Strategic Future Direction: Exposure and Health Linkage

# Designing surveillance for air pollution assessment

Rob Kinnersley (*and many, many more*)

Chief Scientist's Group

# What do we aim to achieve?

Assess exposures in order to

- *Assess **levels** of exposure*
- *Assess the **consequences** of exposure*
- *Assess the **causes** of exposure*
- *Develop equitable **mitigations***
- *Test **efficacy** of mitigations*
- *Identify new **issues***

And so reduce harm from air pollution

# Challenge 1

- Evolving needs and objectives

## Air quality and mental health: evidence, challenges and future directions

Kamaldeep Bhui, Joanne B. Newbury, Rachel M. Latham, Marcella Ucci, Zaheer A. Nasir, Briony Turner, Catherine O'Leary, Helen L. Fisher, Emma Marczylo, Philippa Douglas, Stephen Stansfeld, Simon K. Jackson, Sean Tyrrel, Andrey Rzhetsky, Rob Kinnersley, Prashant Kumar, Caroline Duchaine and Frederic Coulon

**Conclusions**

There are knowledge gaps and a need for more research, for example, around bioaerosols exposure, indoor and outdoor pollution, urban design and impact on mental health over the life course.

## Drivers and changes to AQ

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- Technological developments around the emissions, dispersion and impacts of air pollutants;
- Decarbonisation policies that can affect air quality as well as greenhouse gases;
- Changes in public behaviours that alter the activities causing air pollutant emissions.
- Changes in policies and practices due to UK's departure from the European Union."

## Environment Act 2021

UK Public General Acts ▸ 2021 c. 30 ▸ PART 1 ▸ CHAPTER 1 ▸ Environmental targets ▸ Section 2

- Annual Mean Concentration Target ('concentration target') - a maximum concentration of 10µg/$m^3$ to be met across England by 2040
- Population Exposure Reduction Target ('exposure target') - a 35% reduction in population exposure by 2040 (compared to a base year of 2018).



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# AQMSR Baseline and stakeholder needs

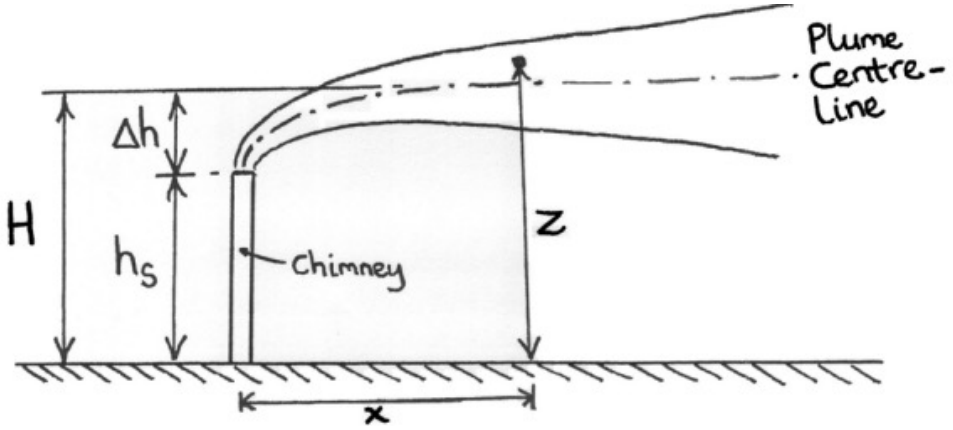
Assessment of needs wrt each pollutant measurement needed

Examples:

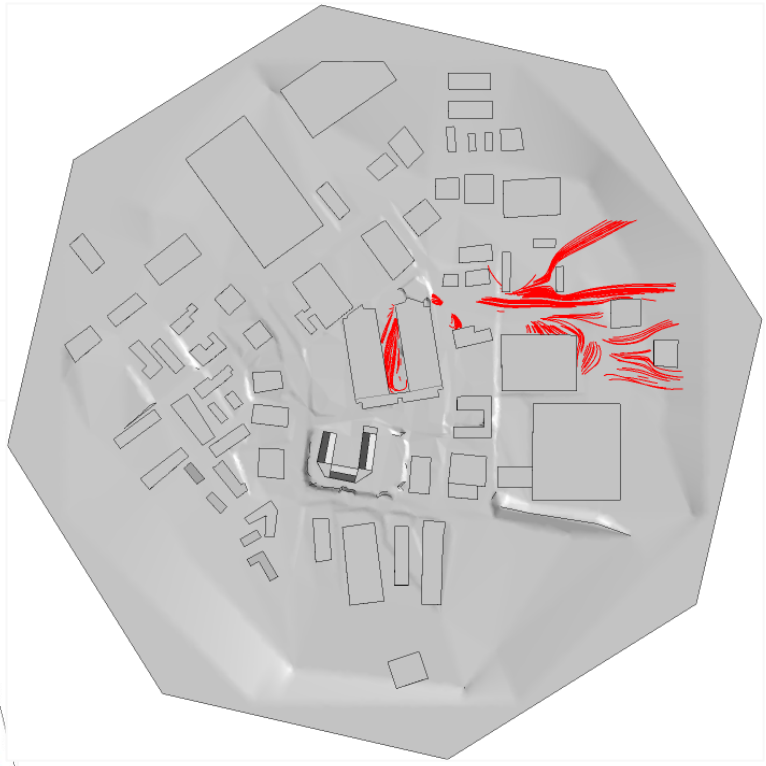
- Greater spatial and/or temporal **resolution**, for impact assessments
- Truly representative **coverage** in network design
- Teasing apart **impacts** of closely correlated pollutants
- Maintain long time series to record **change**
- Right location, resolution and duration for “before and after” **interventions** such as CAZs, AQMA
- Monitoring specifically to improve **modelling** e.g. for data assimilation

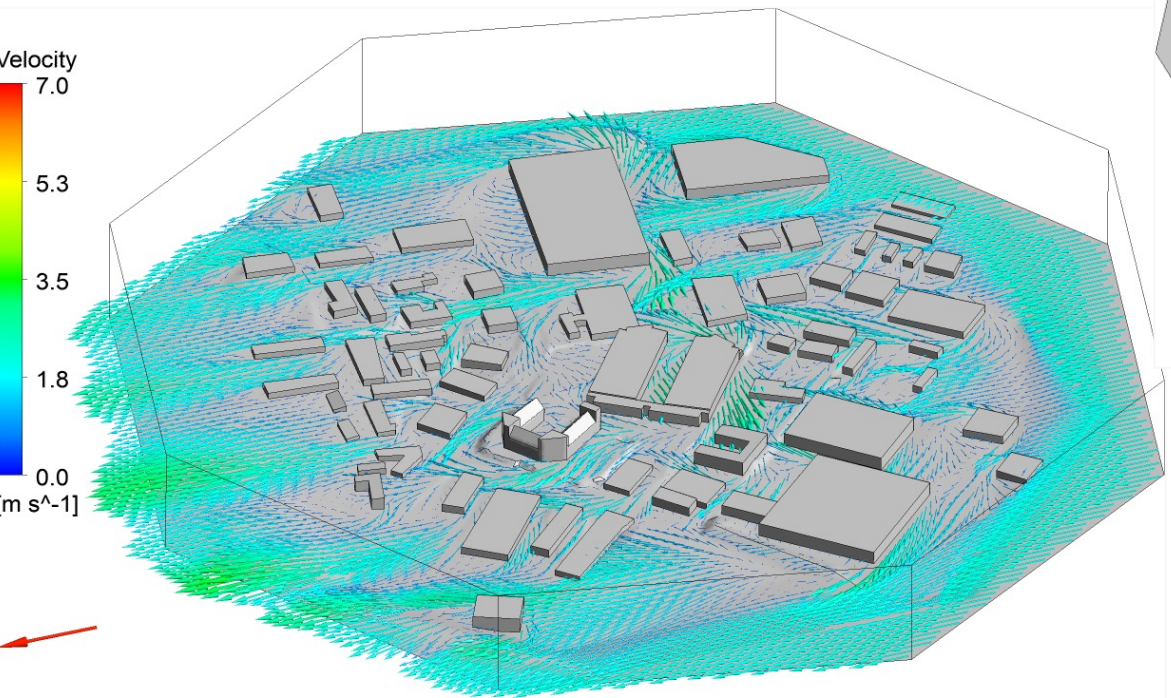
# Challenge 2

- Evolving needs and objectives
- Growing complexity




$$C(x,y,z) = \frac{Q}{U}\frac{1}{2\pi\sigma_y\sigma_z}e^{\left(\frac{-y^2}{2\sigma_y{}^2}\right)}e^{\left(\frac{-z^2}{2\sigma_z{}^2}\right)}$$



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# AMR in bioaerosol

**Objectives?**

Receptor focused – where?

Source focused – which?

How?

Statistical power?

# Challenge 3

- Evolving needs and objectives
- Growing complexity
- Finite resources

Map options

Filter by network

- (●) Automatic Urban and Rural
  - ⓘ Markers show latest pollution index
- ( ) Locally-managed automatic monitoring
- ( ) Automatic Hydrocarbon
- ( ) Non-Automatic Hydrocarbon
- ( ) PAH
- ( ) TOMPs
- ( ) Black Carbon
- ( ) Heavy Metals
- ( ) Particulates
- ( ) Stratospheric Ozone and UV
- ( ) UKEAP: Precip-Net
- ( ) UKEAP: Acid Gas and Aerosol
- ( ) UKEAP: Rural NO2
- ( ) UKEAP: National Ammonia
- ( ) UKEAP: MARGA
- ( ) UKEAP: Automatic Mercury
- ( ) UK Urban NO2 Network

☐ Show UK Regions Overlay

ⓘ Show or hide different markers on the map above for the selected network below. The number in brackets indicates the number of sites with this classification.

**Reasons for site with no current data:**

- C - Communications issue
- M - Instrument fault
- T - Localised temporary unusual source


Filter by environment type

Uncheck all

**Filter by environment type for Automatic Urban and Rural Network**

- ☑ Rural Background (21)
- ☑ Suburban Background (4)
- ☑ Suburban Industrial (2)
- ☑ Urban Background (67)
- ☑ Urban Industrial (7)
- ☑ Urban Traffic (70)

**OR Filter by pollutant**

- ☐ Carbon monoxide (7)
- ☐ Nitrogen dioxide (166)
- ☐ Ozone (89)
- ☑ $PM_{10}$ particulate matter (Daily measured) (2)
- ☑ $PM_{10}$ particulate matter (Hourly measured) (113)
- ☑ $PM_{2.5}$ particulate matter (Daily measured) (1)
- ☑ $PM_{2.5}$ particulate matter (Hourly measured) (103)
- ☐ Sulphur dioxide (28)



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Filter by environment type

Uncheck all

Filter by environment type for UKEAP: Acid Gas and Aerosol Network

☑ Rural Background (28)

## About the UKEAP: Acid Gas and Aerosol Network

The network provides a long-term dataset of monthly speciated measurements of acid gases and aerosols that are used to provide temporal and spatial patterns and trends.

The Monitoring Networks section contains information about this network, as well as other monitoring networks in the United Kingdom.

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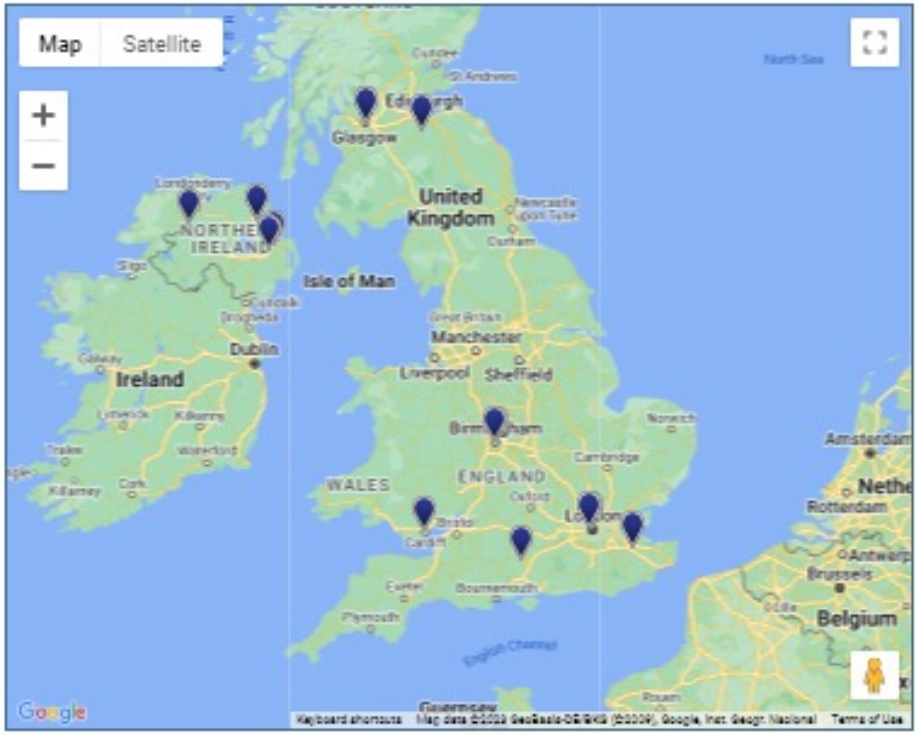


Filter by environment type

Uncheck all

Filter by environment type for Black Carbon Network

- ☑ Rural Background (3)
- ☑ Suburban Background (1)
- ☑ Urban Background (7)
- ☑ Urban Traffic (3)

## About the Black Carbon Network

The UK Black Carbon research monitoring programme began operation on 1st September 2006. Black carbon concentrations are measured using the Magee Aethalometer, model AE33. The Aethalometer measures the light absorption of carbon particles at seven wavelengths from the near-infrared (950 nm) to the near-ultraviolet (370 nm). Results from channel 880 nm (IR), give the quantitative concentration of 'black' carbon and 370 nm (UV) indicate the presence of aromatic organic compounds such as are found in wood smoke, biomass-burning smoke, and tobacco smoke.

Map options

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Filter by environment type

Uncheck all

Filter by environment type for UKEAP: MARGA Network

☑ Rural Background (2)

## About the UKEAP: MARGA Network

The network is used to speciate cations and anions in $PM_{10}$ and $PM_{2.5}$, as well as measure concentration of number of inorganic gases. Measurements are made hourly.

The Monitoring Networks section contains information about this network, as well as other monitoring networks in the United Kingdom.

# The roles of Clean Air Networks

- Identify needs
- Optimise delivery
- Maximise value