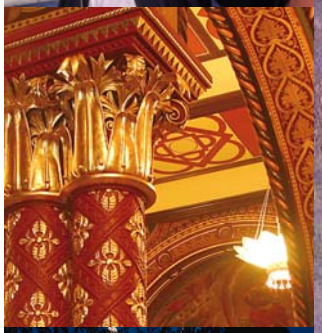
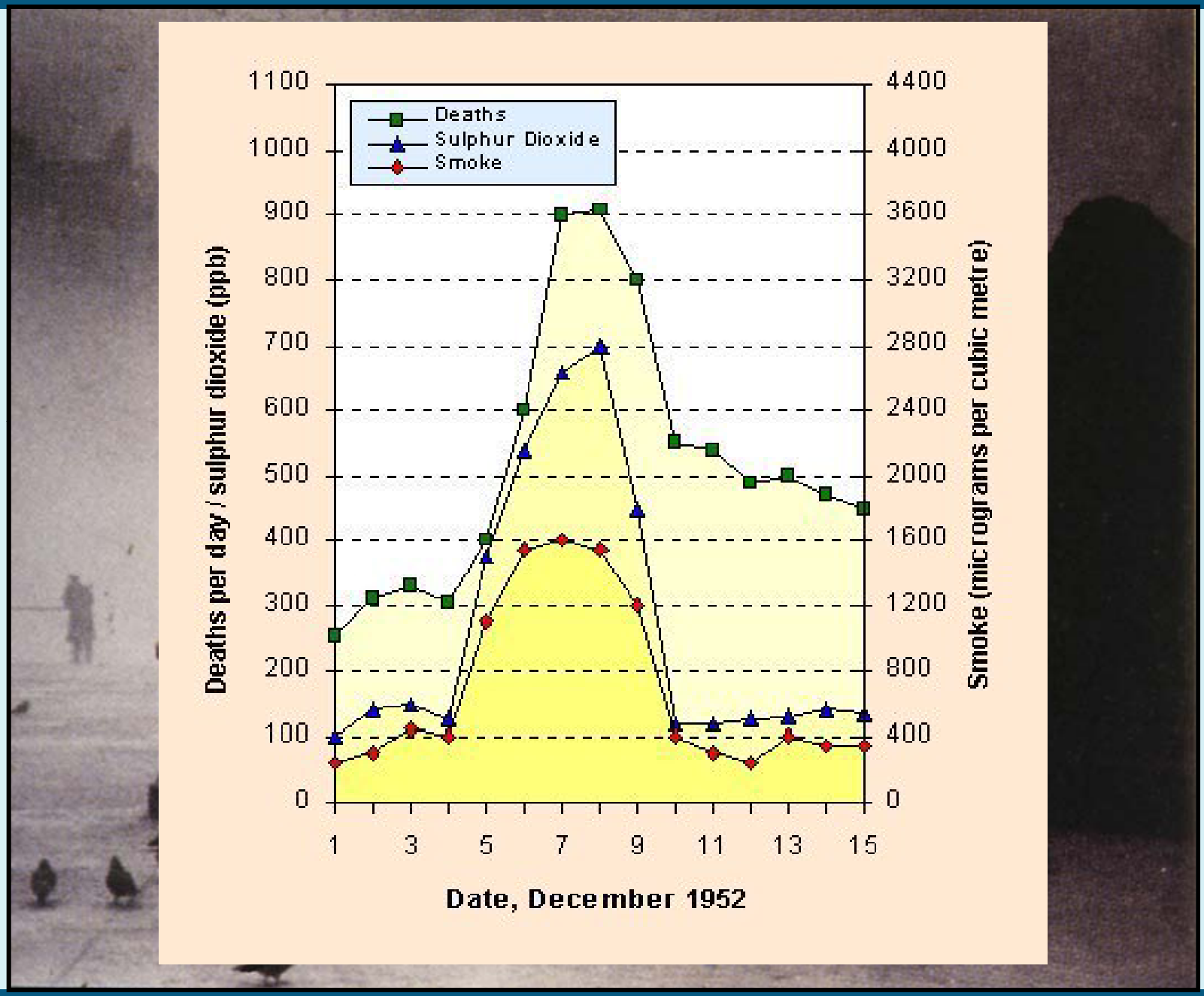


Why is air pollution bad for human health?

Dr Ian S Mudway

MRC-HPA Centre for Environment & Health, King's College London

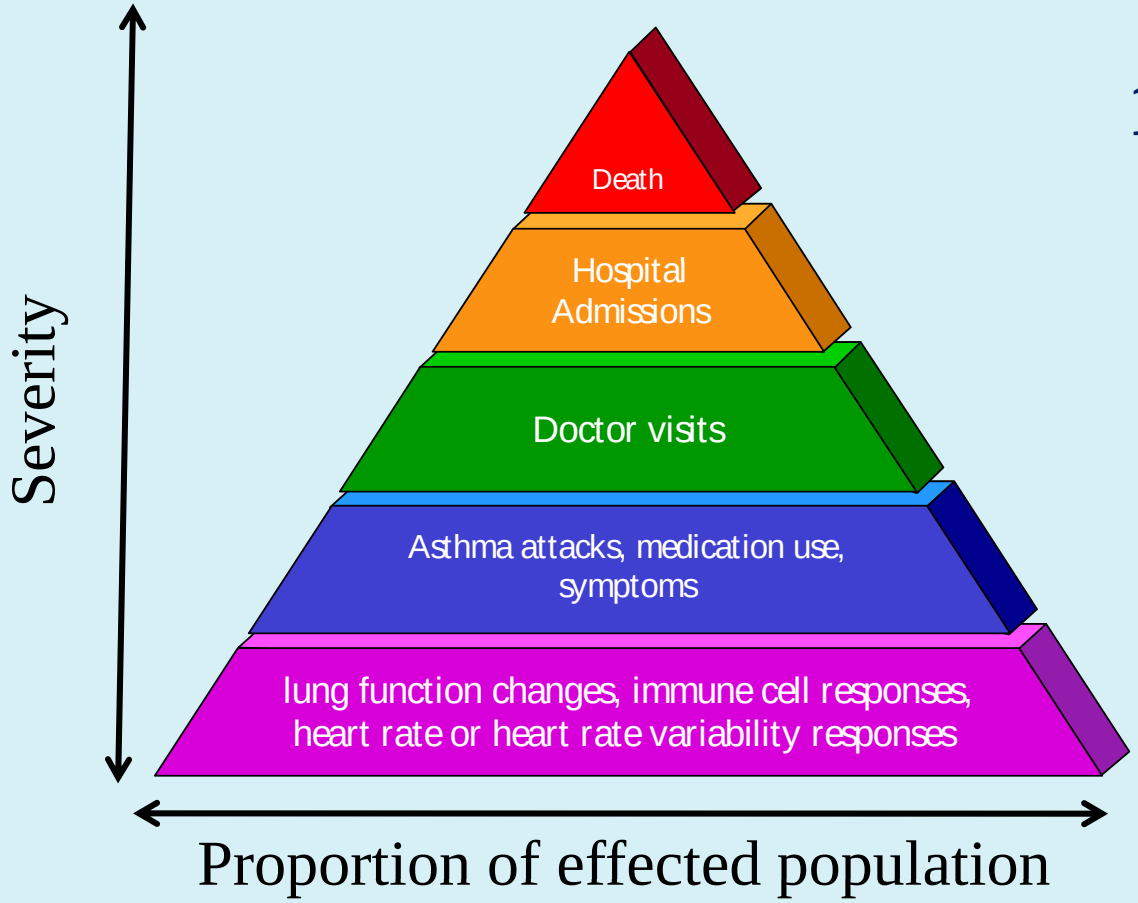

Deaths
Sulphur Dioxide
Smoke
Deaths per day / sulphur dioxide (ppb)
Smoke (micrograms per cubic metre)
Date, December 1952
1100
1000
900
800
700
600
500
400
300
200
100
0
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
1
3
5
7
9
11
13
15

Who died?

Deaths Registered in London Administrative County Classified by Age (Bates, 1995)							
	< 1 Month of Age	**1-12 Mo. Old**	**1-14 Years of Age**	**15-44 Years of Age**	**45-64 Years of Age**	**65-74 Years of Age**	**75+ Years of Age**
Week Before the Episode	16	12	10	61	237	254	335
Week After the Episode	28	26	13	99	652	717	949
Before/ After Episode Ratio	1.75	2.17	1.3	1.62	2.75	2.82	2.83

The greatest relative increase in mortality was from bronchitis, which rose nine-fold

Health Effects of Ambient Pollution



1952 London Fog

- Hospital admissions rose by 50%
- Respiratory admissions by 160%

Health impact of fine particulate pollution

Steubenville

St. Louis

Harrimen

Watertown

Topeka

Portage

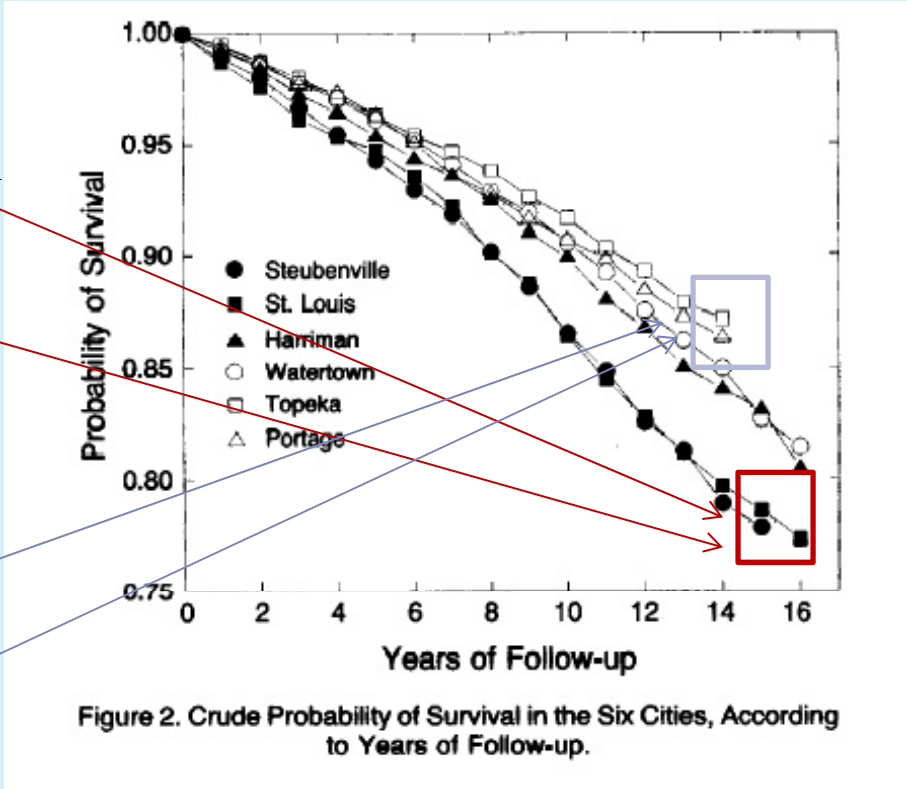
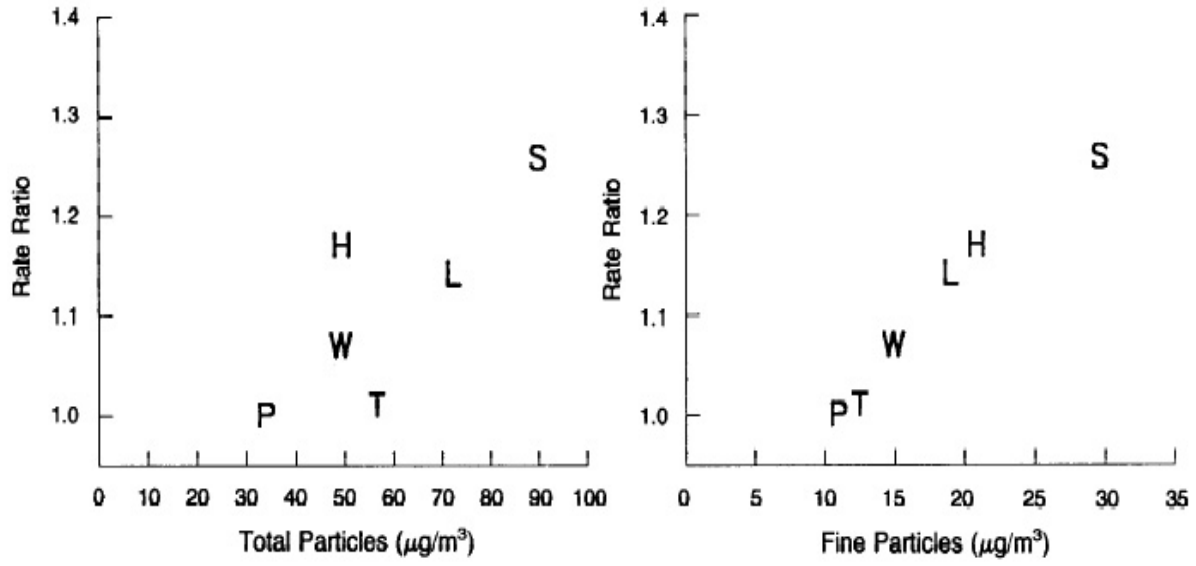
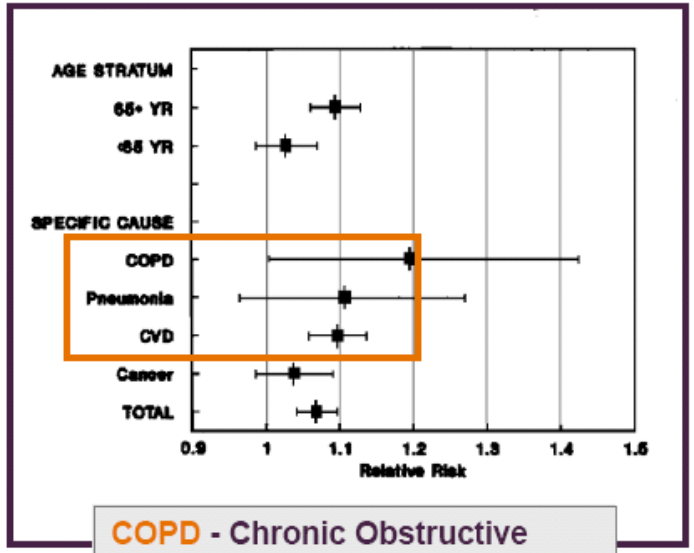


Figure 2. Crude Probability of Survival in the Six Cities, According to Years of Follow-up.

Dockery DW, et al. N Engl J Med 1993;329(24):1753-9

The Six Cities study





COPD - Chronic Obstructive Pulmonary Disease
CVD - Cardiovascular Disease

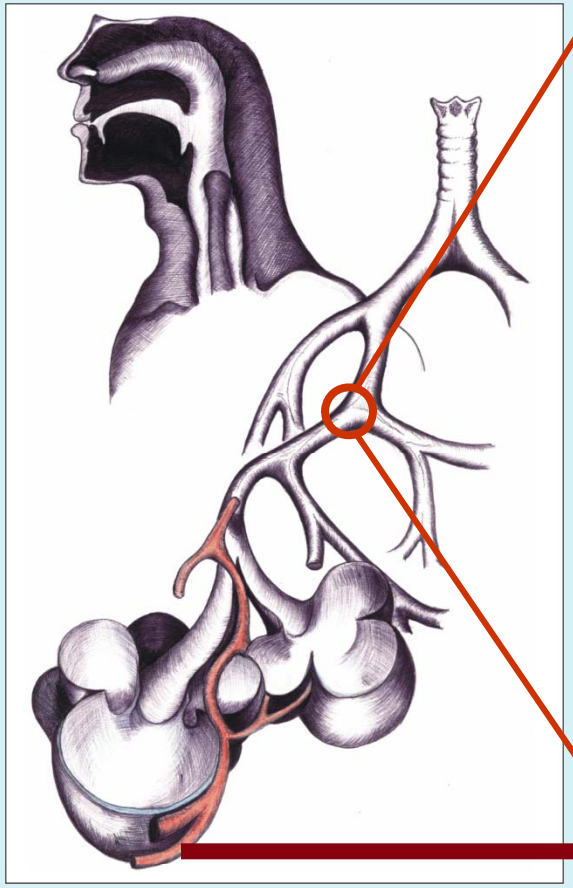
Dockery DW, et al. **N Engl J Med 1993 Dec 9;329(24):1753-9**

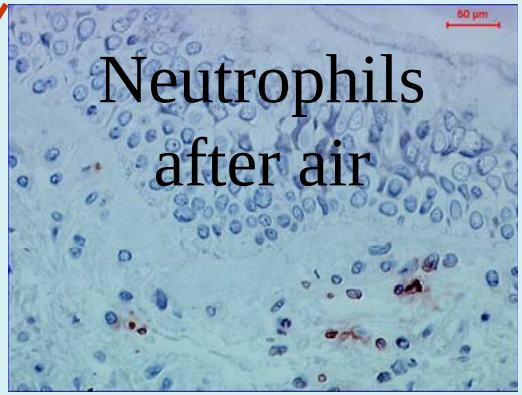
2nd October 2011

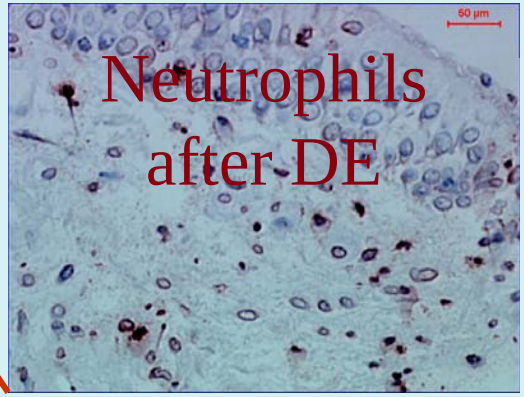
Controlled Diesel Exposures

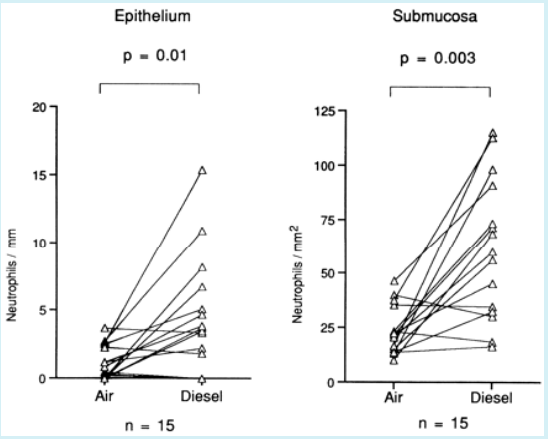
Exposure to DE: PM_{10} 300µg/m^3 and filtered air for 1 hour & 100µg/m^3 and filtered air for 2 hours

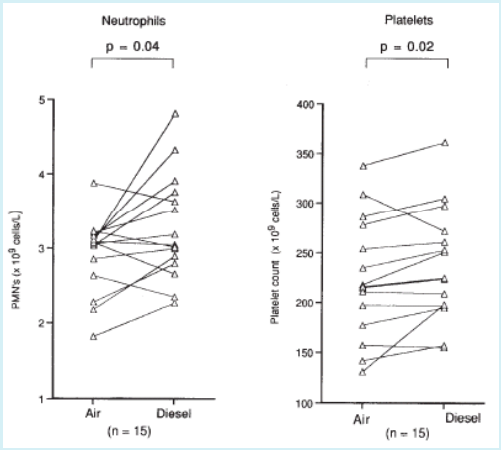
Diesel induces inflammation





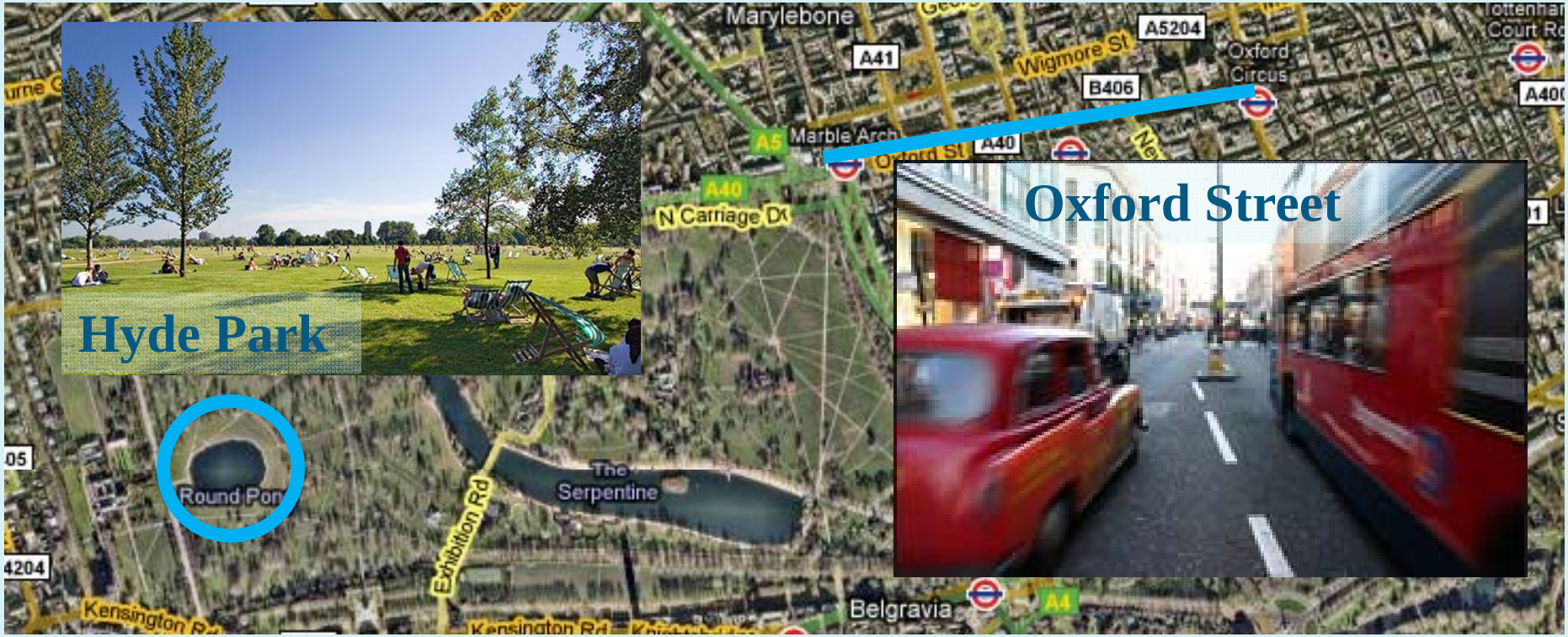






Responses to PM in the Real World

Does short term exposure to real world atmospheres (diesel traffic and background) cause respiratory effects in asthmatics?



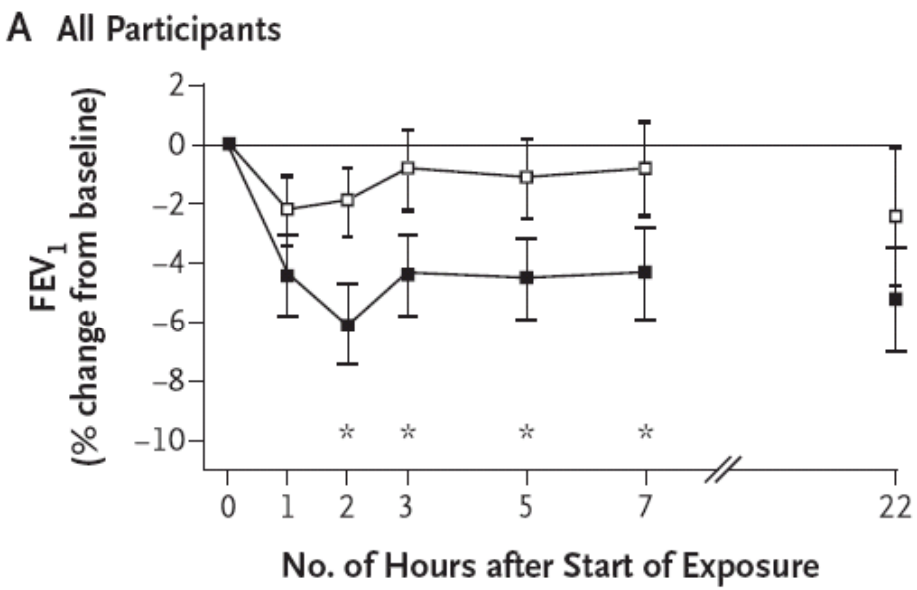
PM_{10} =72 µg m^{-3}, $PM_{2.5}$ =11.2 µg m^{-3}, 11.7 ppb NO_2 18,300 particles cm^{-3}

PM_{10} =125 µg m^{-3}, $PM_{2.5}$ =28.3 µg m^{-3}, 76.5 ppb NO_2 63,700 particles cm^{-3}

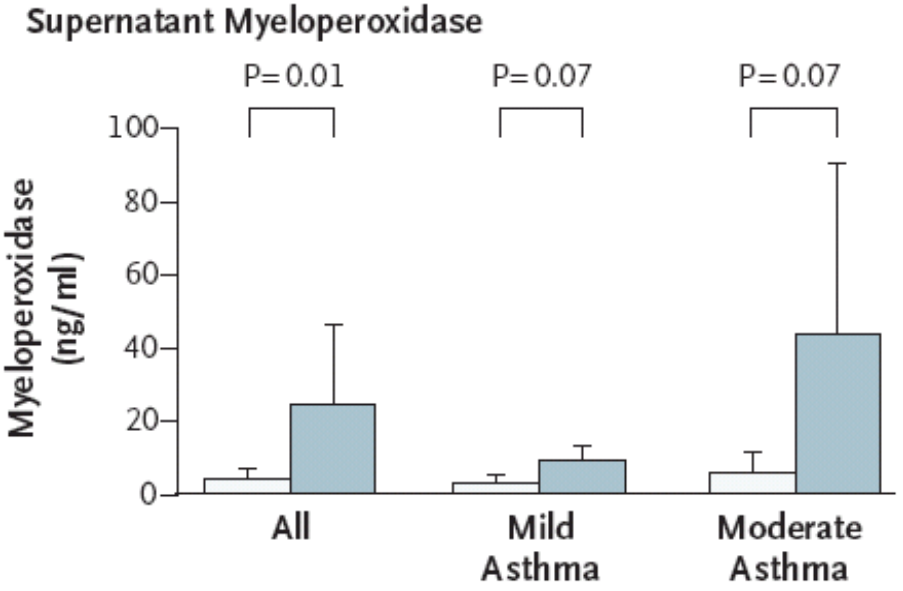
McCreanor al. (2007) New Eng J Med 357: 2348-2358.

Responses to PM in the Real World

Impaired lung function



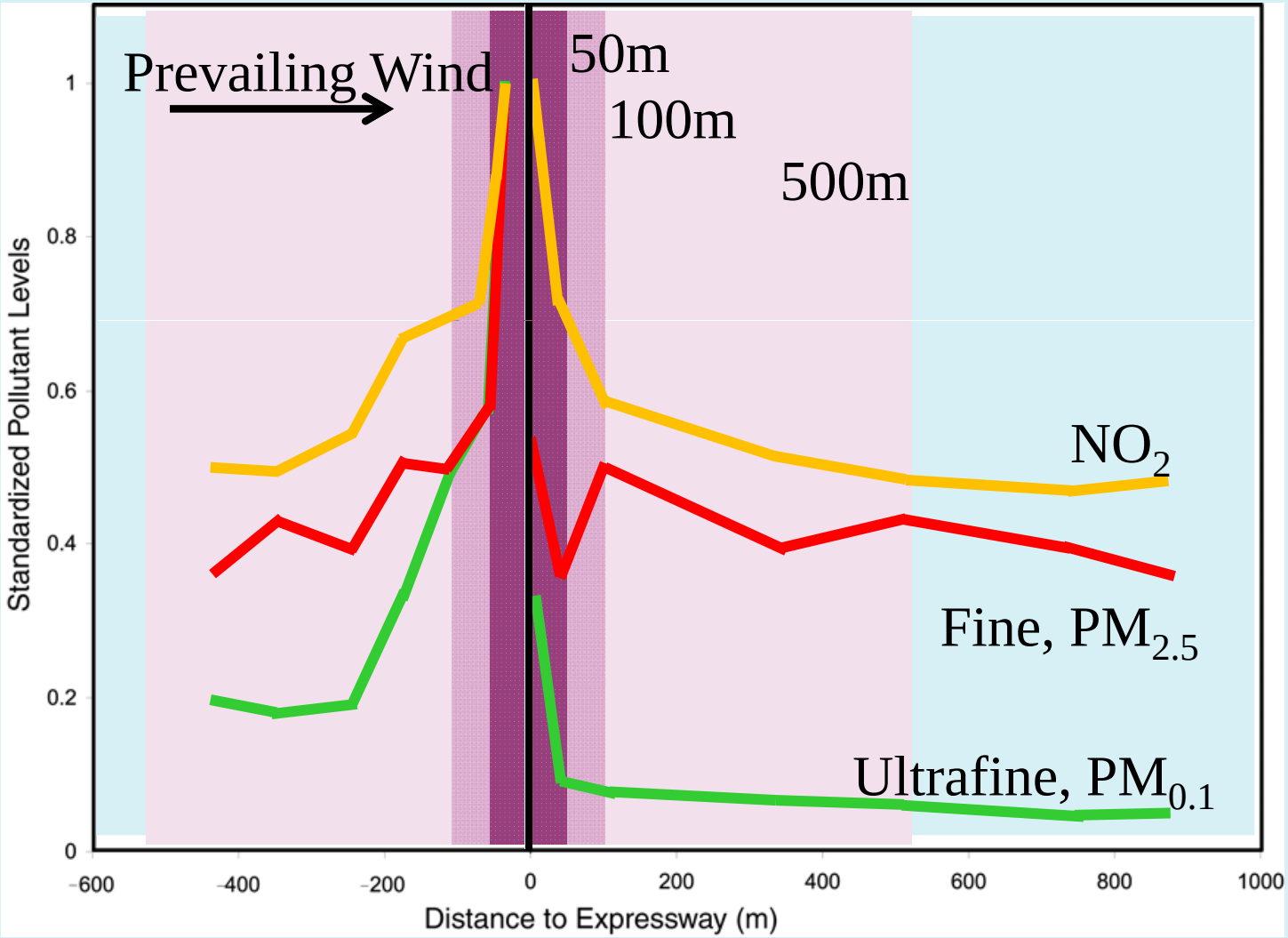
Inflammation



Hyde Park exposure Oxford Street exposure

McCreanor J et al. N Engl J Med. 2007 Dec 6;357(23):2348-58

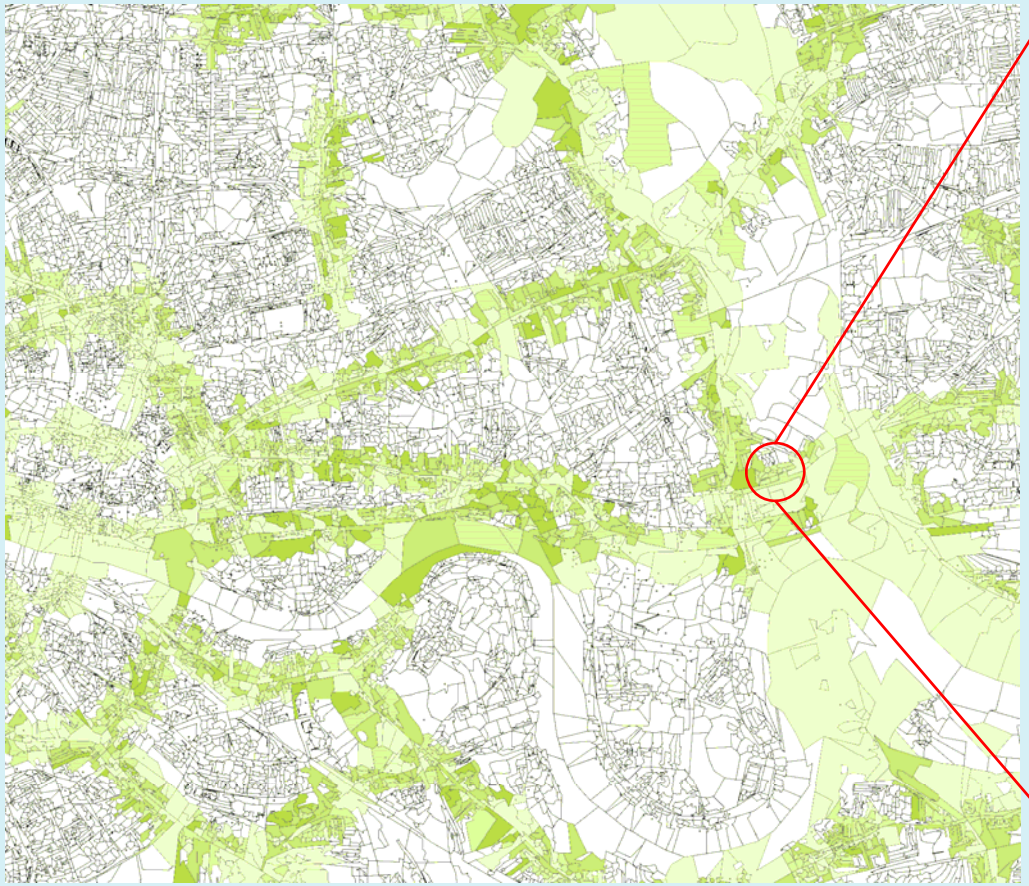
PM Concentration Near a Major Road

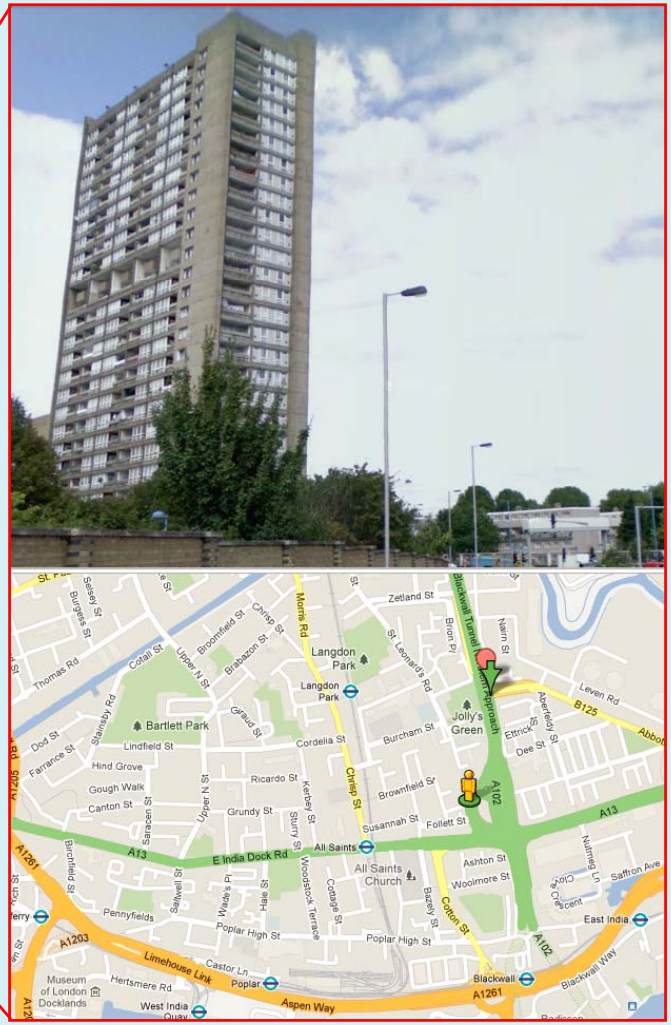


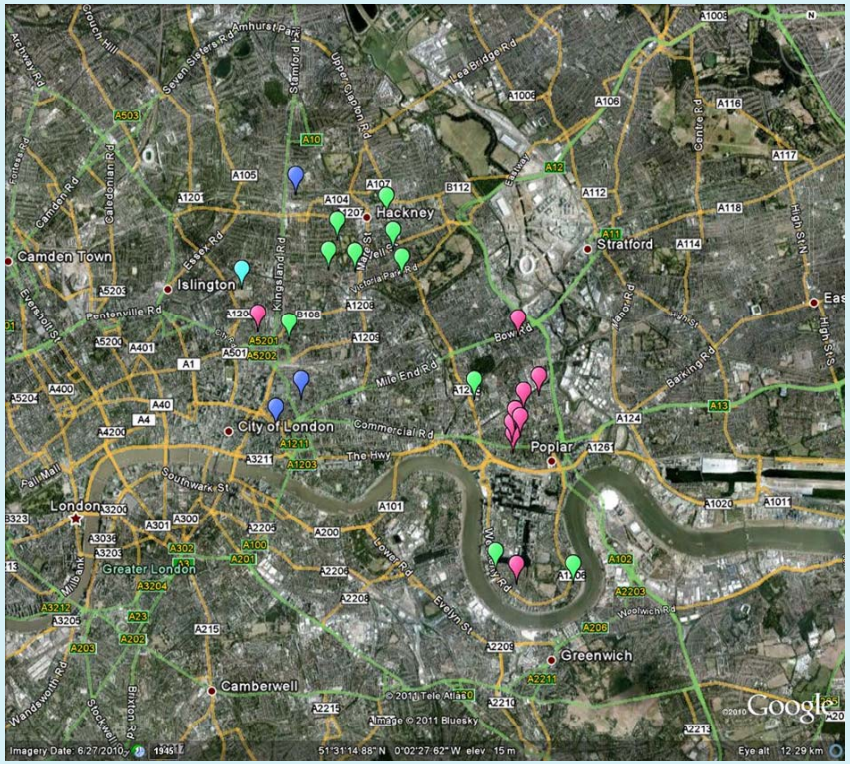
Beckerman et al. (2008) *Atmos Enviro.* 42:275-290.

Children's respiratory health

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







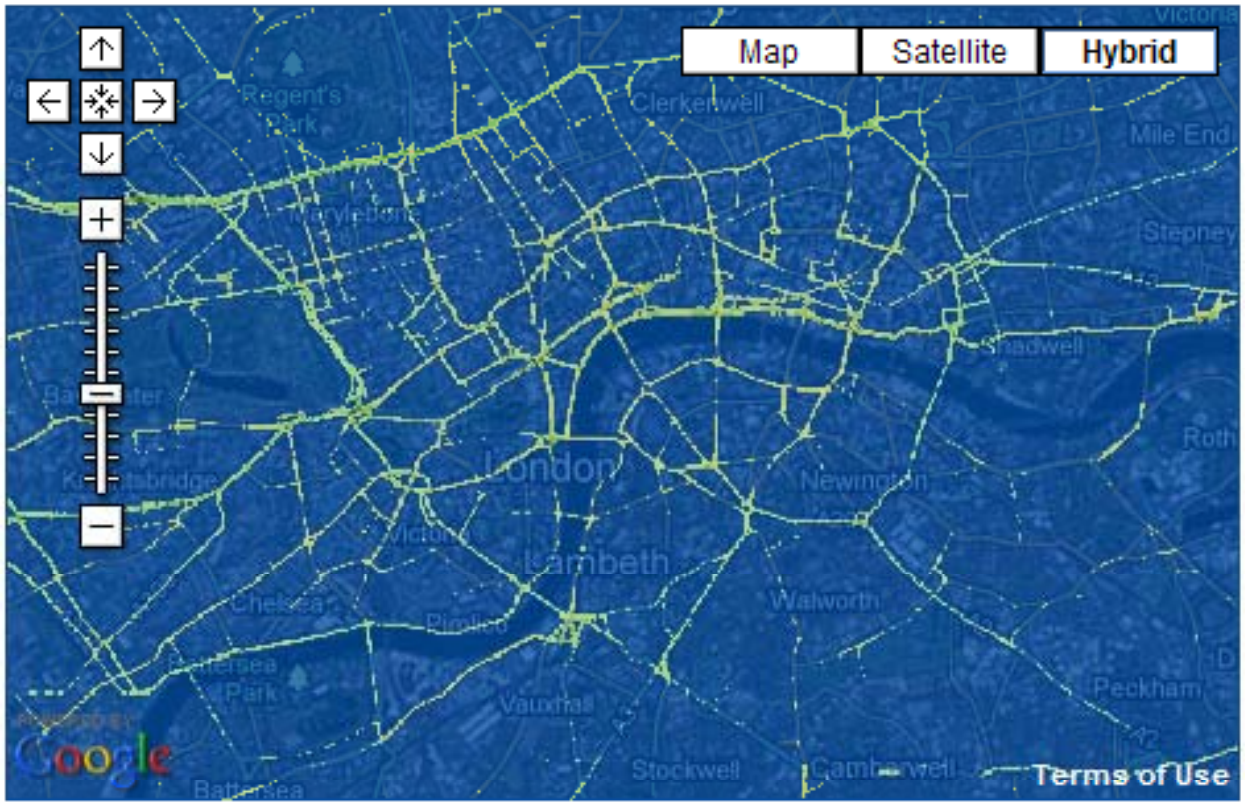
Examine effect of LEZ on:

- **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}, $PM_{2.5}$)

Nowcast – Current Pollution Maps

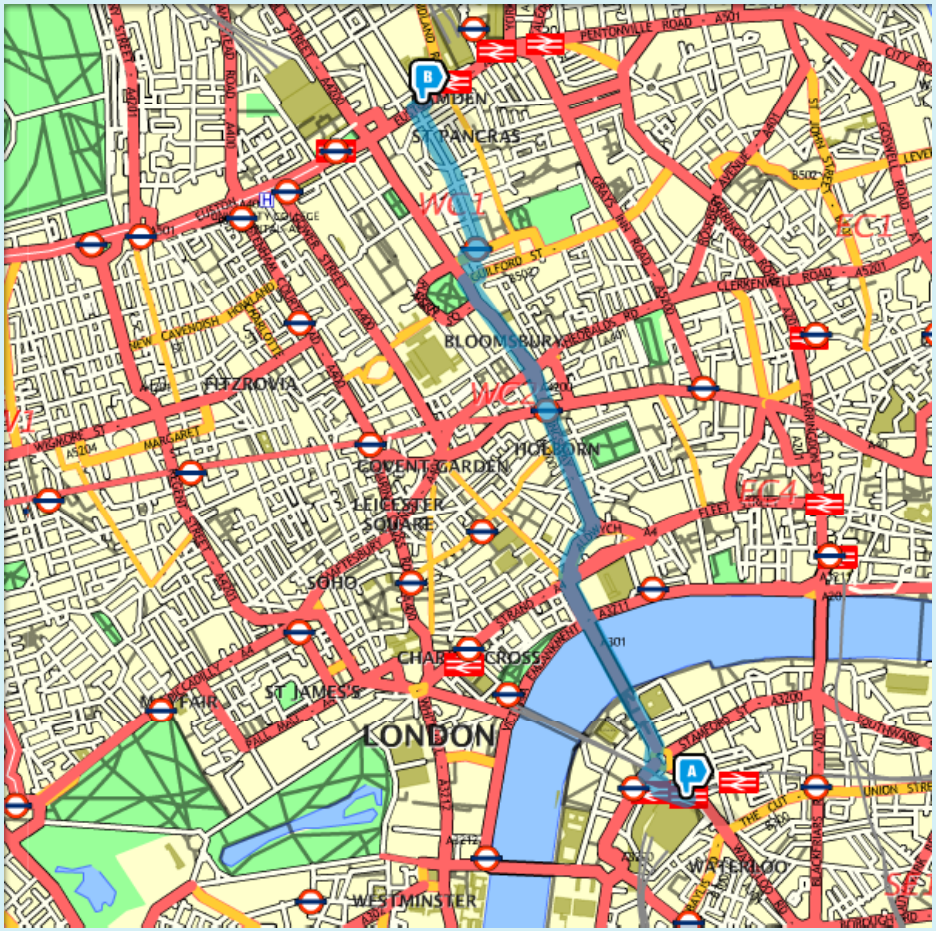
Enter postcode or area: Find

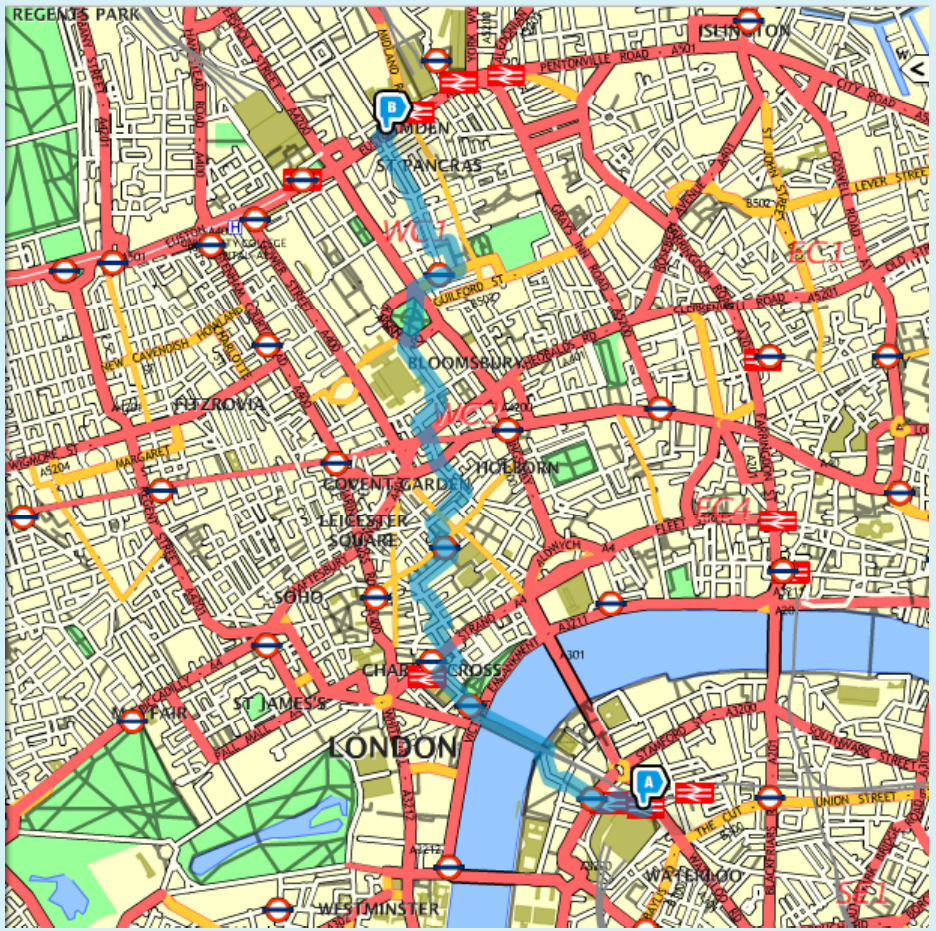


Estimated current PM10 air pollution index levels, based on measurements taken up to *15:00 on Wednesday 9th November*.

Low (1-3) Moderate (4-6) High (7-9) Very High (10)

How does the choice of route impact on an individuals exposure?





Summary

- Prolonged exposure to elevated PM is associated with significant life-shortening and poor respiratory health. Acute episodes can precipitate death in sensitive subjects.
- Subjects with pre-existing cardiopulmonary conditions are particularly sensitive.
- Reductions in ambient PM provide measurable health benefits
- Human chamber and field exposures have provided a mechanistic evidence to underpin the validity of the epi-observations
- Individual exposures can be limited by informed use of the urban environment