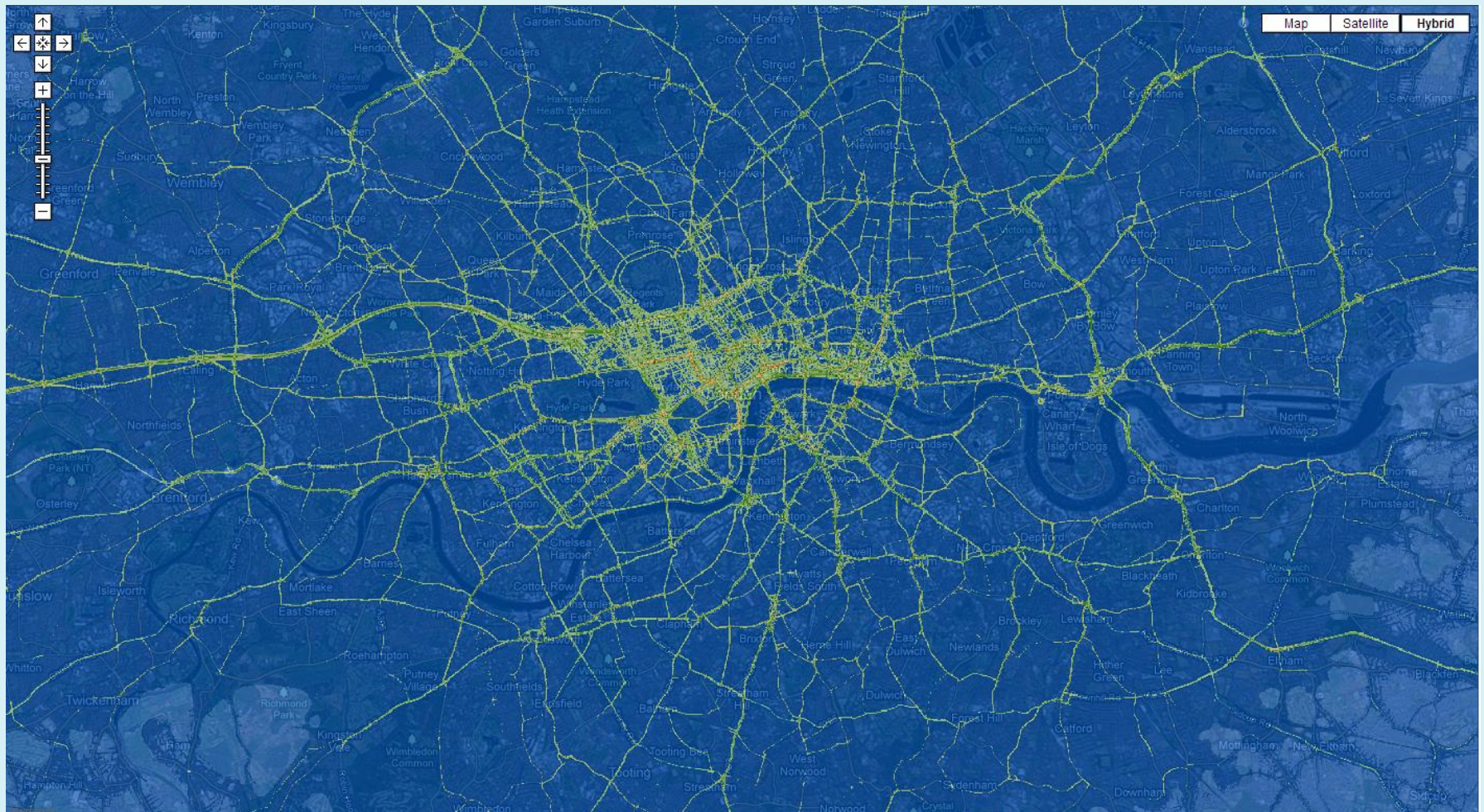


Insights into personal exposure to air pollution

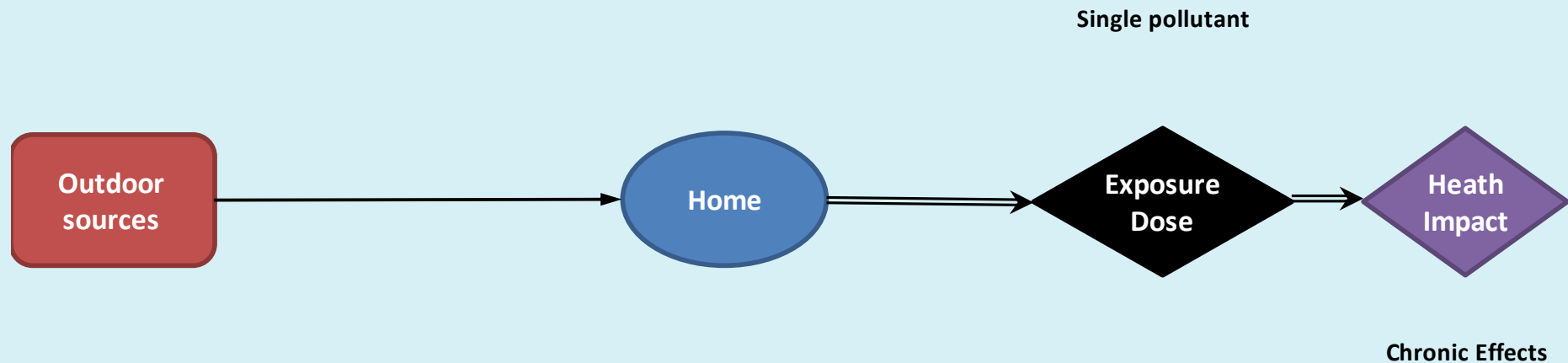
Ben Barratt, King's College London

LAQN Seminar, 21st June 2013

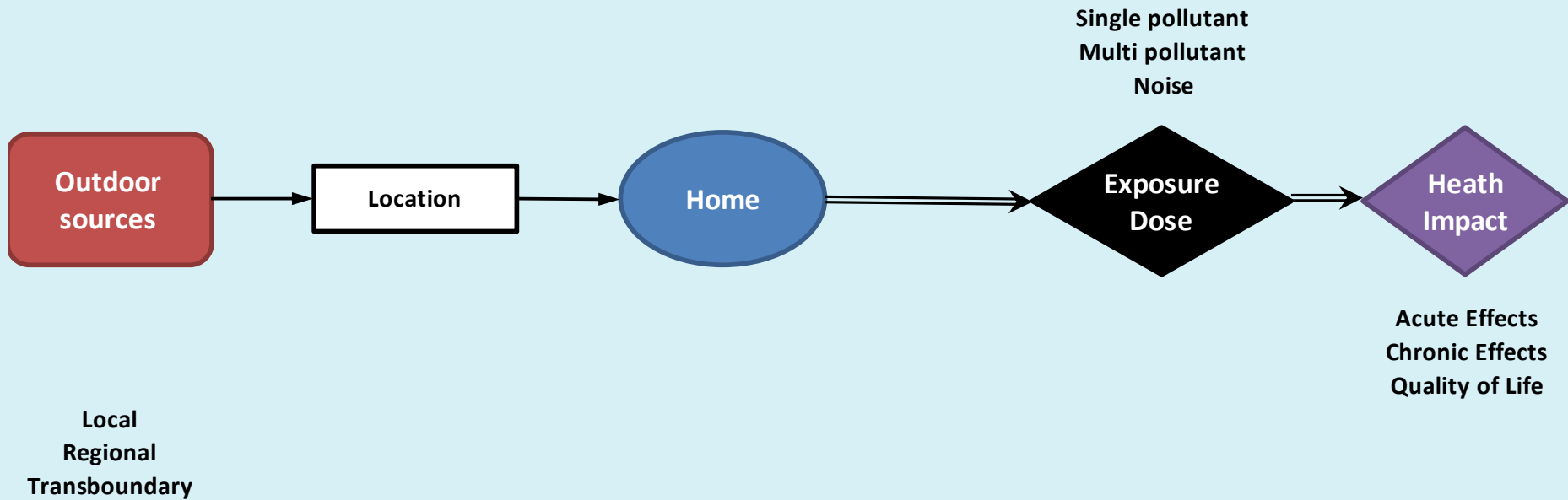
Air quality modelling



The 'traditional' approach to air pollution exposure assessment

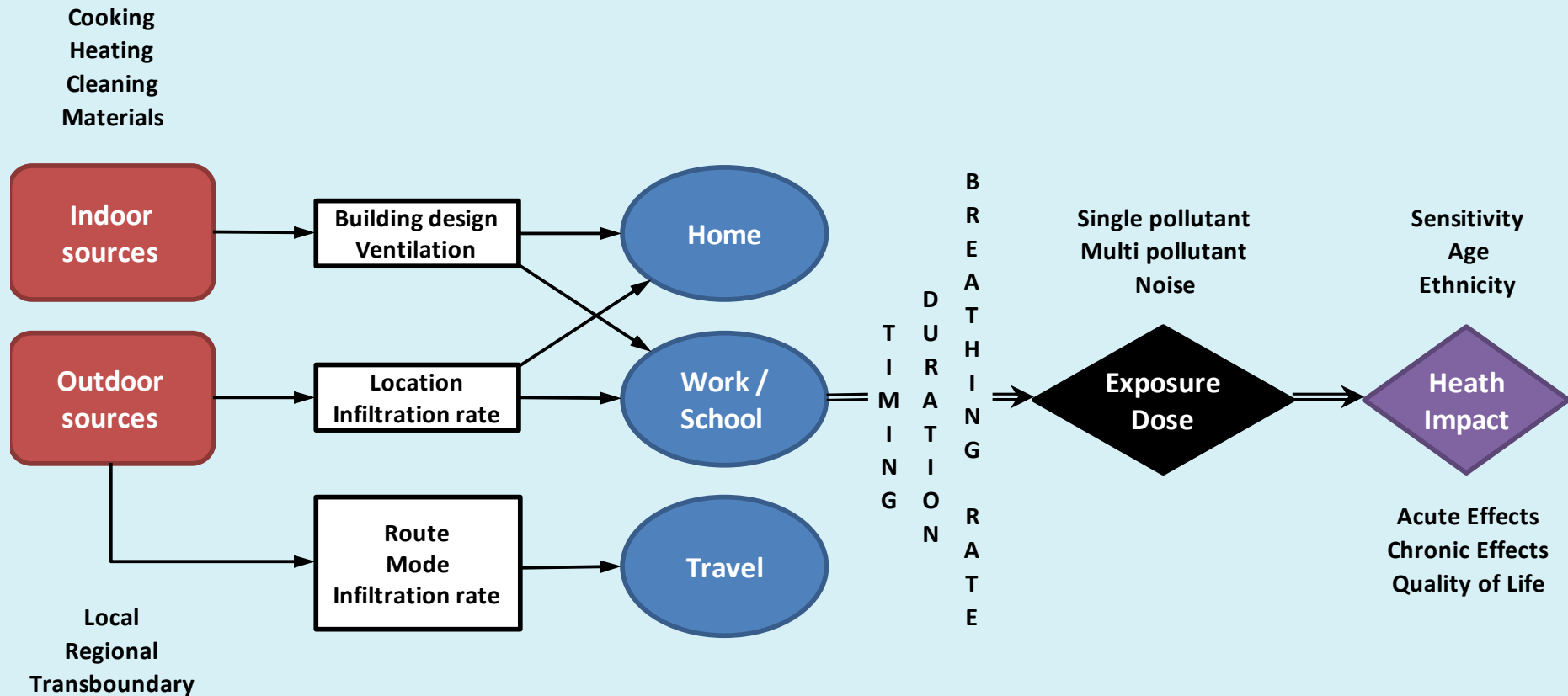


Contemporary approach to air pollution exposure assessment



True/aspirational approach to air pollution exposure assessment

- A detailed attempt to quantify what an individual breathes



Is this disconnect important?

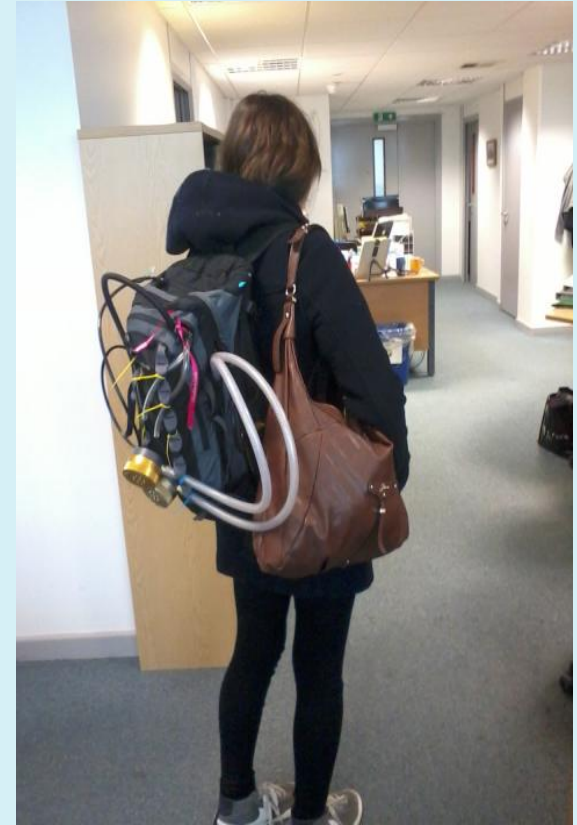
- Perhaps not?:
 - Air Quality Standards are largely based on epidemiological evidence linking fixed monitoring results to health end points.
 - At population level this disconnect *may* not be so important.
- But, improved exposure estimates should provide:
 - Stronger epidemiological evidence (reduced uncertainty)
 - Stronger toxicological evidence
 - More targeted evidence for emissions control
 - More targeted evidence for health protection (sensitive individuals)
- Social justice - the public are entitled to know how they can reduce their own personal exposure to air pollution.

How do we close the gap?

- Personal pollution monitors are theoretically capable of measuring what we breathe.
- We can't give everyone a monitor to carry around for the rest of their lives.
- A model is theoretically capable of estimating what *a population* breathes (based on some assumptions).
- We are all individuals with different behaviours, and how do you know if the estimates are correct?
 - *We therefore require a combined monitoring and modelling approach.*



Mobile or personal monitoring



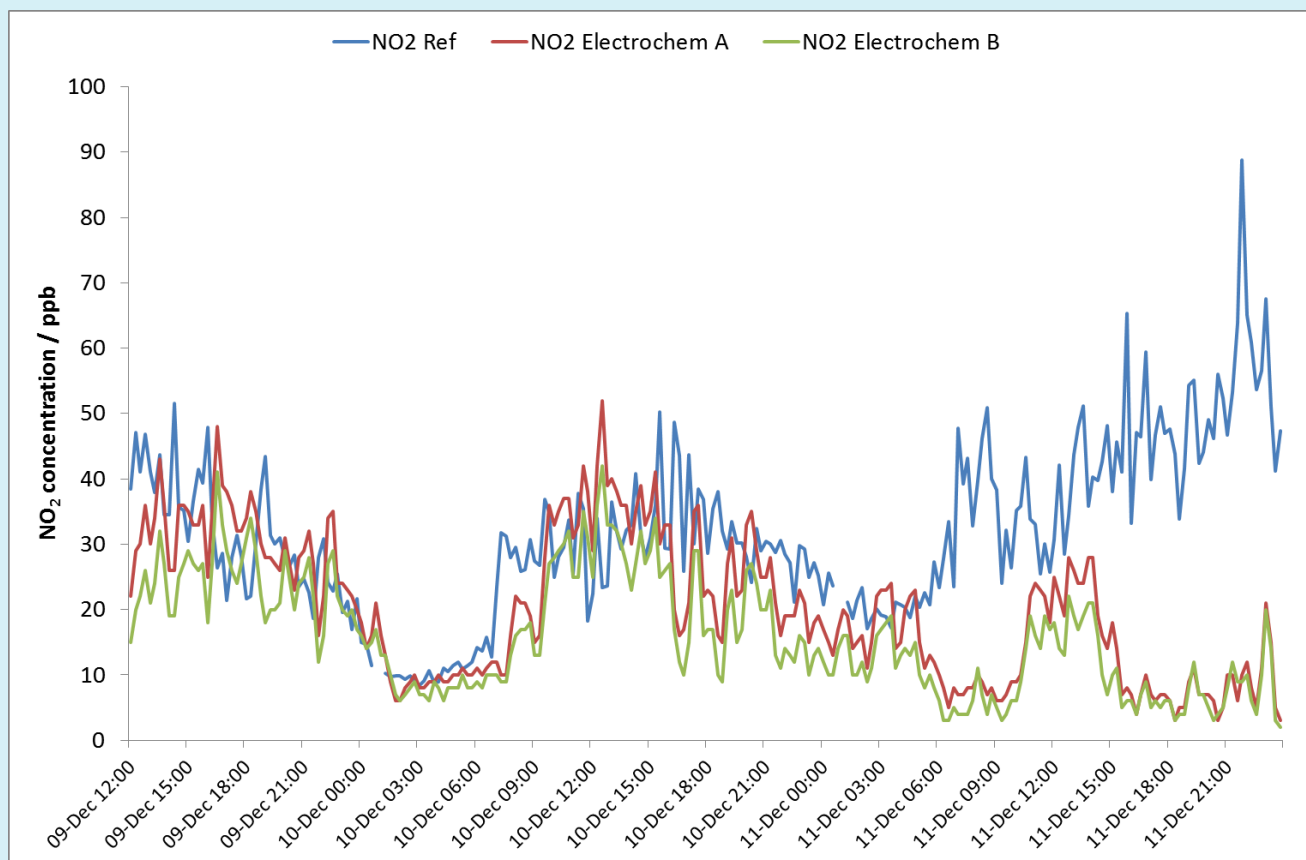
Practical limitations of personal monitoring

- Cost (small cohorts)
- Battery life (short monitoring periods)
- Weight/inconvenience (volunteers)
- Accuracy/precision
- Data volumes (high temporal resolution)
- Interpretation...

Common misconceptions 1

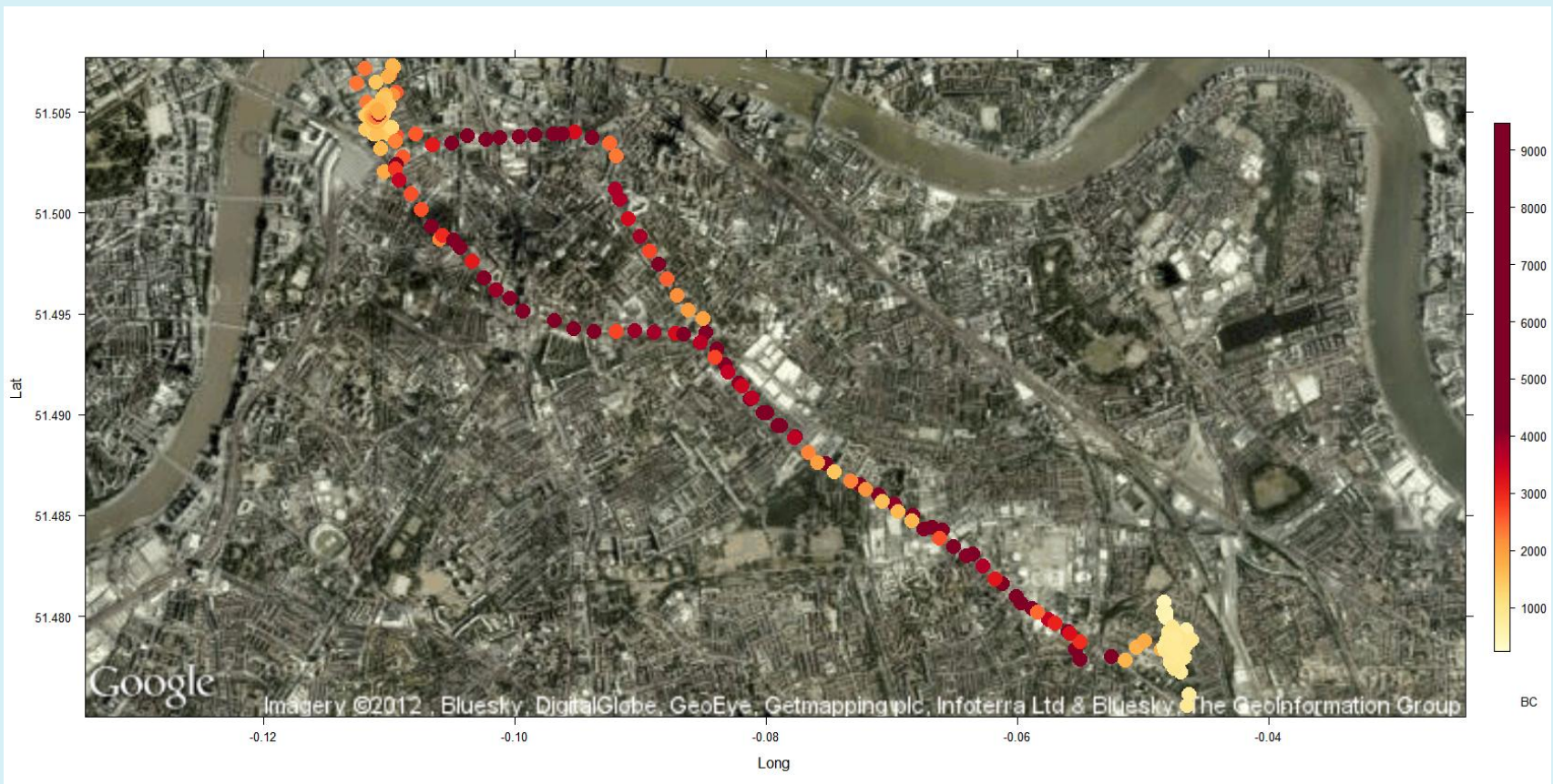
- A 1:1 calibration curve or co-location against reference method equates to an accurate monitor.

A laboratory test does not reflect the complexities of the real world - monitors have to cope with physical abuse, rapid changes in temperature and humidity and an ambient pollutant cocktail.



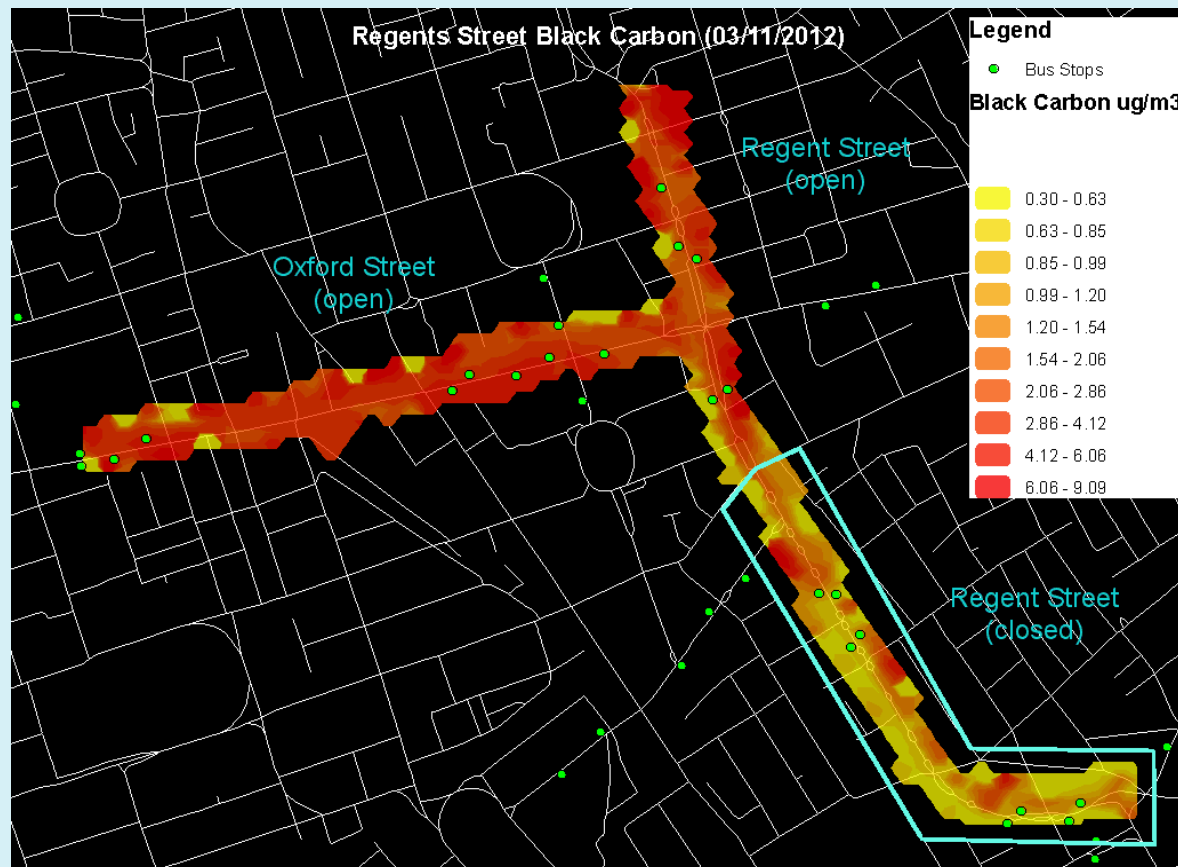
Common misconceptions 2

- You can map pollution levels in a neighbourhood by wandering around with a monitor for a few hours.



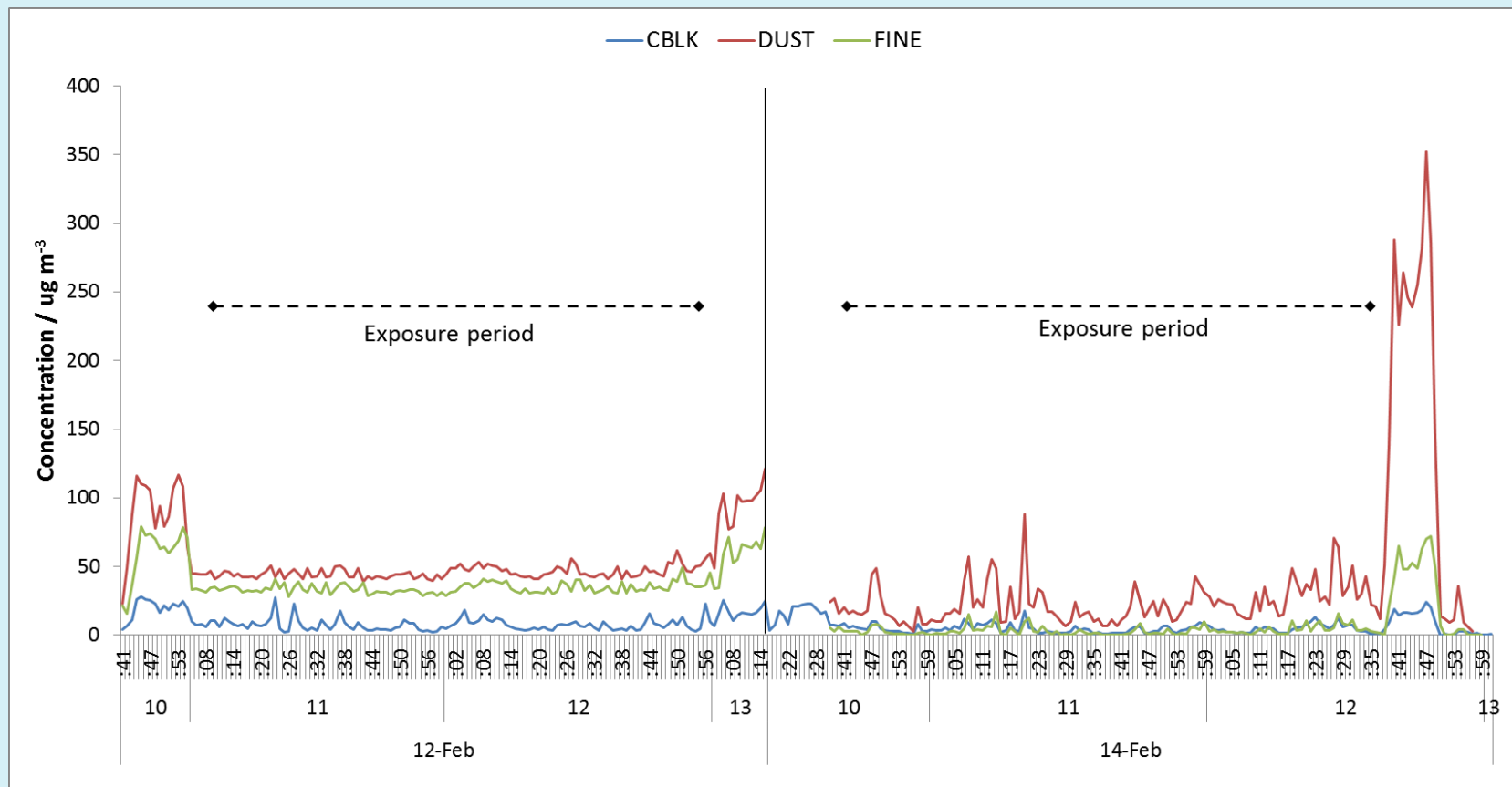
Common misconceptions 2

- You can map pollution levels in a neighbourhood by wandering around with a monitor for a few hours.

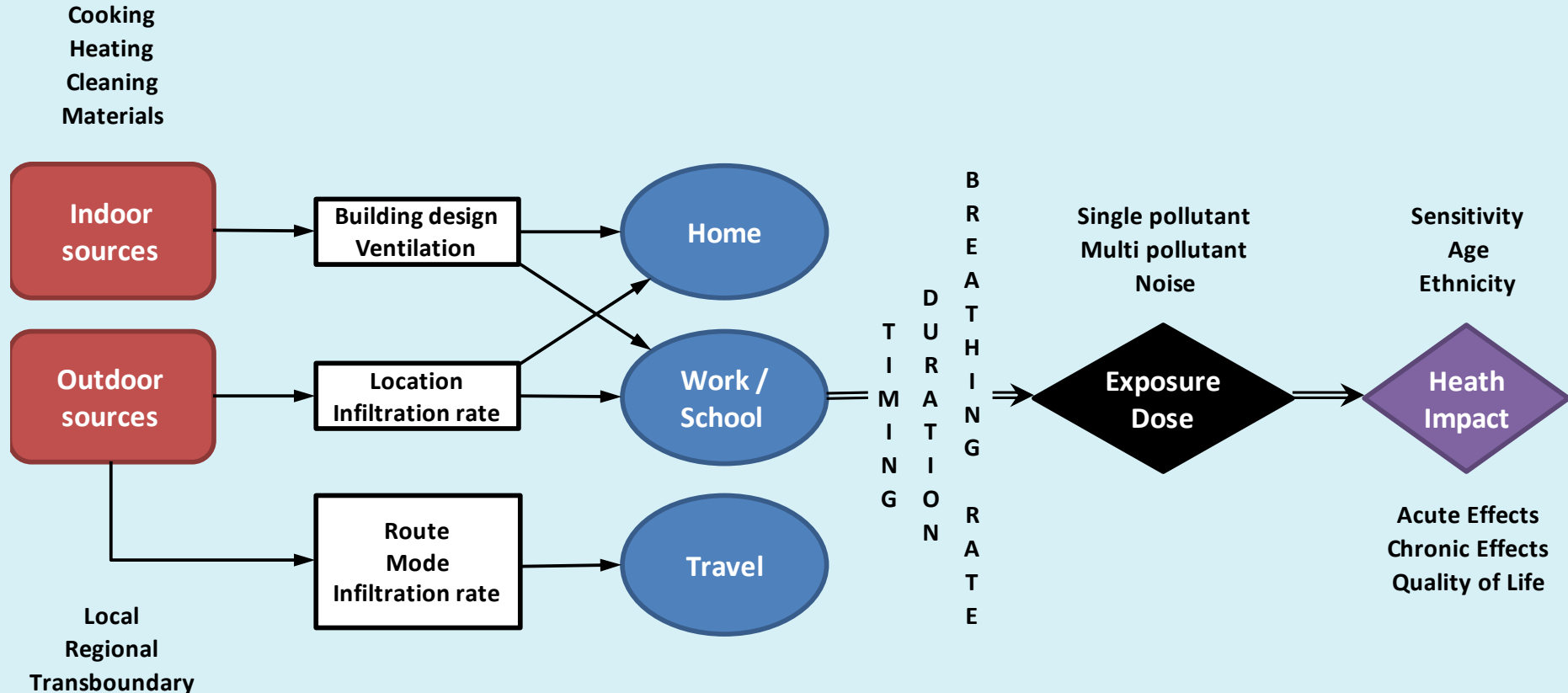


Common misconceptions 3

- Standing next to a bus/junction and recording PM₁₀ levels of 200 µg/m³ means you're going to die/the AQS is wrong.



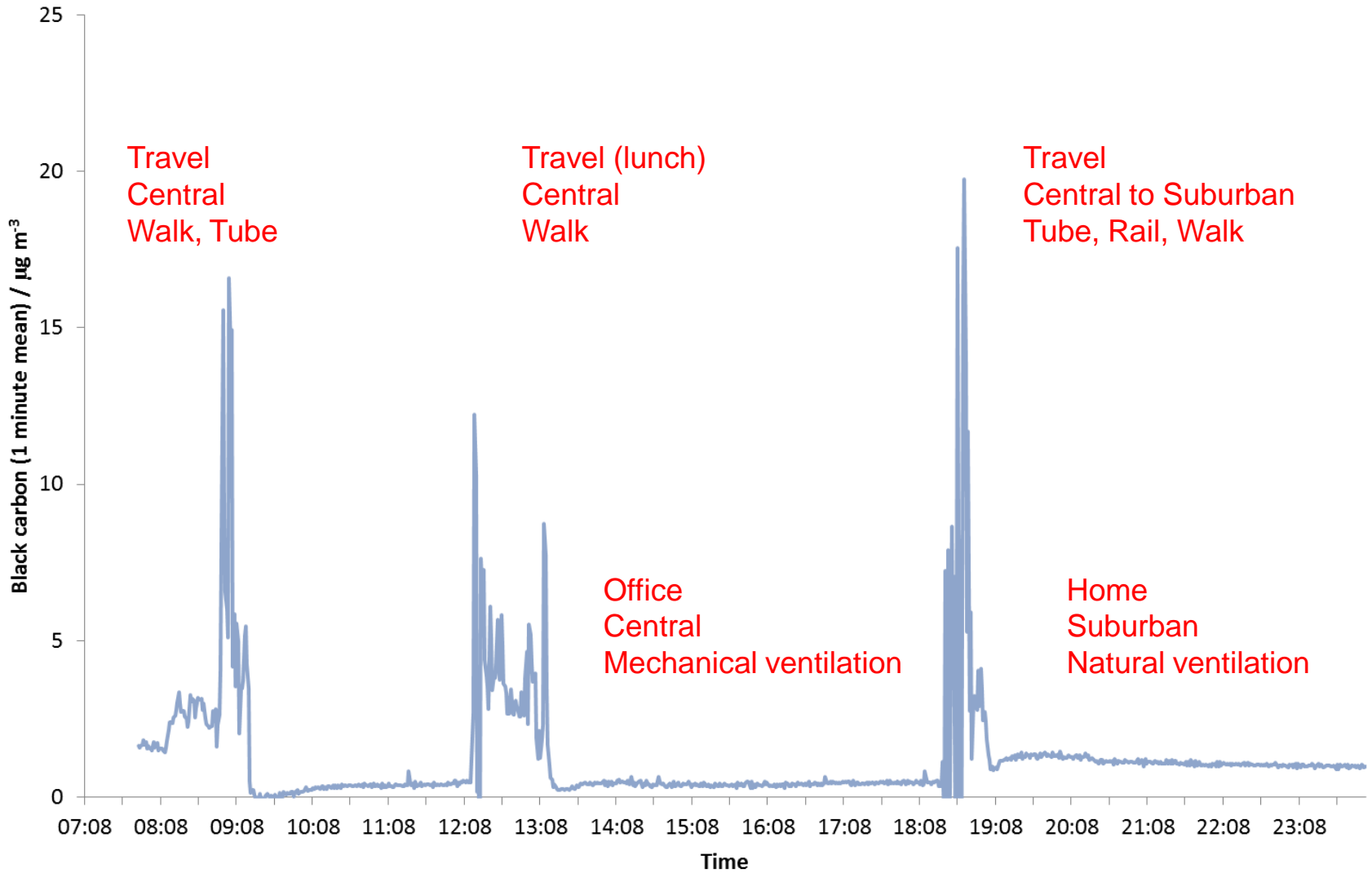
Characterising personal exposure/dose



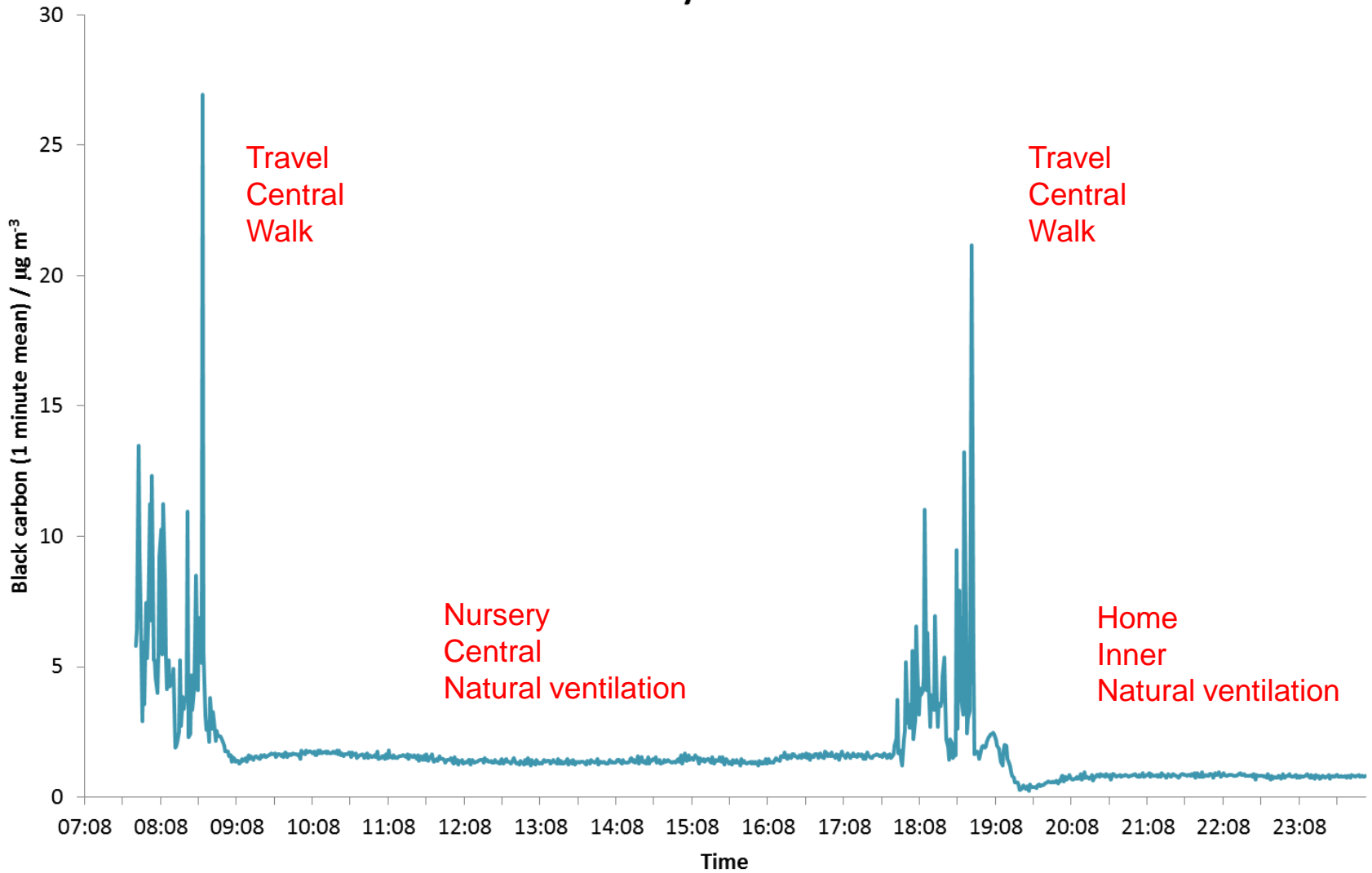
Public engagement demonstration study

- Personal exposure provides an effective way of communicating air pollution issues in an engaging way.
- Pilot study – black carbon and GPS monitors provided to seven volunteers for the same 24 hour period.
- The results were immediately recognisable and personal.
 - ❖ Toddler
 - ❖ School pupil
 - ❖ Officer worker
 - ❖ Home worker
 - ❖ Cycle courier
 - ❖ Ambulance driver
 - ❖ Pensioner

Office Worker



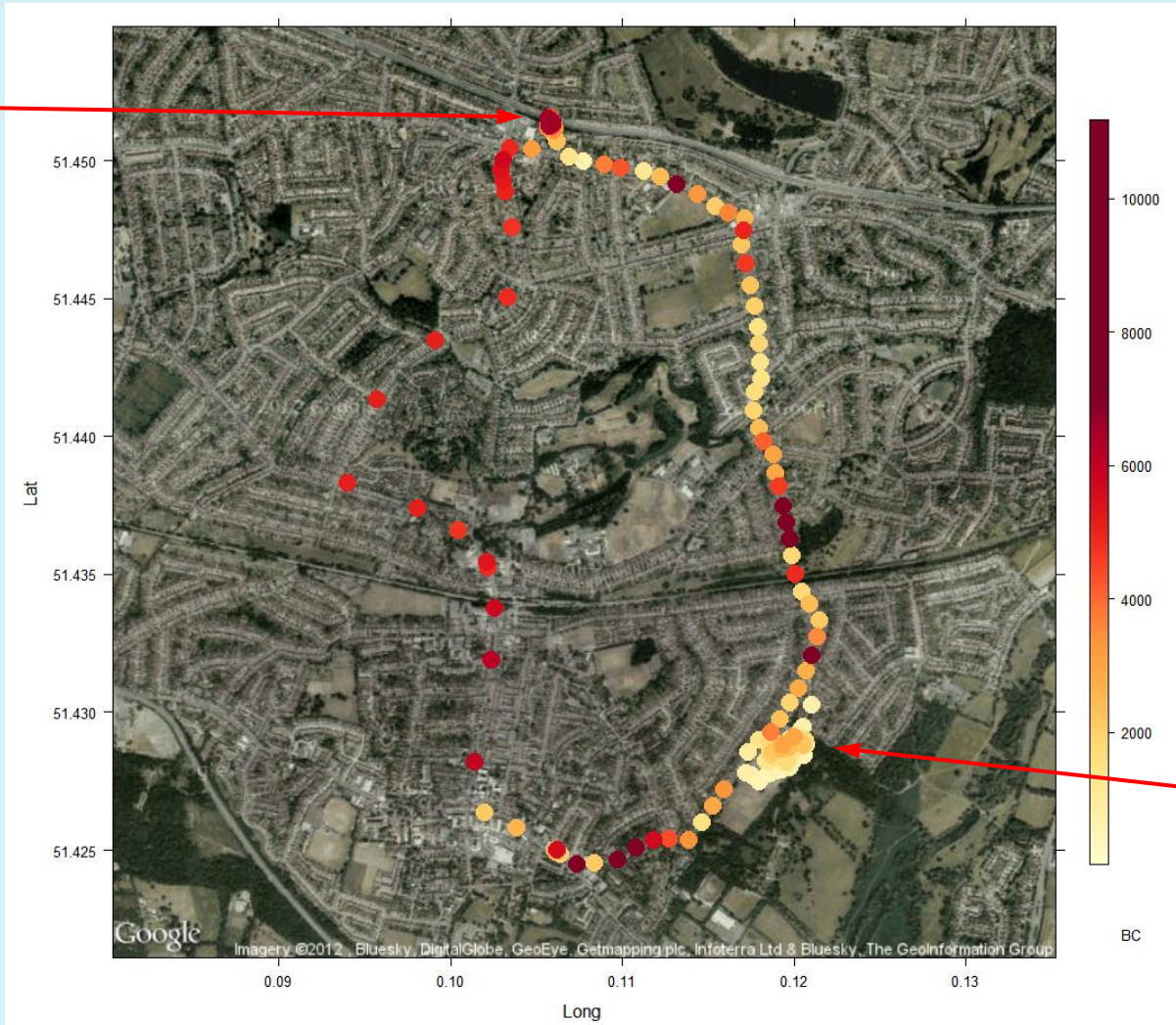
Nursery Toddler



School pupil travelling to/from school

Home close to the A2

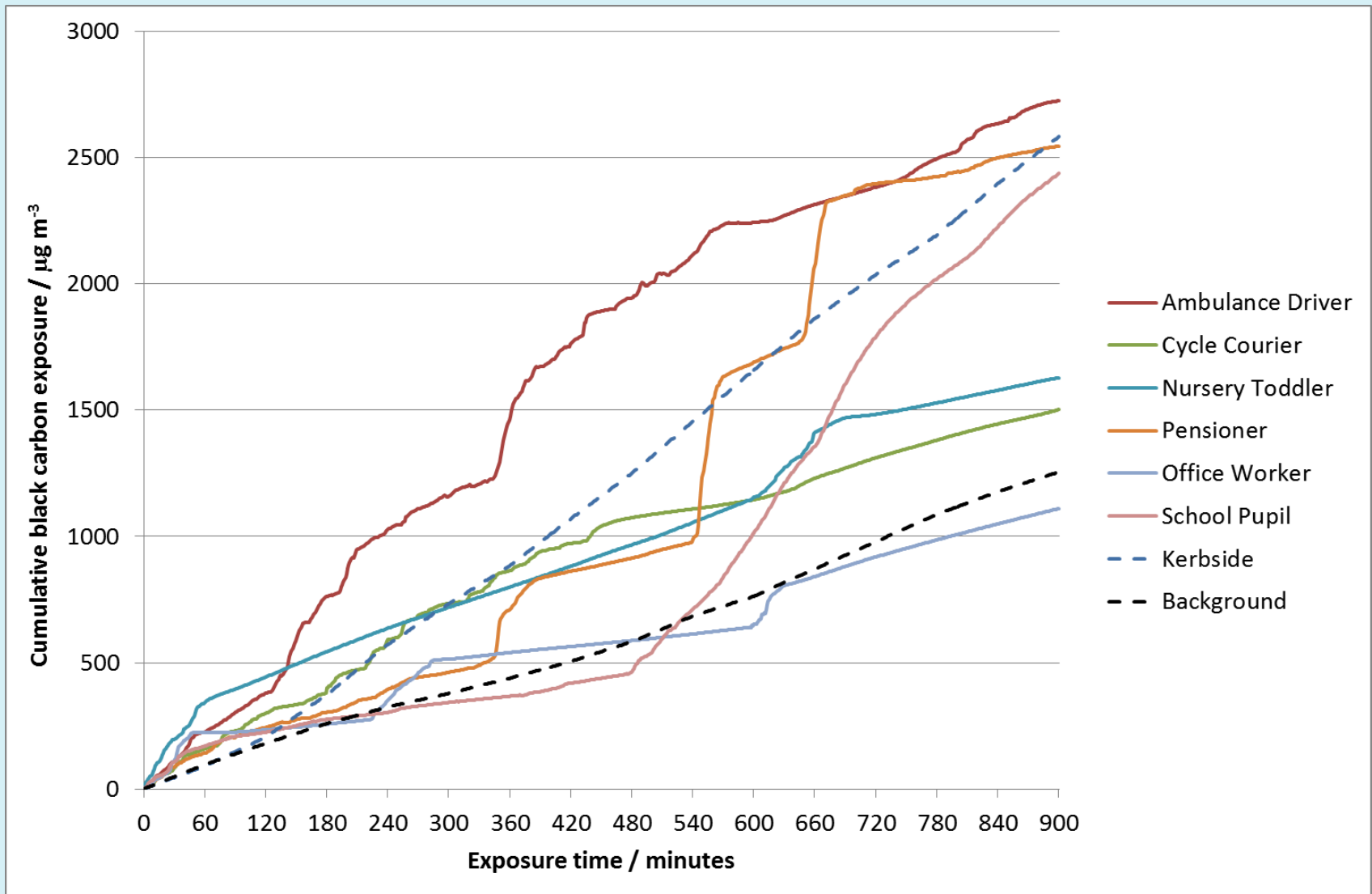
Bus to school along main roads



Walk from school along back roads

School in suburban location

Cumulative BC exposure (7am to midnight)

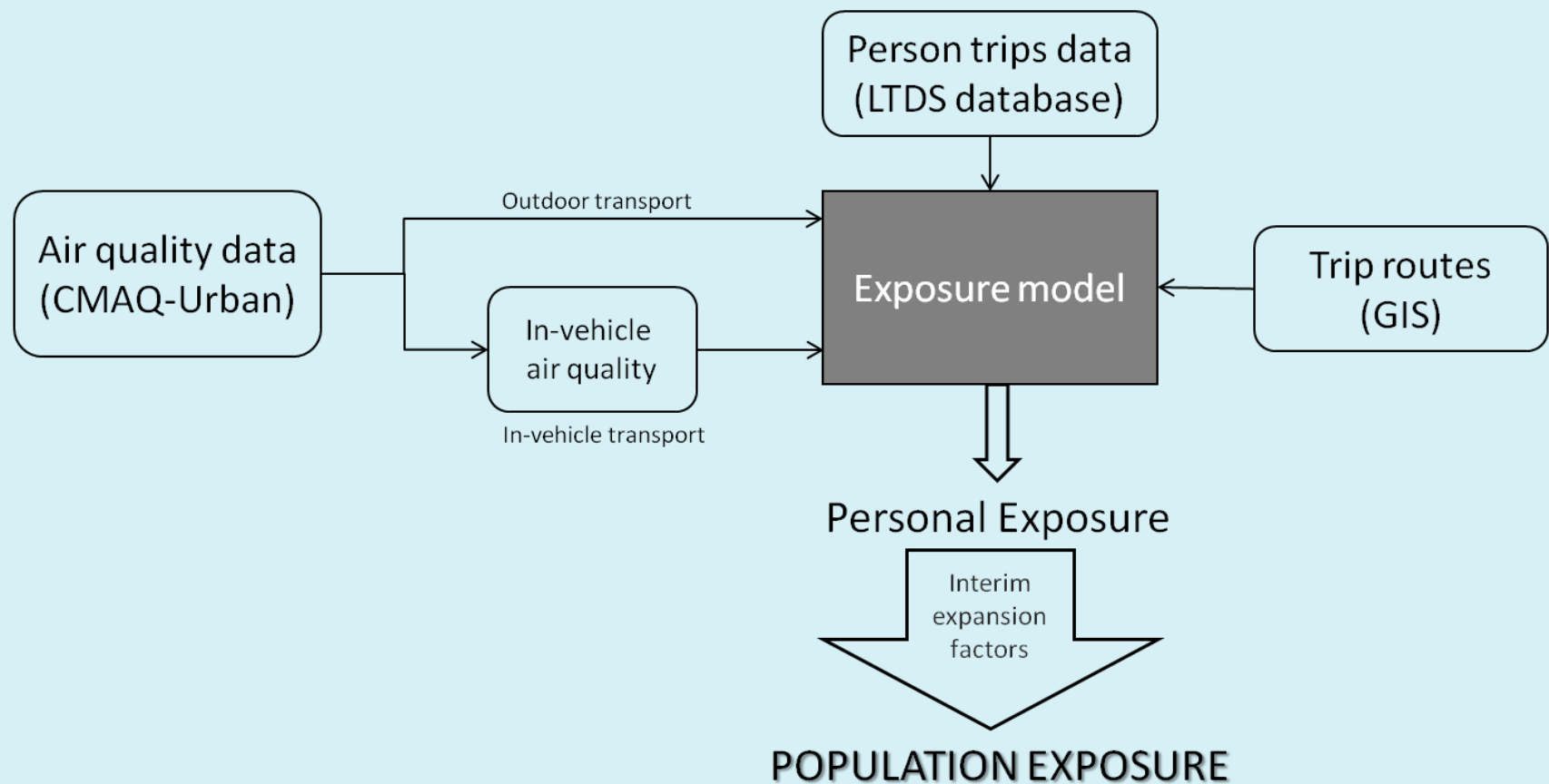


Relative importance of each period

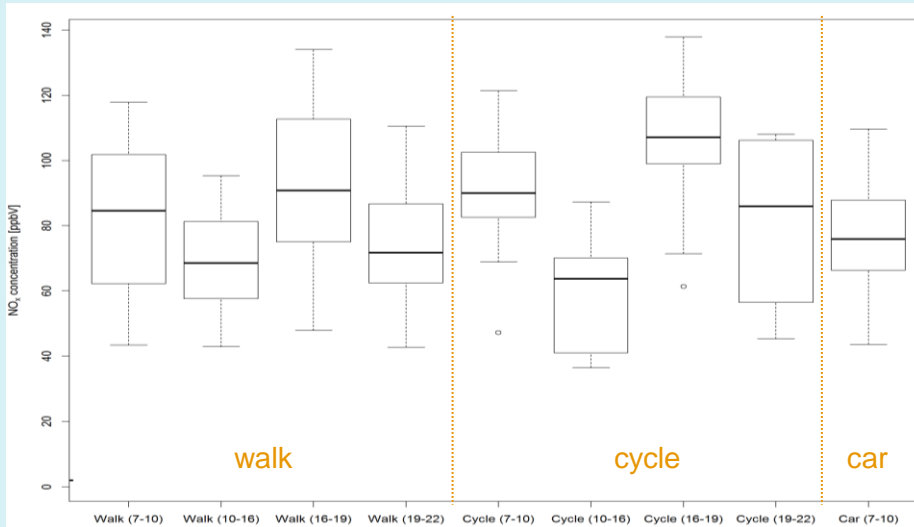


The London Hybrid Exposure model

- Combines pollution model outputs with travel behaviour and route data to create a personal air pollution exposure model.

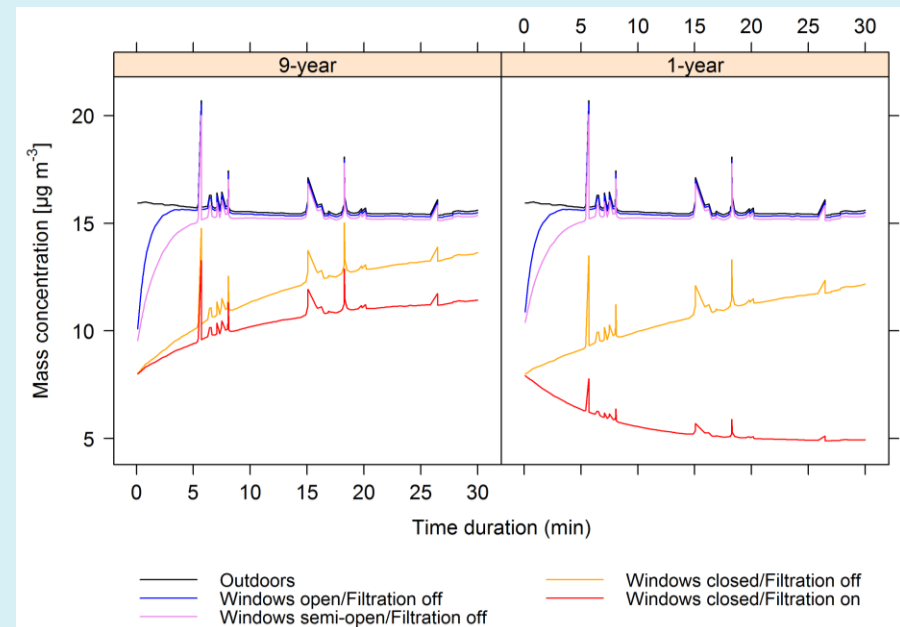


Hybrid exposure model – first steps



Box plots of $PM_{2.5}$ exposure concentrations during walking, cycling trips in different periods of the day and during car driving in morning rush hours.

$PM_{2.5}$ exposure concentrations during car trips for various ventilation settings and for two different age cars.

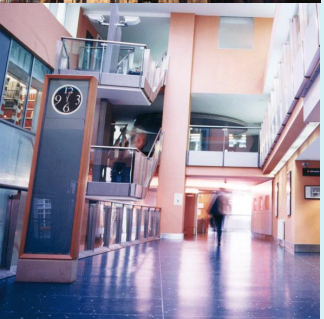


Personal exposure – next steps

- Development and validation of exposure model.
 - Integration of additional travel behaviour information to characterise population
 - Sensitivity testing of model outputs as first validation stage
 - Validation of outputs against PE measurements
- Application of model outputs to epidemiological studies.
- Visualisation of outputs for research and public information.
- Application of combined modelling/monitoring approach to cohort studies to relate exposure to health end points.
- Public exposure reduction activities – tools and information on how air pollution can be avoided (public meetings, website and route planner).

Thank you

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