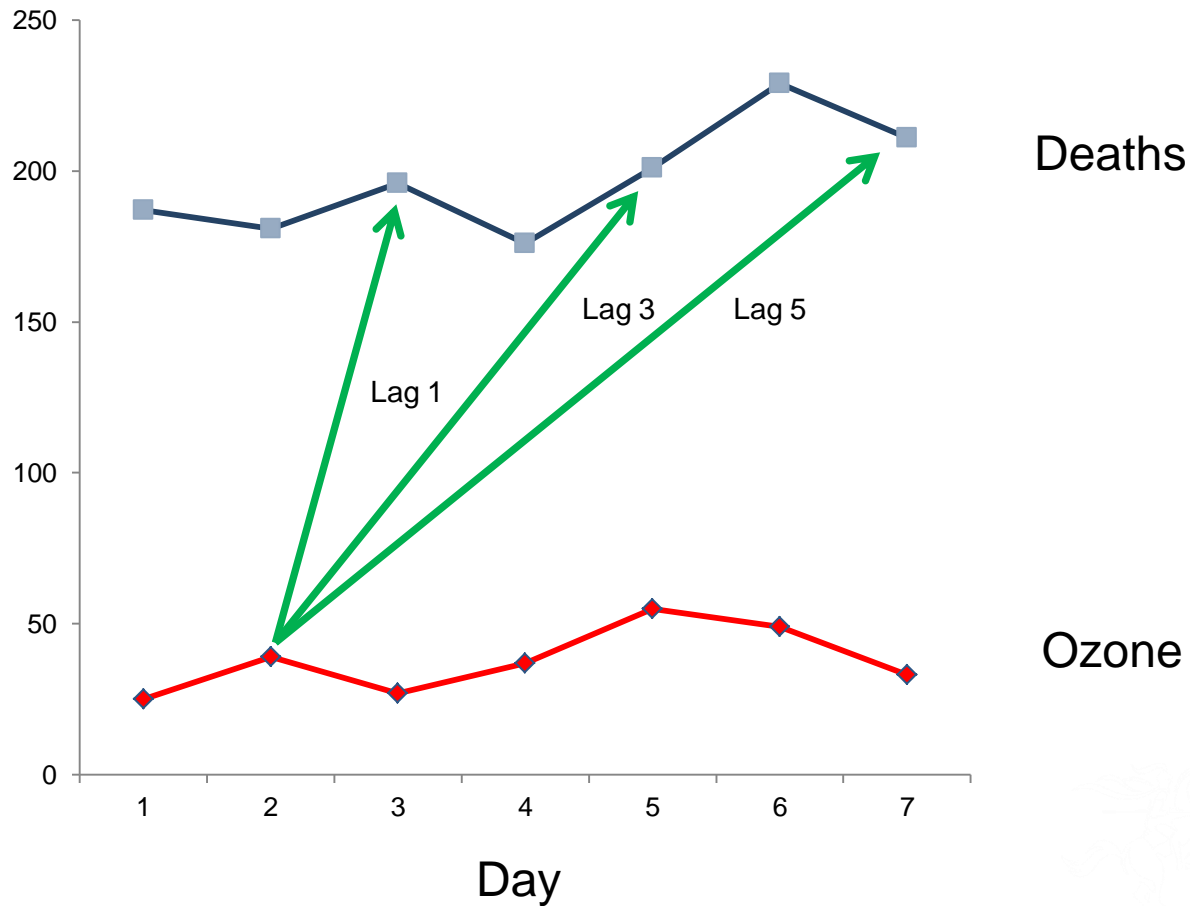
Methodological Developments

Lag structure



Methodological Developments

Lag structure



Deaths

Ozone

Methodological Developments

Lag structure

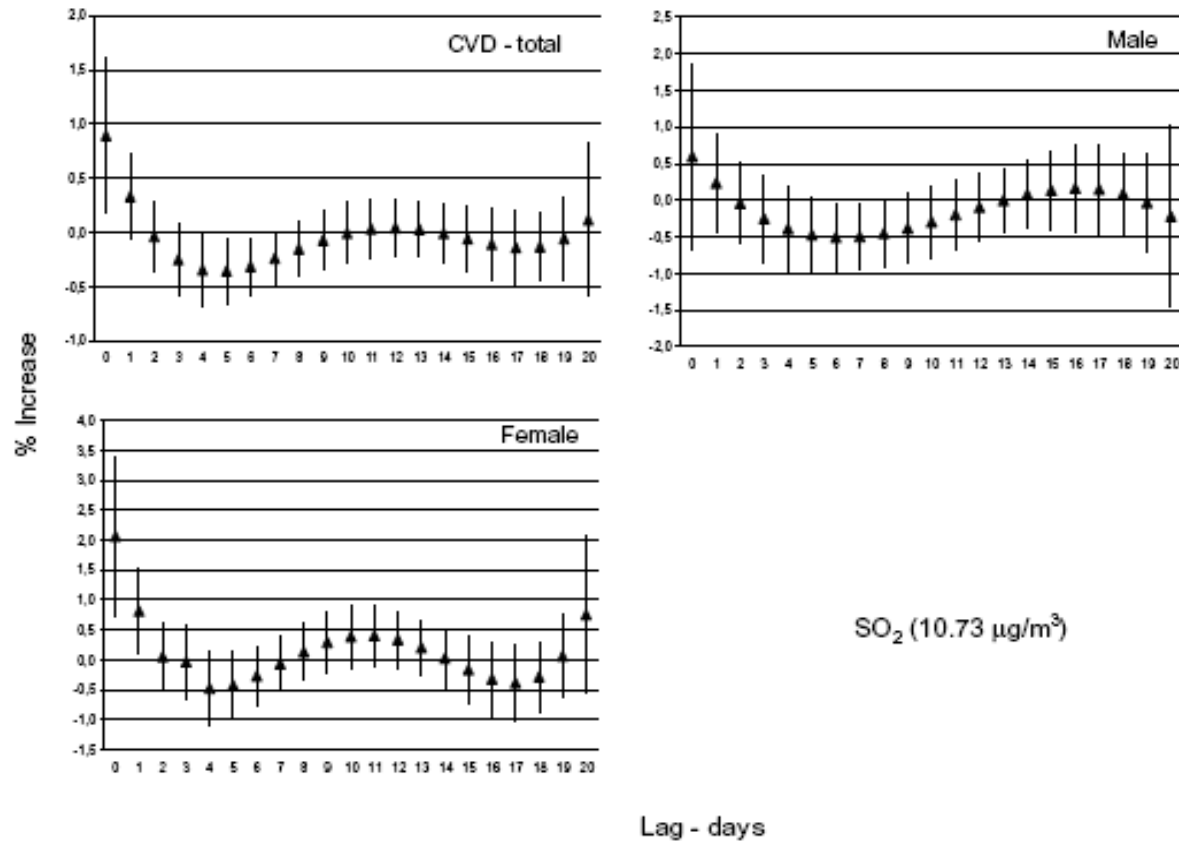


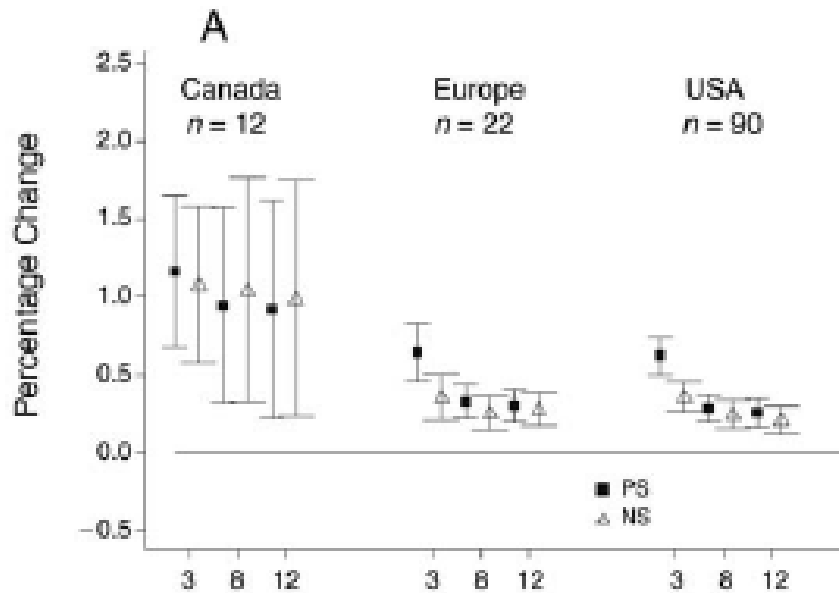
Figure 1 - Lag structure of the effects of an interquartile range increase in SO₂ (10.73 µg/m³) on total, male, and female cardiovascular disease (CVD) hospital admissions. São Paulo, Brazil, 1996-2001.

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



PM₁₀ and all cause mortality

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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 ClearLo 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

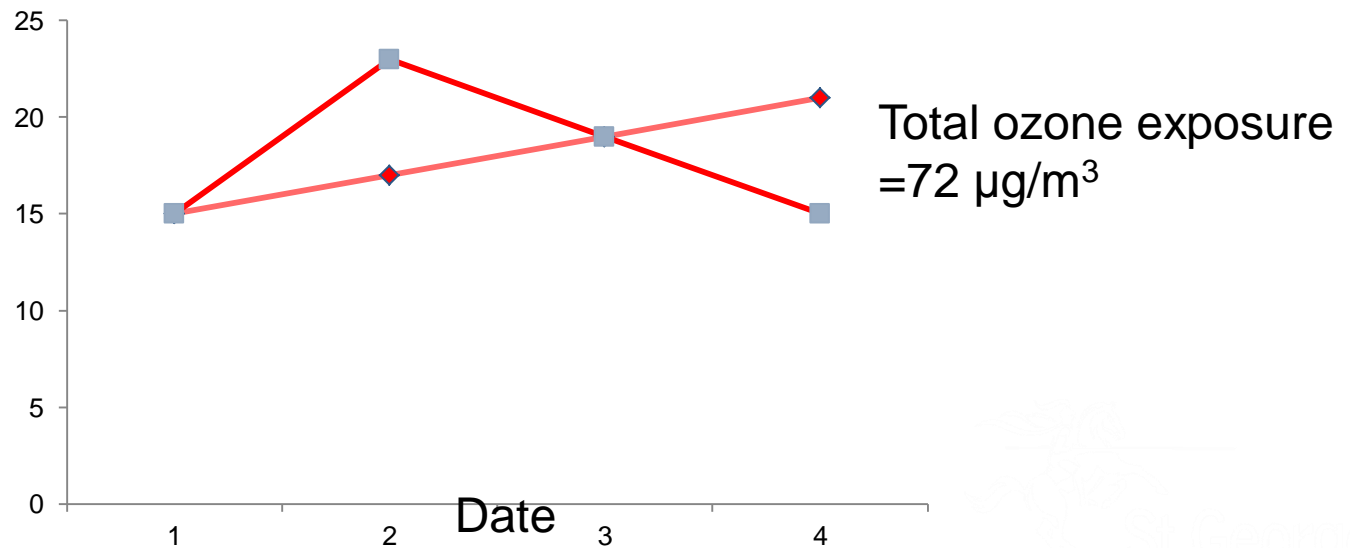
Rationale	Metric
Regulated	
Particles	PM ₁₀
Particles	PM _{2.5}
Gaseous	NO ₂
Gaseous	SO ₂
Gaseous	O ₃
Novel	
Oxidative Potential	OP1A, OP1G, OP1T OP2A, OP2G, OP2T
Wish List	
Heavy fuel oil combustion	Ni, V
Regional secondary particles	SO ₄ , NO ₃
Carbon source apportionment	

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Delta study

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



**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

Thank you

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