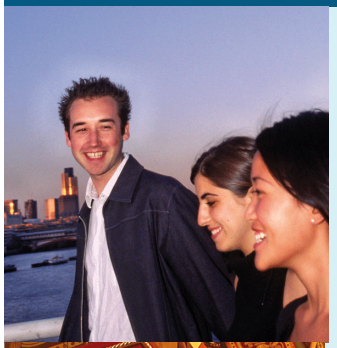
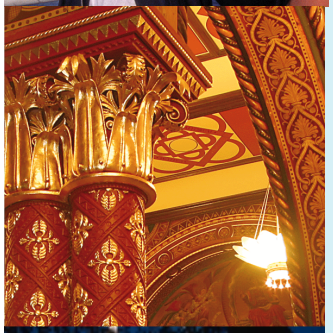
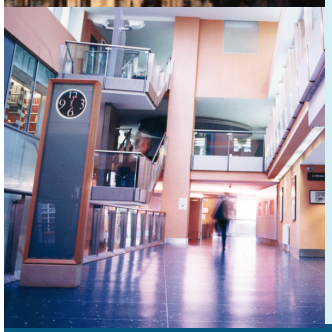






KING'S College LONDON

ERG Research Programme

LAQN Seminar 2009 David Green

Contents

ERG mission statements

"Combine the air pollution sciences to determine the impacts of air pollution on health and the causal factors."

"Provide support to the air quality management process / policy to minimise air pollution health effects."

Monitoring Team

Air Quality Management Interventions

- CCS and LEZ
- Waste sites
- D-NO_X paint

PM measurement

- Accurate mass measurements
- Chemical speciation

Indoor Air

CO_2

Interventions

CCS and LEZ

- Assessing impact
- Gaseous pollutants
- PM measurement and speciation

Waste sites

- Environment Agency
- London Boroughs Ealing, Bexley, Brent

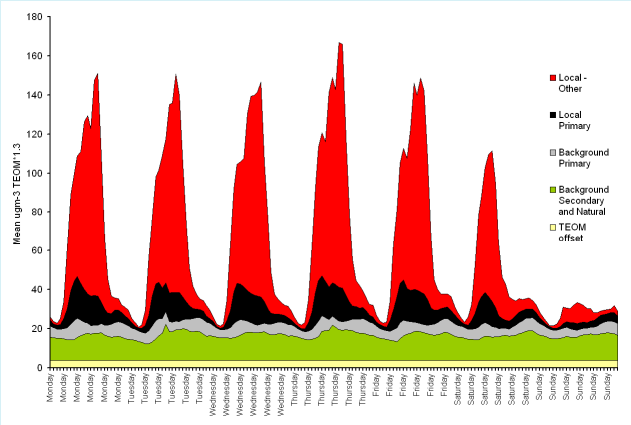
D-NO_X paint

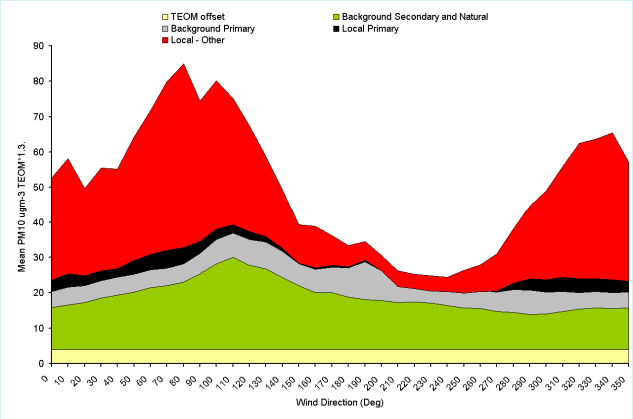
Waste sites

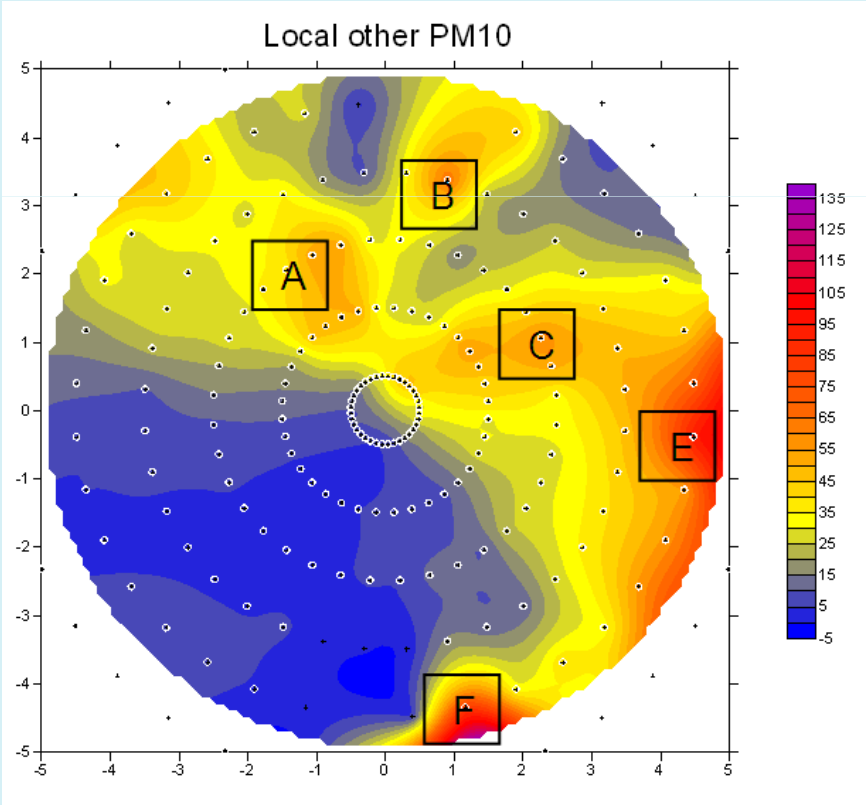
- Greatest concentrations of PM_{10} in London are on residential streets close to waste management sites
- Over 200 days per year with PM_{10} > 50 ✪g m^{-3} TEOM *1.3

Waste sites

PM_{10} source apportionment is necessary to indentify and quantify local sources

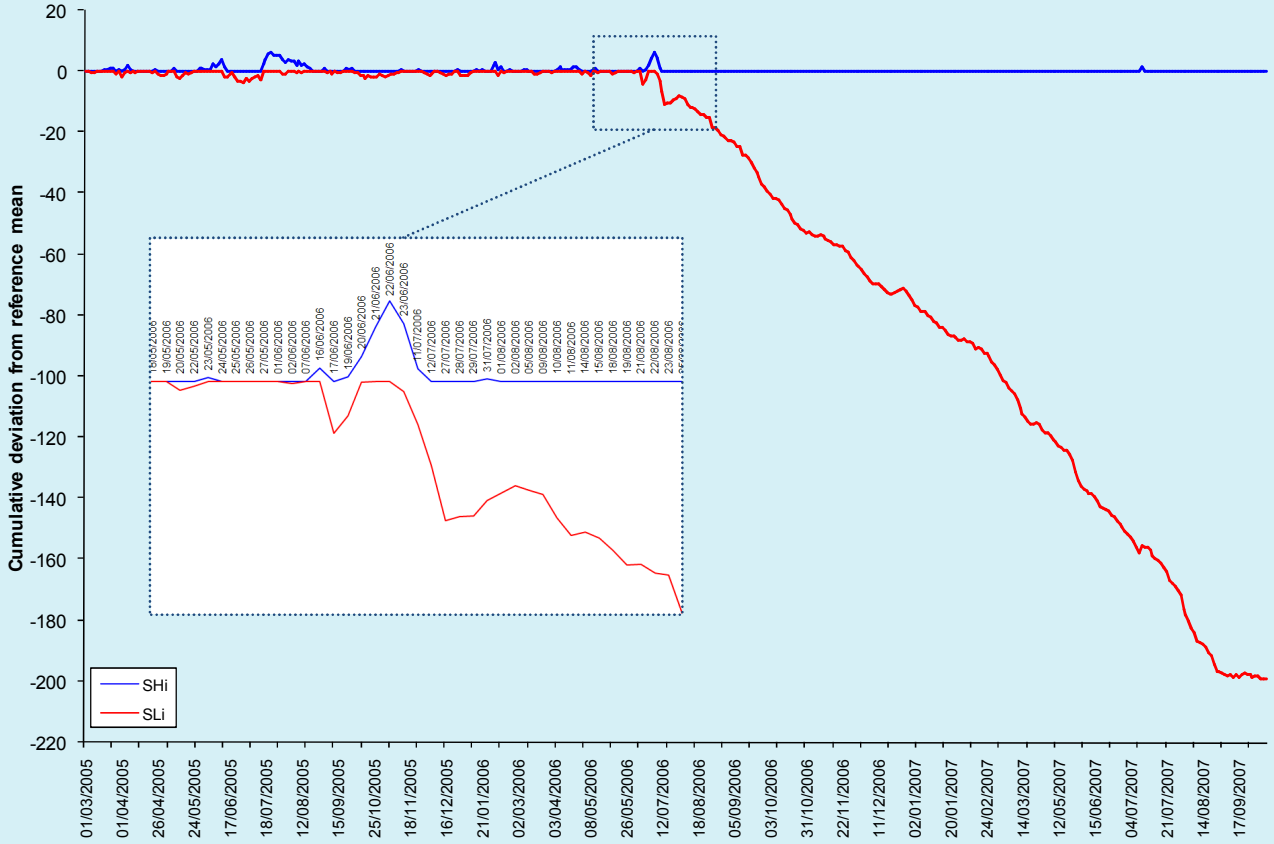






Waste sites

Hybrid model and CUSUM analysis to indentify changes from interventions



D-NO_X paint trial

Photcatalytic degradation of NO_X to nitrate using TiO_2 paint

LB Camden

- Can it be a useful tool for AQM?
- Courtyard of St Martins College
- High concentrations, poor ventilation
- 130 m^2 of wall painted, approx ✪ of courtyard
- 2 NO_X analysers, 10cm and 1m from the wall
- 1 year pre, approx 1 year post paint application

PM measurement

Improving accuracy of PM mass measurement

- FDMS
- Volatile Correction Model

PM chemical speciation

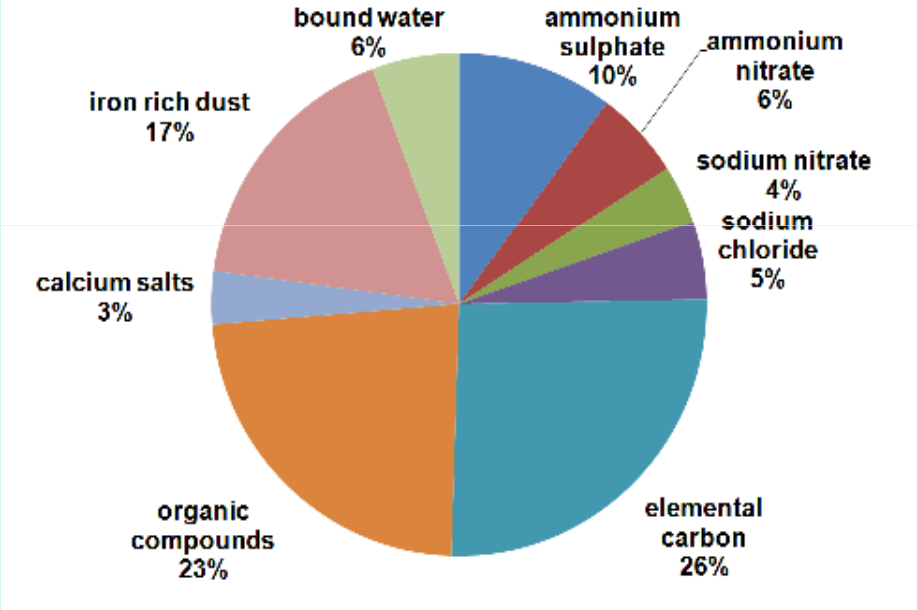
- Semi-volatile PM
  - FDMS purge, ammonium nitrate measurements
- Primary PM
  - Black carbon measurements using Aethalometry
- Mass closure
  - Swiss Cottage, Brent North Circular and Blackwall Tunnel

Volatile Correction Model

- VCM now recommended method for correcting TEOM measurements for LAQM
- VCM Web Portal
- www.volatile-correction-model.info
- Development of $PM_{2.5}$ model

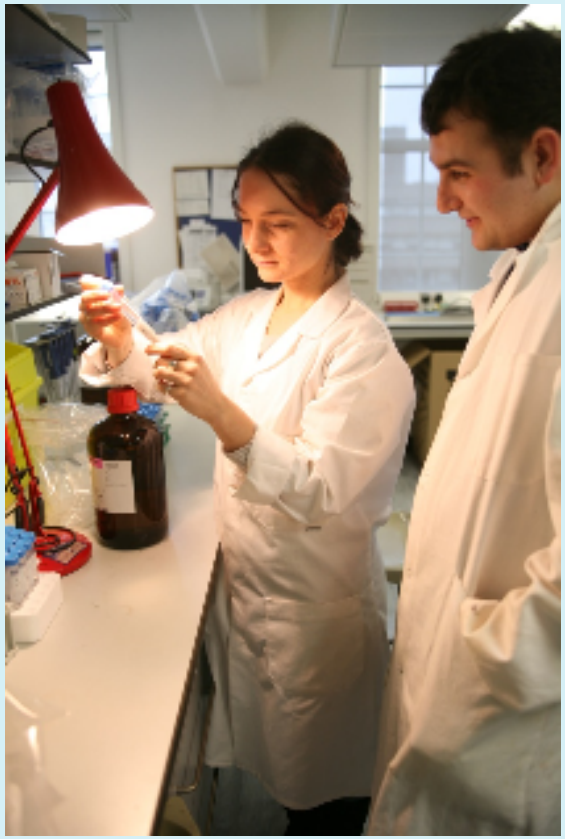
PM chemical speciation

- Diverse chemical and physical composition
- Range of sources, both primary and secondary
- Transformed in the atmosphere and upon measurement
- How do these components respond to quality management practices and climate change?
- Which components are driving the effects on human health?



Composition of roadside PM_{10}. Source: Harrison et al (2004)

Automatic, sampling and laboratory analysis



Biomass baseline for London

- Quantify PM_{10} from wood burning
- Establish a baseline for future comparison
- Sampling and analysis of Levoglucosan
- Sampling completed during winter in Greenwich and Bexley
- Analysis underway at NILU

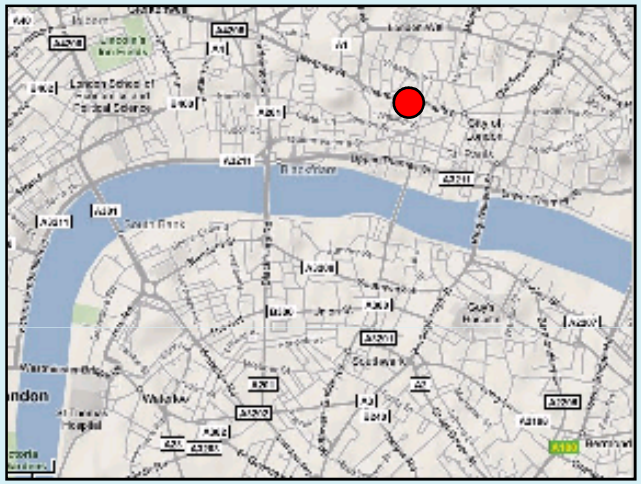
Indoor Air

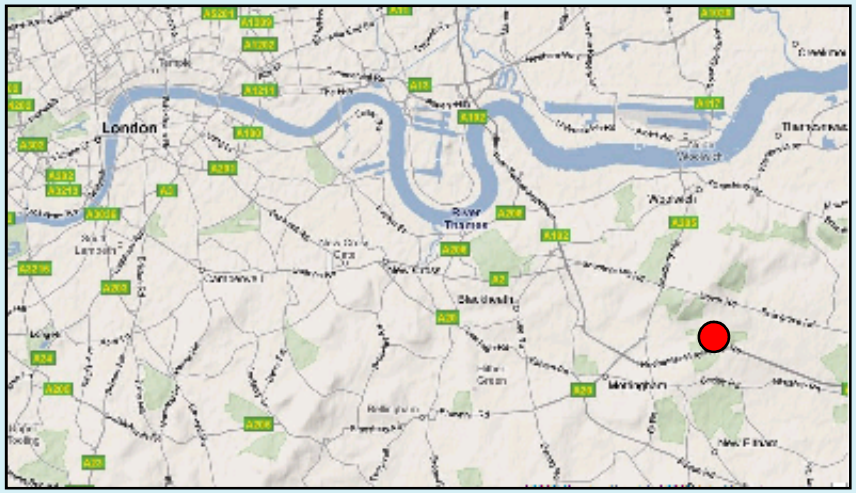
To measure air pollution (NO_X and O_3) indoors and outdoors, to assess the effects of meteorology and building activity on the transfer of air pollutants.

Two contrasting building types: mechanically and naturally ventilated.

Using standard ambient instruments to produce a high quality long-term data set for indoor air quality assessment within London.

Indoor Air – *Corporation of London and LB Greenwich*





CO_2 Monitoring

- Assessing the progress of existing and future vehicle-related CO_2 reduction measures
  - EU emissions standards, electric cars
- Roadside CO_2 measurements used as vehicle emission indicators to support emissions modelling applications.
- The combination of roadside and urban background data used in atmospheric transport studies.

CO_2 – *Marylebone Road and North Kensington*

- Undertook preliminary Li-COR measurements to assess concentration range
- Casella ETI loaned 2 Monitor Labs gas filter correlation IR instruments
  - Marylebone Road and North Kensington
  - Installed October 2008
- ET loaned API gas filter correlation IR instrument and Synspec CO_2 and CH_4 GC
  - Marylebone Road
  - Installed Feb 2009
- Recently been joined by Li-COR measurement made by Imperial College at Marylebone Road in conjunction with those taken at Silwood Park

Modelling Team

Emissions inventories

- Hourly traffic inventory

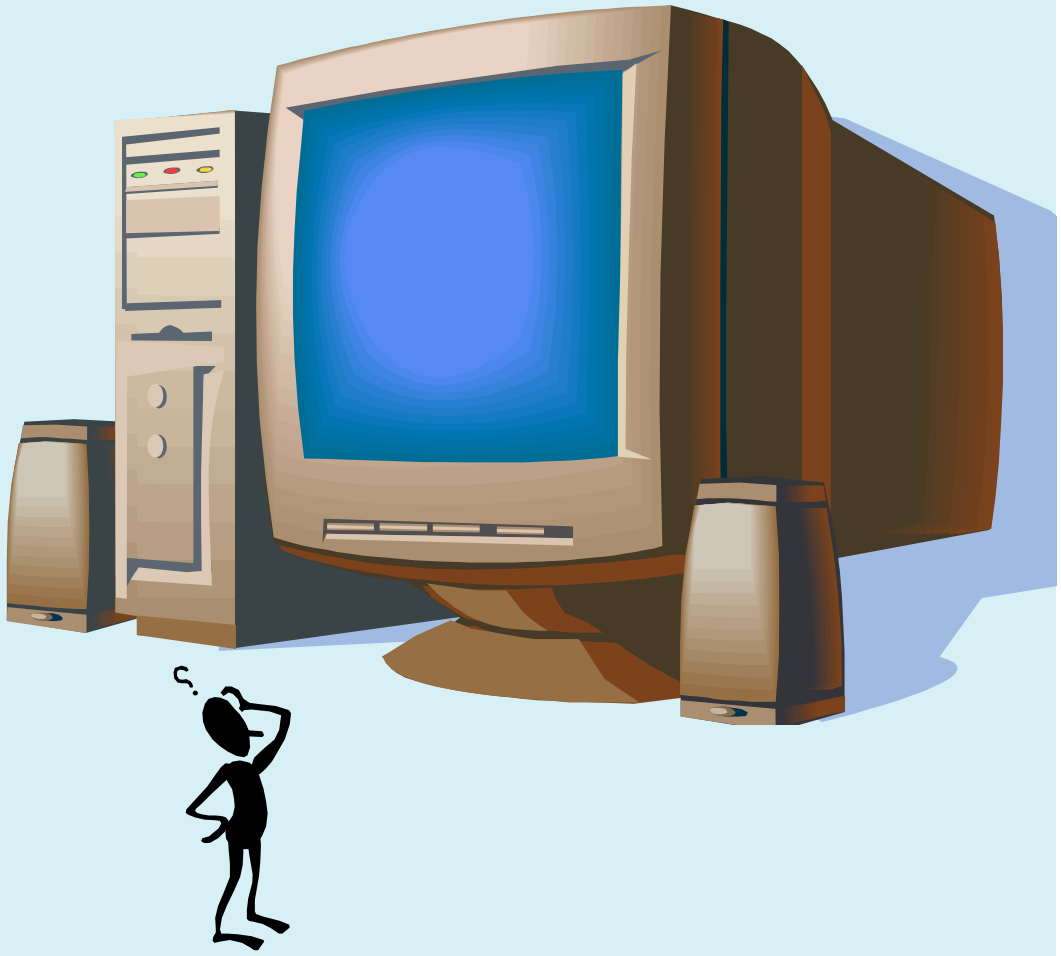
Impacts of climate change on health

- Epidemiology with St. George's Medical School

Community Multiscale Air Quality (CMAQ) Modelling

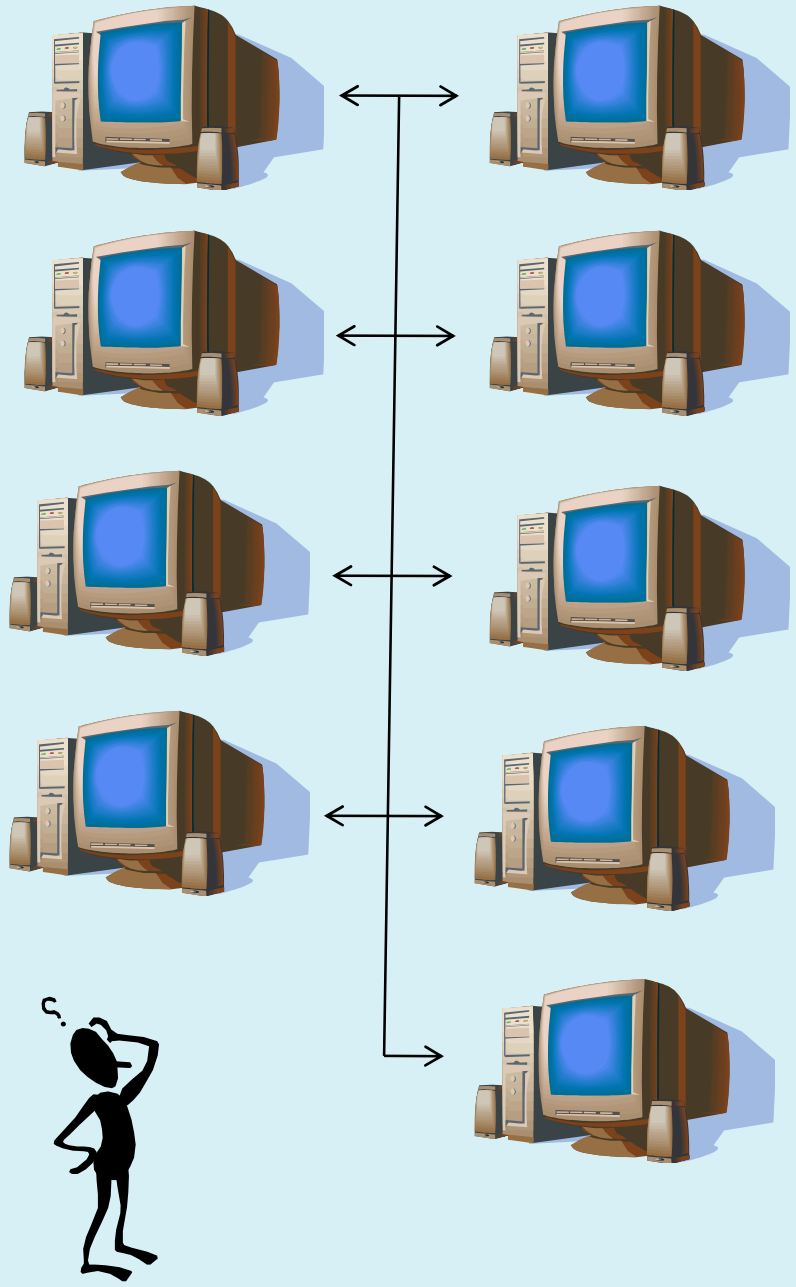
CMAQ

- Developed by US EPA
- Multi-level model
- Multi-pollutant (NO_X, O_3, PM, also PM speciation)
- Evaluate the impacts of air quality management practices and climate change on concentrations and human health
- 2005 and 2006 met years



CMAQ

- Developed by US EPA
- Multi-level model
- Multi-pollutant (NO_X, O_3, PM, also PM speciation)
- Evaluate the impacts of air quality management practices (and climate change) on concentrations and human health
- 2005 and 2006 met years



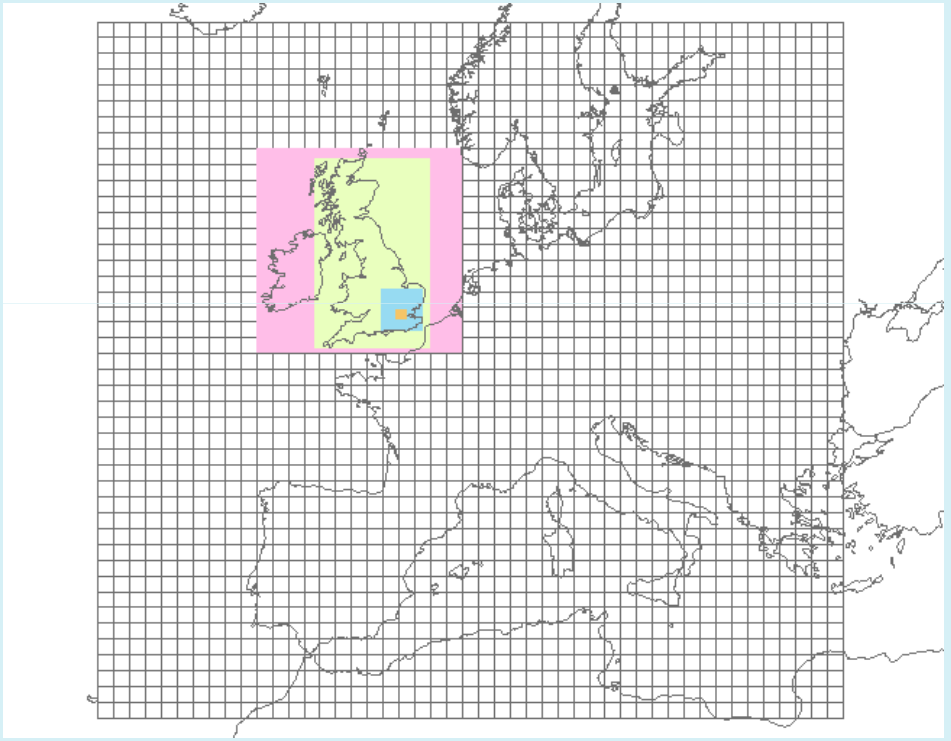
CMAQ Developments

- Emissions
  - Detailed traffic emissions, expanded to south east England
  - Emissions processor biomass burning
  - Biogenic emissions
  - 3D hourly emissions output
- Meteorology
  - MM5, WRF and UK Met Office's Unified model (UM)
  - Urban meteorology (heat fluxes and surface roughness) with Geography Dept at King's

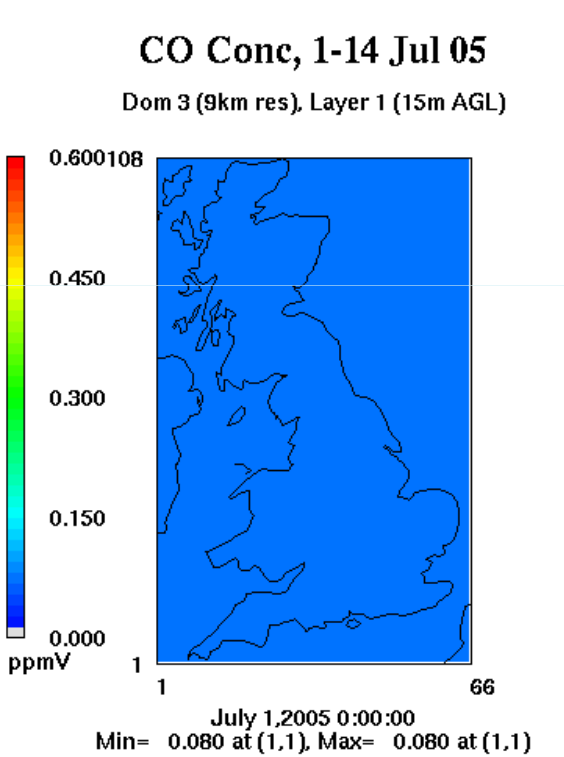
CMAQ Domains

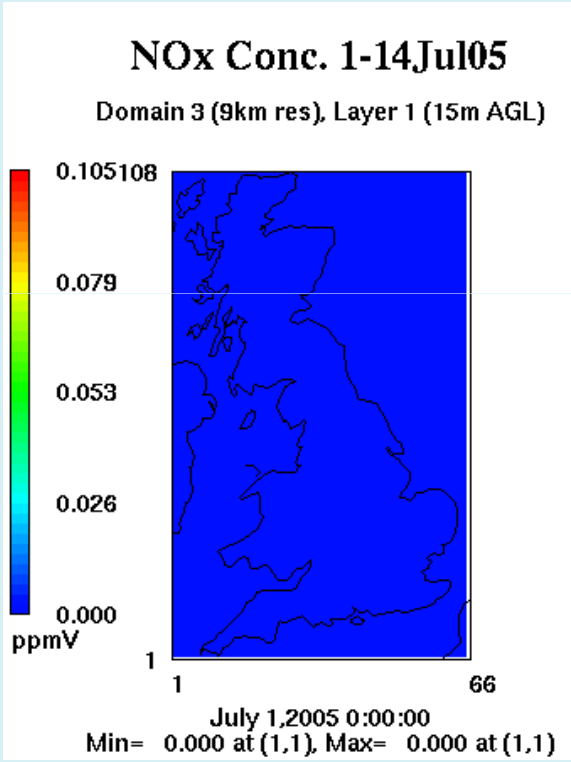
1. 81km grid spacing, 47 x 44 cells
2. 27km grid spacing, 39x39 cells
3. 9km grid spacing, 66x108 cells
4. 3km grid spacing, 72x72 cells
5. 1km grid spacing, 61x51 cells

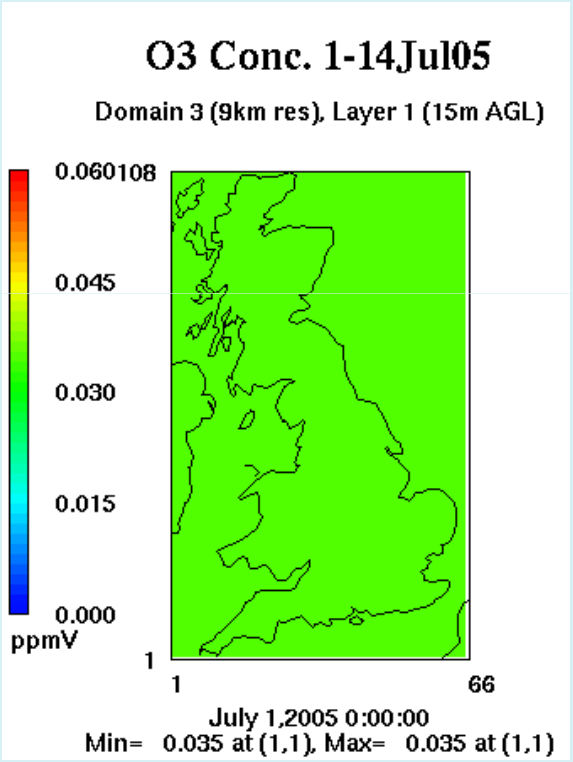
Vertical Domain: 23 Layers with 7 layers under 800 m above ground



CMAQ Outputs







Lung Biology Team

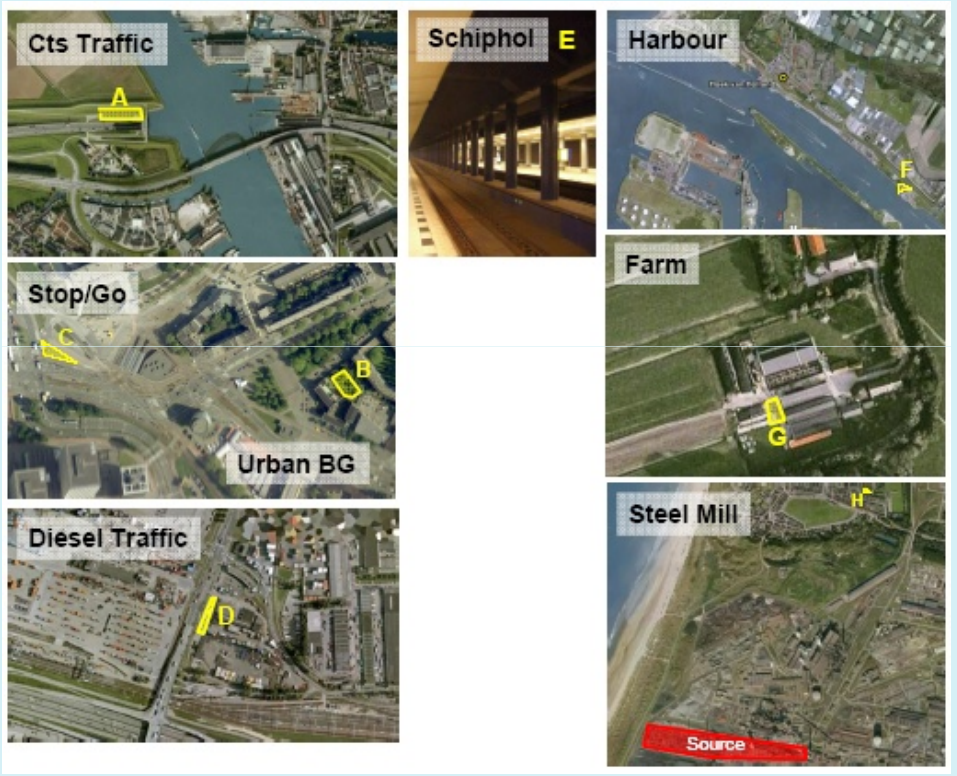
Schools study

Oxidative potential (OP)

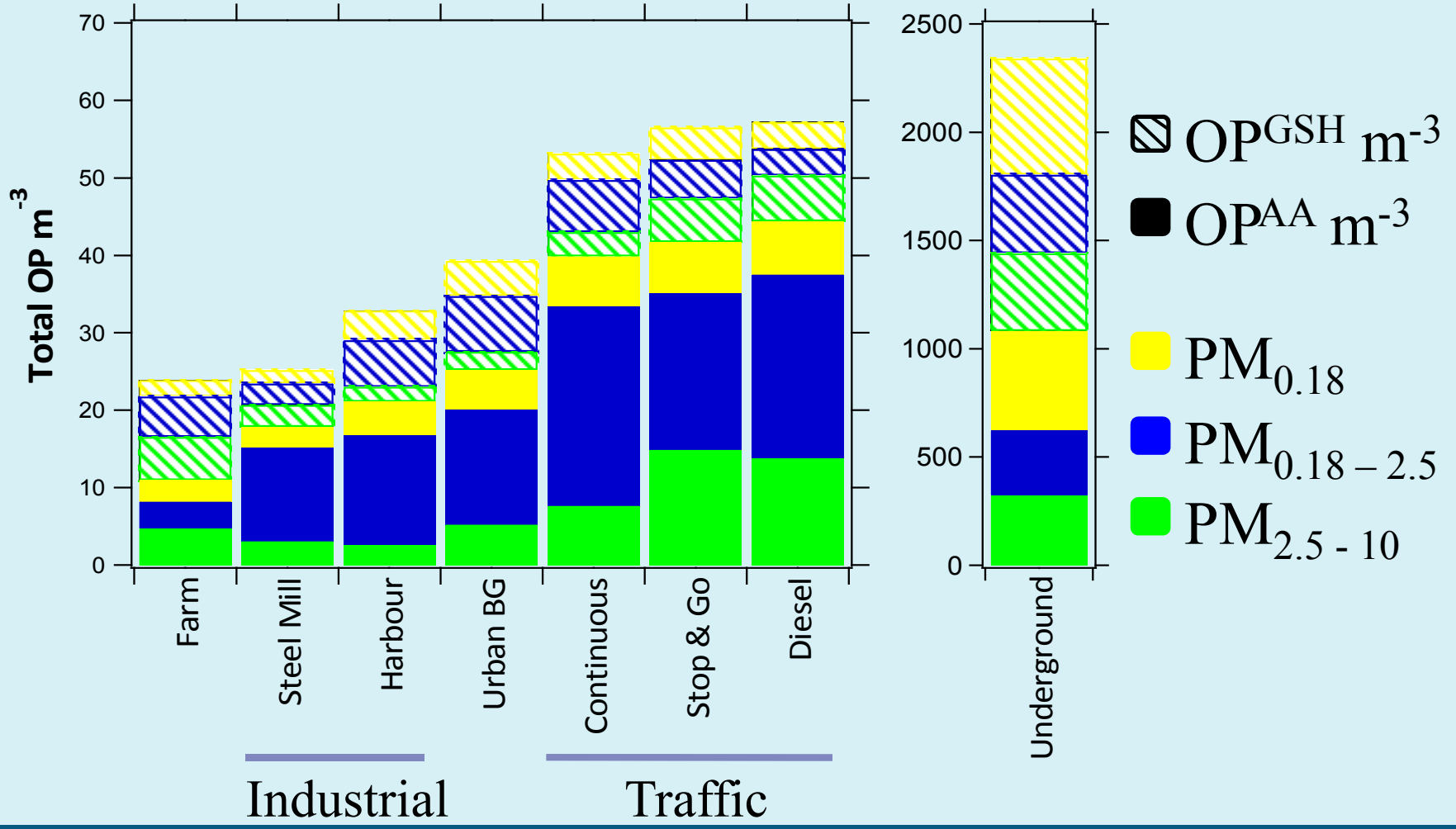
- RAPTES (Risks of Airborne Particles: a hybrid Toxicological-Epidemiological Study)
- Defra OP study
  - increments and daily variation

RAPTES

- Assess the oxidative potential
  - Different size fractions of PM
  - Background, traffic and industrial sites.
- Measurements were to serve as a screening tool to contrast the particulate oxidative burden at each site as means for selecting three of the eight sites for future human and animal exposures.



Oxidative potential - *size fractions and locations*



RAPTES – Human Exposure

Time (hours)		Activity and Endpoint Measurement
t = 0	7:00	• Time-activity questionnaire, blood pressure, symptoms questionnaire, spirometry, exhaled nitric oxide • Blood and nasal lavage (inflammation, oxidative stress)
		TRANSPORT TO SITE
t = 2	9:00	• Symptoms questionnaire, spirometry, exhaled nitric oxide
t = 2.5	9:30	• Intermittent exercise in 20 minute intervals with continuous heart rate and O_2 saturation monitoring
t = 7.5	14:30	• Symptoms questionnaire, spirometry, exhaled nitric oxide
		TRANSPORT FROM SITE
t = 9.5	16:30	• Blood pressure, symptoms questionnaire, spirometry, exhaled nitric oxide • Blood and nasal lavage (inflammation, oxidative stress)
		TRANSPORT TO/FROM CLINIC
t = 25	8:00	• Time-activity questionnaire, blood pressure, symptoms questionnaire, spirometry, exhaled nitric oxide •Blood and nasal lavage (inflammation, oxidative stress)

Defra Oxidative Potential Study

To establish the traffic-specific oxidative activity of PM_{10}

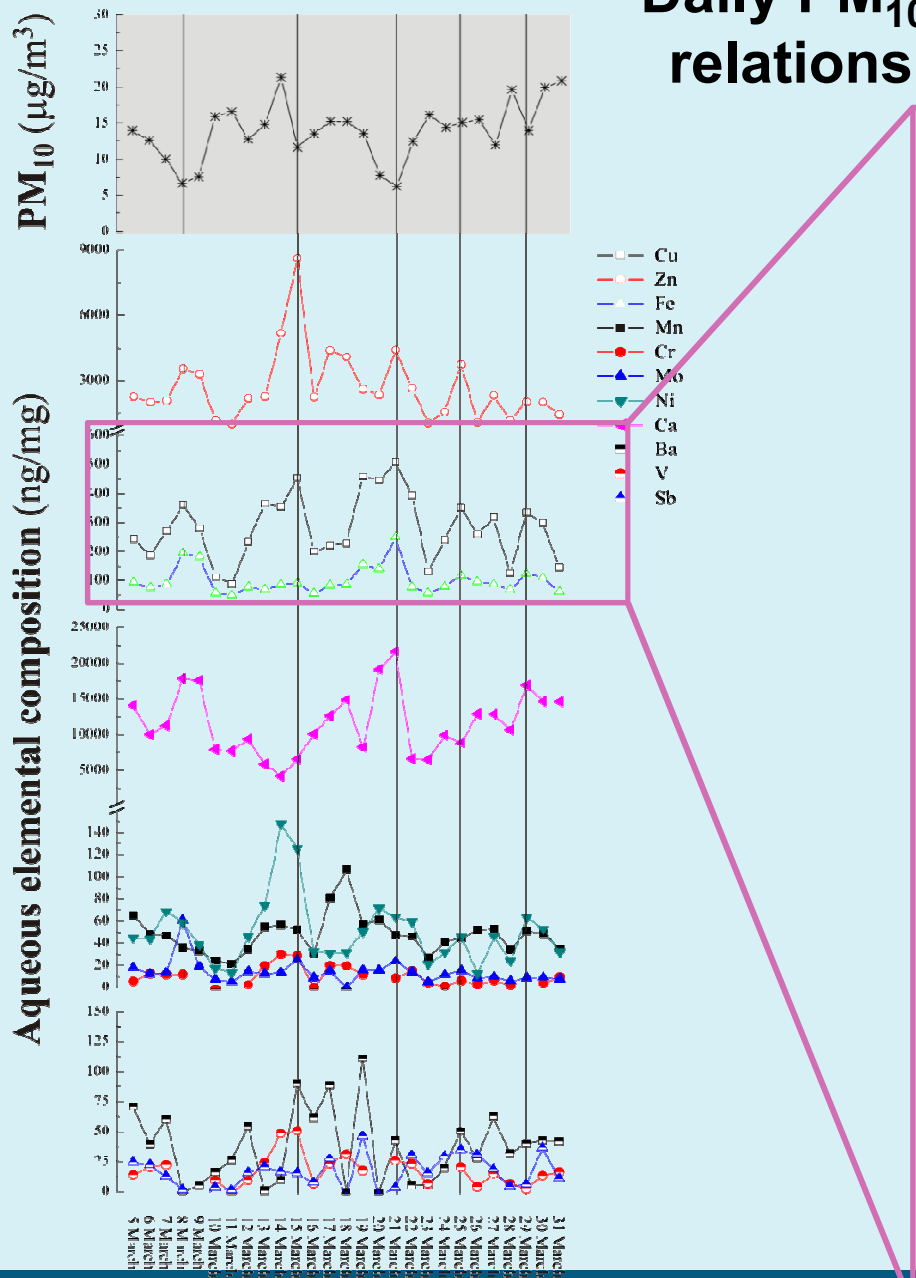
- Central London high traffic site (Marylebone Road) minus the urban (North Kensington) and rural background (Harwell) contributions to this measurement.

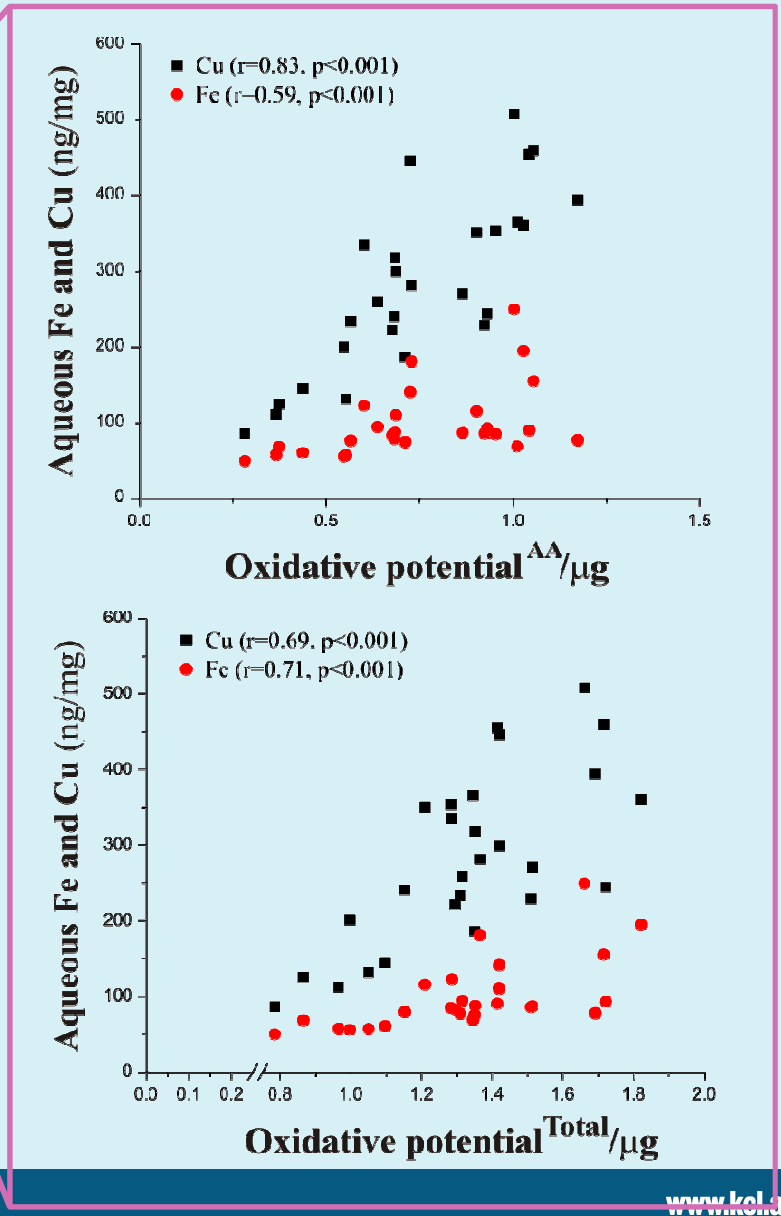
To examine the short-term variability of PM_{10} oxidative activity at the North Kensington

- 24h collections from Partisol samplers over a 4 week period.
- Two 4 week periods will be examined one during spring and one during the winter season with the sampling periods based on predicted PM_{10} episodes.
- Feasibility study

Measuring bioavailable metal concentration

Daily PM_{10} metal concentrations and their relationship with PM oxidative potential





Themes 1

PM measurements

- Importance of chemical speciation and source apportionment
  - Measurement, modelling and toxicological perspective
  - Impact on health
  - Measuring impact of air quality management practices now and in the future

Air quality management interventions

- Traffic, waste sites + others
- Assessing the impact of these interventions now (CCS, LEZ, waste sites etc) and in the future (CMAQ)

Themes 2

Assessing exposure

- Indoor air
- Exposure studies
  - Schools and RAPTES
- Epidemiology

Climate change effects

- Win-win and win-lose scenarios
- Health impact
- Biomass
- CMAQ

ERG mission statements

"Combine the air pollution sciences to determine the impacts of air pollution on health and the causal factors."

"Provide support to the air quality management process / policy to minimise air pollution health effects."