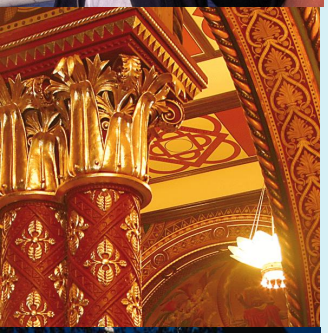
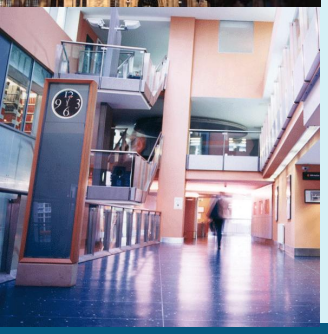




MRC & Asthma UK Centre in Allergic Mechanisms of Asthma

Exploration of Health and Lungs in the Environment

Measuring the impacts of air pollution on East London school children

Ian Mudway, King's College London

ian.mudway@kcl.ac.uk

Low Emission Zone Study

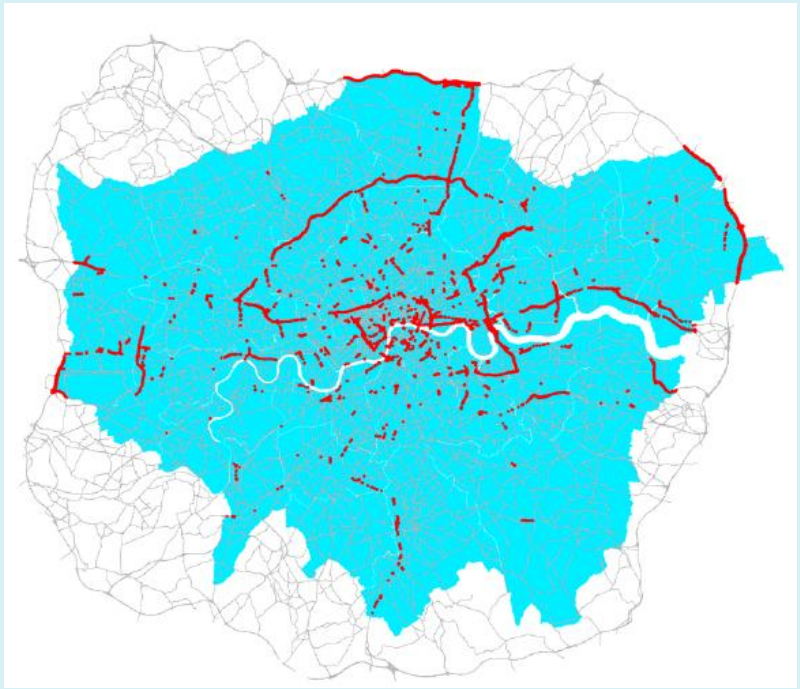
Example of a ‘natural experiment’ – change in pollutant exposure can be predicated and its effects monitored prospectively.

Objective: To quantify the impact of the Low Emission Zone (LEZ) on children’s health in East London.

Hypothesis: Reductions in exposure to traffic emissions will be associated with improvements in respiratory health in sequential yearly cross-sectional samples of 8-10 year-old children.

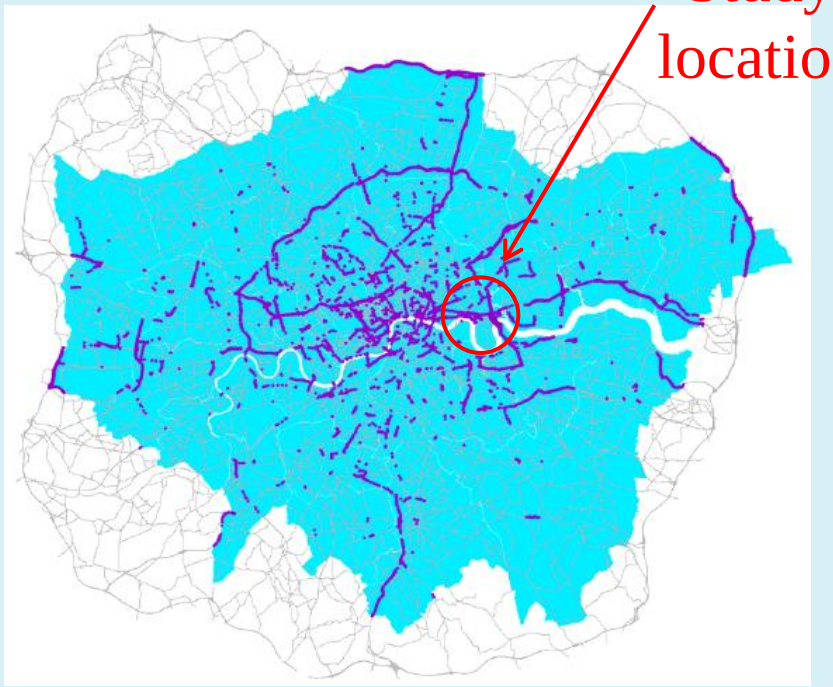
Projected benefits of the LEZ

NO_2 difference plot –base case 2010



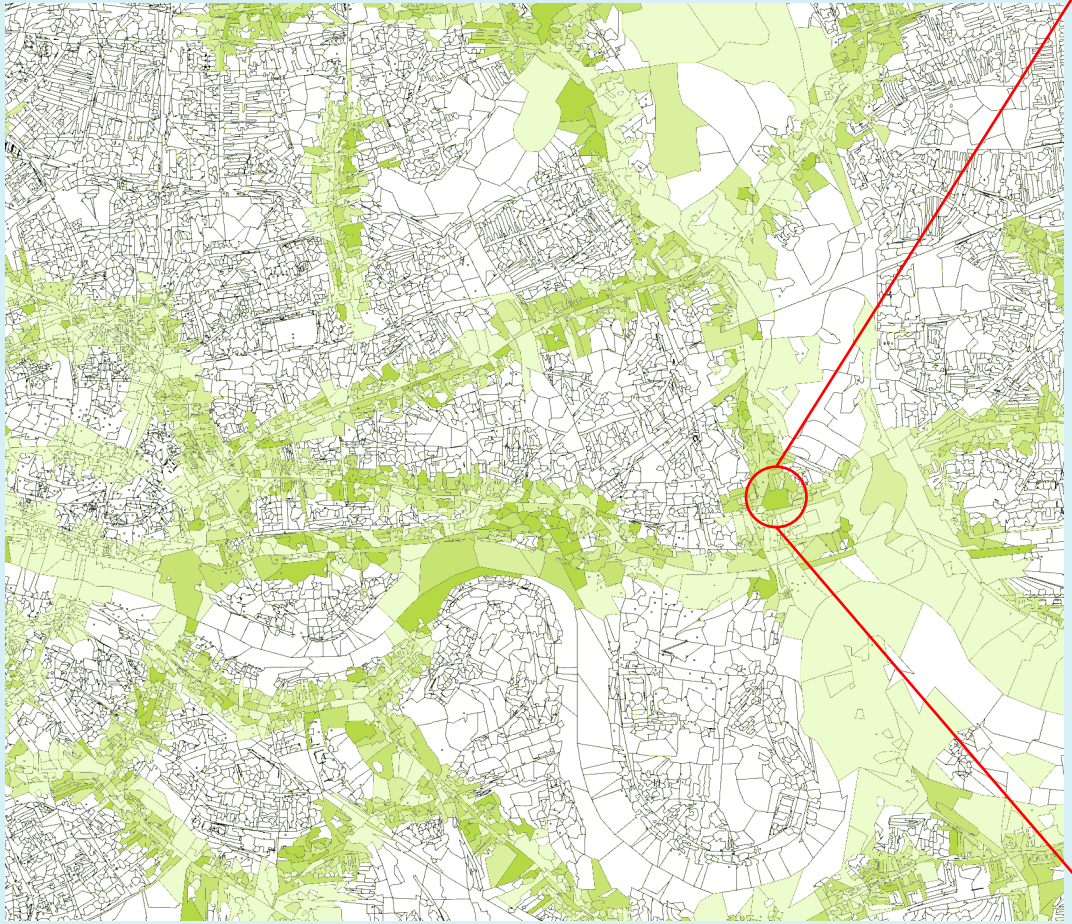
Red lines indicate a 3 μg m^{-3} difference

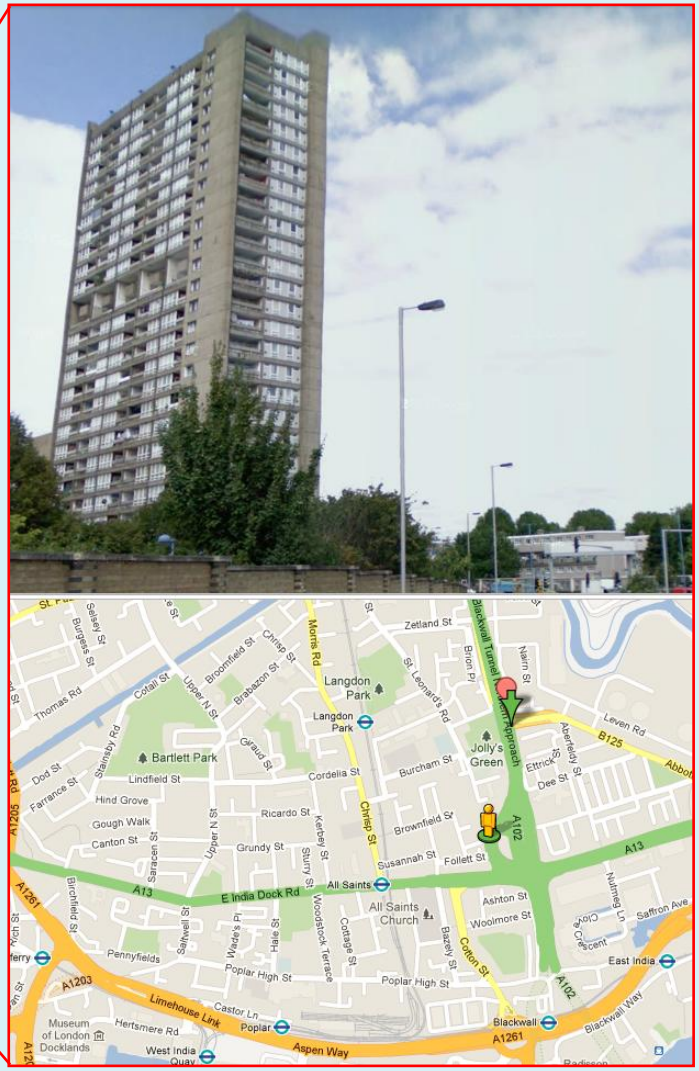
PM_{10} difference plot –base case 2010



Blue lines indicate a 0.75 μg m^{-3} difference

Postcodes in the Tower Hamlets area within 100 m of major road





Studying the impact of the LEZ on children's respiratory health

In an ideal world

Within the intervention area

Period pre-intervention ⟶ Period post-intervention

Outside the intervention area

Period pre-intervention ⟶ Period post-intervention

X-years before X-years after

Thousands of children (matched for age, ethnicity, SES) followed longitudinally over the duration of the study

In the real world, or at least London

Within the intervention area

~~Period pre-intervention~~ → Period post-intervention

Outside the intervention area

~~Period pre-intervention~~ → Period post-intervention

~~X-years before~~ X-years after

~~Thousands~~ Hundreds of children (matched for age, ethnicity, SES~~)~~ followed ~~longitudinally~~ cross sectionally over the ~~duration of the study~~ post implementation period, but able to capture effect attributed to the tightening of the scheme

In the real world, or at least London

Within the intervention area

~~Period pre-intervention~~ → Period post-intervention

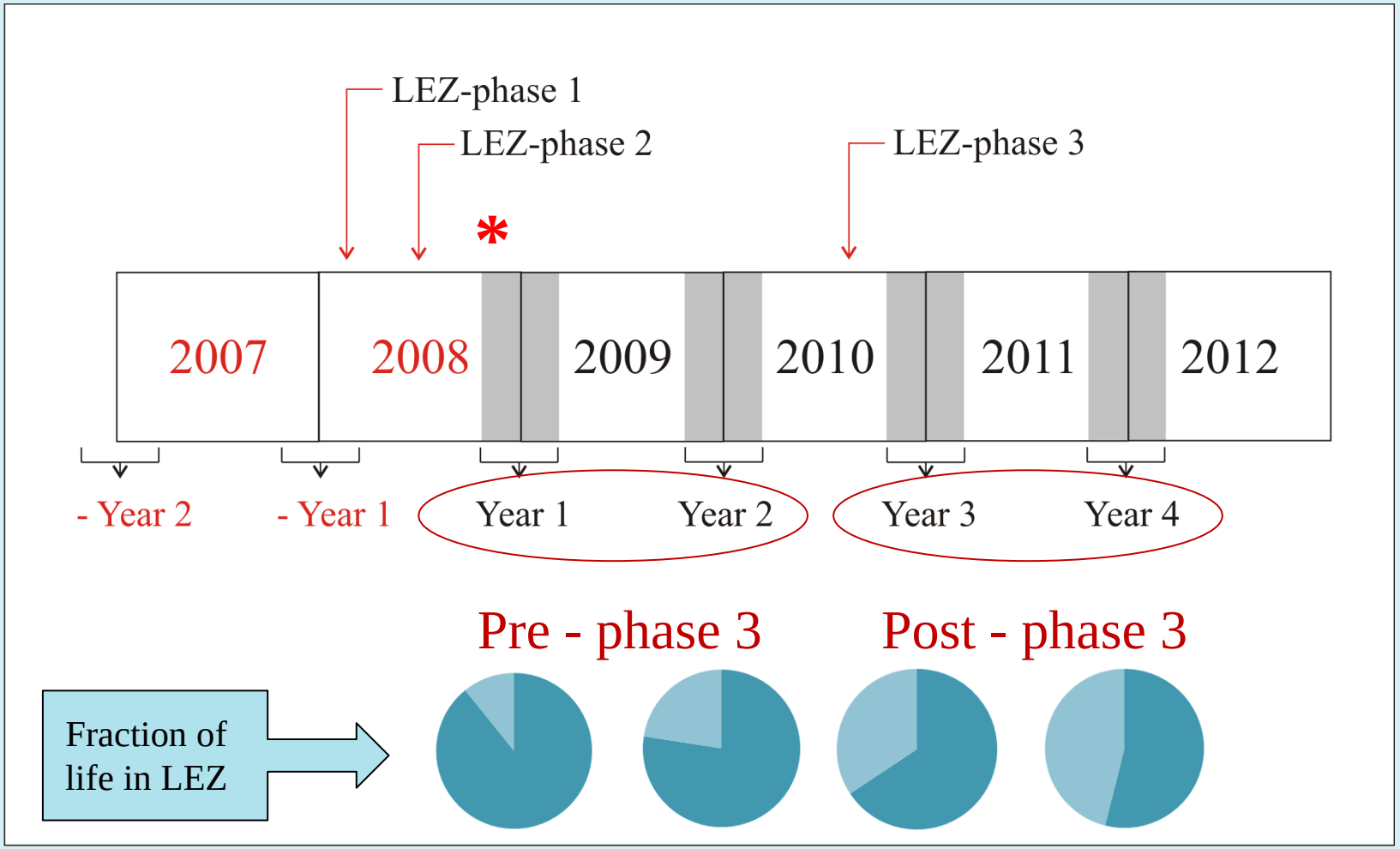
~~Outside the intervention area~~

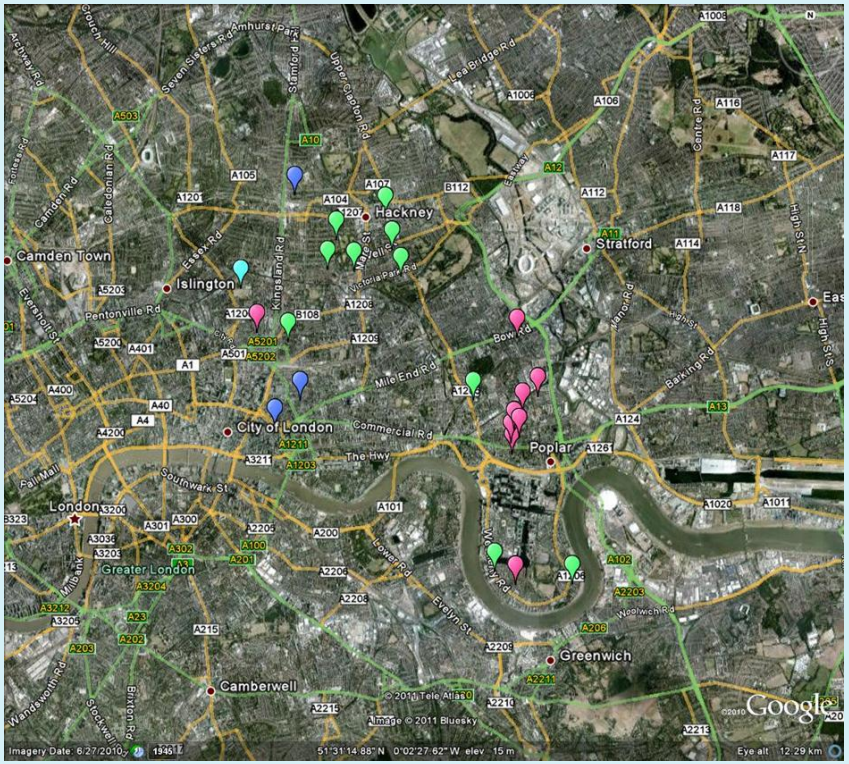
~~Period pre-intervention~~ → ~~Period post-intervention~~

~~X-years before~~ X-years after

~~Thousands~~ Hundreds of children ~~(matched for age, ethnicity, SES)~~ followed ~~longitudinally~~ cross sectionally over the ~~duration of the study~~ post implementation period, but able to capture effect attributed to the tightening of the scheme

What are you left with and how does this refine the question being asked?





Examine effect of LEZ on:

- **Respiratory health -**
  - Spirometry, exhaled NO, respiratory symptoms
- **Biomarkers of exposure**
  - Urinary metals, carbon content of airway macrophages
- **Susceptibility**
  - Gene polymorphisms
- **Response**
  - Urinary 8-isoprostanes
  - Urinary 8-oxydG

Linkage at residential address level to estimated modelled exposures (NOx, NO_2, PM_{10}, $PM_{2.5}$)

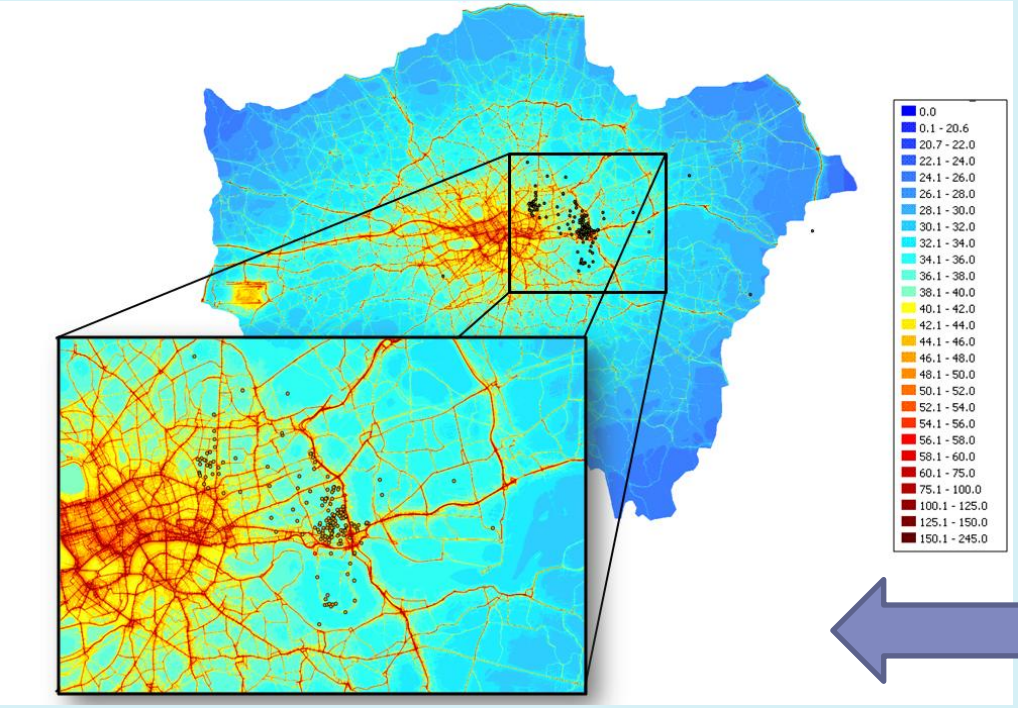
Progress in assessments and analyses

Year 1: 2008/9	202 children
Year 2: 2009/10	452 children
Year 3: 2010/11	460 children
Year 4: 2011/12	444 children

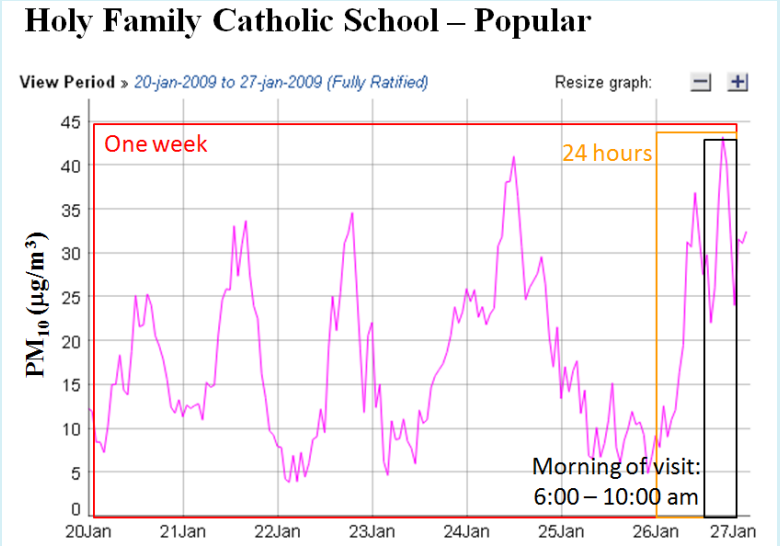
Variable	***Data***
Air quality modelled	*years 1,2,3*
Lung function	*years 1,2,3*
FeNO	*years 1,2,3*
Urinary isoprostanes	*years 1,2,3*
Urinary metals	*years 1,2,3*
Urinary 8-oxo-2'-deoxyguanosine	*years 1,2,3*
Genotyping	*years 1,2,3*

Estimating exposures

Models



Measurements



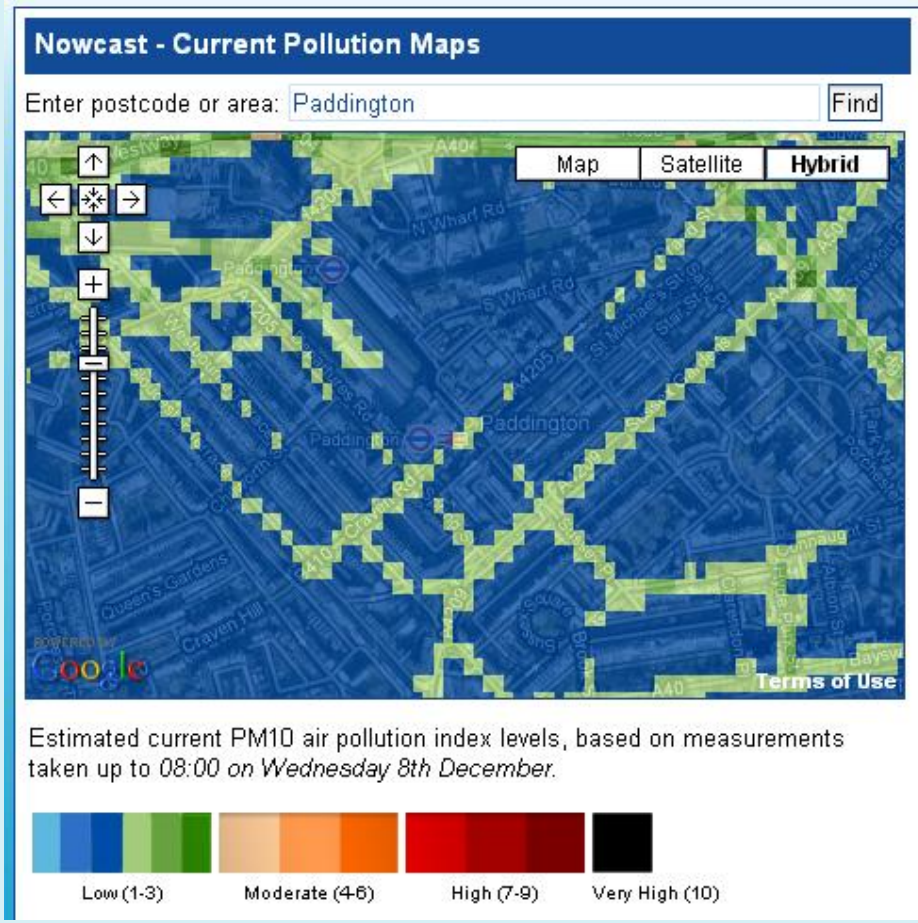
Annual means: NOx, NO_2, PM_{10}, $PM_{2.5}$

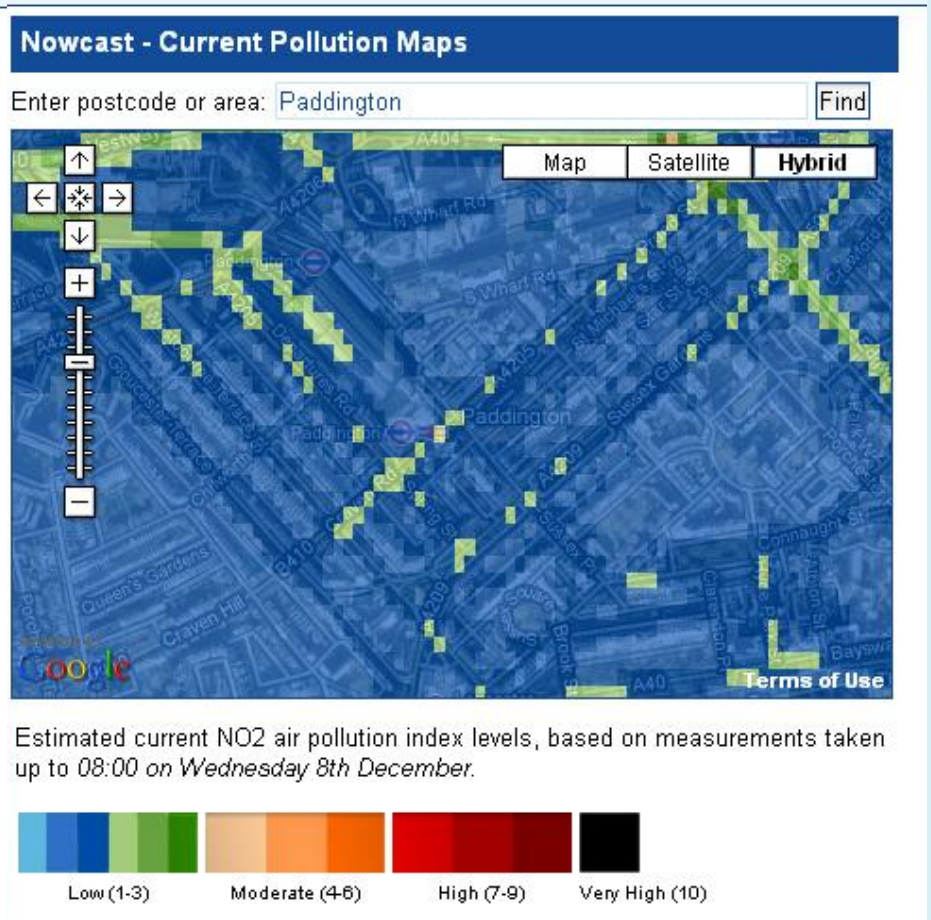
- By residential address
- Weighted for time spent at home and school
- Varying buffer zones: 50, 100 and 200m
- Model updated to include resuspension

Acute exposures: NOx, NO_2, PM_{10}, $PM_{2.5}$

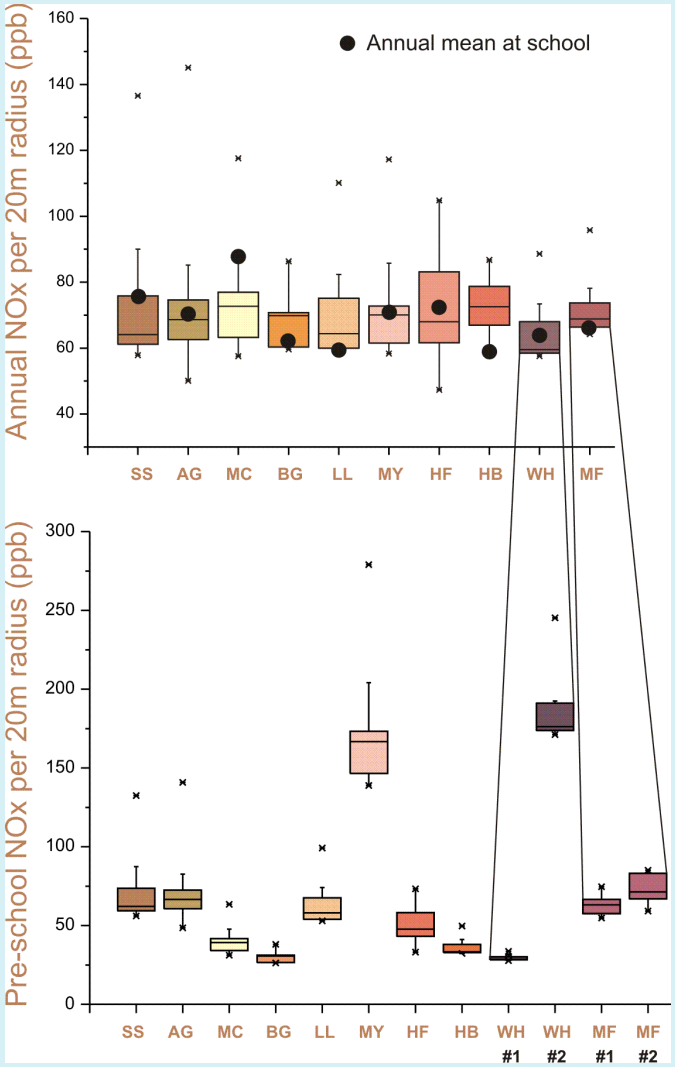
- London background
- PM components – toxicological parameters
- NOWCAST time resolved estimates

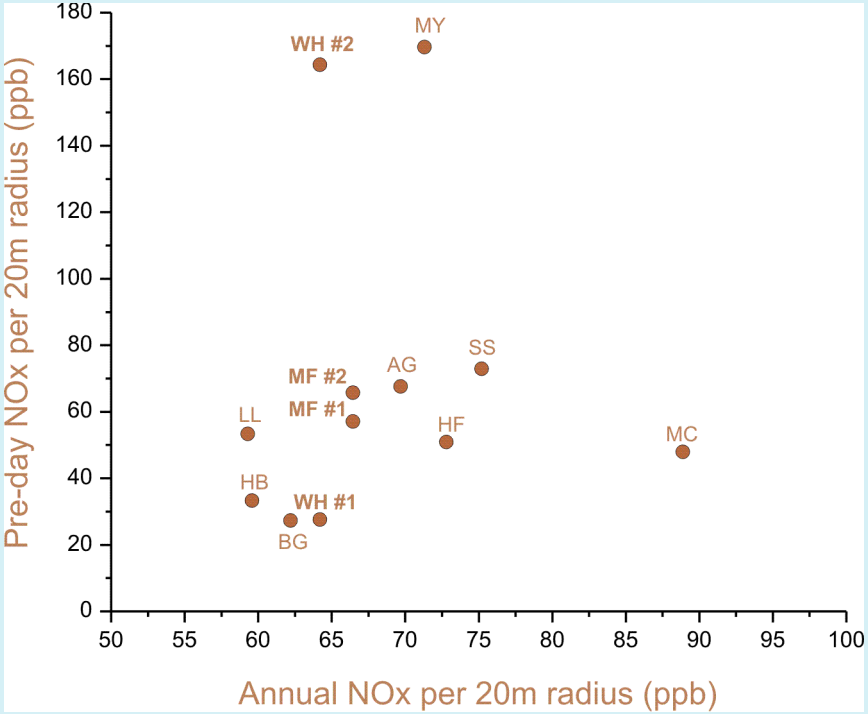
Nowcast to predict acute and sub-chronic exposures





Distribution of pupils chronic and acute NOx exposures





Then add in few unpredictable events

LEZ-phase 3

X

2007

2010

2011

2012

- Year 2

- Ye

Year 3

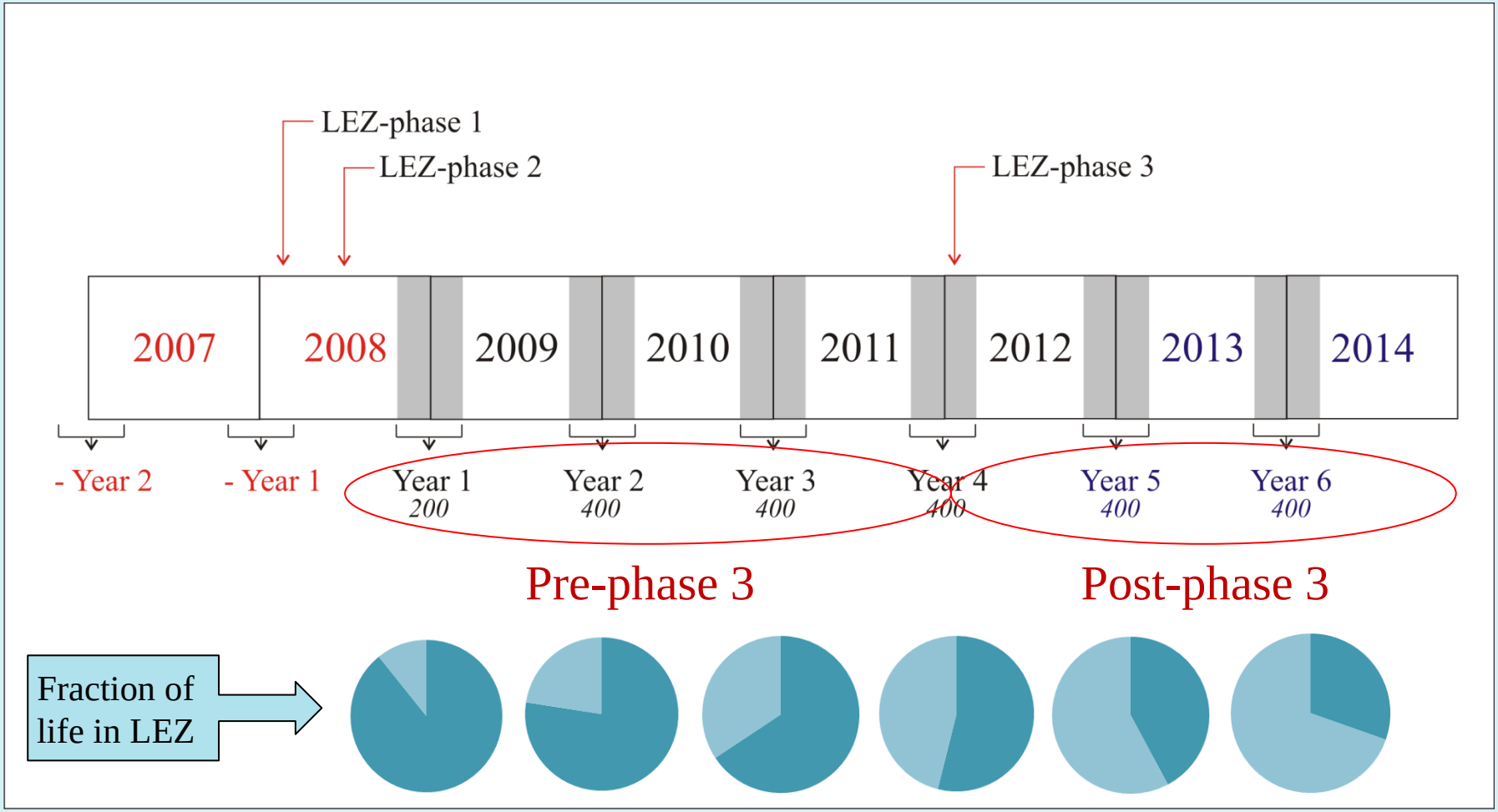
Year 4

Pre - phase 3

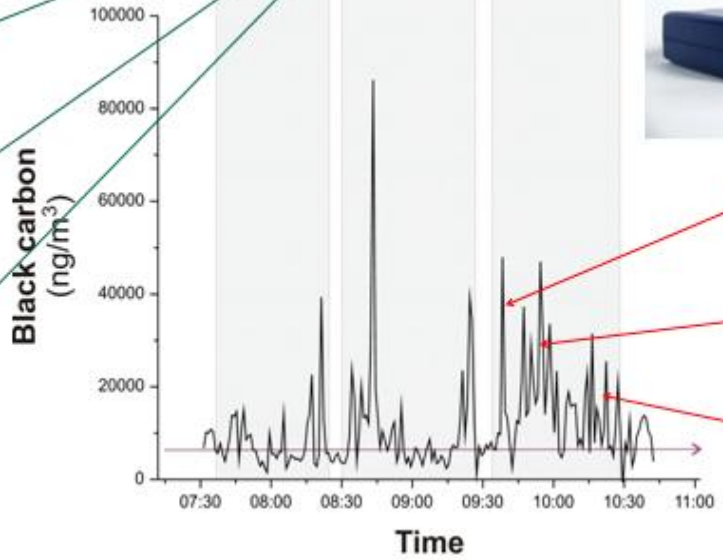
Post - phase 3

Fraction of life in LEZ

Revisions


LEZ-phase 1
LEZ-phase 2
LEZ-phase 3
2007
2008
2009
2010
2011
2012
2013
2014
- Year 2
- Year 1
Year 1
200
Year 2
400
Year 3
400
Year 4
400
Year 5
400
Year 6
400
Pre-phase 3
Post-phase 3
Fraction of life in LEZ

Route 1

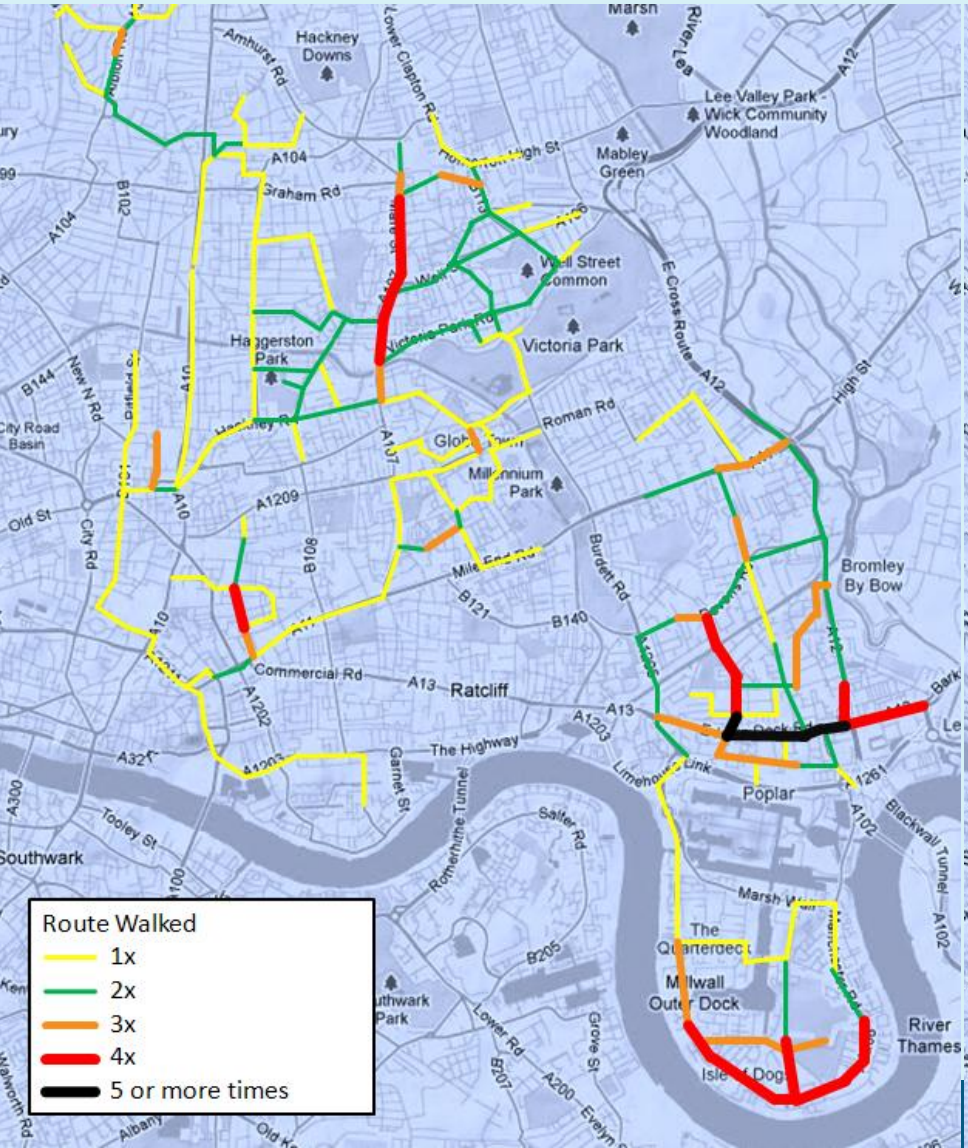


Route 2

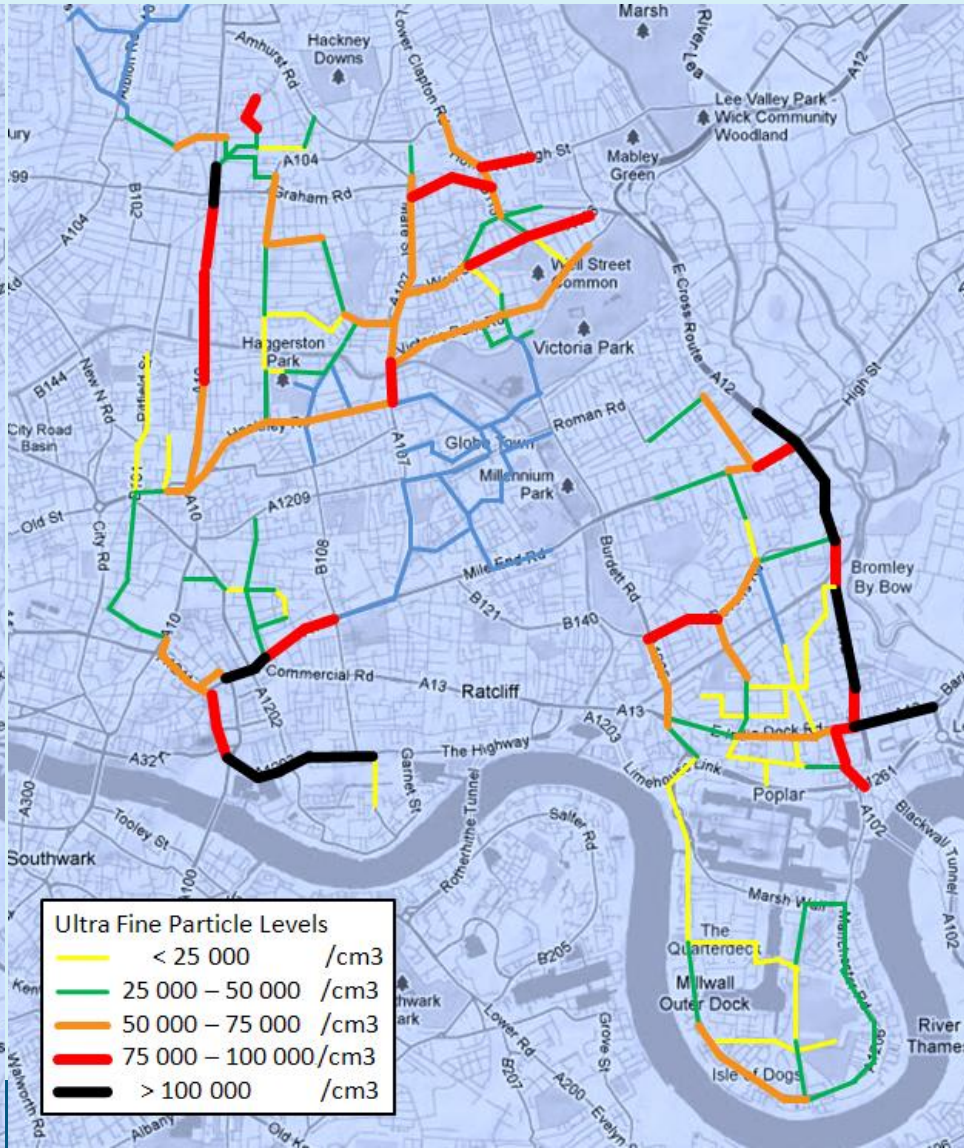
Route 3

Routes covered 2011 - 2012

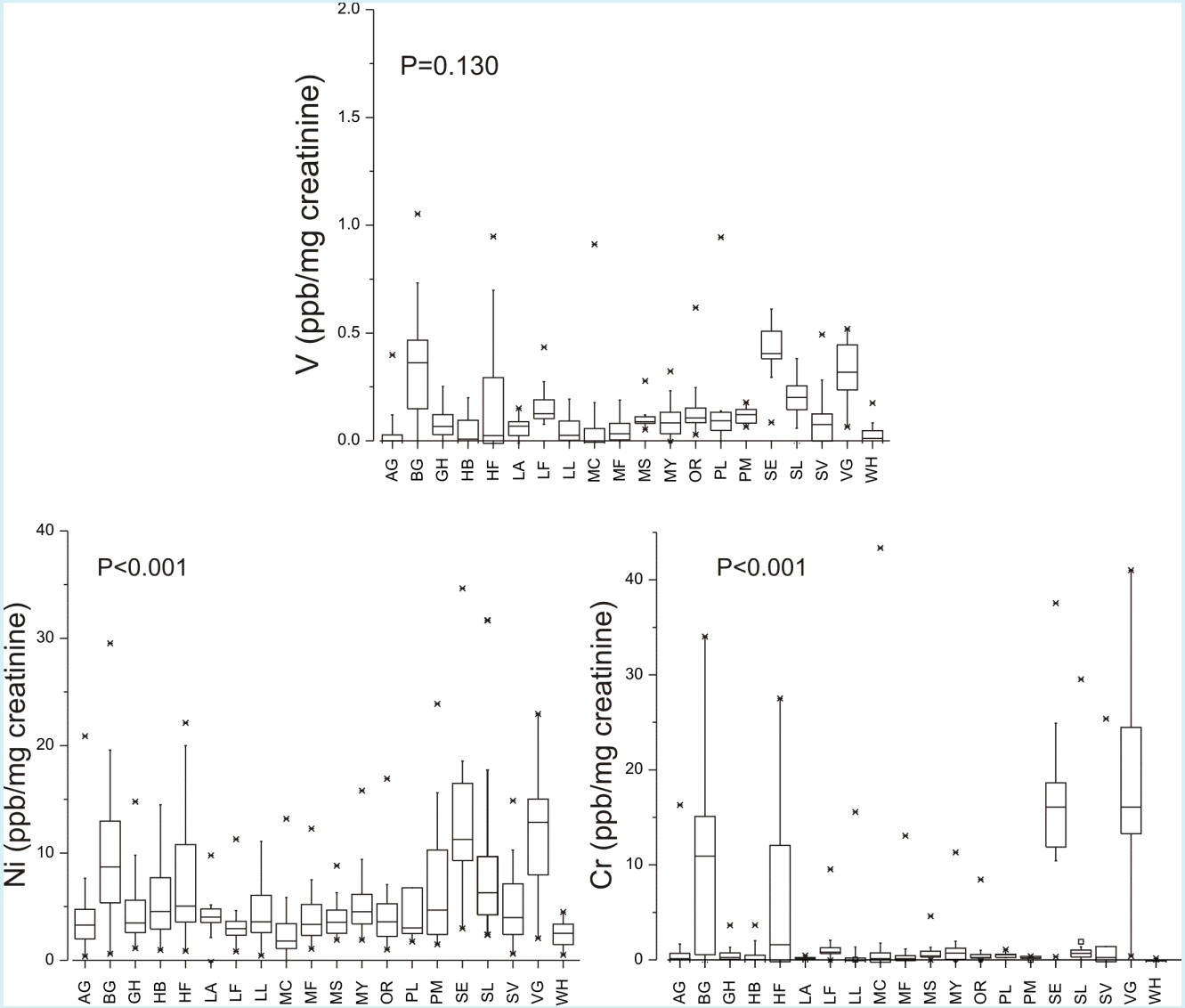
Frequency



By pollutant concentration



Urinary metals: Fuel combustion



Conclusions

1. Improvements in vehicle fleet, but limited improvements in air quality
2. Successful engagement of schools and children, over 4-years
3. High quality lung function and other outcome data
4. Successful modelling of pollutant exposures for each child. Novel use of acute exposure data
5. Demonstration of reduced FVC with increased exposure to traffic derived pollutants
6. Successful genotyping, for subsequent analysis of sensitivity
7. Examination of personal exposure to primary traffic pollutants
8. Examination of the biological dose of BC and metals

Contributions

LEZ study team

Centre for Primary Care and Public Health, QMUL: Chris Griffiths, Jonathan Grigg, Robert Walton, Isobel Dundas, Stephen Bremner, Neeru Garg, Alex Nanzer, Yasmeen Hanifa, Harpal Kalsi, Tom Round, Grace Tuaf-Toro, Peter Bridge, Ratna Sohanpal, Adam Briggs, Jonathan Grigg, Dev Ghadvi, Grace Tuaf Toro, Peter Timms, Louise Cross, Niki Jakeways, Seif Shaheen

MRC Centre in Allergic Mechanisms of Asthma, KCL: Tak Lee, Alex Faith

MRC-HPA Centre for Environment and Health:, KCL: Frank Kelly, Ian Mudway, Helen Wood, Jeenath Jamaluddin, Andy Grieve, Esme Purdie, Eleanor Smith

City University London: Les Mayhew. Gill Harper

University of Edinburgh: Aziz Sheikh

We gratefully acknowledge funding from King's Biomedical Research Centre, Mr H Lee and Hackney PCT