Contents

- **Simple estimates of exposure in London for AQS**

- **MESSAGE – Monitoring with mobile sensors**

- **Genesis Project**

- **US Approach**
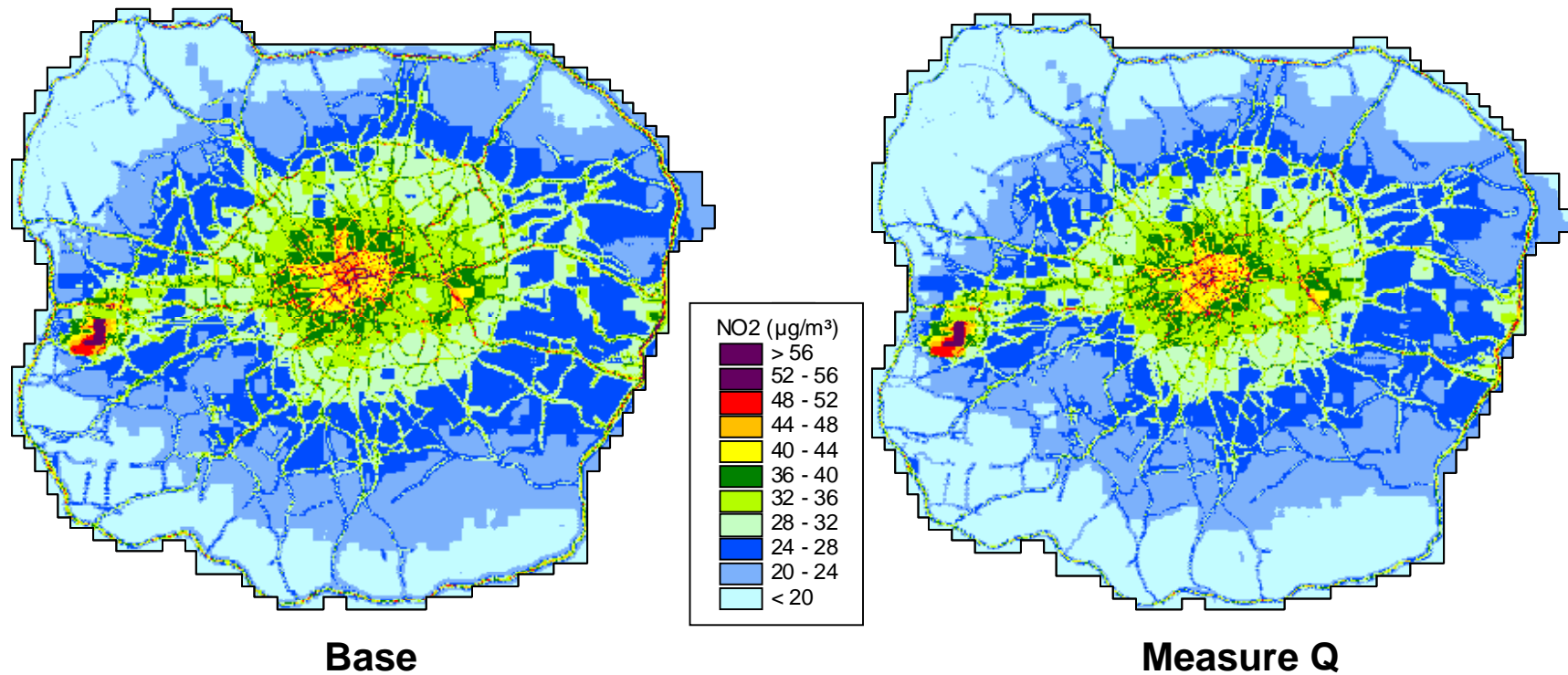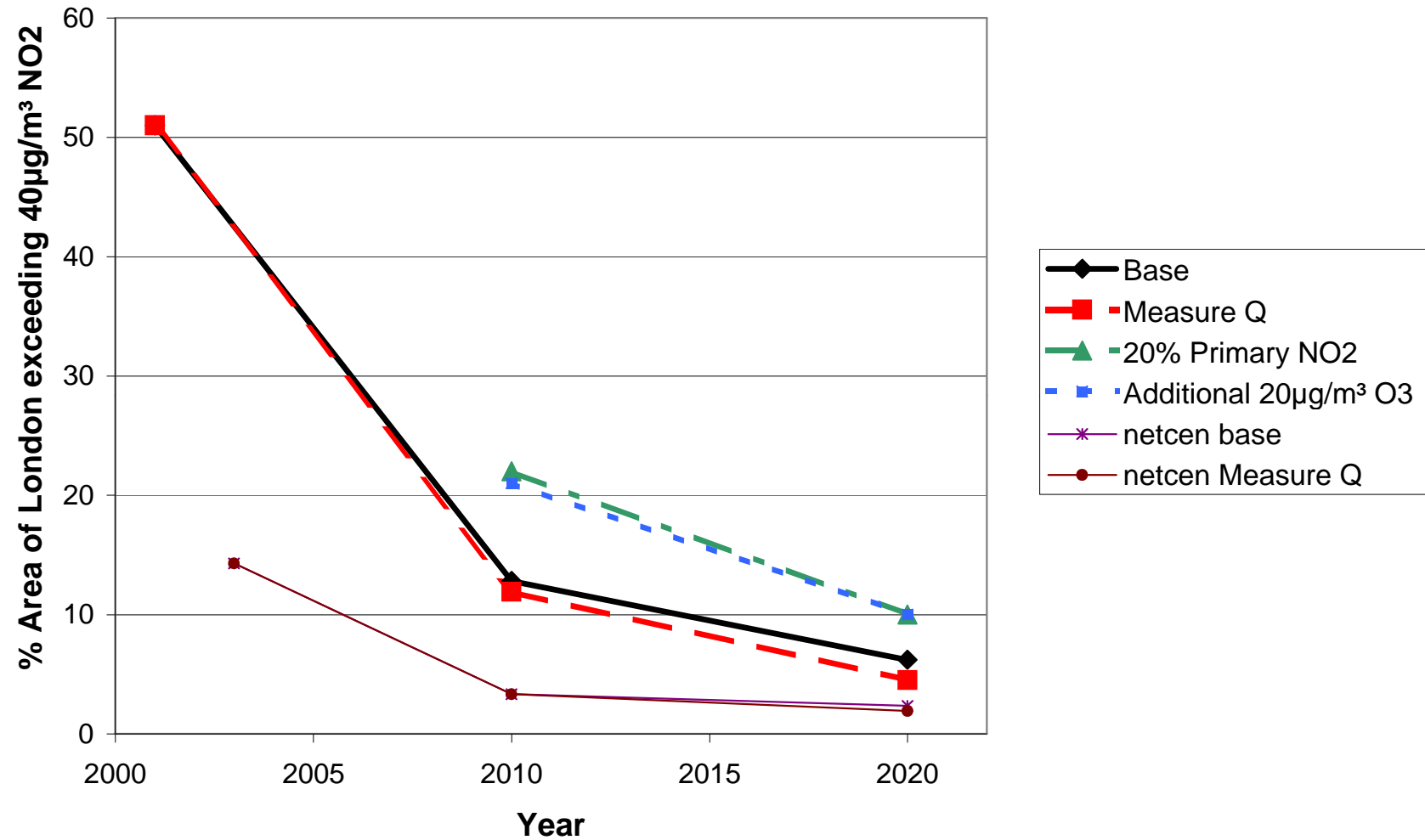
- **Conclusions**

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'EXPOSURE' IN LONDON

Example from Air Quality Strategy Review - annual average NO$_2$ Concentrations calculated using ADMS-Urban

NO2 (µg/m³)

> 56
52 - 56
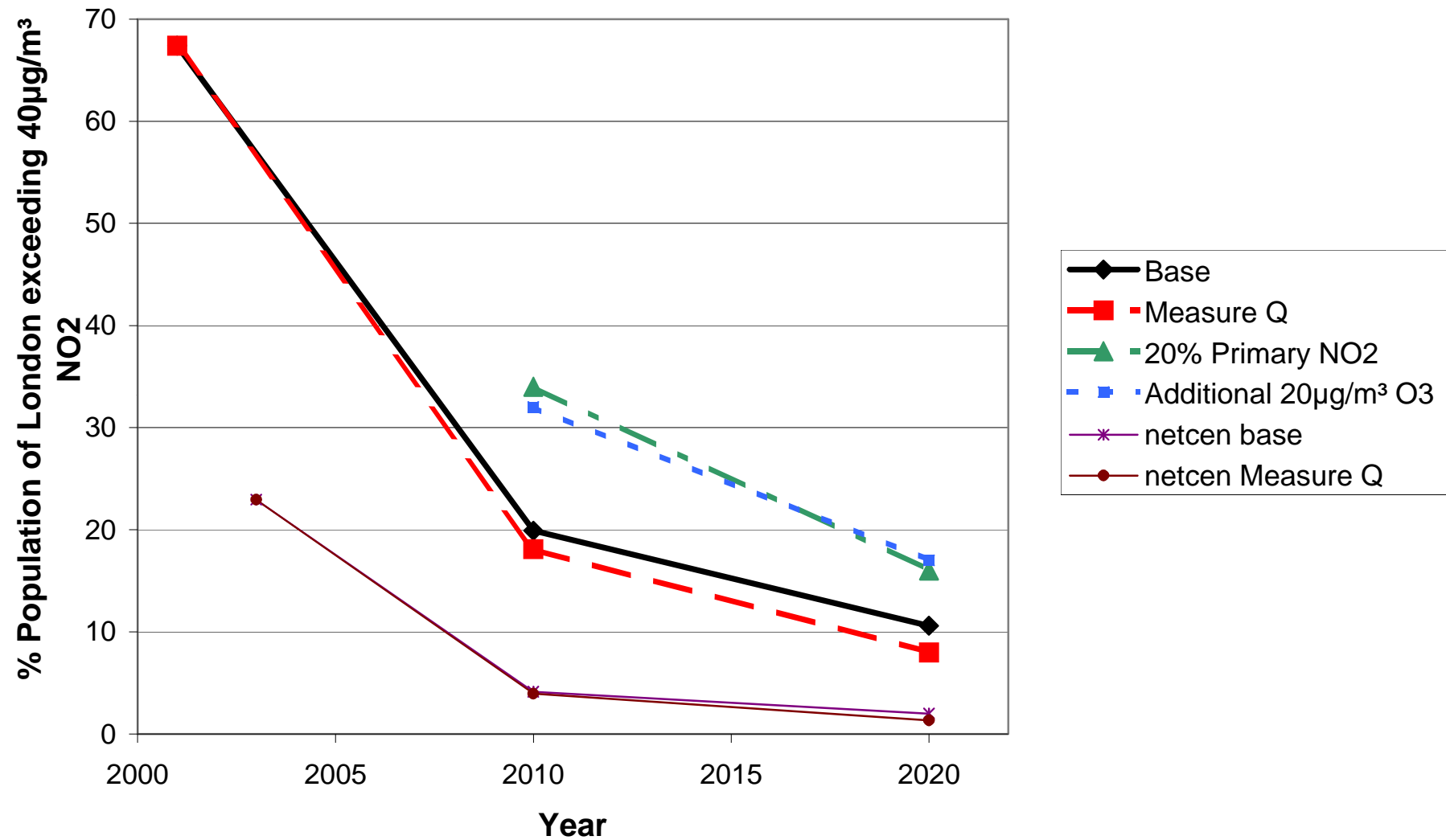48 - 52
44 - 48
40 - 44
36 - 40
32 - 36
28 - 32
24 - 28
20 - 24
< 20

Base

Measure Q

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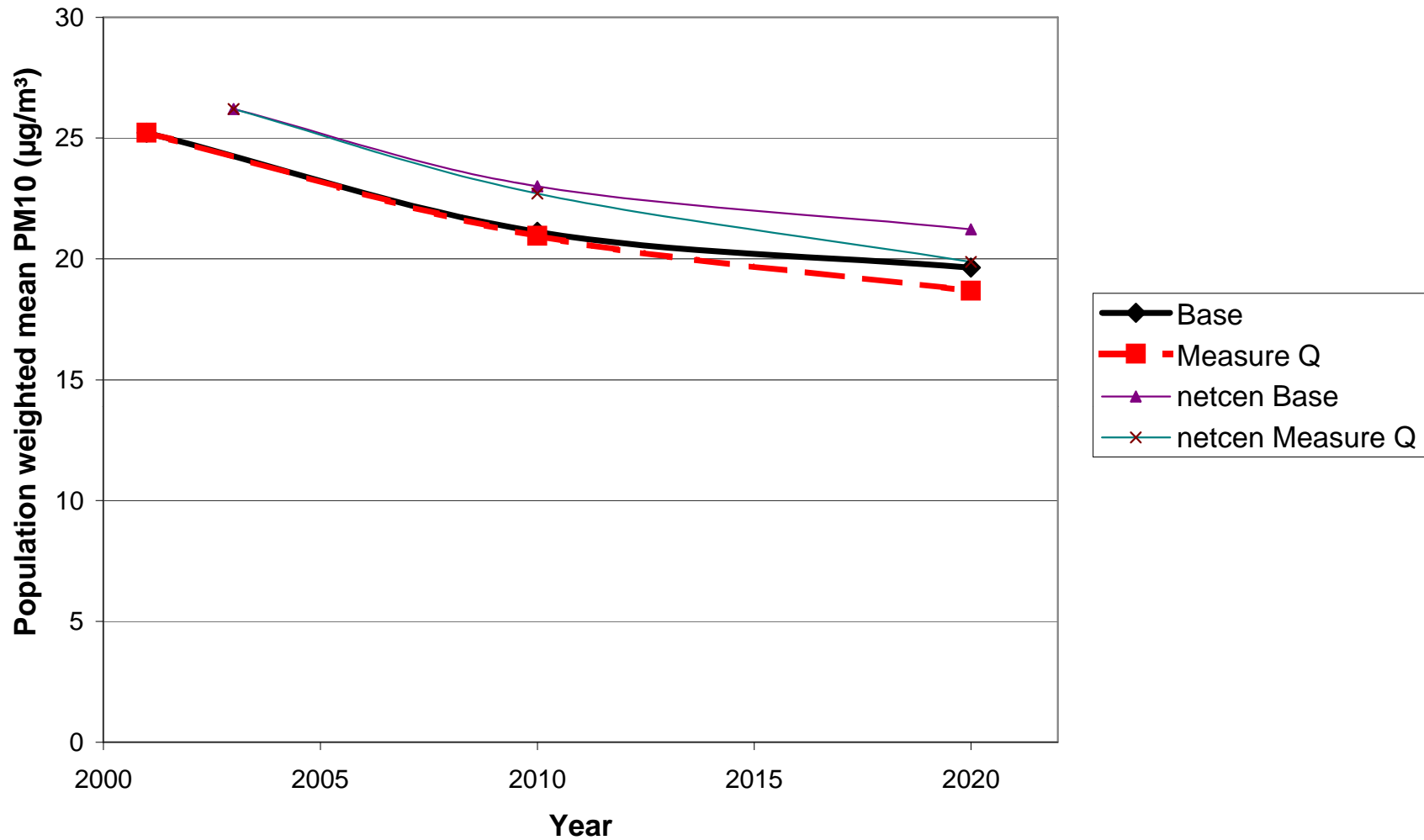
Area of London exceeding 40µg/m³ NO$_2$

Population of London exceeding 40µg/m³ NO₂

Population weighted mean NO₂ concentrations
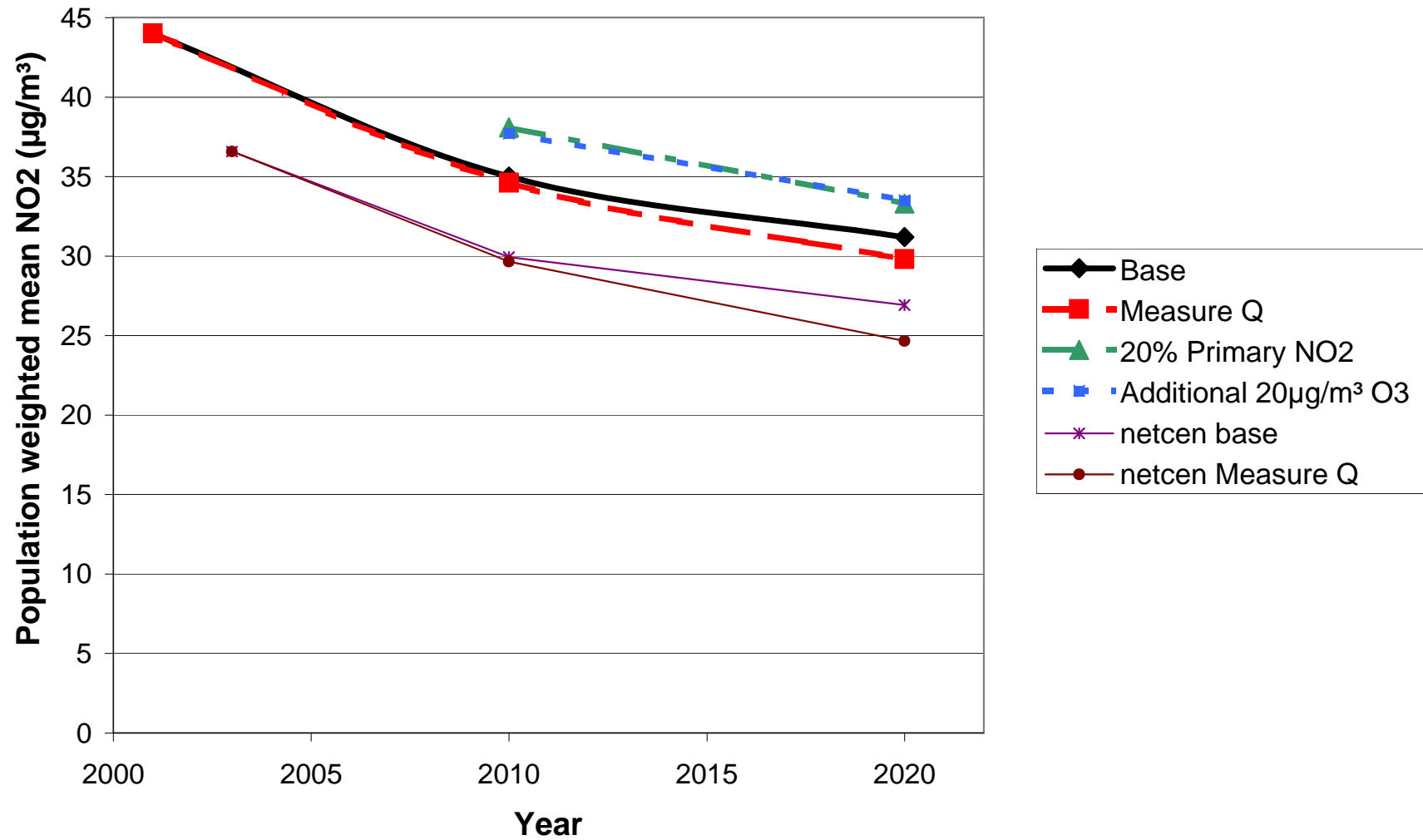
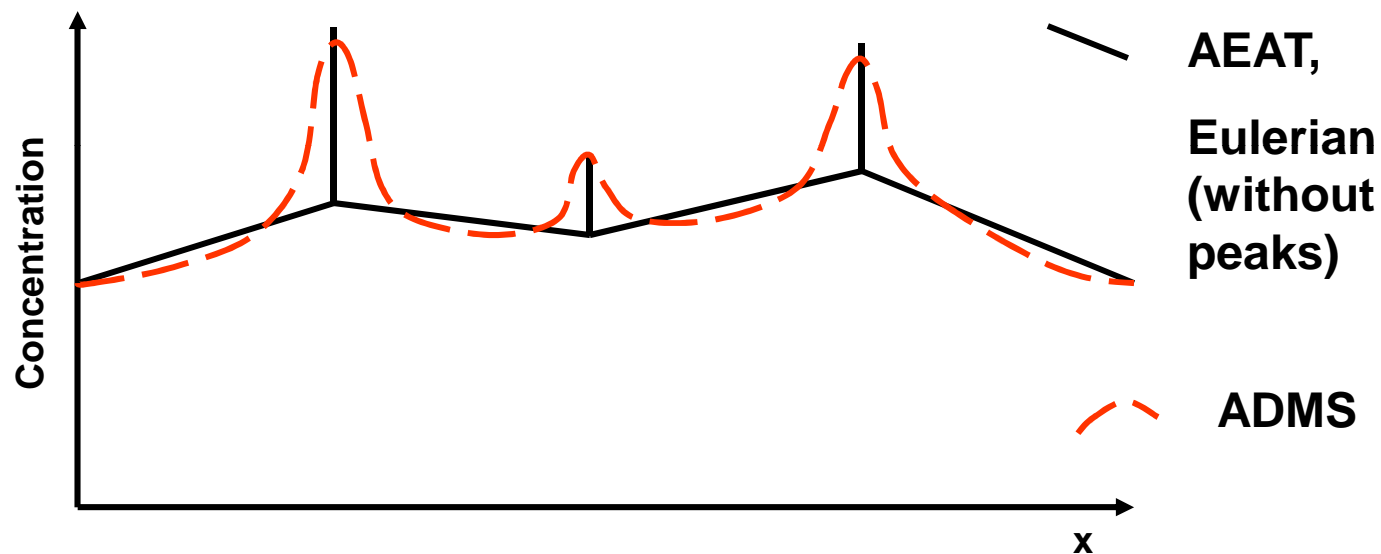# Population weighted mean PM$_{10}$ concentrations

Similarly for PM$_{2.5}$

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Model resolution effects

- ADMS-Urban *cf* AEAT *cf* Eulerian model

MESSAGE PROJECT

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MESSAGE

• **Mobile Environmental Sensing System Across Grid Environments**

•Collection and analysis of information from 'complex' environments (urban air quality)

http://www.message-project.org

(Prof. Rod Jones)

Statistical evaluation: NOx

NO	MEAN	MAX
CAR	0.211	0.973
BIKE	0.213	5.308
WALK	0.156	3.808

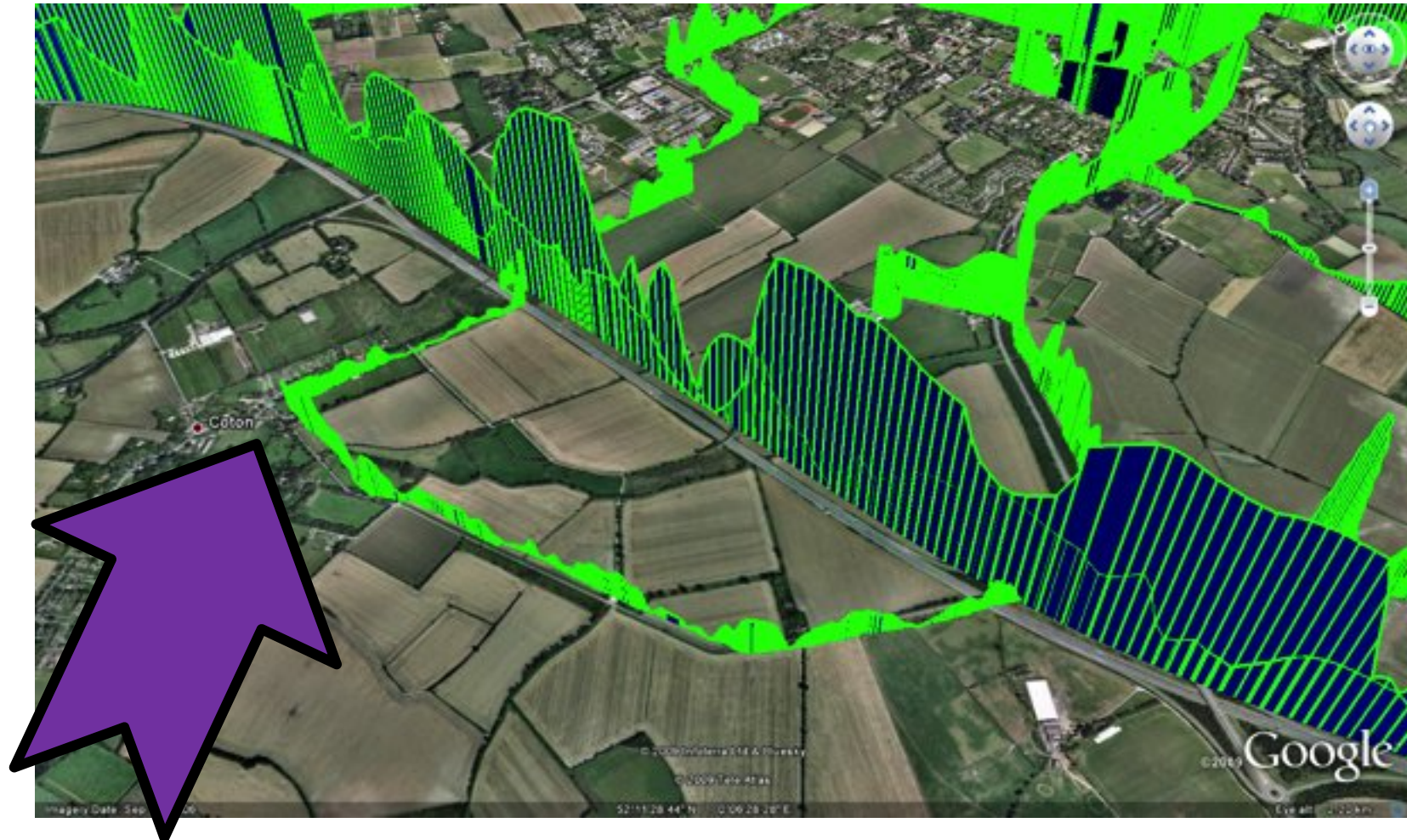| NO2	MEAN	MAX
CAR	0.030	0.156
BIKE	0.022	0.404
WALK	0.017	0.438

UNIVERSITY OF CAMBRIDGE

message
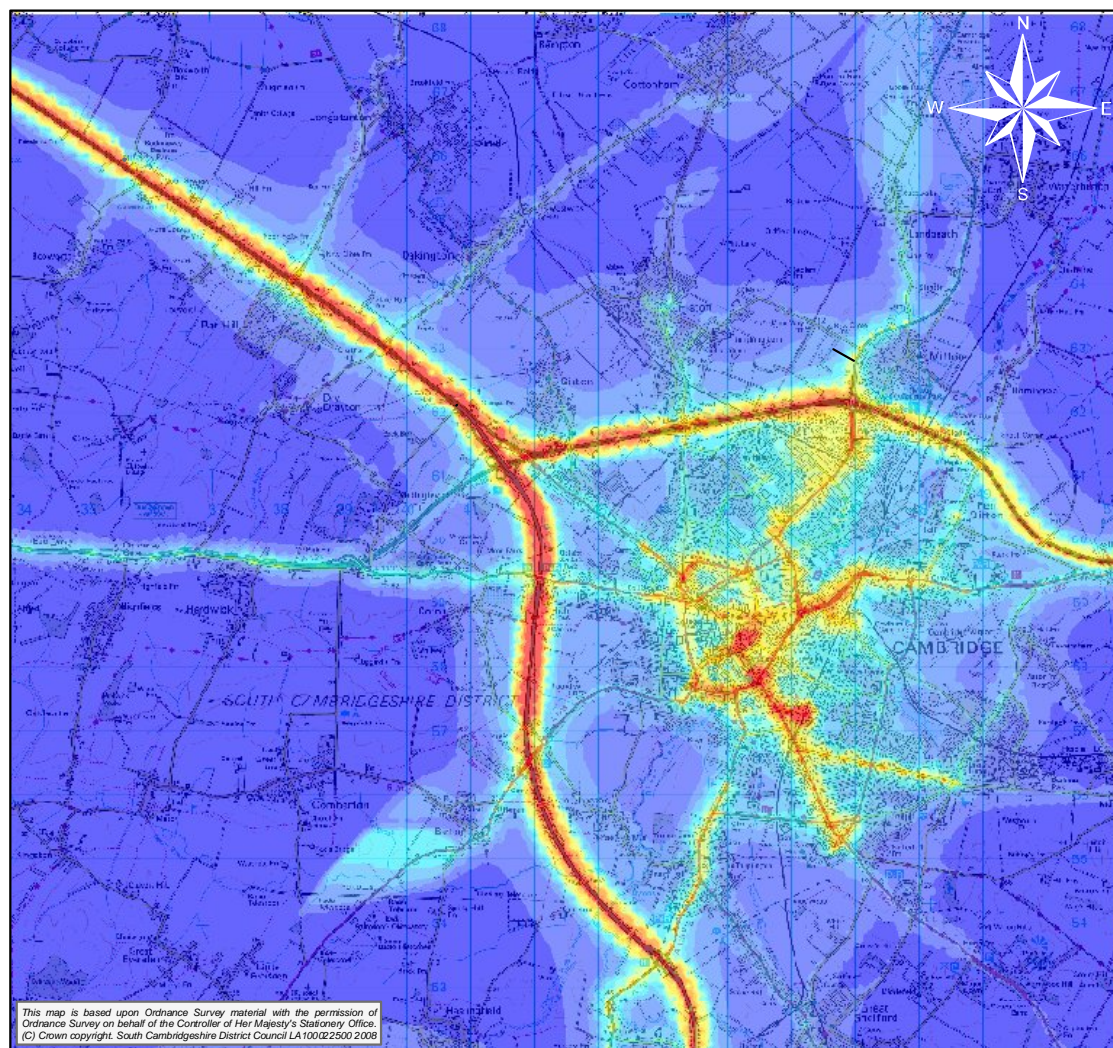
NO$_2$: car vs bike – rural road vs motorway

Calculated Annual average NO2 Cambridge - ADMS-Urban

NO₂ concentration (µg/m³)

- < 15
- 16 - 18
- 18 - 20
- 20 - 22
- 22 - 24
- 24 - 26
- 26 - 28
- 28 - 30
- 30 - 32
- 32 - 34
- 34 - 38
- 38 - 40
- > 40

Kilometres
0   3   6   9   12   15

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Cambridge City Council & South Cambridgeshire District Council

Predicted annual average NO₂ concentrations for the 2006 scenario

Figure 10.7

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EU GENESIS PROJECT

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EU GENESIS Project

- **GENESIS: GEN**eric **E**uropean **S**ustainable **I**nformation **S**pace for Environment, is an EU 7th Framework Project.

- **Objective:** *providing Environment management and Health actors with an efficient solution based on **advanced ICT** to constitute **collaborative information networks, integrating existing systems**. The proposed solution is based on a **thematic-neutral and open "information system set up framework" made of Web services, portal components and toolkits**. This framework can be easily customized for various thematic fields e.g. air quality, water quality, and deployed in many contexts (Regional, European,…)*

- **CERC** are working with **Imperial College** (Gioia Mosler at St. Mary's Hospital) and John Gulliver at the **University of the West of Scotland** on an air quality thematic that considers local scale air quality, different target groups and delivery modes e.g. web, GIS.

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EU GENESIS Project

- ## The air quality thematic will involve
  - **STEMS**: development of the STEMS system and deployment of STEMS functionality within GENESIS or as a web publishing service.
  - Input data are:
    - Air quality concentration – from ADMS-Urban
    - Origin destination data, part of census data, on SOA (super output area) level, refers to e.g. home and work destinations of people in the UK
    - "National Time Use Survey" & "National Travel Survey" as a basis for time-activity data (origin-destination data available only for very big areas). The time interval is 10 minutes.
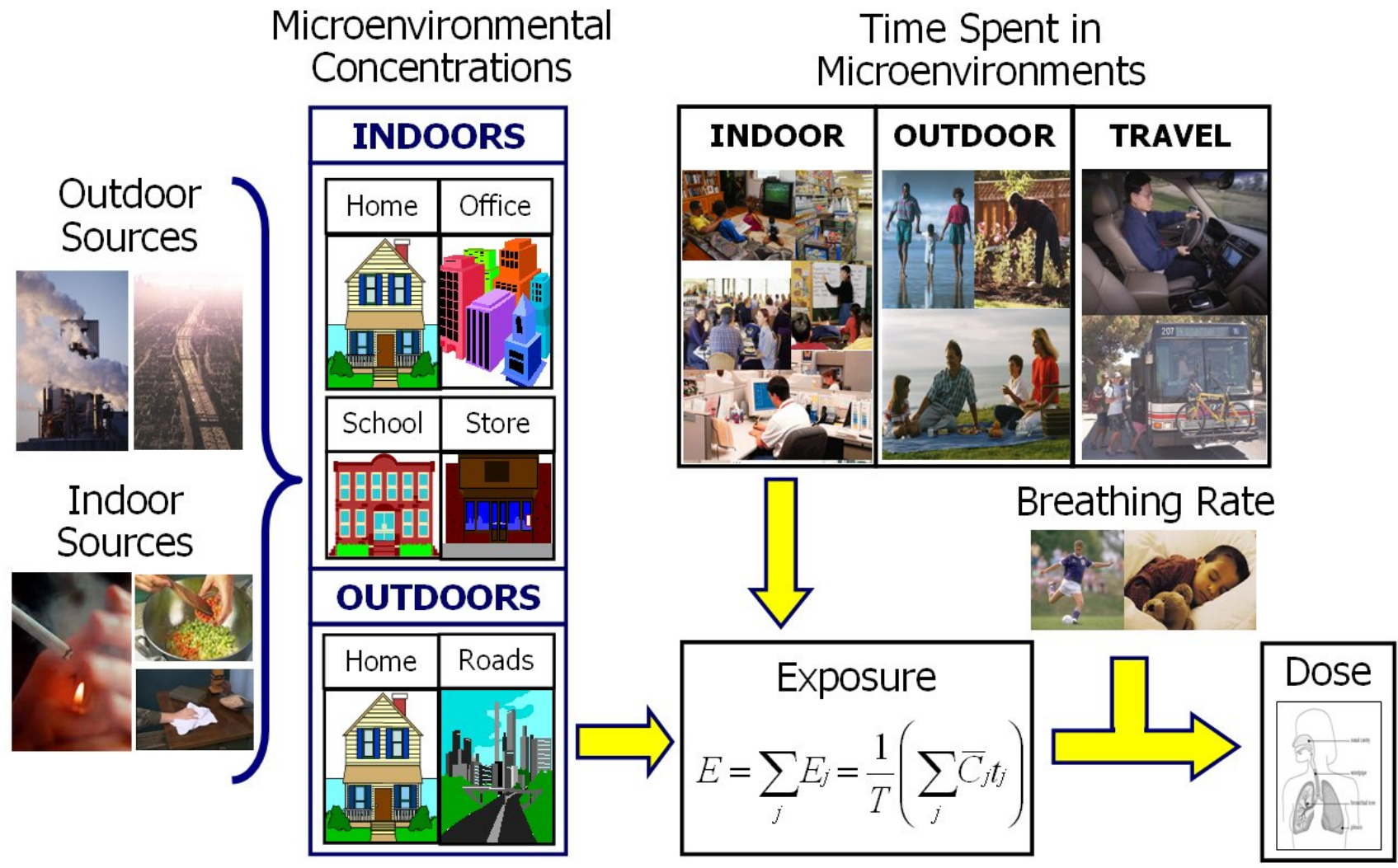
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EU GENESIS Project

- The air quality thematic will use the following in STEMS:
  - **Bradford**: Data from Born in Bradford (BiB) **- time activity sheets** and samples (approx 44 diaries), questionnaire information, personal and other monitoring data
  - **London**: Personal monitoring campaigns starting mid-2010 to investigate:
    - different transport modes
    - the variation in one transport mode at one route between days or times of the day
    - different daily routines and routes
  - **ADMS-Urban/*air*TEXT**: will be used to calculate the high spatial and temporal scale concentrations
  - **Project ongoing**

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US EPA WORK ON EXPOSURE

US EPA work on Exposure (Haluk Ozkaynak)

• **Stochastic Human Exposure and Dose Simulation (SHEDS) Model for Air Pollutants**

Microenvironmental Concentrations

Time Spent in Microenvironments

Outdoor Sources

Indoor Sources

INDOORS
Home | Office
School | Store

OUTDOORS
Home | Roads

INDOOR | **OUTDOOR** | **TRAVEL**

Breathing Rate

Exposure

$$E = \sum_j E_j = \frac{1}{T}\left(\sum_j \overline{C}_j t_j\right)$$

Dose

US EPA work on Exposure

- **Predicted PM$_{2.5}$ Exposures by Ambient and Non-ambient Sources: Philadelphia Case Study**

OUTDOOR (5%)

IN-VEHICLE (7%)
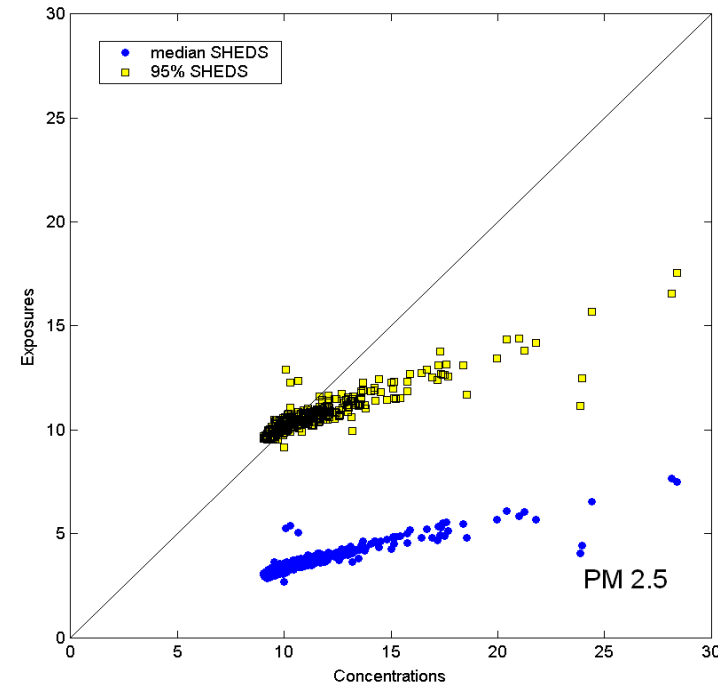
INDOOR NON-AMBIENT (21%)

INDOOR AMBIENT (67%)
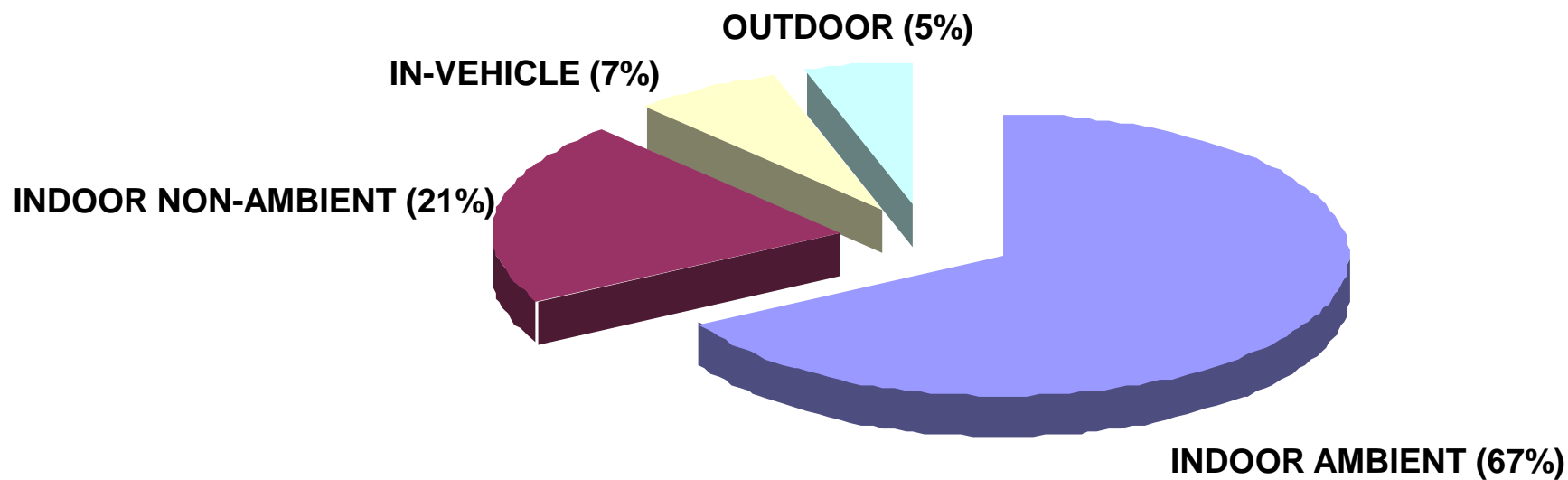
US EPA Work on Exposure
Exposures are different from concentrations
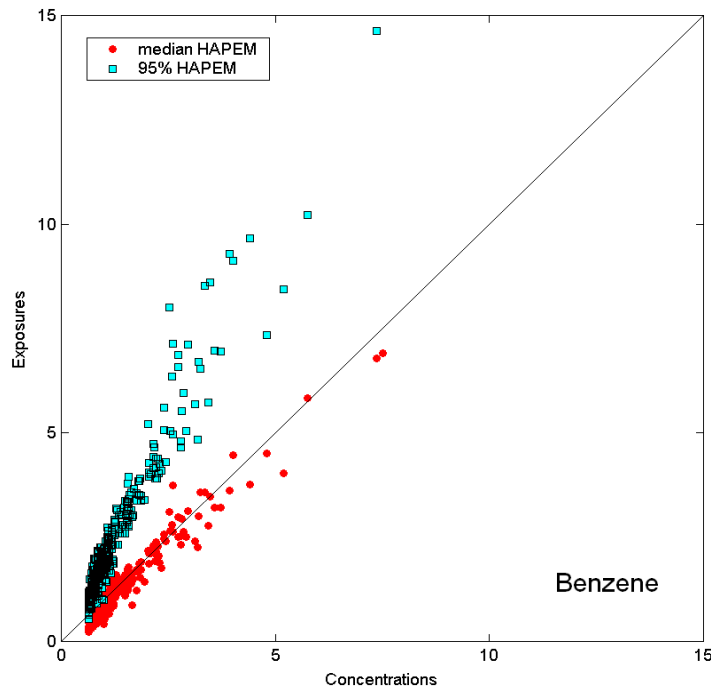
Benzene from HAPEM

PM2.5 from SHEDS

– Benzene typically infiltrates readily indoors - median exposures are similar to ambient concentrations

– Population subgroups have higher exposures due to elevated residential outdoor levels near roadways estimated by HAPEM model

– $PM_{2.5}$ penetrates less efficiently indoors, thus personal exposures to $PM_{2.5}$ ranges between 40 to 100 % of ambient $PM_{2.5}$ concentration values (from SHEDS model)

HEATHROW AIRPORT

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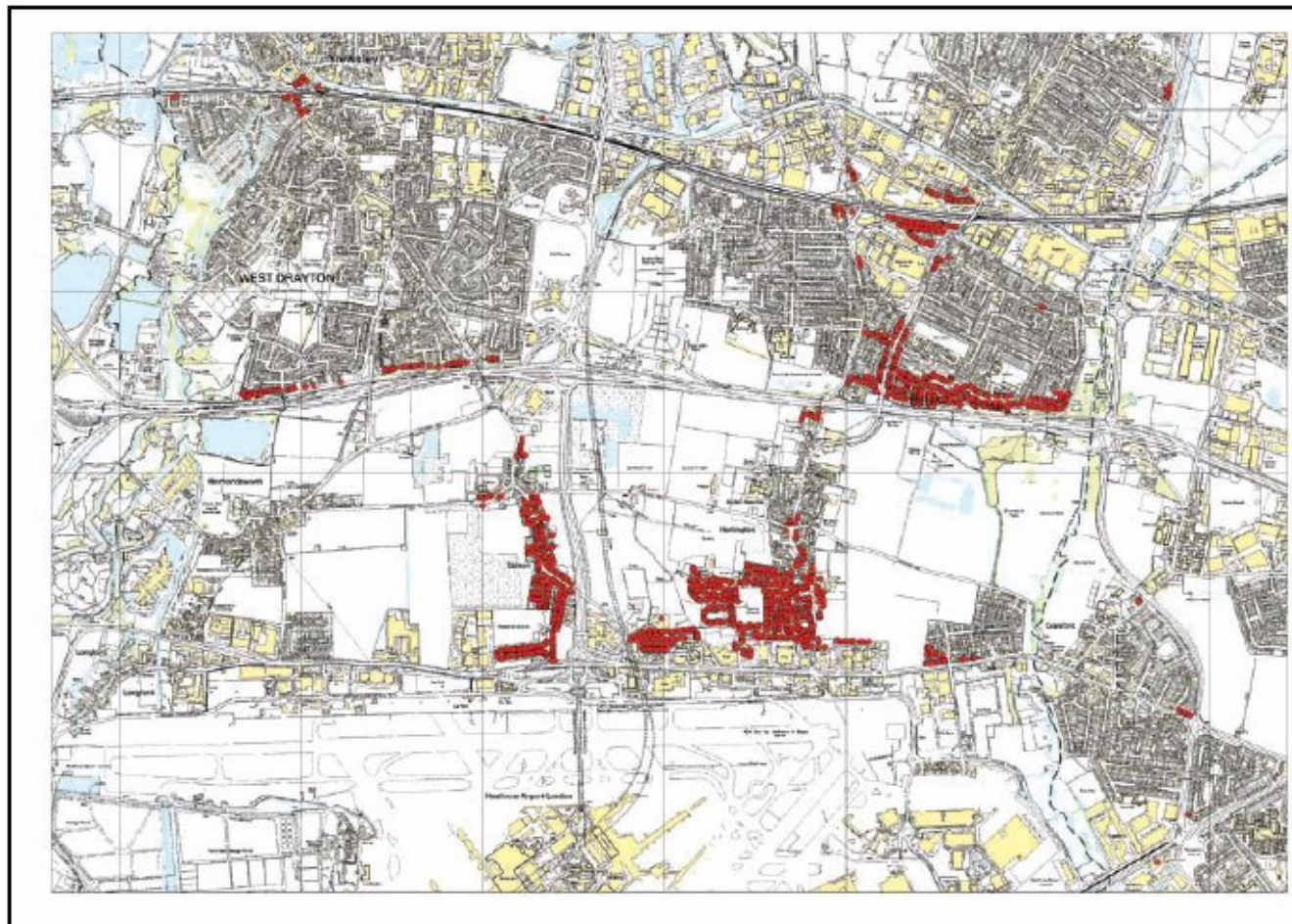# Heathrow

- From Population Exposure report (DfT consultation)

Figure 2.6 – Location of discrete receptor modelling points
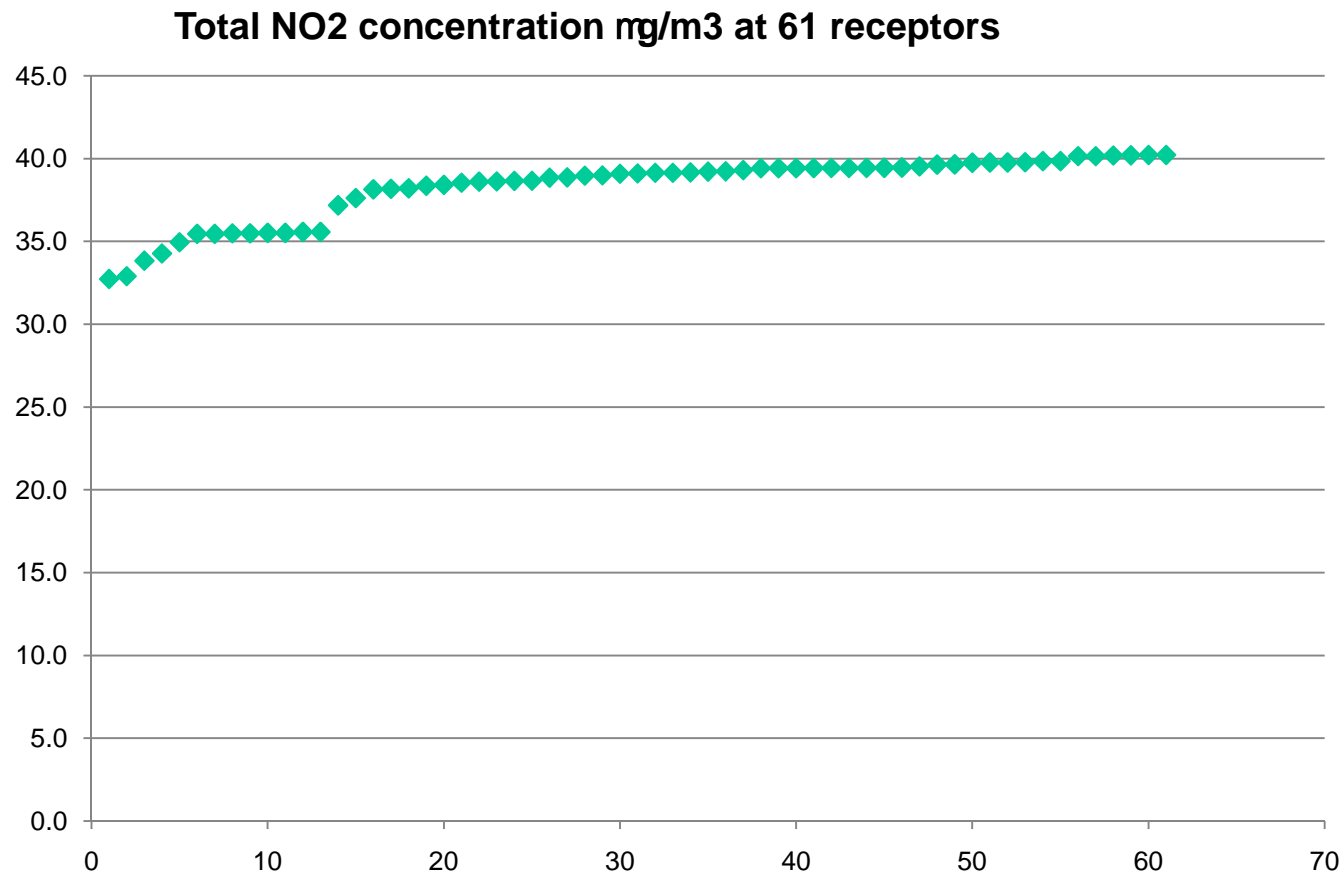
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Heathrow

- Heathrow 2015 scenario, concentration of NO2 at top 61 properties

Total NO2 concentration mg/m3 at 61 receptors

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Conclusions/Implications

- **Exposure Calculations – do we mean exposure?**

- **AQ Directive – 'reduce *exposure* in urban areas by an average of 20%'**

- **Exposure model required to be used in conjunction with air quality model**

Acknowledgements - Professor Rod Jones (University of Cambridge); Professor Haluk Ozkaynak, US-EPA

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