

# ***A journey through time – series analyses***

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

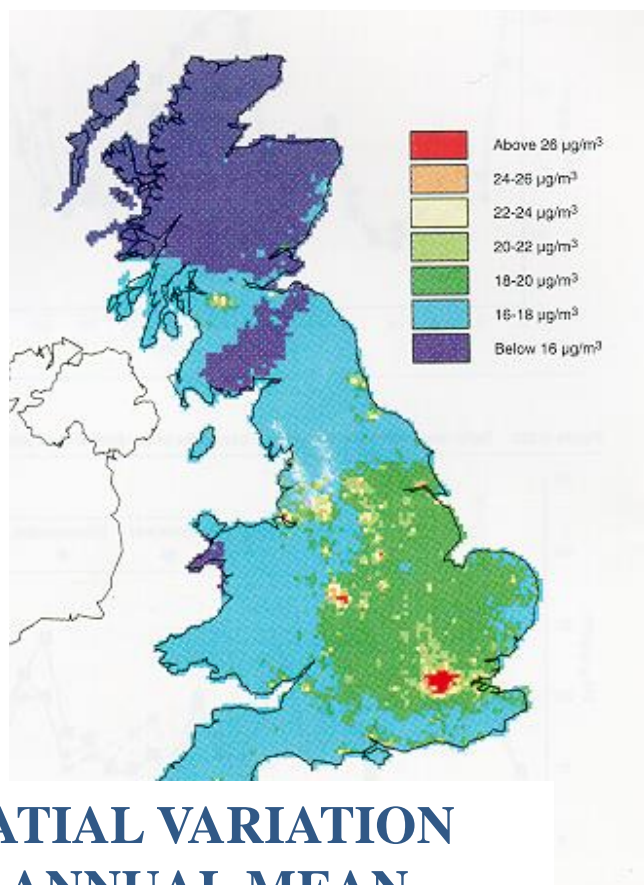
# Exposure and effect

	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)



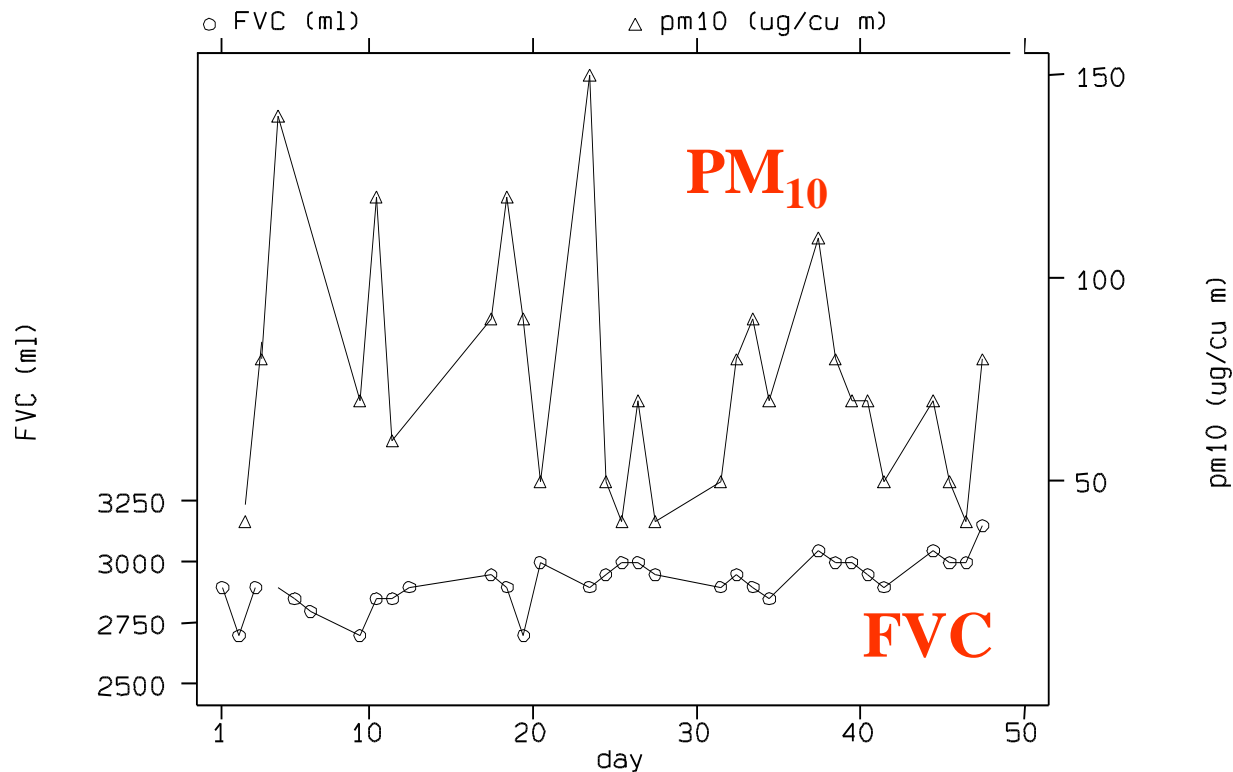
**SPATIAL VARIATION  
IN ANNUAL MEAN  
PM<sub>10</sub> IN UK 1991**

- mortality or utilisation rates (ecological studies)

- prevalence (cross-sectional studies)

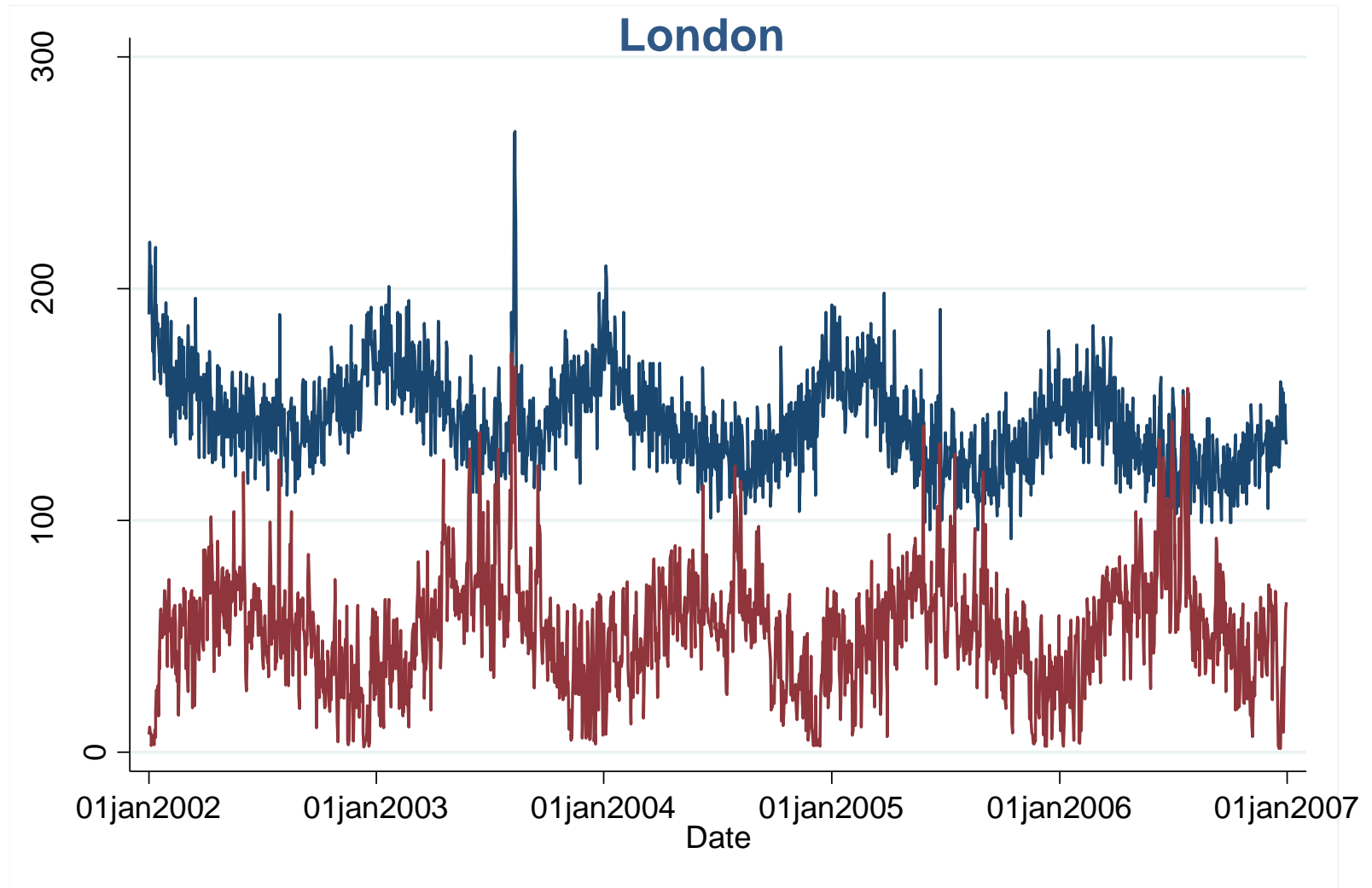
- incidence (cohort studies)

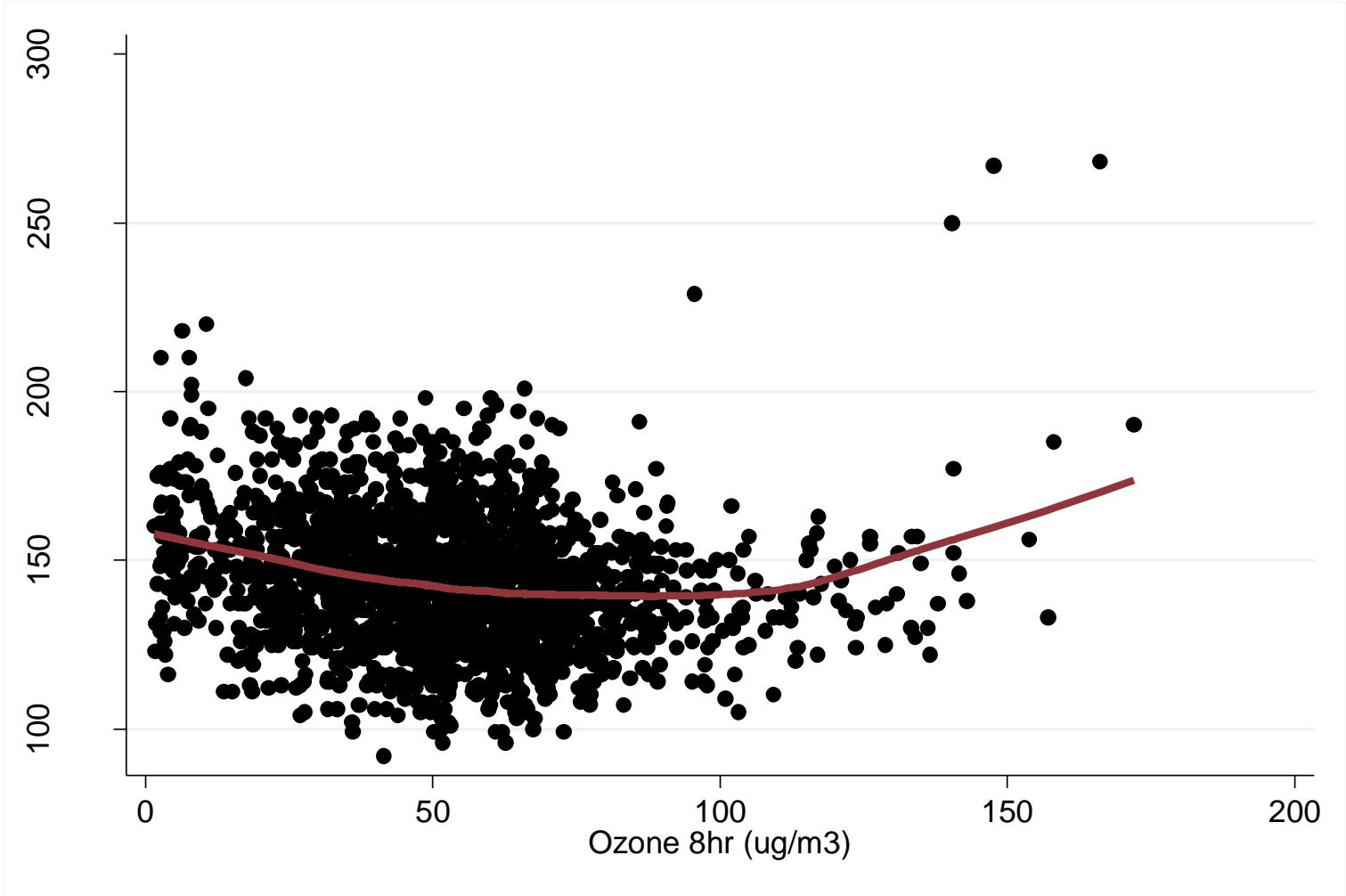
# Short-term exposure studies - Panel

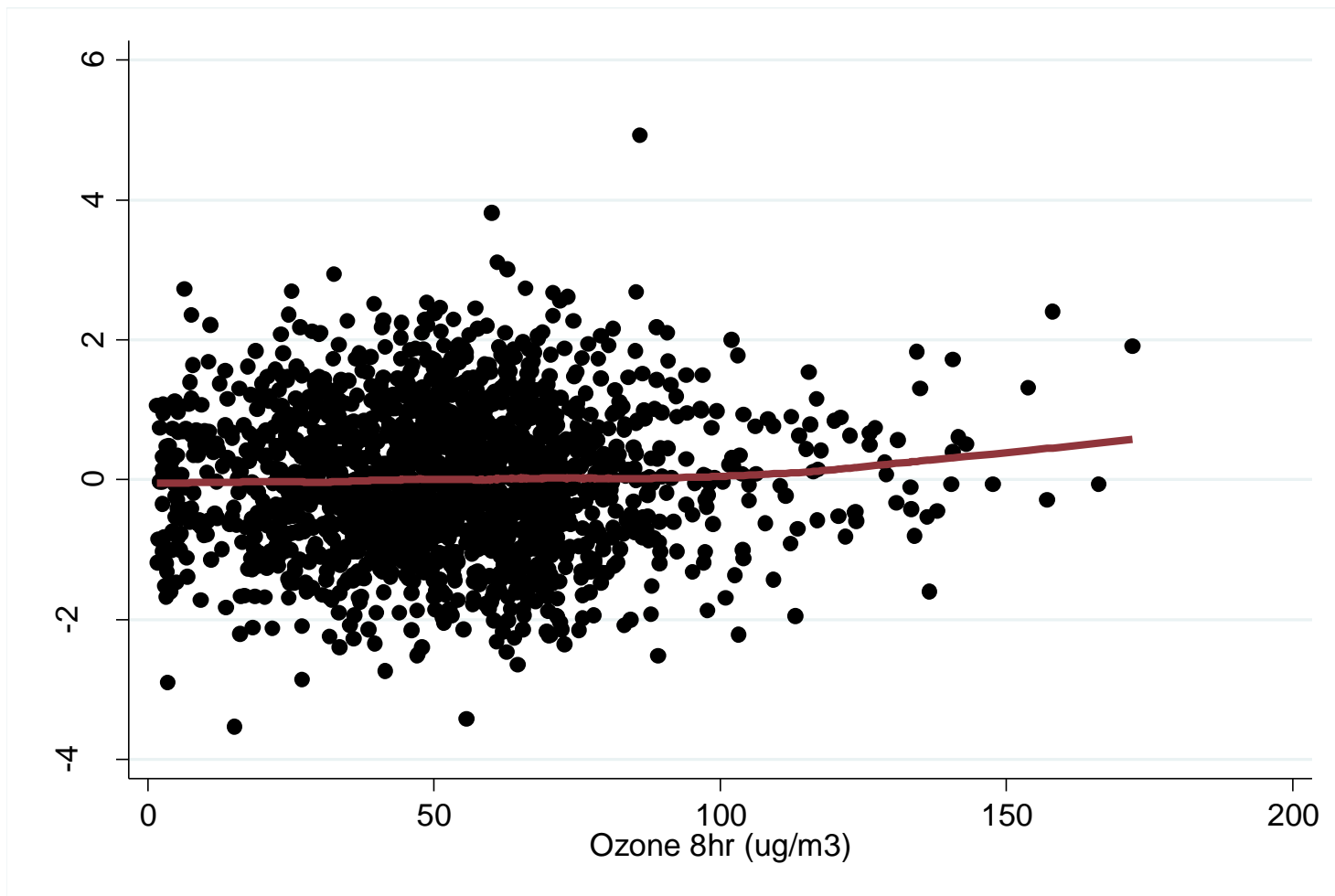


**FVC and PM<sub>10</sub> daily over 46 days Surrey UK, June 1994**  
(Scarlett et al 1996)

# Short-term exposure studies – Ecological







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



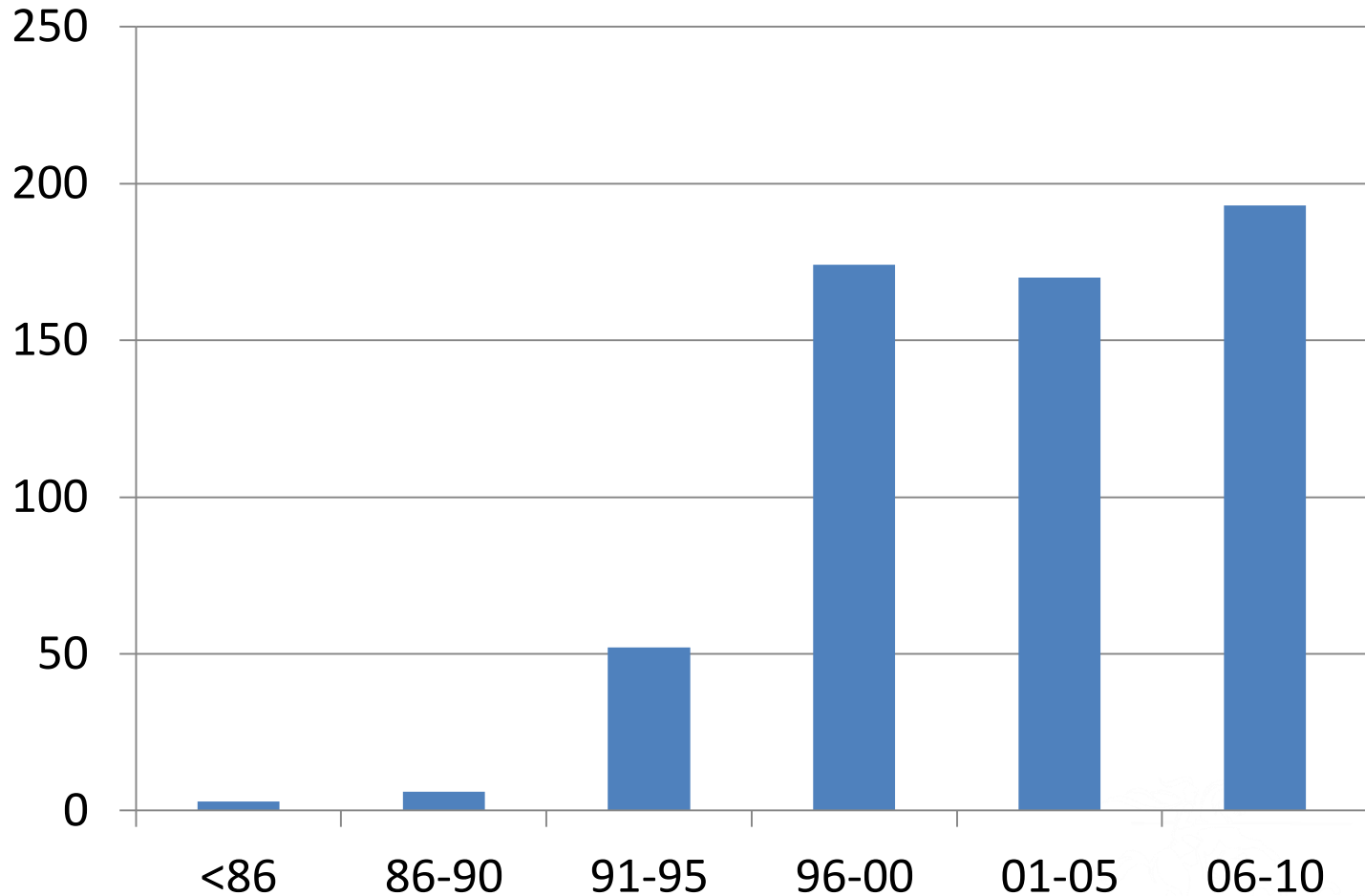
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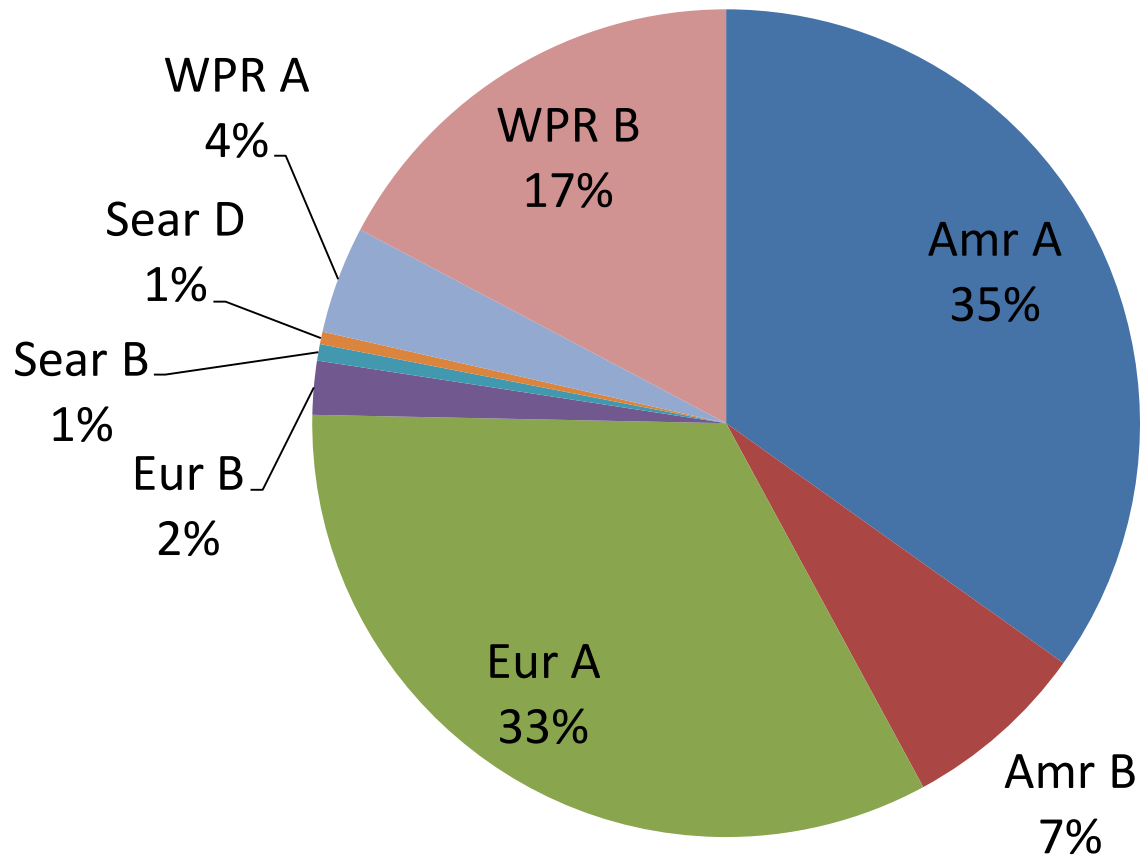
# Air Pollution Epidemiology Database

- >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

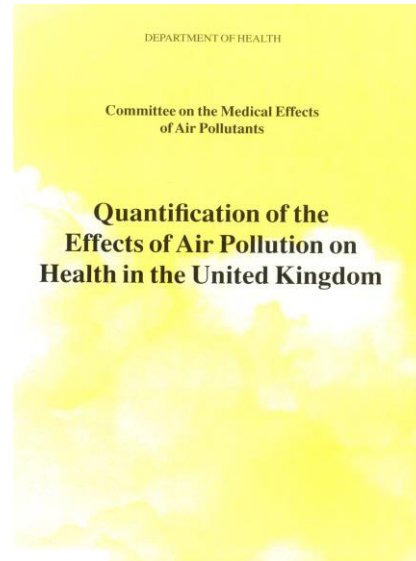
# # published studies by lustrum



# 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.

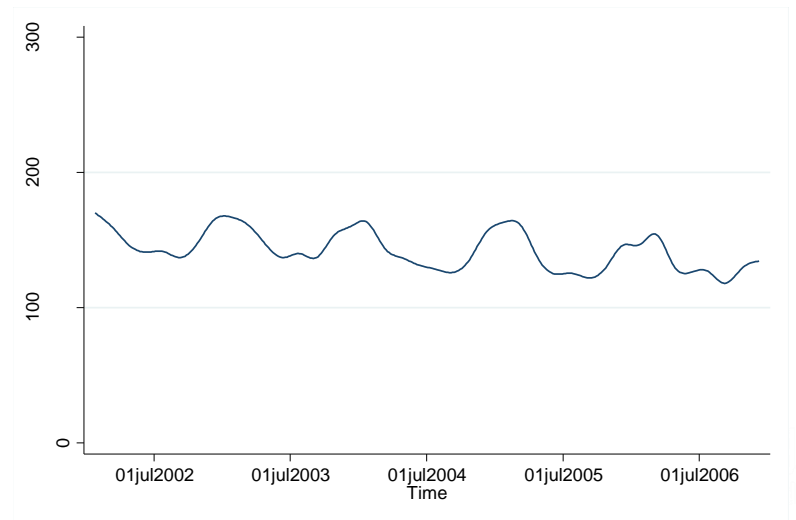
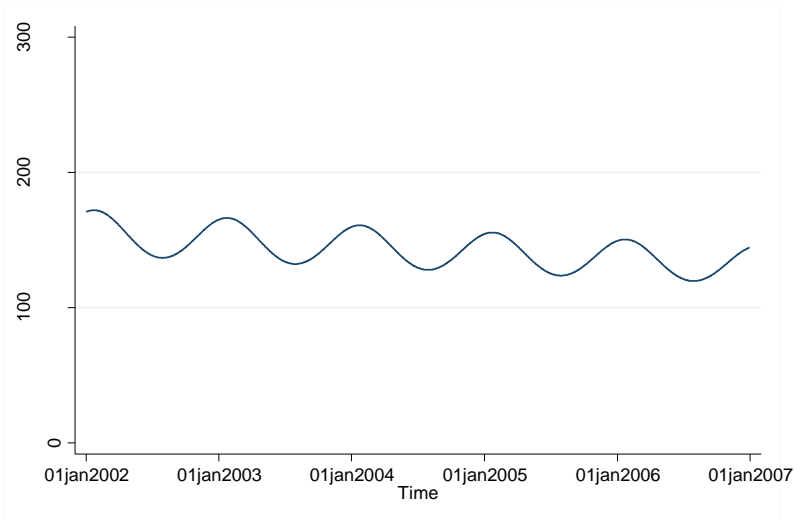
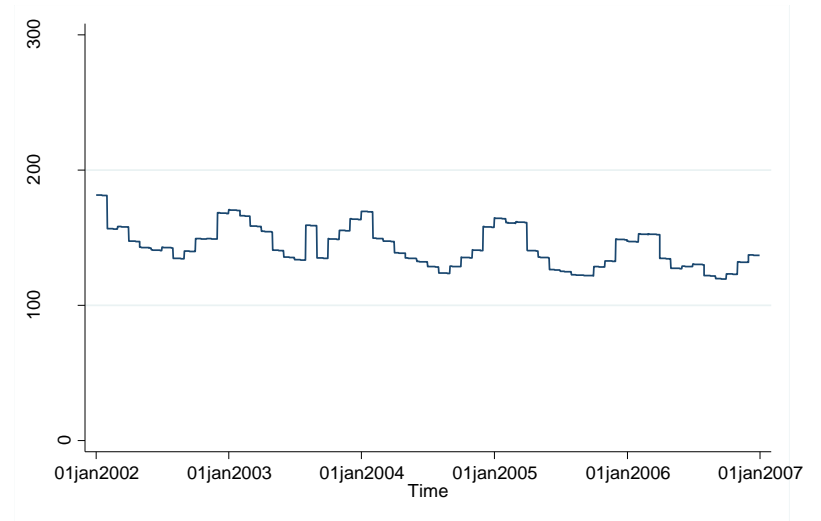
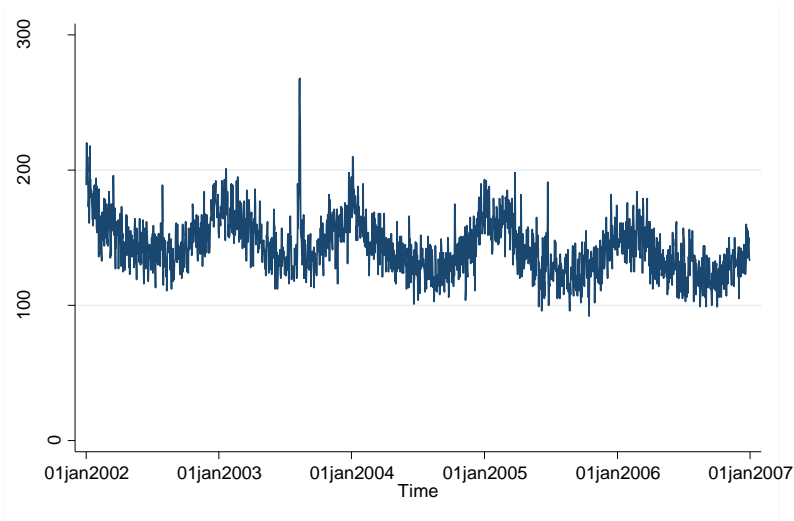


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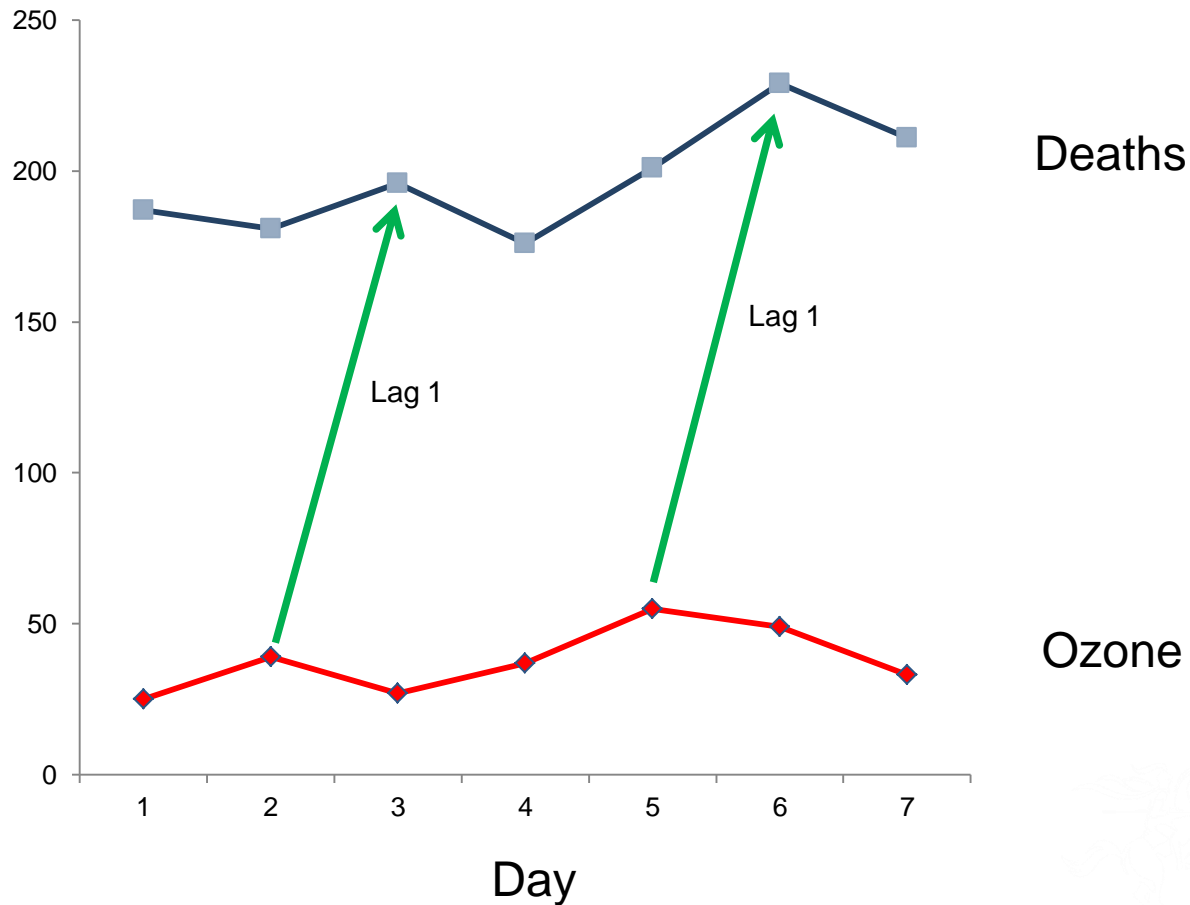
# Methodological Developments

## Seasonal control



# Methodological Developments

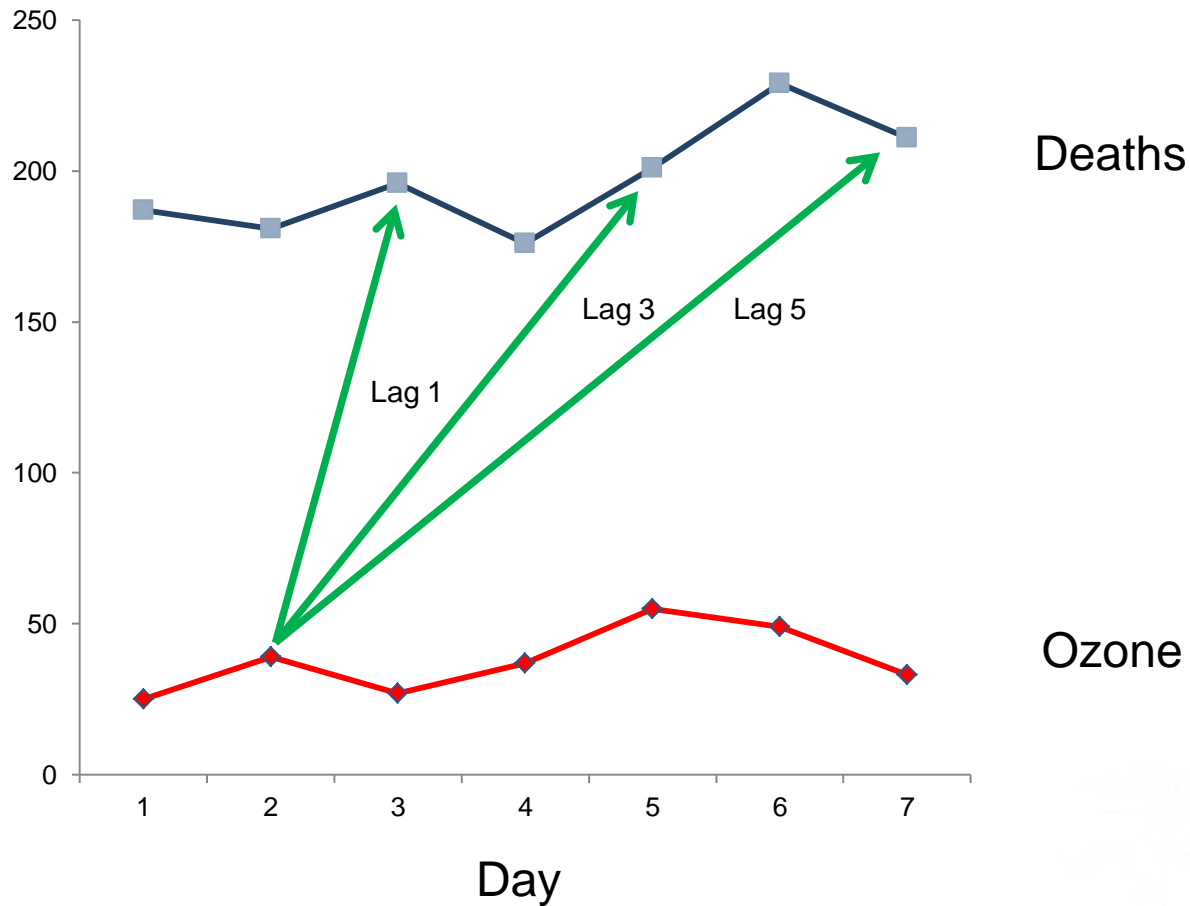
## Lag structure





# Methodological Developments

## Lag structure

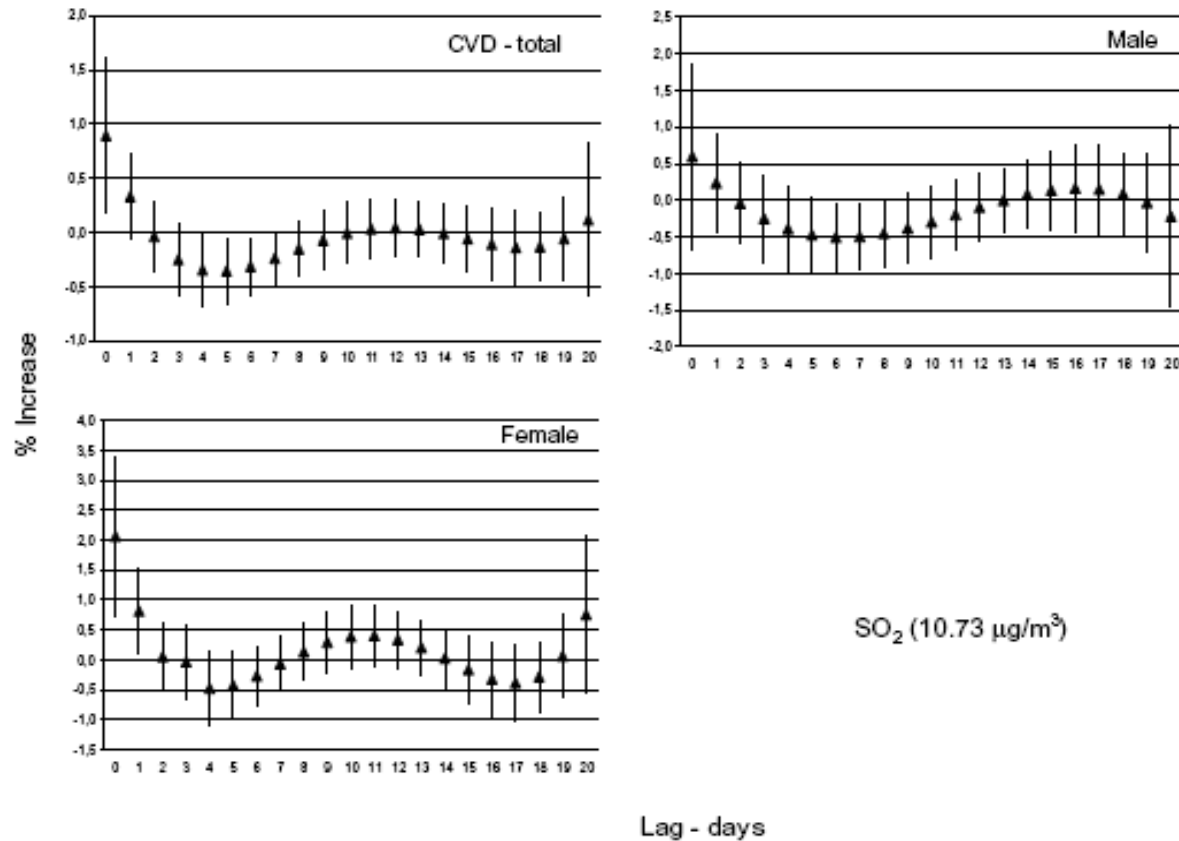


Deaths

Ozone

# Methodological Developments

## Lag structure



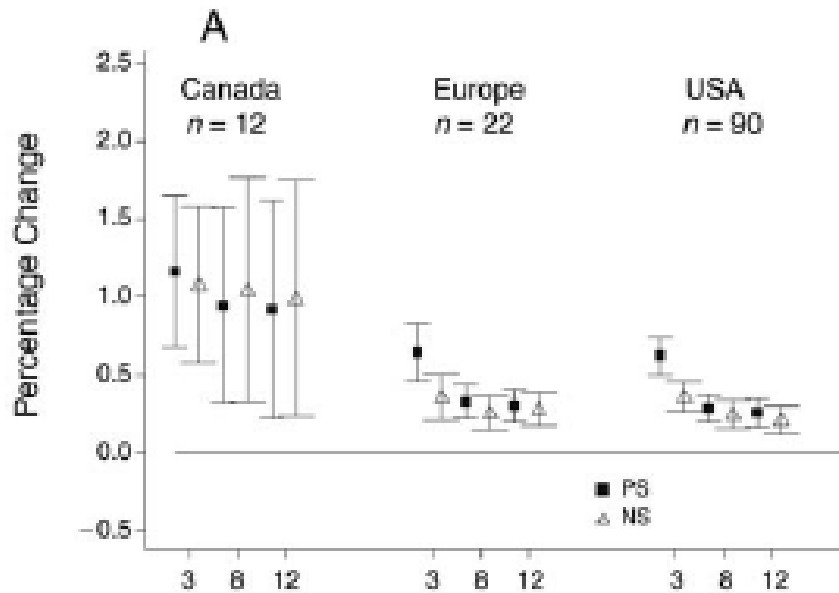
**Figure 1** - Lag structure of the effects of an interquartile range increase in SO<sub>2</sub> (10.73 μg/m<sup>3</sup>) on total, male, and female cardiovascular disease (CVD) hospital admissions. São Paulo, Brazil, 1996-2001.

# 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<sub>10</sub> 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
<b>Source</b>	
Traffic - general	NOX
Traffic – general	PMF Traffic source - Composition - Particle size
Traffic - exhaust – Diesel	BC/EC in PM <sub>2.5</sub>
Traffic - exhaust – Petrol	CO
Traffic - non-exhaust – Brake	Cu
Traffic - non-exhaust – Tyre	Zn
Traffic - non-exhaust - Re-suspension	Al

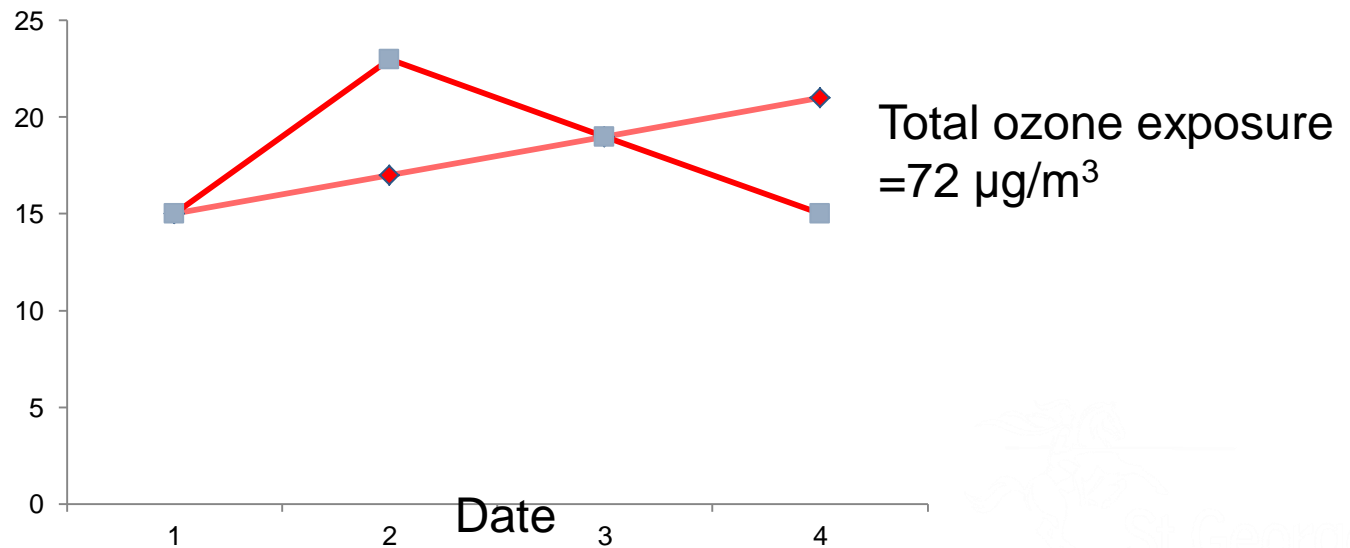
Rationale	Metric
<b>Regulated</b>	
Particles	PM <sub>10</sub>
Particles	PM <sub>2.5</sub>
Gaseous	NO <sub>2</sub>
Gaseous	SO <sub>2</sub>
Gaseous	O <sub>3</sub>
<b>Novel</b>	
Oxidative Potential	OP1A, OP1G, OP1T OP2A, OP2G, OP2T
<b>Wish List</b>	
Heavy fuel oil combustion	Ni, V
Regional secondary particles	SO <sub>4</sub> , NO <sub>3</sub>
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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